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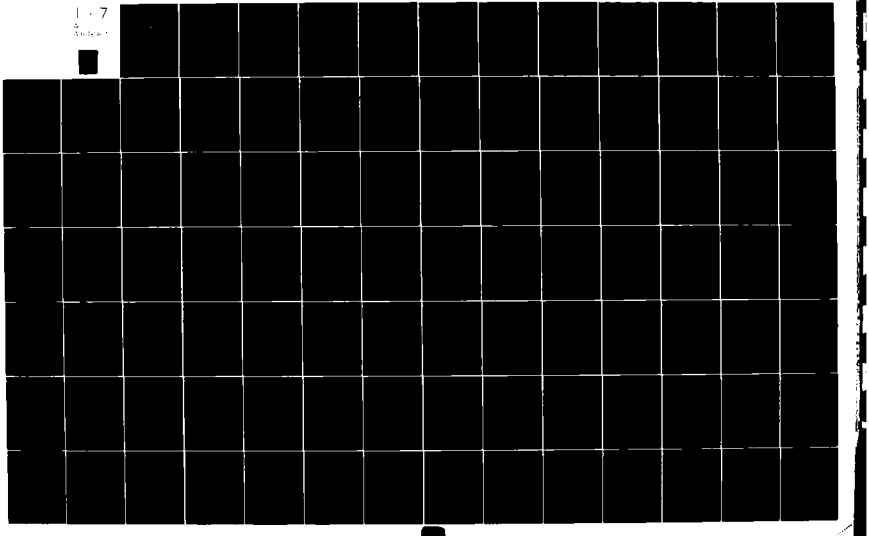

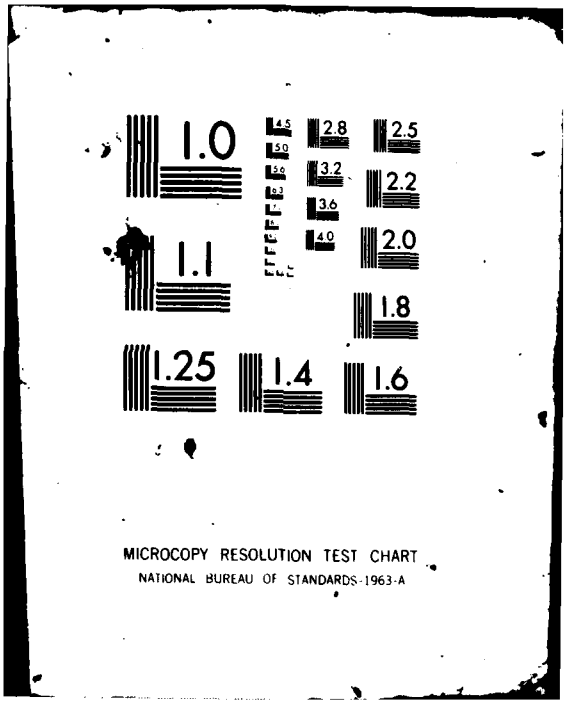
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VOLUME I

Supporting Data FY 1983
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Submitted to CONGRESS-Feburary 1982

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Army Appropriation FY 1983

DEPARTMENT OF THE ARMY DEPUTY CHIEF OF STAFF
FOR RESEARCH DEVELOPMENT AND ACQUISITION
RDTE PROGRAMS AND BUDGET DIVISION

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VOLUME I

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS

OF THE

RESEARCH, DEVELOPMENT, TEST AND EVALUATION, ARMY PROGRAM

FY 1983 (U)

FEBRUARY 1982

Department of the Army
Deputy Chief of Staff for Research, Development, and Acquisition

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FORWARD

These volumes have been prepared to provide information on the US Army Research, Development, Test and Evaluation Program for Congressional Committees during the Fiscal Year 1983 budget hearings. This information supplements the testimony given by US Army witnesses.

In recent years the Army RDTE program has concentrated on the development of a new generation of major weapons systems across the entire spectrum of Army mission areas. Most of these systems are now completing development and will be transitioning to procurement in the next few years. In FY 1983 and beyond, increased emphasis will be placed on the technology base in areas such as advanced surveillance and target acquisition; improved command, control, communications, and intelligence; self-contained munitions; biotechnology; and the soldier-machine interface. New technology which is advancing from exploratory development to advanced development in areas such as laser weapons systems and lightweight air defense and armor/antiarmor systems will be demonstrated. Efforts will be accelerated in research for microelectronics, millimeter wave technology, fire control, and development of medical, chemical, and life support materiel for use in chemical/biological defense. Product improvement programs on fielded systems such as the Cobra helicopter's engine, M1 Abrams Tank, and Bradley Fighting Vehicle System will be aggressively pursued in the future. The development of the Ballistic Missile Defense System will have high priority in this program to support the President's strong commitment to developing a viable ballistic missile defense. The Congressional Descriptive Summaries address these and other thrusts in detail.

These volumes contain a descriptive summary for each program element to be financed during FY 1983. Descriptive Summaries for projects within the program elements to be financed during FY 1983 for $5.0 million or more appear immediately following the applicable program element. Where there are several items under development within a project, a separate summary has been provided for each item that exceeds $5.0 million during FY 1983. A Test and Evaluation Section is provided for all major weapon systems. Major weapon systems are identified by an asterisk in the Table of Contents. The formats and contents of these volumes are in accordance with guidelines and requirements of the Congressional Committees.

A direct comparison of FY 1981, FY 1982, and FY 1983 data in the Program Element Listing with data shown in the Program Element Listing dated March 1981 will reveal differences. Major procedural causes for differences are attributable to the following factors:

a. Restructuring of the FY 1983 program to provide greater visibility for certain eff[illegible]nd to improve the effective management of the RDTE program, AMC

b. Restructuring of the FY 1981 and FY 1982 programs for comparability to the FY 1983 pr[illegible]ructure.

Procurement data are shown where applicable for items in engineering or operational development. Military construction data are also provided where applicable. Classified information is identified by the use of brackets [ ].

TABLE OF CONTENTS

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME I

TECHNOLOGY BASE		PAGE NO.
6.11.01.A	IN-HOUSE LABORATORY INDEPENDENT RESEARCH (ILIR)	I-1
6.11.02.A	DEFENSE RESEARCH SCIENCES	I-8
AH43	RESEARCH IN BALLISTICS	I-25
AH45	AIR MOBILITY RESEARCH	I-29
BH57	RESEARCH IN SCIENTIFIC PROBLEMS WITH MILITARY APPLICATIONS	I-33
BH57-03	ELECTRONICS	I-38
BH57-04	MATERIALS	I-43
BH57-05	MATHEMATICS	I-47
BH57-06	MECHANICS AND AERONAUTICS	I-50
BH57-07	PHYSICS	I-54
BH57-08	CHEMISTRY	I-57
BH57-09	UNIVERSITY RESEARCH INSTRUMENTATION	I-60
AH60	RESEARCH IN LARGE CALIBER ARMAMENTS	I-62
BS10	RESEARCH ON MILITARY DISEASES, INJURY AND HEALTH HAZARDS	I-68
BS10-A0	MILITARY DISEASE HAZARDS RESEARCH	I-72
BS10-C0	SYSTEMS HEALTH HAZARD RESEARCH	I-75
BS10-E0	MEDICAL CHEMICAL DEFENSE SCIENCE BASE/MECHANISMS OF ACTION OF CHEMICAL WEAPON AGENTS AND ANTIDOTES	I-79
A31B	NIGHT VISION AND ELECTRO-OPTICS RESEARCH	I-82
A71A	RESEARCH IN CHEMICAL/BIOLOGICAL WARFARE DEFENSE	I-87
6.21.05.A	MATERIALS	I-92
6.21.11.A	ATMOSPHERIC INVESTIGATIONS	I-98

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME I

TECHNOLOGY BASE (con't)		PAGE NO.
6.21.20.A	NUCLEAR WEAPONS EFFECTS, FLUIDICS	I-105
6.22.01.A	AIRCRAFT WEAPONS TECHNOLOGY	I-110
6.22.02.A	AIRCRAFT AVIONICS TECHNOLOGY	I-115
6.22.09.A	AERONAUTICAL TECHNOLOGY	I-123
6.22.10.A	AIRDROP TECHNOLOGY	I-130
6.23.03.A	MISSILE TECHNOLOGY	I-135
A214-01	SENSORS TECHNOLOGY	I-140
A214-06	TECHNOLOGY INTEGRATION	I-143
6.23.07.A	LASER WEAPONS TECHNOLOGY	I-146
6.26.01.A	TANK AND AUTOMOTIVE TECHNOLOGY	I-151
6.26.03.A	LARGE CALIBER AND NUCLEAR ARMAMENTS TECHNOLOGY	I-158
6.26.17.A	SMALL CALIBER AND FIRE CONTROL TECHNOLOGY	I-163
6.26.18.A	BALLISTICS TECHNOLOGY	I-168
6.26.22.A	CHEMICAL AND SMOKE MUNITIONS	I-173
A552	SMOKE AND OBSCURANTS MUNITIONS	I-180
A554	CHEMICAL MUNITIONS	I-183
6.26.23.A	JOINT SERVICES SMALL ARMS PROGRAM	I-187
6.27.01.A	COMMUNICATION/TECHNOLOGY	I-191
6.27.03.A	COMBAT SURVEILLANCE, TARGET ACQUISITION AND IDENTIFICATION	I-197
6.27.04.A	MILITARY ENVIRONMENTAL CRITERIA DEVELOPMENT	I-201
6.27.05.A	ELECTRONICS AND ELECTRON DEVICES	I-207
6.27.06.A	CHEMICAL BIOLOGICAL DEFENSE AND GENERAL INVESTIGATIONS	I-213
6.27.07.A	MAPPING AND GEODESY	I-218
6.27.09.A	NIGHT VISION INVESTIGATIONS	I-222
6.27.15.A	TACTICAL ELECTRONIC WARFARE TECHNOLOGY	I-226
A042	TACTICAL ELECTRONIC WARFARE TECHNIQUES	I-232
6.27.16.A	HUMAN FACTORS ENGINEERING SYSTEM DEVELOPMENT	I-236
6.27.17.A	HUMAN PERFORMANCE EFFECTIVENESS AND SIMULATION	I-241

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME I

TECHNOLOGY BASE (con't)		PAGE NO.
6.27.19.A	MOBILITY AND WEAPONS EFFECTS TECHNOLOGY	I-245
6.27.20.A	ENVIRONMENTAL QUALITY TECHNOLOGY	I-251
6.27.22.A	MANPOWER, PERSONNEL, AND TRAINING	I-257
6.27.23.A	CLOTHING, EQUIPMENT, AND SHELTER TECHNOLOGY	I-262
AH98	CLOTHING AND EQUIPMENT TECHNOLOGY	I-269
6.27.24.A	JOINT SERVICES FOOD SYSTEM TECHNOLOGY	I-274
6.27.25.A	COMPUTER AND INFORMATION SCIENCES	I-279
6.27.27.A	NON-SYSTEMS TRAINING DEVICES (NSTD) TECHNOLOGY	I-285
6.27.30.A	COLD REGIONS ENGINEERING TECHNOLOGY	I-290
6.27.31.A	MILITARY FACILITIES ENGINEERING TECHNOLOGY	I-295
6.27.32.A	REMOTELY PILOTED VEHICLES (RPV) SUPPORTING TECHNOLOGY	I-300
6.27.33.A	MOBILITY EQUIPMENT TECHNOLOGY	I-305
6.27.34.A	MEDICAL DEFENSE AGAINST CHEMICAL AGENTS	I-312
6.27.46.A	TACTICAL AUTOMATIC DATA PROCESSING (ADP) TECHNOLOGY	I-317
6.27.70.A	MILITARY DISEASE HAZARDS TECHNOLOGY	I-325
A871	PREVENTION OF MILITARY DISEASE HAZARDS	I-330
A871-01	PREVENTION OF DISEASE AFFECTING TROOP OPERATION AND MOBILIZATION	I-333
A871-02	PREVENTION OF BIOLOGICAL WARFARE DISEASES	I-335
6.27.72.A	COMBAT CASUALTY TREATMENT TECHNOLOGY	I-337
6.27.75.A	COMBAT MAXILLOFACIAL INJURY	I-341
6.27.77.A	SYSTEMS HEALTH HAZARD PREVENTION TECHNOLOGY	I-345
A878	HEALTH HAZARDS OF MILITARY MATERIEL	I-350
A879	MEDICAL FACTORS LIMITING SOLDIER EFFECTIVENESS	I-355
6.27.81.A	ENERGY TECHNOLOGY APPLIED TO MILITARY FACILITIES	I-359

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME I

ADVANCED TECHNOLOGY DEVELOPMENT		PAGE NO.
6.31.02.A	MATERIALS SCALE-UP	I-363
6.31.04.A	FUELS AND LUBRICANTS ADVANCED DEVELOPMENT	I-368
6.32.01.A	AIRCRAFT POWER PLANTS AND PROPULSION	I-372
D447	DEMONSTRATION ENGINES	I-377
6.32.06.A	AIRCRAFT WEAPONS	I-381
D043	AIRCRAFT WEAPONS FIRE CONTROL	I-386
6.32.07.A	AIRCRAFT AVIONICS EQUIPMENT	I-390
6.32.09.A	AIR MOBILITY SUPPORT	I-394
6.32.11.A	ROTARY WING CONTROLS, ROTORS, AND STRUCTURES	I-401
DB41	ADVANCED STRUCTURES	I-407
D315	ADVANCED FLIGHT CONTROLS	I-412
6.32.16.A	SYNTHETIC FLIGHT SIMULATORS	I-416
6.32.18.A	AIRDROP EQIUIPMENT AND TECHNIQUES	I-421
6.32.20.A	LIGHT HELICOPTER ADVANCED TECHNOLOGY DEMONSTRATION	I-425
6.32.21.A	NAP-OF-THE-EARTH AVIONICS AND NAVIGATION EQUIPMENT	I-429
6.33.06.A	TERMINALLY GUIDED PROJECTILES	I-434
6.33.13.A	MISSILE/ROCKET COMPONENTS	I-439
D261	FIBER OPTICS GUIDANCE	I-444
6.33.14.A	HIGH ENERGY LASER COMPONENTS	I-446
D056	FORWARD AREA LASER WEAPONS	I-451
D057	CLOSE COMBAT LASER ASSAULT WEAPON	I-454
6.33.24.A	HIGH TECHNOLOGY TEST BED	I-457
D180	DISTRIBUTED DATA TEST BED	I-462
6.36.02.A	ADVANCED LAND MOBILITY SYSTEM CONCEPTS	I-465
6.36.06.A	LANDMINE WARFARE/BARRIER DEVELOPMENT	I-469

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME I

ADVANCED TECHNOLOGY DEVELOPMENT (con't)		PAGE NO.
D608	COUNTERMINE AND BARRIER DEVELOPMENT	I-473
6.36.07.A	JOINT SERVICES SMALL ARMS PROGRAM (JSSAP)	I-476
6.36.21.A	COMBAT VEHICLE PROPULSION SYSTEMS	I-480
DG07	COMBAT VEHICLE ENGINES	I-485
6.36.31.A	COMBAT VEHICLE TURRET AND CHASSIS	I-488
D424	COMBAT VEHICLE TRACK AND SUSPENSION	I-493
6.36.36.A	COMBAT VEHICLE ARMOR/ANTI-ARMOR	I-496
D221	COMBAT VEHICLE SURVIVAL-ARMOR	I-500
D223	COMBAT VEHICLE ANTI-ARMOR	I-502
6.37.10.A	NIGHT VISION ADVANCED DEVELOPMENT	I-504
DK70	NIGHT VISION ADVANCED DEVELOPMENT	I-509
DK87	NIGHT VISION COMBAT VEHICLES	I-512
6.37.25.A	REMOTELY PILOTED VEHICLE (RPV'S)/DRONES	I-515
6.37.31.A	MANPOWER AND PERSONNEL	I-520
6.37.34.A	COMBAT ENGINEERING SYSTEMS	I-526
6.37.37.A	ANTI-RADIATION MISSILE COUNTERMEASURES	I-531
6.37.39.A	HUMAN FACTORS IN TRAINING AND OPERATIONAL EFFECTIVENESS	I-536
6.37.42.A	ADVANCED ELECTRONIC DEVICES	I-541
6.37.43.A	EDUCATION AND TRAINING	I-545
6.37.44.A	TRAINING SIMULATION	I-549
6.37.48.A	ADVANCED DEVELOPMENT OF AUTOMATIC TEST EQUIPMENT AND SYSTEMS	I-553
DJ29	AUTOMATIC TEST SUPPORT SYSTEMS (ATSS)	I-558
6.37.49.A	TECHNICAL VULNERABILITY REDUCTION	I-561
6.37.52.A	DEMILITARIZATION CONCEPTS	I-565
6.37.61.A	ELECTRONIC WARFARE VULNERABILITY/SUSCEPTIBILITY SUPPORT	I-569

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME I

ADVANCED TECHNOLOGY DEVELOPMENT (con't)		PAGE NO.
6.37.62.A	ELECTRONIC WARFARE FEASIBILITY DEVELOPMENT	I-574
6.37.63.A	INDUSTRIAL BASE/BIOLOGICAL WARFARE DRUGS	I-578
6.37.65.A	NONTACTICAL ADP TECHNOLOGY	I-581

VOLUME II

STRATEGIC PROGRAMS		
1.28.14.A	SPECIAL PROGRAM	II-1
1.28.17.A	MOBILE COMMAND CENTERS	II-4
1.28.21.A	CLASSIFIED PROGRAM	II-9
6.33.04.A	BALLISTIC MISSILE DEFENSE ADVANCED TECHNOLOGY PROGRAM	II-12
6.33.08.A	BALLISTIC MISSILE DEFENSE SYSTEMS TECHNOLOGY PROGRAM	II-17
TACTICAL PROGRAMS		
2.37.24.A	HEAVY ANTITANK/ASSAULT WEAPON SYSTEM (TOW)	II-23
2.37.26.A	ADVANCED FIELD ARTILLERY TACTICAL DATA SYSTEM	II-29
2.37.30.A	CHAPARRAL	II-36
2.37.31.A	SURFACE-TO-AIR MISSILE HAWK/HAWK IMPROVEMENT PROGRAM (SAM HAWK/HIP)	II-46
2.37.35.A	COMBAT VEHICLE IMPROVEMENT PROGRAM	II-53
D330	M1E1 BLOCK IMPROVEMENT PROGRAM	II-60
2.37.39.A	AN/TSQ-73 MODIFICATIONS	II-65

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME II

TACTICAL PROGRAMS (con't)

		PAGE NO.
2.37.40.A	MANEUVER CONTROL SYSTEM	II-69
2.37.42.A	COMMUNICATION SYSTEM ENGINEERING PROGRAM	II-75
2.80.10.A	JOINT TACTICAL COMMUNICATIONS (TRI-TAC) PROGRAM	II-79
D104	JOINT TACTICAL COMMUNICATIONS (TRI-TAC) OFFICE	II-87
D107	MODIFICATIONS TO ARMY TRI-TAC INTERFACE	II-91
D110	MOBILE SUBSCRIBER EQUIPMENT (MSE)	II-93
D111	DIGITAL GROUP MULTIPLEXER	II-96
D119	MODULAR RECORD TRAFFIC TERMINAL (MRTT)	II-100
D222*	AUTOMATIC COMMUNICATIONS CENTRAL OFFICE, AN/TTC-39	II-105
3.31.45.A	EUROPEAN COMMAND; COMMAND, CONTROL, AND COMMUNICATIONS SYSTEMS (EUCOM C^3 SYSTEMS)	II-121
6.32.15.A	JOINT SURVIVABILITY INVESTIGATIONS	II-125
6.32.22.A	SPECIAL ELECTRONIC MISSION AIRCRAFT (SEMA-X)	II-130
6.33.02.A	ANTITACTICAL MISSILE (ATM)	II-134
6.33.03.A	MULTIPLE LAUNCH ROCKET SYSTEM (MLRS) TERMINAL GUIDANCE WARHEAD (TGW)	II-138
6.33.16.A	ADVANCED ROCKET CONTROL SYSTEM	II-145
6.33.20.A	CORPS SUPPORT WEAPON SYSTEM (FORMERLY ASSAULT BREAKER)	II-148
6.33.23.A	LIGHTWEIGHT AIR DEFENSE SYSTEM	II-153
6.36.04.A	NUCLEAR MUNITIONS AND RADIACS	II-158
6.36.12.A	RATTLER (FORMERLY IMAAWS)	II-164
6.36.15.A	LETHAL CHEMICAL MUNITIONS CONCEPTS	II-168
6.36.19.A	LANDMINE/BARRIER SYSTEMS	II-173
6.36.27.A	COMBAT SUPPORT MUNITIONS	II-177
6.36.28.A	FIELD ARTILLERY AMMUNITION DEVELOPMENT	II-181
D007	FIELD ARTILLERY AMMUNITION AND FUZES	II-186
D276	SENSE AND DESTROY ARMOR (SADARM)	II-189

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME II

TACTICAL PROGRAMS (con't)		PAGE NO.
6.36.29.A	DIVISION SUPPORT WEAPON SYSTEM	II-192
6.36.32.A	ARMORED COMBAT LOGISTICAL SUPPORT VEHICLE	II-198
6.36.33.A	TANK AND MORTAR AMMUNITION	II-200
D161	TANK AMMUNITION AND FUZES	II-204
6.36.35.A	MOBILE PROTECTED GUN SYSTEM	II-207
D166	MOBILE PROTECTED GUN FAR-TERM	II-213
D170	MOBILE PROTECTED GUN NEAR-TERM	II-217
6.37.02.A	ELECTRIC POWER SOURCES	II-221
6.37.05.A	PHYSICAL SECURITY	II-226
6.37.06.A	IDENTIFICATION FRIEND-OR-FOE (IFF) DEVELOPMENT	II-234
D297	IDENTIFICATION FRIEND OR FOE NATO	II-238
6.37.07.A	COMMUNICATIONS DEVELOPMENT	II-241
D246	TACTICAL COMMUNICATIONS SYSTEMS DEVELOPMENT	II-245
6.37.11.A	AIRCRAFT SURVIVABILITY EQUIPMENT (ASE)	II-248
6.37.13.A	ARMY DATA DISTRIBUTION SYSTEM (Formerly JTIDS)	II-254
6.37.18.A	ELECTRONIC VULNERABILITY/SUSCEPTIBILITY	II-259
D234	SURFACE/SURFACE WEAPON ELECTRONIC WARFARE	II-264
D267	AIR DEFENSE/MISSILE VULNERABILITY/SUSCEPTIBILITY	II-269
D626	C3 SYSTEM VULNERABILITY/SUSCEPTIBILITY	II-273
6.37.21.A	CHEMICAL DEFENSE MATERIEL CONCEPTS	II-278
DJ30	COLLECTIVE PROTECTION MATERIEL ARMORED VEHICLES	II-283
D601	CHEMICAL DETECTION AND WARNING MATERIEL	II-287
6.37.23.A	COMMAND AND CONTROL	II-290
D186	MILITARY COMPUTER FAMILY (MCF)	II-296
6.37.26.A	COMBAT SUPPORT EQUIPMENT	II-300

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME II

TACTICAL PROGRAMS (con't)

		PAGE NO.
DG01	COMBAT ENGINEER EQUIPMENT	II-306
6.37.30.A	TACTICAL SURVEILLANCE SYSTEM	II-309
6.37.32.A	COMBAT MEDICAL MATERIEL	II-313
6.37.40.A	DIVISION AIR DEFENSE COMMAND CONTROL (SHORAD-C2 SYSTEM)	II-317
6.37.45.A	TACTICAL ELECTRONIC SUPPORT MEASURES SYSTEMS	II-324
6.37.46.A*	SINGLE CHANNEL GROUND AND AIRBORNE RADIO SYSTEM (SINCGARS)	II-328
6.37.47.A	SOLDIER SUPPORT/SURVIVABILITY	II-339
6.37.50.A	DRUG AND VACCINE DEVELOPMENT	II-344
6.37.51.A	MEDICAL DEFENSE AGAINST CHEMICAL WARFARE	II-349
6.37.53.A	BATTLEFIELD DATA SYSTEM (AD)	II-353
6.37.55.A	TACTICAL ELECTRONIC COUNTERMEASURES SYSTEMS	II-357
DK12	COMMUNICATIONS ELECTRONIC COUNTERMEASURES SYSTEMS	II-363
DK13	NON-COMMUNICATIONS ELECTRONIC COUNTERMEASURES SYSTEMS	II-368
DK14	EXPENDABLE JAMMERS	II-371
6.37.64.A	MEDICAL CHEMICAL DEFENSE LIFE SUPPORT MATERIEL	II-374
6.37.66.A	TACTICAL ELECTRONIC SURVEILLANCE SYSTEMS	II-378
6.42.02.A	AIRCRAFT WEAPONS	II-382
6.42.04.A	AIR MOBILITY SUPPORT EQUIPMENT	II-386
6.42.06.A	BLACKHAWK	II-392
D069	UH-60 FEASIBILITY DEMONSTRATION	II-397
6.42.07.A*	ADVANCED ATTACK HELICOPTER	II-401
6.42.12.A	COBRA/TOW	II-419
6.42.16.A	AIRCRAFT PROPULSION SYSTEMS	II-425
6.42.17.A	SYNTHETIC FLIGHT TRAINING SYSTEMS	II-429
6.42.18.A	AIRDROP EQUIPMENT DEVELOPMENT	II-434

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME II

TACTICAL PROGRAMS (con't)		PAGE NO.
6.42.20.A*	ARMY HELICOPTER IMPROVEMENT PROGRAM	II-439
6.42.21.A	AN/UPD-7 SURVEILLANCE SYSTEMS	II-451
6.42.22.A	JOINT SERVICES ROTARY WING AIRCRAFT DEVELOPMENT	II-459
6.42.68.A	COMPONENT IMPROVEMENT PROGRAM	II-463
6.43.06.A	STINGER	II-468
6.43.07.A	PATRIOT (SAM-D)	II-469
D212*	PATRIOT (SAM-D)	II-476
D213	PATRIOT ELECTRONIC COUNTER-COUNTERMEASURE (ECCM) ENHANCEMENT	II-492
6.43.09.A	ROLAND	II-495
6.43.10.A*	HELIBORNE MISSILE - HELLFIRE	II-496
6.43.11.A*	PERSHING II	II-515
6.43.13.A	GRASS BLADE	II-530
6.43.14.A*	MULTIPLE LAUNCH ROCKET SYSTEM (MLRS) FORMERLY KNOWN AS GENERAL SUPPORT ROCKET SYSTEM (GSRS)	II-533
6.43.18.A*	DIVISION AIR DEFENSE (DIVAD) GUN	II-552
6.43.21.A	JOINT TACTICAL FUSION PROGRAM	II-568

VOLUME III

6.46.01.A	INFANTRY SUPPORT WEAPONS	III-1
6.46.03.A	NUCLEAR MUNITIONS	III-10
D385	IMPROVED 155MM NUCLEAR PROJECTILE	III-17
6.46.09.A	COMBAT SUPPORT SYSTEMS	III-24
6.46.10.A	LETHAL CHEMICAL MUNITIONS	III-28

x

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME III

TACTICAL PROGRAMS (con't)

		PAGE NO.
6.46.12.A	COUNTERMINE AND BARRIERS	III-29
D415	MINE NEUTRALIZATION/DETECTION	III-35
6.46.16.A*	BRADLEY FIGHTING VEHICLE SYSTEMS (BFVS) (PREVIOUSLY FIGHTING VEHICLE SYSTEMS)	III-39
6.46.19.A	LANDMINE WARFARE	III-55
6.46.20.A*	TANK SYSTEMS	III-62
6.46.21.A*	COPPERHEAD (CANNON-LAUNCHED *GUIDED PROJECTILE*)	III-76
6.46.24.A	HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE (HMMWV)	III-85
6.46.26.A	FIRE SUPPORT TEAM VEHICLE (FISTV)	III-90
6.46.28.A	INDIRECT FIRE TRAINING MUNITIONS	III-96
6.46.30.A	M1E1 DEVELOPMENT PROGRAM	III-97
D064	120MM TANK GUN AMMUNITION DEVELOPMENT	III-104
D287	SYSTEM INTEGRATION	III-110
6.46.31.A	FIELD ARTILLERY AMMUNITION, 155MM	III-114
6.46.32.A	105MM TANK AMMUNITION	III-119
6.47.01.A	COMMUNICATIONS ENGINEERING DEVELOPMENT	III-124
D487	TACTICAL MULTICHANNEL COMMUNICATIONS	III-129
6.47.02.A*	JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS)	III-132
6.47.04.A	UNATTENDED GROUND SENSORS	III-139
6.47.05.A	MODULAR INTEGRATED COMMUNICATION AND NAVIGATION SYSTEM (MICNS)	III-143
6.47.06.A	RADIOLOGICAL DEFENSE EQUIPMENT	III-147
6.47.09.A	IDENTIFICATION FRIEND OR FOE (IFF) EQUIPMENT	III-152
6.47.10.A	NIGHT VISION DEVICES	III-157
6.47.11.A	AIRCRAFT SURVIVABILITY EQUIPMENT (ASE)	III-161
6.47.12.A	US ARMY TACTICAL COMMAND, CONTROL, AND COMMUNICATIONS SYSTEMS ENGINEERING	III-168

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME III

TACTICAL PROGRAMS (con't)

		PAGE NO.
D322	SYSTEMS ENGINEERING FOR ARMY TACTICAL COMMAND, CONTROL, AND COMMUNICATIONS (C3) SYSTEMS	III-176
6.47.13.A	COMBAT FEEDING, CLOTHING, AND EQUIPMENT	III-181
6.47.14.A	TACTICAL ELECTRIC POWER SOURCES	III-186
6.47.17.A	GENERAL COMBAT SUPPORT	III-190
6.47.18.A	PHYSICAL SECURITY	III-197
6.47.22.A	EDUCATION AND TRAINING SYSTEMS	III-203
6.47.24.A	BIOLOGICAL DEFENSE MATERIEL	III-207
6.47.25.A	CHEMICAL DEFENSE MATERIEL	III-212
DF97	CHEMICAL DECONTAMINATION MATERIEL	III-218
D017	CHEMICAL BIOLOGICAL COLLECTIVE PROTECTION	III-221
D020	CHEMICAL DETECTION WARNING SAMPLING DEVICES	III-224
D023	COLLECTIVE PROTECTION MATERIEL-ARMORED VEHICLES	III-227
6.47.27.A	COMMAND AND CONTROL	III-230
DC98	POSITION LOCATION REPORTING SYSTEM (PLRS)	III-238
6.47.30.A*	REMOTELY PILOTED VEHICLES (RPV'S)	III-243
D040	REMOTELY PILOTED VEHICLES (RPV'S)	III-257
6.47.40.A	TACTICAL SURVEILLANCE SYSTEM	III-262
6.47.46.A	AUTOMATIC TEST SUPPORT SYSTEM (ATSS)	III-267
6.47.50.A	TACTICAL ELECTRONIC COUNTERMEASURES SYSTEMS	III-270
6.47.53.A	BATTLEFIELD DATA SYSTEM (BD)	III-276
6.47.66.A	TACTICAL ELECTRONIC SURVEILLANCE SYSTEMS	III-281
6.47.79.A	JOINT INTEROPERABILITY OF TACTICAL COMMAND AND CONTROL SYSTEMS (JINTACCS)	III-286
D298	JOINT INTEROPERABILITY OF TACTICAL COMMAND AND CONTROL SYSTEMS (EA, NATO)	III-293
D309	JOINT INTEROPERABILITY OF TACTICAL COMMAND AND CONTROL SYSTEMS (ARMY)	III-297

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME III

TACTICAL PROGRAMS (con't)		PAGE NO.
D310	JOINT INTEROPERABILITY OF TACTICAL COMMAND AND CONTROL SYSTEMS (EXECUTIVE AGENT)...	III-302
6.57.10.A	JOINT CHEMICAL/BIOLOGICAL CONTACT POINT/TEST/ASSESSMENT.....	III-307
INTELLIGENCE AND COMMUNICATIONS		
3.13.07.A	FOREIGN SCIENCE AND TECHNOLOGY CENTER.....	III-311
3.13.27.A	TECHNICAL RECONNAISSANCE AND SURVEILLANCE (TECRAS).....	III-315
3.31.11.A	STRATEGIC COMMUNICATIONS (STARCOM).....	III-319
3.31.26.A	LONG HAUL COMMUNICATIONS (DCS).....	III-323
3.31.42.A	SATELLITE COMMUNICATIONS GROUND ENVIRONMENT.....	III-327
D253	DEFENSE SATELLITE COMMUNICATIONS SYSTEM-DEFENSE COMMUNICATIONS SYSTEM (PHASE II)...	III-333
D456	TACTICAL SATELLITE COMMUNICATIONS SYSTEM.....	III-337
3.34.01.A	COMMUNICATIONS SECURITY (COMSEC) EQUIPMENT.....	III-341
6.37.12.A	MAPPING AND GEODESY.....	III-346
6.42.01.A	AIRCRAFT AVIONICS.....	III-352
DC96	AIRCRAFT NAVIGATION AND CONTROL.....	III-356
6.47.16.A	MAPPING AND GEODESY.....	III-358
6.47.78.A*	NAVSTAR GLOBAL POSITIONING SYSTEMS (GPS) USER EQUIPMENT.....	III-366
DEFENSEWIDE MISSION SUPPORT		
6.37.38.A	NON-SYSTEMS TRAINING DEVICES (NSTD) DEVELOPMENT.....	III-377
6.47.15.A	NON-SYSTEMS TRAINING DEVICES (NSTD) ENGINEERING.....	III-379
D241	NON-SYSTEMS TRAINING DEVICES COMBINED ARMS.....	III-385
6.47.26.A	METEOROLOGICAL EQUIPMENT AND SYSTEMS.....	III-388

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME III

DEFENSEWIDE MISSION SUPPORT (con't)		PAGE NO.
6.51.02.A	US ARMY TRAINING AND DOCTRINE COMMAND (TRADOC) STUDIES AND ANALYSES	III-394
6.52.01.A	AVIATION ENGINEERING FLIGHT ACTIVITY	III-400
6.53.01.A	KWAJALEIN MISSILE RANGE	III-406
6.57.02.A	SUPPORT OF DEVELOPMENT TESTING	III-409
DE95	US ARMY COLD REGIONS TEST CENTER	III-415
D127	METEOROLOGICAL SUPPORT TO RDTE ACTIVITIES	III-417
D618	AVIATION DEVELOPMENT TEST ACTIVITY	III-420
6.57.06.A	MATERIEL SYSTEMS ANALYSIS	III-422
6.57.09.A	*EXPLOITATION OF FOREIGN ITEMS*	III-427
6.57.12.A	SUPPORT OF OPERATIONAL TESTING	III-432
DV02	TEST BOARDS	III-438
DV03	US ARMY TRAINING AND DOCTRINE COMMAND (TRADOC) INITIAL OPERATIONAL TEST AND EVALUATION (IOTE)	III-441
D001	US ARMY OPERATIONAL TEST AND EVALUATION AGENCY (OTEA) INITIAL OPERATIONAL TEST AND EVALUATION (IOTE)	III-444
D986	US ARMY TRAINING AND DOCTRINE COMMAND (TRADOC) SUPPORT EQUIPMENT	III-447
6.57.15.A	DEFENSE SYSTEMS MANAGEMENT COLLEGE	III-451
6.58.01.A	PROGRAMWIDE ACTIVITIES	III-454
MM88-01	COMMAND HEADQUARTERS SUPPORT	III-459
MM88-03	SPECIAL PURPOSE AND AUTOMATIC DATA PROCESSING EQUIPMENT	III-461
6.58.02.A	INTERNATIONAL COOPERATIVE RESEARCH AND DEVELOPMENT	III-463
6.58.03.A	TECHNICAL INFORMATION ACTIVITIES	III-468
6.58.04.A	US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND (DARCOM) RANGES/TEST FACILITIES	III-474
DE90	YUMA PROVING GROUND	III-479
DE91	ABERDEEN PROVING GROUND	III-483

BUDGET ACTIVITY
PROGRAM ELEMENT
PROJECT/SCIENTIFIC AREA/TECHNICAL AREA

VOLUME III

DEFENSEWIDE MISSION SUPPORT (con't)		PAGE NO.
DE92	DUGWAY PROVING GROUND	III-487
DE93	WHITE SANDS MISSILE RANGE	III-490
DE94	ARMY ELECTRONIC PROVING GROUND	III-494
6.58.05.A	MUNITIONS STANDARDIZATION, EFFECTIVENESS, AND SAFETY	III-497
D620	DOD MUNITIONS EFFECTIVENESS	III-502
6.58.06.A	DOD HIGH ENERGY LASER SYSTEMS TEST FACILITY (HELSTF)	III-507
6.58.07.A	MODULAR AUTOMATED INTEGRATED SYSTEMS INTEROPERABILITY TEST AND EVALUATION (MAINSITE)	III-513
6.58.72.A	PRODUCTIVITY INVESTMENT FUNDING	III-517
ME88	RESHAPE - DARCOM	III-521
DE98	PRODUCTIVITY INVESTMENT FUNDS-OSD	III-524
6.58.90.A	AUDIOVISUAL SUPPORT FOR RESEARCH AND DEVELOPMENT PROGRAM	III-526
6.58.98.A	ARMY MANAGEMENT HEADQUARTERS ACTIVITIES	III-529

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.11.01.A
DOD Mission Area: #510 - Defense Research

Title: In-House Laboratory Independent Research (ILIR)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	19476	21506	21902	24611	Continuing	Not Applicable
A91	In-House Laboratory	19476	21506	21902	24611	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides Army RDTE activity directors the opportunity to perform highly promising and innovative research without having to acquire formal approval and subsequent funding. It is one of several measures used to strengthen scientific and engineering competence, aid scientific and technical personnel recruitment and retention, and facilitate communication and interaction within the scientific community. Not only does this program provide the resources and the flexibility to respond quickly to new technical challenges, but also it serves as a wellspring for innovative and imaginative ideas, of which the more promising ones progress into development programs.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: This request is based on the policy that this program is important to the Army laboratories and should be provided modest growth. Funds are allocated to directors of participating laboratories by the Assistant Secretary of the Army (Research, Development, and Acquisition) and are not subject to reallocation by intervening echelons. This allocation is based on a review of the use of funds and of the accomplishments during the preceding fiscal year.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	19476	21506	21902	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	19506	21560	24368	Continuing	Not Applicable

Program Element: #6.11.01.A
Title: In-House Laboratory Independent Research (ILIR)
DOD Mission Area: #510 - Defense Research
Budget Activity: #1 - Technology Base

The reduction of $30 thousand in FY 1981 funding level is a result of reprograming to higher priority Army requirements. The FY 1982 decrease reflects application of revised inflation and civilian pay pricing indices. The decrease in FY 1983 reflects reprograming to other important technology base efforts.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.11.01.A
DOD Mission Area: #510 - Defense Research

Title: In-House Laboratory Independent Research (ILIR)
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program promotes creativity, innovation, efficiency, and recruitment/retention of scientists and engineers by providing funds to maintain or increase individual professional competence through original work relevant to assigned military missions. It also provides a vehicle whereby innovative, high-risk ideas with high potential payoff can be pursued to the benefit of the Army. This program is keyed to increasing innovative creativity and professional competence.

G. (U) RELATED ACTIVITIES: The Navy and Air Force have similar programs. Coordination is accomplished through scientific symposia, literature reviews, exchange of research and technology resumes, Department of Defense topical reviews, and through reports transmitted by the Defense Technical Information Center.

H. (U) WORK PERFORMED BY: In-house Laboratory Independent Research is performed in thirty-seven Army RDTE activities.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The following is a sample of accomplishments obtained during FY81 from among the ILIR tasks conducted:

a. (U) Construction Engineering Research Laboratory, Champaign, IL, developed experimental polyurethane films which completely camouflaged hot 60-kilowatt diesel-driven electrical generators from infrared detection in tests conducted at Fort Sill. Such hot generators would reveal our headquarters to enemy night sights unless effectively camouflaged. Another important accomplishment was the development of materials for quieting blast noise. Such materials would be emplaced near a construction site to quiet noises which might reveal positions. They would also reduce the probability of hearing damage to weapons crews.

b. (U) Human Engineering Laboratory, Aberdeen, MD, tested various levels of Nuclear, Biological, and Chemical (NBC) warfare protection for crews performing tactical and technical artillery fire direction. The Army needs data in this area in order to evaluate the need for and effectiveness of NBC "button down" concepts.

c. (U) The Army Research Institute for the Behavioral and Social Sciences concentrated on four efforts which focus on potential problems arising from manning, training, and equipping of the Army of the future. One of these efforts examines the values of incentives in work organizations with emphasis on changing values placed upon such incentives by the soldier. Such information will be invaluable in evaluating recruitment/retention alternatives.

Program Element: #6.11.01.A
DOD Mission Area: #510 - Defense Research

Title: In-House Laboratory Independent Research (ILIR)
Budget Activity: #1 - Technology Base

d. (U) Walter Reed Army Institute of Research, Washington, DC, has initiated and will continue research in three areas to obtain information about the physiological effects of nerve agents. These projects are designed to: (a) define the link between acetylcholine receptor stimulation and red blood cell changes, (b) study acetylcholinesterase bound to red blood cell membranes, and (c) to determine the mechanism by which abnormal red blood cell structured membrane proteins result in premature red blood cell destruction. This work will provide a basis for understanding how nerve agents work and how to design better antidotes.

e. (U) One of the six projects conducted at the United States Army Medical Research Institute of Infectious Diseases, Fort Detrick, MD, has resulted in a reliable test method for determining whether threat bacteri have been altered by genetic engineering. This remarkable contribution will be invaluable in evaluating airborne or water-b rne threats which may have been bioengineered.

f. (U) The Army Research Institute of Environmental Medicine, Natick, MA, concentrated upon the protective clothing and devices soldiers must wear in the presence of threat chemical or biological warfare (CW/BW) agents, especially the limitations due to loaded breathing. They found that even though the lung sac carbon dioxide content rose significantly during extreme exercise and ventilation increased, there was no significant decrease in performance. This preliminary work will aid immensely in evaluating performance of CW/BW protective clothing.

g. (U) The US Army Tropic Test Center, APO, Miami, FL, also provided the Army with new data to model differences in troop unit performance when wearing C/B protective clothing. The soldier will be required to perform standard military tasks. Performance efficiency at these tasks will be tested by techniques such as video rifle marksmanship. This work is a valuable adjunct to evaluating effects of C/B clothing on soldier performance in a tropic environment.

h. (U) The Chemical Systems Laboratory (CSL), Aberdeen, MD, reported four investigations whose achievements are especially significant. One of these was the development of an extremely sensitive technique for rapid classification of airborne biological materials for near and remote detection of biological warfare threat agents. Another was the discovery of a totally new fluorescence enhancement method for CW/BW warfare threat detection that does not involve double labeling techniques where enzyme-tagged immunogens are required.

i. (U) The Army Engineer Topographic Laboratories, Ft. Belvoir, VA, contributed some outstanding examples of research in the area of remote sensing of terrain. This research when fully developed will offer a significant improvement

Program Element: #6.11.01.A
DOD Mission Area: #510 - Defense Research

Title: In-House Laboratory Independent Research (ILIR)
Budget Activity: #1 - Technology Base

in production of terrain mapping information for the Defense Mapping Agency. An effort in artificial intelligence and robotics was initiated in order to prepare a coordinated Army program with significant impact on Army materiel and combat multiplier factors.

j. (U) The Army Materials and Mechanics Research Center, Watertown, MA, conducted a vigorous program of investigations in new ceramics and composite materials for armaments ground vehicles and aircraft. One study advanced nuclear projectiles with greater reliability and material strength. Another study exploited the use of fiber-reinforced composite structures of complex shape in order to demonstrate that the pultrusion process can produce variable cross-section aircraft and armor components. A variable die body and hydraulic activators together with a computer control unit successfully produced a small component. This program continues to take advantage of our national supremacy in this important technology.

k. (U) The Aviation Research and Development Command Laboratories developed methods for making computerized holograms of the motion of helicopter rotor blades. By tomographic techniques they were able to record in-depth pictures of the air flow about rotor wing tips. They found that the "pop-pop" sound of rotors is due to breaking the sound barrier by collision of the rotor tip with the air vortex created by the beat of the preceding tip. Newer, quieter designs of Army helicopter rotor tips have resulted which have attracted intense interest by our NATO allies.

l. (U) US Armament Research and Development Command, Dover, NJ, has successfully isolated the cause of premature ignition of explosives. Knowledge of the cause provides for better future propellent design and in general enhanced safety of soldiers firing small arms and artillery.

m. (U) The Ballistic Research Laboratory, Aberdeen, MD, has developed a new technique which accurately determines the stability and modes of decomposition of propellants utilized in Army weapons. Propellant composition can be optimized to ensure maximum effectiveness of Army weapons. BRL has also adapted an ion plating technique that deposits a longer lasting protective coating of chromium on gun tubes. A factor of 10 decrease in wear over conventional methods has been measured. Longer gun life will result, saving considerable replacement costs for the Army.

n. (U) Atmospheric Science Laboratory, White Sands, NM, has investigated the effects of near millimeter wave (NMMW) propagation through controlled, uniform rain fields and is in the process of validating and improving NMMW propogation model predictions. These models can be utilized to optimize design techniques for future NMMW surveillance and target acquisition systems.

Program Element: #6.11.01.A
DOD Mission Area: #510 - Defense Research

Title: In-House Laboratory Independent Research (ILIR)
Budget Activity: #1 - Technology Base

o. (U) At White Sands Missile Range, NM, significant improvements were achieved in the man/machine interface involving radar data processing for target acquisition and tracking. The theoretical work and subsequent experimental improvements were implemented and greatly reduce the likelihood of human errors and data delivery time leading to better missile and projectile guidance designs.

p. (U) Harry Diamond Laboratories, Adelphi, MD, examined the nuclear radiation sensitivity of both commercial and research-type fiber optic wave guides. A practical and cost effective photo bleach process to clean up radiated wave guides has been demonstrated. HDL has developed a measurement system that is to be utilized to extract target recognition information of military targets. The ability to accurately identify targets is required to ensure effective use of brilliant munitions. HDL has continued research in its development of inexpensive, radiation-hardened, linear detector arrays for use in solid state TV cameras and other pixel-type instruments. HDL has devised a test system which quickly determines that acceptable radiation hardness exists during manufacture of electronic devices. Testing performed at this stage is extremely cost effective, while yielding high-quality chips suitable for military use.

q. (U) Electronic Warfare Laboratory, Fort Monmouth, NJ, has demonstrated a surface accoustic wave compressive phase discriminator that recognizes and characterizes a phase-coded pulse (spread spectrum) radar in the presence of higher level conventional radar modulations. Detection of spread spectrum radars represents an extremely important contribution to ELINT collection and radar warning systems (air and gound based). Two homing direction-finding techniques were developed and proven to be useful in assisting troop units to locate their equipment after a parachute drop. One technique can be applied to existing Army FM band radios; the other requires design but allows a capability at VHF. Both are excellent cost effective techniques that support location of troops and their supplies. Hardware facilities have also been developed which allow data acquisition and analysis to be performed on optical countermeasure sources. A technique to improve image analyses from remote Army sensors (RPV, etc) is being optimized based on this analysis.

r. (U) Electronics Technology and Devices Laboratory, Ft Monmouth, NJ, has developed a procedure that improves the patterns of the electron beam utilized in fabricating high-speed solid state devices. The controlling of the beam shape will allow submicron patterns to be placed on solid state chips, thereby tremendously increasing processing speed over present and near-term future solid state circuitry. The causes of surface defects developed during the fabrication process were assessed and solutions were devised. Minimization of surface defects will further enhance the purity, thus the speed, of solid state products. A new radio frequency "bunching" process is being applied to millimeter wave tube development. Success in this area will yield reduced size, weight, and cost by an order of magnitude, permitting remotely piloted vehicles, lightweight air defense and missile guidance applications.

Program Element: #6.11.01.A
DOD Mission Area: #510 - Defense Research

Title: In-House Laboratory Independent Research (ILIR)
Budget Activity: #1 - Technology Base

s. (U) Communication Electronics Command (CECOM), Fort Monmouth, NJ, developed techniques which can reduce the cost of global positioning system manpacks. Areas of broadband matching of antennas and spread spectrum techniques can be directly applied to communications of both digital and analog voice data. CECOM is pursuing fiber optics fabrication techniques which ensure low-cost, high-transmission fibers to be developed. Improvements of this type can be connected directly into cost savings for the Army.

t. (U) Night Vision and Electro-Optics Laboratory, Ft. Belvoir, VA, has developed a novel dielectric electrode which is expected to significantly improve the reproducibility and reduce the cost of carbon dioxide lasers. Organic dye material has been identified which will allow optimal low-power miniaturized lasers to be economically developed and utilized for troop training.

u. (U) The Army Missile Command, Redstone Arsenal, AL, has demonstrated a photonic (photon-electronics) computerized tracker using holographic optics. This discovery provides a new major approach toward development of "brilliant" missile seekers.

2. (U) FY 1982-FY 1984 Program: Based on the merits of the annual report submitted by each participating activity at the close of each fiscal year, new funding is allocated for the subsequent fiscal year. Directors of individual laboratories or activities then assign funds to both new and continuing promising work efforts. The freedom from a rigidly structured program and the resulting autonomy at activity level permit the Directors to effectively utilize their in-house laboratory independent research funds. This highly successful program will continue with the current objectives of addressing high-technology leverage areas.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	124896	156610	199921	218098	Continuing	Not Applicable
AF22	Research in Vehicular Mobility	733	855	1602	1726	Continuing	Not Applicable
AH40	**Signals Warfare Research	0	0	198	394	Continuing	Not Applicable
AH42	Research in Materials and Mechanics	2245	2450	3332	3254	Continuing	Not Applicable
AH43	*Research in Ballistics	5804	6530	6621	8573	Continuing	Not Applicable
AH44	Research in Fluidics, Nuclear Effects, and ISTA Electronics	2373	2300	2189	2486	Continuing	Not Applicable
AH45	*Air Mobility Research	5744	6559	8336	8662	Continuing	Not Applicable
AH46	Research in Combat Surveillance and Target Acquisition	210	70	279	424	Continuing	Not Applicable
AH47	Electronic Devices Research	2664	2384	3373	4008	Continuing	Not Applicable
AH48	Electromagnetic Propagation and Antenna Research	1258	1475	2668	2935	Continuing	Not Applicable
AH49	Missile and High Energy Laser Research	2969	3309	4518	4997	Continuing	Not Applicable
AH51	Combat Support Research	895	1172	1710	2021	Continuing	Not Applicable
AH52	Research in Support of Equipment for Individual Soldier	2090	2396	2772	2257	Continuing	Not Applicable

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
BH57	*Research in Scientific Problems with Military Applications	46508	56829	75399	80876	Continuing	Not Applicable
AH60	*Research in Large Caliber Armaments	5069	5652	6729	7252	Continuing	Not Applicable
AH61	Research in Fire Control and Small Caliber Armament	1060	1334	2541	2923	Continuing	Not Applicable
AH63	Research in Electronic Warfare	279	395	540	614	Continuing	Not Applicable
AH68	Research in Pollution Abatement	167	363	400	441	Continuing	Not Applicable
BS04	Identification and Health Effects of Military Pollutants	445	481	562	713	Continuing	Not Applicable
BS10	*Research on Military Diseases, Injury and Health Hazards	22723	35764	44112	50702	Continuing	Not Applicable
AT22	Research in Soil and Rock Mechanics	560	674	1030	1231	Continuing	Not Applicable
AT23	Basic Research in Military Construction	590	691	744	799	Continuing	Not Applicable
AT24	Research in Snow, Ice, and Frozen Ground	1580	1826	2549	2912	Continuing	Not Applicable
A31B	*Night Vision and Electro-optics Research	7358	7166	9726	10395	Continuing	Not Applicable

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
B52C	Research in Geodetic, Geographic, and Mapping Sciences	1460	1714	2414	2421	Continuing	Not Applicable
B53A	Research in Atmospheric Sciences	3587	3735	4987	4940	Continuing	Not Applicable
A71A	*Research in Chemical/ Biological Warfare Defense	2498	6399	5076	3776	Continuing	Not Applicable
B74A	Research in Human Engineering	1977	1738	2552	2803	Continuing	Not Applicable
B74F	Basic Research in Behavioral and Social Sciences	2050	2349	2962	3563	Continuing	Not Applicable

* These projects are covered by separate Congressional Descriptive Summaries.
** This is a new project.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Research performed under this program in the physical, biological-medical, engineering, environmental, and behavioral-social sciences initiates new developments leading to improved Army capabilities and provides solutions to identified Army problems. Each project is associated with a particular Army mission. Flexibility exists to take advantage of scientific and technological opportunities. This research program responds to high-priority capability requirements as stated in the Army Science and Technology Objectives Guide (STOG). This is the Army's principal guidance document for formulating and prioritizing user-oriented requirements for the mid-to-long-range planning periods.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: New and continuing research will provide the Army with improved and advanced weapons and with improved care and support of the individual soldier, and will be responsive to new objectives defined by the Army user. An increase of $22.0 million for FY82 was requested to support new concepts in chemical/biological warfare defense development. This work will continue to be accelerated in FY 1983. The Army's Chemical Warfare and Chemical

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

Biological Warfare Defense Technology Base Enhancement Program calls for exploiting new concepts in chemical warfare agent detection and warning, individual and collective protection, decontamination, casualty prevention, and medical treatment. The Chemical Systems Laboratory (A71A), the Army Medical R&D Command (BS10), and the Army Research Office (BH57) will support research in-house, at universities and industry for work in new concepts already identified which will support and enhance our CW/BW defense posture. The basic research program is constantly being changed to favor areas of R&D emphasis designed to concentrate management attention on technologies with potential high payoff in new combat capabilities. Current Department of Army areas of emphasis are in Millimeter Waves; Gun Propulsion; Fire Control; Command, Control, Communications Intelligence Systems Engineering; Microelectronics; and Chemical/Biological Warfare defense.

D. COMPARISON WITH FY 1982 RDTE REQUEST ($ in thousands):

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	124896	156610	199921	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	124016	172311	187635	Continuing	Not Applicable

The increase in FY 1981, $880,000, is a result of reprograming to increase research in Chemical/Biological Warfare defense and electro-optics. The funding decrease in FY 1982 reflects a Congressionally directed change and reprograming to higher priority DOD and Army requirements. The increase in FY 1983 is principally a result of addition of funds for university instrumentation; transfer of funds from the Navy for research in infectious diseases; and an increase to restore a 3% real growth to the basic research budget.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program element is the total Army's investment in basic science and engineering. Experience has shown that virtually all major advances in military capability can be traced to the exploitation of basic science discoveries; for example, nuclear weapons, radar, lasers, and synthetic rubber. The objective of this program is to explore new scientific opportunities primarily through the Army's in-house research community and under contract with leading researchers in academia and industry. About 35% of the Army's Defense Research Sciences program is managed by the Army Research Office. This portion of the program is totally dedicated to contract support of leading national scientists. In addition to addressing specific Army needs for scientific information, this program element provides a mechanism for stimulating interest of the at-large scientific community in Army problems. There is an intimate relationship fostered between in-house and contractor laboratories to focus effort in areas of greatest payoff. A significant effort is directed to topics which have a high potential payoff in new combat capabilities and receive high-level attention at the Army Headquarters level. At the present time there are six of these topics; namely, millimeter waves; gun propulsion; fire control; command, control, communications and intelligence system engineering; microelectronics; and chemical/biological warfare defense. Other areas of high technological interest include armor-antiarmor, advanced composite materials, military medicine and human factors, vertical lift R&D, adverse weather guided missiles and projectiles, and high-energy lasers. These areas of emphasis and high interest areas typically involve the participation of several in-house laboratories and the Army Research Office contract program, and are coordinated through the Office of the Director of Army Research. This Program Element consists of a large number of scientific tasks. Many of the objectives deal with persistent problems as, for example, that of increasing the ability to penetrate armor. Changes in the program are much more apparent in the approaches to the objective rather than in the objective itself. For example, research on electromagnetic acceleration of hypervelocity particles is an alternate approach to armor penetration, the practical application of which hinges on the resolution of several specific scientific issues. Increases in funding in the 6.1 program have been applied in two directions: the first, to offset past serious erosion in the capability of this program to accelerate areas of scientific strength such as missiles and electronics, and the second, to develop technical objectives of opportunity such as the areas of emphasis described above.

G. (U) RELATED ACTIVITIES: The Navy, Air Force, and other Department of Defense agencies; National Aeronautics and Space Administration; National Academy of Sciences/National Academy of Engineering/National Research Council; National Science Foundation; Department of the Interior; Department of Energy; National Bureau of Standards; Department of Health and Human Services; other Government agencies; Government agencies of allied nations; and the industrial and academic community all sponsor related research in some areas of this program. Coordination to eliminate duplication is accomplished by tri-Service topical reviews; exchange of progress reports and technical reports; inter-Service/agency liaison; and formal national and international meetings and symposia. Informal coordination occurs through: visits to governmental, industrial, and academic laboratories, and installations; review of the scientific literature; and publications of current

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

research. The Army's Defense Research Sciences Program is included in the Tri-Service Technology Coordinating Papers. Additional details on related activities are provided in individual project descriptive summaries.

Program Element: #6.11.02.A
Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research
Budget Activity: #1 - Technology Base

H. (U) WORK PERFORMED BY: The research supported under this program is performed by in-house laboratories and activities and by academic institutions, not-for-profit organizations, and industrial laboratories through contracts. Specific contractors are listed in the project and scientific area descriptive summaries. The laboratories/activities responsible for research under this program are the following, listed by major Army developing agencies.

US Army Materiel Development and Readiness Command:
Tank-Automotive Command, Warren, MI
Signals Warfare Laboratory, Warrenton, VA
Materials and Mechanics Research Center, Watertown, MA
Ballistic Research Laboratory, Aberdeen Proving Ground, MD
Harry Diamond Laboratories, Adelphi, MD
Aviation Research and Technology Laboratories, Moffett Field, CA
Combat Surveillance and Target Acquisition Laboratory, Fort Monmouth, NJ
Electronics Technology and Devices Laboratory, Fort Monmouth, NJ
Communications and Electronics Command, Fort Monmouth, NJ
Electronic Warfare Laboratory, Fort Monmouth, NJ
Missile Command, Redstone Arsenal, AL
Mobility Equipment Research and Development Command, Fort Belvoir, VA
Natick Research and Development Command, Natick, MA
Large Caliber Weapon Systems Laboratory, Dover, NJ
Benet Weapons Laboratory, Watervliet, NY
Fire Control and Small Caliber Weapon Systems Laboratory, Dover, NJ
Army Research Office, Research Triangle Park, NC
Night Vision and Electro-Optics Laboratories, Fort Belvoir, VA
Atmospheric Sciences Laboratory, White Sands Missile Range, NM
Chemical Systems Laboratory, Aberdeen Proving Ground, MD
Human Engineering Laboratory, Aberdeen Proving Ground, MD

US Army Corps of Engineers:
Waterways Experiment Station, Vicksburg, MS
Construction Engineering Research Laboratory, Urbana, IL
Cold Regions Research and Engineering Laboratory, Hanover, NH
Engineer Topographic Laboratories, Fort Belvoir, VA

US Army Medical Research and Development Command:
Walter Reed Army Institute of Research, Washington, DC
Letterman Army Institute of Research, Presidio of San Francisco, CA
Medical Research Institute of Infectious Diseases, Fort Detrick, MD
Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD
Institute of Surgical Research, Fort Sam Houston, TX
Institute of Dental Research, Washington, DC
Aeromedical Research Laboratory, Fort Rucker, AL
Research Institute of Environmental Medicine, Natick, MA
US Army Institute for Chemical Defense, Aberdeen Proving Ground, MD

Office of the Deputy Chief of Staff for Personnel:
US Army Research Institute for the Behavioral and Social Sciences, Arlington, VA

Program Element: #6.11.02.A
Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research
Budget Activity: #1 - Technology Base

I. PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Several recent accomplishments have the potential of significantly increasing future Army capabilities. These include the ability to detect, identify, and classify targets and guided weapons as a result of the development of new, higher frequency microwave and millimeter wave components. Progress that has been made in the integration of detection and image processing on the same electronic chip is the start of "smart" night vision devices for improving operations in limited visibility conditions, target-cueing capability, and counter-countermeasures. In the area of armaments, research has shown that certain chemical compounds may contain as much as 50% greater explosive energy than the standard explosives. A new form of ductile chrome has been developed which affords a fivefold increase in gun barrel erosion life. In medical research, a model has been developed to predict the ability to survive after using certain antidotes to nerve agents. The feasibility of antitoxin protection from intestinal generalized shock has been demonstrated. These are representative accomplishments in the areas of electronics, armaments, and medical science. Additional accomplishments by major Army Commands are as follows:

a. (U) Electronics Research and Development Command (AH40, AH44, AH46, AH47, A31B, B53A, AH63): An extensive effort to develop a near millimeter wave (NMMW) capability has led to the successful operation and test of both a 70-gigahertz (GHz) orotron and a 240-GHz gyrotron transmitter. In pursuit of traveling wave tube (TWT) technology, lightweight, temperature-insensitive magnetic materials were combined and analyzed to maximize their magnetic properties. A variety of solid state materials was studied to access their suitability for use in the fabrication of components utilized in electronic systems. Performance of the NMMW components is being optimized through an analysis of the causes of defects in the actual interface between the semiconductor crystal materials the device is composed of. Photo-resist materials were also analyzed to ensure that an optimal type needed for extremely fine-line pattern generation will be available. Electron beam plasmas and chemical techniques that are used to etch the photo-resist material were also analyzed for generation of the extremely fine-line geometry. These techniques can be used to develop actual components (travelling wave tubes, transistors, mixers, isolators, and circulators). Component fabrication will enable the Army to develop a lightweight, cost effective NMMW system for use as a radar, missile guidance tracker and in brilliant munitions. Radar doppler data, utilizing a breadboard NMMW system, were analyzed utilizing the Fast Fourier Transform technique to show that identification of moving targets was feasible. A computer model was improved to provide for the addition of NMMW components into its data base. Component performance, when subject to nuclear radiation, can now be catalogued, enabling hardened systems to be more easily developed. Terrain transport and diffusion modeling that enables accurate transport predictions to be made during chemical and biological warfare was initiated. Models, including a vehicular dust- and fire-induced optical turbulence

model, were developed that predict performance of a variety of electronic sensors in different atmospheric conditions. Models of these types allow optimal designs for electric sensors to be developed. The adverse weather conditions in Europe can be taken into account prior to final design decisions. A novel application for an accurate fluidic angular rate sensor was investigated, having potential application for a navigation system for land vehicles. Accomplishments in the area of night vision research and electro-optics are reported in a separate Descriptive Summary.

b. (U) Tank-Automotive Research and Development Command (AF22): A solid state, field-portable instrument to quantify the quality of armor vehicle ride was developed, which will enable selection of optimal tank and other armored vehicle design parameters. Tests with this instrument will be combined with previously developed equations of motion which represent terrain-vehicle interaction, vehicle suspension and chassis, and track action which impact on design of combat vehicles, including fire control and gun/turret drive servo control systems.

c. (U) Aviation Research and Development Command (AH45): Model test data have been used to design an advanced rotor for the attack helicopter. The design varies the twist, platform tip shape, and the airfoil distribution. Rotor research and new engine and helicopter structure concepts developed in this program are outlined in a separate Descriptive Summary.

d. (U) Army Research Office (BH57): This program continued to support a vigorous program of advanced science and engineering research related to solving identified Army problems and exploiting new technological opportunities. The projects are performed mainly by academic and not-for-profit institutions in atmospheric and terrestrial sciences, chemical and biological sciences, electronics, materials, mechanics, mathematics, aeronautics, and physics. This program, in whole and in its smallest parts, is closely coordinated with the in-house laboratories in order to assure responsiveness to Army needs. In this manner, the program serves to promote information exchanges among Army laboratories and academic institutions and to prevent duplication. The many accomplishments of the past year are discussed in separate Descriptive Summaries for Project BH57.

e. (U) Army Research Institute (B74F): Completed research on the effective use of feedback in organizations in order to influence improved performance, and produced models to measure the effectiveness of an individual in achieving objectives of the organization. Also, research was completed on the development of a model of learning under various conditions of drill and practice, and a model for understanding of complex problem-solving strategies, including a study of factors influencing the learning and use of information from maps. Research was also completed on the differences between individuals performing visual tasks based on their motor-related behaviors.

Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

f. (U) Toxic and Hazardous Materials Agency (AH68): Completed basic studies for use of activated carbon in regeneration and reuse of munition plant discharge wastes.

g. (U) Armaments Research and Development Command (AH43, AH60, AH61, A71A): Computer models were developed to describe the dynamics of gun tubes and projectiles. Preliminary results indicate that substantial savings in production and logistics can be made using bulk-loaded liquid propellant in large caliber guns. The computer was also used to determine the most effective projectile nose shape and to examine explosion dynamics in order to improve antiarmor effectiveness. The cost and sensitivity of explosive/propellant fillers have been reduced with no loss in performance by the development of cheap, readily available, additive materials. Armor laminate research has resulted in an aluminum titanium material with a 22% increase in ballistic resistance and 50% increase in residual fatigue strength, compared to rolled homogenous steel. A composite depleted uranium-tungsten filement-reinforced penetrator material with increased dynamic yield strength was successfully formed by extrusion. This material could substantially improve direct-fire antiarmor effectiveness. A theoretical investigation suggested that sound waves in air might be detected by means of an optical fiber interferometer in which sound waves induce a phase shift. Based upon this theory, a laboratory model of a fiber optic sound sensor was designed and assembled. This concept may lead to valuable methods for target detection/tracking and fire control. In an effort to improve propellant burning characteristics, researchers discovered that the nature of molecular groupings surrounding the nitro group in nitrocellulose can have a considerable influence on the ultimate burning rate of propellants. Considerable progress was made in characterization of surfaces which might be contaminated with chemical or biological agents. Surface energetics, morphology, texture, and other micro properties will affect how tenaciously agents might cling to the surface. Conversely, the same properties will enable predictions of how best to decontaminate equipment which has been in a nuclear or biological or Chemical environment. More detailed accounts of the accomplishments for Projects AH43, AH60, and A71A are contained in separate Descriptive Summaries.

h. (U) Mobility Equipment Research and Development Command (AH51): New compounds were discovered which selectively absorb 1.06 micrometer laser radiation. Liquid and solid coatings containing these new compounds were shown to be very effective camouflage agents against lasers and their associated detectors operating in the 1.06-micrometer spectral region. In the area of power transmission, the discovery of intercalated graphite which conducts electricity better than copper cable is being exploited.

i. (U) Human Engineering Laboratory (B74A): Developed a theory of hearing loss due to blast overpressure from artillery which is the basis for design of better hearing protection, and completed experiments relating visual response,

eye movement, and hand coordination, in order to understand this behavior of soldiers in combat situations. Over the long range, these experiments will lead to improved display design principles.

j. (U) Communications Electronics Command (AH48): A mathematical procedure for locating the shortest path and a new method of acknowledgement for digital communications were developed. Also, theories were developed and adapted for designing tapered dielectric disc antennas and rod antennas which will be useful for millimeter wave transmitters and receivers. This capability will enable direct and covert communications in a battlefield environment. Optical fibers for use in communications have been made much less susceptible to pulsed nuclear radiation. Treated samples showed acceptably reduced loss of signal after continued pulsing at realistic threat radiation levels. This important discovery keeps alive the promise of large information capacity transmission through optical fibers for tactical operations and for weapons systems.

k. (U) Missile Command (AH49): Several concepts were developed for optical correlation guidance and tracking including holographic methods using a small laser diode to compare the target with a prestored hologram of the target. This is an important step in the development of a class of small, very inexpensive fire-and-forget missile seeker systems which can acquire and track a target autonomously. An optical correlator design based upon integrated optics was achieved which occupies a very small space, less than 100 cubic centimeters. Imaging was achieved at 0.89-millimeter wavelength. This is a special accomplishment which may lead to realtime imaging devices useful in tactical combat in foul-weather or battlefield dust-obscured visibility.

l. (U) Natick Research and Development Command (AH52): A new radiometric technique was developed that allows for rapid screening of foods to determine if the bacterial content is low enough for consumption. A test model was developed to better understand criteria of food acceptance by the individual. Fundamental photo/thermal mechanisms were studied to determine methods of enhancing the radiation protection qualities of fabrics. The use of dyes on cloth is extremely important for camouflage and individual soldier survivability since dye can effect the performance of well-designed cloth. Infrared spectrum analysis, calorimetric, fire retardation, and waste repellant measurements were conducted to ensure proper selection of dye material. The feasibility of providing a nutrient liquid capable of being ingested through the drinking tube of a CW/BW protective mask was demonstrated.

m. (U) Materials and Mechanics Research Center (AH42): From computer simulations of penetrator-armor interaction, coupled with analysis of flash X-rays and post-mortem examinations, researchers were able to define the "processing-zone," that is, the local armor-penetrator problem area where all phenomena affecting performance occur. The definition of this

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

local zone will greatly simplify future three-dimensional analysis of how penetrators work on armor, and conversely, how armor may defeat penetration. Also using this processing-zone concept, it is now possible to quantify effects of other failure modes such as erosion and shear. A highly advanced polymer characterization capability was developed using liquid chromatography, viscometry, osmometry, and light-scattering techniques. This characterization capability is crucial in designing plastics for better polymer composite materials which, in turn, may be used for stronger, lightweight aircraft or armor structures.

n. (U) Office of the Surgeon General (BS04, BS10): The many accomplishments in these projects cover a broad area of medical research aimed at better understanding prevention or treatment of combat service-related diseases and injuries. Among these programs, emphasis is placed on the treatment of chemical and biological warfare-related injury. Examples of accomplishments during the past year include: development of a nerve cell model to define mechanisms of intoxication by botulism and other neurotoxins of biological warfare importance; discovery of evidence that nerve agents cause nerve degeneration in specific areas of the brain; and discovery that central nervous system centers involved in respiration were found to be more sensitive to nerve agent poisoning than the surrounding respiratory centers indicating that nerve agents may be more centrally active than previously believed. In pollution abatement, more reliable aquatic bioassay protocols and techniques for evaluating bioassay data have been developed. A more complete account of the Army's medical research is given in the separate Descriptive Summaries for Project BS10.

o. (U) Corps of Engineers (AT22, AT23, AT24, B52C): Research in soil and rock mechanics yielded the best methods for detecting subsurface voids and cavities in foundation sites for military construction and water detection. The construction engineering program yielded a computer program called BLAST, which predicts the energy consumption for new or remodeled buildings. This capability is invaluable in designing new facilities or remodeling old ones with optimum heating and air-conditioning control and minimum energy consumption. At the Cold Regions Laboratory, winter battlefield obscuration conditions were characterized and data was acquired to support material developers of electro optical equipment. By analyzing airborne snow concentration and particle size distribution and its effects on military surveillance and target acquisition equipment defects and limitations may be avoided saving procurement funds later on. At the Engineering Topographic Laboratory, research on mapping and scene interpretation resulted in completion of a hybrid optical/digital image processing system. A photographed scene can be recorded on tape and replayed at other frequencies and aspect angles. This capability will enable the soldier to immediately recognize his position and surrounding region and allow him to assess the enemy's view.

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Program: Approximately 80% of the program will be related-armaments, electronics, chemical warfare, and medical research. Emphasis will be placed on the following areas of high-priority Army technological needs: millimeter waves; gun propulsion; fire control; mobility and installation energy; command, control, communication, and intelligence systems; microelectronics; and chemical warfare and chemical/biological warfare defense. The programs planned by the major Army commands are as follows:

a. (U) Electronics Research and Development Command: To insure the optional development of near millimeter wave (NMMW) systems, efforts to maximize the output power of both the 70-gigahertz (GHz) orotron and 240-GHz gyrotron transmitters will continue. To insure maximum flexibility in utilizing the millimeter wave frequency domain, transmitters centered at 140-GHz, utilizing the orotron technique, are planned for development. Receiver technology will be pursued utilizing the gyrotron approach. Fabrication of state-of-the-art magnets for NMMW traveling wave tube will commence. The goal is to decrease the mass/volume to 1/20 that of conventional magnets, while maintaining proper operation. Development of a lightweight TWT opens up additional areas for uses of electronic systems, especially NMMW systems. Fabrication of components utilizing electron beam plasma techniques will be started to ensure that the proper solid state and photo-resist material has been selected that yields the required high-quality, fine-line patterns. These components, when coupled with planned developments of mixers, limiters, and insulators, make possible the development of a lightweight NMMW system. Radar data analysis of moving targets is planned to insure that optimal target identification algorithms are developed that will yield a high probability of correct classification. A library cataloging NMMW materials and their corresponding reaction to nuclear radiation will be finalized, enabling future selection of high-quality hardened devices for use in NMMW systems. A terrain transport and diffusion (T&D) model will be completed and teated. It will allow accurate prediction of the T&D of chemical/biological agents and obscurants. Vehicle dust model and the fire-induced optical turbulence models will be upgraded to include realistic battlefield conditions, allowing more accurate predictions of weapon system performance in these environments. The fabrication of a lowest, effective fiber-optic dosimeter will be completed. Due to the high quantity of dosimeters that the Army buys, a cost effective dosimeter will result in considerable dollar savings. A remote radiometric sensor will be designed and fabricated to measure boundary layer winds. Data obtained will be utilized to validate existing computer models of the atmosphere. Fluidic laminar jet angular rate sensor research will be completed, and applications to a navigation system for land vehicles will be determined. A fluidic gas concentration sensor for chemical warfare applications will be fabricated and tested. This device may prove to be a cost effective sensor to warn troops of a lethal chemical environment. A new project, Signal Warfare Research, will be initiated in FY 1983. The detection and identification of signal sources in a noisy tactical environment is of extreme importance to a military commander. Enemy position and/or battle plans may well be ascertained by skillful monitoring of radio frequency sources. This task will utilize

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

digital processing techniques to automatically detect, analyze, and display SIGINT data. Data from multiple sources will be further processed and fused together to present a coherent picture of enemy forces. The goal is to provide information fusion techniques that decrease manpower requirements yet yield accurate results. Future plans in the area of night vision research and electro-optics are reported in a separate Descriptive Summary (A31B).

b. (U) Tank-Automotive Research and Development Command: Efforts will continue to provide fundamental knowledge to improve combat vehicle performance. This work will include: studies of improved elastomers and design for tank treads; effects of engine overload "Burst Power" on engine-chassis performance; "closed loop" control systems which will allow a diesel engine to perform with alternate fuels; and structural vibration and stress analysis using holographic techniques which relate fringe pattern to vehicle vibration. Methods for rapid interpretation of the fringe patterns and vibration will be developed.

c. (U) Aviation Research and Development Command: This program will provide basic information applicable in aerodynamics of rotors, aircraft materials, advanced propulsion engines, and aviation electronics needed to increase the safety, survivability, and mission effectiveness of future aircraft. A separate Descriptive Summary has been provided for further details of this research (AH45).

d. (U) Army Research Office: Descriptions of this major contractual program with academic, industrial, and not-for-profit institutions are discussed in separate Descriptive Summaries (BH57)

e. (U) Army Research Institute: Research efforts will continue to provide a knowledge base for people-related problems which influence operational effectiveness. Three general areas will be addressed: manpower and personnel, education and training, and human factors in military operations. New initiatives in manpower and personnel relative to evaluating cognitive abilities including computer-based methods will be stressed. In education and training computer-based instructional procedures which resemble as closely as possible conditions of the actual battle will be emphasized. In operational systems training, the emphasis will be on understanding cognitive processes involved in information-handling in systems such as tanks. For example, it is anticipated that research will be completed into the most effective way to update and present information concerning tactical situations in ways to best suit the user, and into how the capabilities of a computer may be used to process information to merge with the behavioral style of the individual who uses that information. The FY 1982 to FY 1984 period will see an emphasis in the man-machine interface.

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

f. (U) Toxic and Hazardous Materials Agency: Efforts to develop new methods and technology for treatment and disposal of munition plant wastes will be continued. Research will include biodegradation of hazardous wastes and use of chemical ion mass spectroscopy for rapid wastewater analysis.

g. (U) Armament Research and Development Command: Research in Ballistics, AH43: Many initiatives which will improve ammunition, fire control, and armor protection are planned. Very high burn-rate propellants will be developed for very high muzzle velocity, direct-fire weapons, increasing range and accuracy. Three-dimensional predictive techniques will be developed to improve design of shaped charge and self-forging fragment warheads Techniques will be developed to measure flight performance and improve target discrimination capabilities of SMART munitions. The feasibility of using electric currents and magnetic fields will be examined for use in active armor and to enhance performance of shaped charge warheads. Research in Large Caliber Armaments, AH60: Efforts to develop high-density, high-output explosives--some using energetic polymers--will continue. Propellants with higher force, lower flame temperatures and signature will be a major goal. Energetic materials which can serve as structural elements in munitions will be sought. Use and behavior of composite materials in both penetrators and armor will be examined. Research in Fire Control, AH 61: Innovative techniques for target location, identification, and tracking will be pursued. Techniques identified to improve signal processing capabilities and weapon/turret stabilization will be prime areas for research. Fire control concepts to achieve extended-range, day-night, all-weather battlefield target sensing; identification; target range and azimuth data processing; and other operations for accurate gunfire will be generated and evaluated for future applications. Research in Chemical/Biological Warfare Defense Systems, A71A: A strong program of in-house and contractual research in chemical and biological warfare defense will continue in order to provide fundamental information and new concepts for defense and for a sound deterrence system of chemical munitions. This program will also support research in smoke and obscuration as a part of the Army Smoke Mission. New concepts will be exploited in individual and collective protection, detection and warning, decontamination, contamination avoidance, and in training systems. Needed research in chemical deterrence will examine new agents and new concepts for storage and delivery. Research leading to improvements in smokes and obscurants will be conducted in the infrared and millimeter wave regions of the spectrum in order to defeat enemy seekers in those regions. Further details of planned work for AH43, AH60, and A71A are presented in separate Descriptive Summaries.

h. (U) Mobility Equipment Research and Development Command (AH51): Work will continue on camouflage techniques, new fuels and lubricants, mine and countermine concepts, and power source and transmission. Work on camouflage paints will include studies of passive countermeasures and an investigation of deterioration of fuels in automotive equipment and storage.

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

i. (U) Human Engineering Laboratory (B74A): Continue to address issues of reading and perception, visual search, comprehension, linguistic aspects, and readability of materials that relate to US Army soldier performance. Continue experiments on logical inferences from displays, with special emphasis on mistake-free interpretation of information. This research will be useful in command and control and command, control, and communications systems design. Similarly, research in auditory and visual information processing during selective attention periods and in high-excitement states will lead to improved performance in processing information and in decision making.

j. (U) Communications Electronics Command (AH48): Efforts will address urgent communication needs of evolving fire control systems facing severe problems in data distribution, antenna design, signal transmission and reception, and digital communications. Research in battlefield information distribution will be continued to develop network management theory and practice and protocols and distribution procedures required. Specifically, work will be initiated or continued in: network management, with emphasis on recovery techniques after a network controller has failed; dielectric millimeter wave antennas; communications in built-up areas; developing nuclear radiation-resistant and covert fiber-optics communications; and development of quantitative communications command and control systems theories to allow improvements in development of survivable systems.

k. (U) Missile Command (AH49): Efforts will continue to provide the research base necessary to support development of future missile systems and high-energy lasers. This program will address problems in missile guidance and control, terminal homing, propulsion aerodynamics, structures, and simulation in order to seek and foster new concepts and techniques that offer improvements in state-of-the-art weaponry. Research will include: design of a flight-size optical correlator; investigation of tomographic analysis of images obscured by smoke and dust; design of millimeter and submillimeter radar; analysis of deformable wings coupled with thrust vector in future missile systems; and initial design of an ogive window for infrared seekers on missiles.

l. (U) Natick Research and Development Command (AH52): The effects of food additives on the growth of spores which cause food poisoning will be studied. Chemical stabilizations of enzymes that cause the deterioration of textiles will be attempted. Fiber surfaces and chemical modifications to surfaces will be investigated to minimize reactions with fluids used in chemical and biological warfare. The effects of water activity, PH, temperature, and packaging on the spoilage of a broad category of food will be investigated. Analytical systems are planned for development that will separate and identify components of food and packaging materials which affect ration quality and stability.

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

m. (U) Materials and Mechanics Research Center (AH42): This project will focus on armor and armor-penetration materials and penetration phenomena in order to establish a basis of new armor to counter the threat posed by enemy equipment. Another major thrust will be development and microstructural analysis of organic, metallic, ceramic, and composite materials for use as stuctural components for aircraft, tanks, armored personnel carriers, and for artillery and gun tube liners. Such materials should be tough and lightweight, requiring little or no maintenance. A third major area will be in seeking advanced materials concepts for combined kinetic energy (projectiles), blast, and laser protection. Emphasis will be on better metal and ceramic processing for enhanced weapon systems performance at lower cost.

n. (U) Office of the Surgeon General: Basic research on military disease, injury, and health hazards, including research in medical defense against chemical and biological warfare agents, and in medical factors which limit soldier effectiveness are presented in separate Descriptive Summaries (BS10). A new scientific area will be pursued--"Medical Chemical Defense Science Base/Mechanism of Action of CW Agents and Antidotes." This is a major DOD effort on medical chemical warfare defense and supports the requirements of other services.

o. (U) Corps of Engineers: Major new emphasis will be placed on artificial intelligence-related to architectural and engineering plans, to monitoring and control of energy consumption, and to monitoring the construction process. Testing and evaluation of components for gravity field determination will be undertaken, and tests of new methods and systems for automated terrain feature extraction will be performed. Again, applications of artificial intelligence for mapping and terrain interpretation will be investigated. The Cold Regions Laboratory will continue to support winter battlefield obscuration experiments in order to determine how seekers and trackers may best be used under conditions of snow, ice, and frozen soil. A part of the research in soil and rock mechanics will involve digital data processing of geographical data. The results obtained will have direct application to expedient and permanent construction and combat engineering support.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #AH43 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to increase our knowledge in the ballistic related scientific areas of propulsion dynamics, launch and flight dynamics, warhead mechanics, kinetic energy penetrator mechanisms, blast dynamics, ballistic protection, mathematical analysis, system statistics, and fundamental structural vulnerability. Major emphasis is devoted to developing an understanding of the processes occurring in the operation of a weapon system such as the chemical kinetics of reacting explosives and propellants under conditions of high temperature and pressure; analytical descriptions of two-dimensional, two-phase gas flow in gun tubes; aerodynamics of projectiles, rockets, and missiles; fluid dynamics and heat transfer involved in combustion, detonation, and muzzle flash; continuum mechanics controlling explosive-metal interaction and ballistic material dynamic response under very high stress strain.

B. (U) RELATED ACTIVITIES: Research in ballistics is indirectly related to, but not duplicative of, work in Research in Large Caliber Armament (AH60), Research in Fire Control and Small Caliber Armament (AH61), and Research in Defense Systems for Chemical and Biological Warfare (A71A), all in program element 6.11.02.A. Elements of Research in Ballistics are coordinated with portions of the Army Research Office Program, Research in Scientific Problems with Military Applications (BH57), also in program element 6.11.01.A. Research achievements complement efforts in Project AH80, Ballistic Technology in program element 6.26.18.A. Visits by other service personnel, participation in interservice technical groups, and interagency transfers of information preclude unnecessary duplication of effort. International coordination is achieved through joint participation in the Technical Cooperation Program, North Atlantic Treaty Organization Advisory Group and by Data Exchange Agreements.

C. (U) WORK PERFORMED BY: Ninety percent of the work in this program is performed in-house at the Ballistic Research Laboratory, Aberdeen Proving Ground, Maryland. Other Government agency support will be provided by Kirtland Air Force Base, Naval Ordnance Station - Indian Head, the Department of Energy and the National Aeronautics and Space Administration. Principal contract support will be provided by Calspan Corporation ($100 thousand); Massachusetts Institute of Technology ($60 thousand); and Iowa State University ($45 thousand). Request for advisory assistance for three-dimensional computer codes will be with a to-be-determined contractor. Total estimated costs for all supporting efforts including Government agencies and contractors will not exceed $650 thousand.

Project: #AH43 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAM:

1. (U) FY 1981 and Prior Accomplishments: Substantial progress has been made in development of a computational predictive technique to describe complex interior ballistic flows within gun tubes. A numerical solution to describe the bulk-loaded liquid-propellant (LP) process has been completed. Evaluations of LP materials by the Army Environmental Hygiene Agency have shown no unacceptable level of toxicity. Preliminary systems evaluation concludes substantial savings in production and logistics can be attained with LP for large caliber guns. Enhanced capabilities have been developed to predict secondary muzzle flash and blast through use of muzzle flow computational codes and flash prediction schemes. Computational techniques have been developed for predicting aerodynamics of spinning shell and nose bluntness effects of shell at supersonic velocity. Experimental results show that magnus force for a flat nose projectile, typical of the 155mm Army shell is increased 60 percent over that of a pointed nose projectile. The CRAY IS vector computer at Kirtland Air Force Base has been accessed at BRL for Navier-Stokes computations of transonic shell magnus. Computations are two and one-half times faster than with the BRL Cyber 7600 computer. The roles of shock, shear, and heat transfer in hot-fragment impact of explosives have been examined. Results show that shear is the dominant mechanism both for ignition and growth to explosion upon impacted explosives. Recent advances in understanding of adiabatic shear have been exploited to correlate strain gradient transitions with temperature of metallurgical changes in rolled homogeneous armor. Substantial progress in explosive acceleration of metal has permitted design of shaped charge warheads with enhanced jet velocities. A two-dimensional mathematical simulation describing arc dynamics of an arc armature rail gun has been completed. Dynamic gas density data have been obtained from an M-16 rifle using a monoenergetic X-ray attenuation technique.

2. (U) FY 1982-FY 1984 Program: Develop very high burn rate propellants for very high muzzle velocity direct fire weapons. Provide design guidelines for injection of reactive fluid in bulk-loaded regenerative liquid-propellant guns. Characterize combustion mechanisms of new propellants and determine extent of propellant deconsolidation in gun chambers. Extend the TD NOVA computer code to treat multiple-increment, bagged propellant charges. Implement the PAGAN (UK) computer program to predict tank gun firing vibrations and evaluate importance of tube curvature. Predict magnus effects for shells at transonic velocities. Decrease and control hazards from muzzle blast. Begin full-scale tests of muzzle blast control technique derived from scale model concepts. Evaluate suitability of substituting tests with a laboratory gyroscopic flight simulator for selected full-scale ballistic flight tests. Modify explosive material properties to control response of explosives to shock loading. Define and control particle size distribution of explosive components in high explosive (HE) formulation. Enhance effectiveness of shaped charges by refining warhead design to include nonsteady state processes.

Project: #AH43 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

Develop three-dimensional predictive techniques to improve design of shaped charge and self-forging fragment warheads. Exploit stochastic differential games and distributed decision processes to obtain control structures for artillery command, control, and communication systems. Validate theoretical prediction techniques for describing radar absorption by compacted chaff. Develop theoretical and experimental program to determine effects of surface snow on millimeter wave radiometric sensors for warheads. Evaluate failure theories pertaining to multiaxial stress states. Incorporate germane theories into response techniques for predicting structural failure in military targets. Determine effects of porosity and mechanical strength on burning rate of selected hivelite propellants. Develop two phase flow interior ballistic analytical simulations to treat influence of ignition, propelling charge parameters, and pressurization profiles. Characterize ignition mechanisms in isolated propellant grains exposed to rapid convective heating. Determine effect of local bending of gun tubes on projectile accuracy. Develop capability to predict wave propagation through threaded or other projectile joints. Analyze injection dynamics, droplet size distributions, and droplet-geometry interactive effects for liquid propellants. Treat numerically, three-dimensional flow within muzzle brake using finite element technique. Examine blast propagation in vicinity of gun crew. Exploit thin-layer Navier-Stokes computational codes for predicting effects of unsteady flow field phenomena. Measure flight performance of advanced improved sensing munitions. Identify primary processes by which ignition of explosive occurs as a result of external stimuli. Determine principal mechanical properties of explosives which control reaction violence when munitions are deformed. Identify initiation pathways in an explosive and determine control parameters to guide development of threat resistant munitions. Evaluate new and unique mechanisms for accelerating metals; e.g., electro/explosives, novel jet formations, and nonconical geometries for high explosive, antitank (HEAT) devices. Determine feasibility of using electric currents and magnetic fields to provide active armor. Evaluate material failure theories for predicting structural failures in military targets. Measure stress at high rates in penetrator and armor targets. Apply nonclassical target discrimination techniques to sensors for "Smart" munitions. Conduct theoretical and experimental evaluations of radar-absorbing coatings. Validate computer simulation of combustion processes of super-burning rate propellants through detailed physical and chemical phenomenological evaluation. Examine role of propellant deformation and fracture in the growth of pressure waves and subsequent overpressures in guns. Relate distribution of shot exit conditions to variations of projectile balloting and tube vibrations. Couple deterministic balloting vibration simulations to bending of gun tubes to provide means for computing shot exit conditions. Obtain experimental data to validate computational predictions of gas flows in muzzle devices. Predict three-dimensional flow fields over spinning shell and the destabilizing effects of rotating payloads. Evaluate effects of loose payload motion on stability of projectiles using laboratory gyroscope and free flight ballistic tests. Develop techniques to cushion mechanical energy transfer--through deformations--to explosives. Establish transient effects of shock in coupling explosive energy to shaped charge liner. Evaluate electric field

Project: #AH43 Title: Research in Ballistics
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

augmentation of explosives to enhance performance of shaped charge warheads. Determine feasibility of applying pulse power technology to evaluate the stability of shaped charge jets. Determine effects of electromagnetic propulsion environment on high explosives. Conduct instrumented impact experiments of unsteady phase penetration into new armors. Characterize ballistic material response under high loading rate and high pressure. Develop small-scale experimental facility to synthesize new magnetic reactive/active armors. Develop techniques to exploit pattern recognition for signature enhancement research. Apply natural languages used in fire control computers and C3 problems to the Artillery Command Experiment (ACE). Evaluate techniques to measure radial density profiles of propellant gases in large caliber guns. Establish effects of temperature on materials used in aircraft and armored vehicles. Determine effects of thermal radiation and finite inelastic deformation heating of these materials by nuclear weapons.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5804	6530	6621	8573	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6663	7170	9300	-	Continuing	Not Applicable

The reduction in FY 1981 is a result of reprograming to higher priority Army requirements. The funding decrease in FY 1982 reflects Congressional cuts and the application of revised inflation and civilian pay pricing indices. The decrease in FY 1983 is a result to reprograming to higher priority programs.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #AH45 — Title: Air Mobility Research
Program Element: #6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This project supports research to advance the state-of-the-art in rotary-wing aerodynamics, structures, propulsion, mathematical models, and avionics. The objective is to expand the technologies in those areas which are most likely to produce improvements in operational effectiveness, safety, survivability, and life-cycle costs of Army aircraft. Aerodynamics research is oriented toward advanced airfoils and rotors and will address basic fluid mechanics, acoustics, dynamics, control, and flight simulation. Structures research is oriented toward advanced materials and structural concepts such as advanced metal and composite aircraft components. Fatigue and fracture characteristics of these materials are being investigated, and fracture control procedures and techniques are being developed. Propulsion research is directed at small-engine technology to improve the internal aerodynamics of combinations of compressors, combustors, and turbines, and to increase turbine operating temperatures. Avionics research is aimed at reducing the proliferation of visual displays in helicopter cockpits and enhancing the capability to maneuver safely at nap-of-the-earch altitudes.

B. (U) RELATED ACTIVITIES: This project supports the Army's aeronautical research program conducted in joint participation with the National Aeronautics and Space Administration (NASA) in accordance with agreements between NASA and the Army. Related research is performed by the Navy, Air Force, Department of Transportation, and Department of Energy. Coordination to eliminate undesirable duplication within the Department of Defense is accomplished by program and topical reviews, through the exchange of program data sheets, research and technology resumes, technical reports, by interservice liaison, and by visits. Broader coordination, including international coordination and cooperation, is accomplished by participation in the Quadripartite Standardization Program, the Technical Cooperation Program, NASA Research and Technology Committees, Interdependency Activities, and the North Atlantic Treaty Organization Advisory Group on Aerospace Research and Development. The work supported under this project is closely related to, and planned in conjunction with, the scientific program of contracts with industry and academic institutions that is implemented by the Army Research Office under Project BH57, Research in Scientific Problems with Military Applications. The results of investigations carried out under this program are coordinated with the exploratory development program supported under Element 6.22.09.A, Aeronautical Technology.

C. (U) WORK PERFORMED BY: This work is performed by the Research and Technology Laboratories of the US Army Aviation Research and Development Command. The laboratories involved are located at Moffett Field, CA; Cleveland, OH; Langley, VA; and Ft. Monmouth, NJ. Much of this work is performed jointly with NASA Research Centers at the first three locations. The

Project: #AH45 Title: Air Mobility Research
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

top known contractors for FY 1983 are Bell Helicopter Textron, Ft. Worth, TX; Dynamic Engineering, Inc., Newport News, VA; General Applied Sciences Laboratory, Westbury, NY; Lockheed Georgia Company, Marietta, GA; and Spectron Development Laboratory, Mountain View, CA. The remaining contract program will involve twenty contractors for a total of approximately $2 million.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Performance and acoustic measurements of the advanced UH-1H rotor in the V/STOL wind tunnel indicate that a substantial increase in payload can be realized for a UH-1H with a reconfigured rotor. Results of dynamic stall experimental investigations of six helicopter airfoil sections have been made available to industry. Model rotor tests have been conducted with both twisted and untwisted rotor blades to determine the effect of twist on tip vortex trajectory and structure. A model rotor has been tested in the SEPRA 19 facilities in France, showing that the blade vortex interaction noise from model rotor as small as 1/7 scale can be correlated with full-scale measurements. A code for computing aerodynamic design of a multistage axial compressor and associated blading has been completed. A performance prediction code has been completed for centrifugal compressor. Stator performance test was completed to determine the effect of contoured end-wall stators. A computer code has been completed which is capable for predicting off-design performance of pivoting stator vane variable area turbine with hub-to-tip calculation. An in-house study of radial turbine performance aimed at reevaluating previously collected data was completed for a 2:1 pressure ratio stage. A Lamilloy combustor is being evaluated over a wide range of operating conditions. A fatigue life analysis for traction drive has been developed. The analysis provides the traction drive designer with a rigorous design solution. Major efforts are underway to establish the long-term durability of newer composite materials in Army helicopter applications. This will lead to reduced maintenance and life cycle costs of all future air mobility systems. Significant progress has been made in several design technology areas related to helicopter structures. Among them are extended use of minicomputers, improved methods of structural integrity, and the introduction and characterization of new material.

2. (U) FY 1982-FY 1984 Program: Model rotor experiments will be conducted in hover and in the 7 X 10-foot wind tunnel to study rotor wakes in more detail and to determine the impact of nonconventional rotor tip geometry on the rotor wake. Transonic codes will be applied to rotor analysis to identify design parameters for improved performance, and minimize noise to be demonstrated in small-scale rotor wind tunnel testing. Coding of a computer analysis (GRASP) will be completed for the hover flight condition and made available to industry. Techniques developed to couple rotor design variables to

Project: #AH45 Title: Air Mobility Research
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

high-speed rotor acoustic emission will be expanded to treat blade-vortex interaction noice in order to provide a more detailed understanding of rotorcraft acoustic signatures. A 10-pound/sec, 8:1 compressor will be fabricated and studied to obtain overall performance and detailed measurements in the blading. A comprehensive analytical turbine design model and a study of the effect of contoured end-wall stator configurations on turbine performance will be completed. Optimized designs of felt-ceramic combustor liners will be generated and evaluated in a flame-tube rig. Evaluation of a full annular swirl combustor will be completed. A cavitation and dissolved gas theory of hydrodynamic lubrication will be completed, and analysis of gear toothforms for lower noise will be continued. Other research underway includes: an analysis of composite material behavior in helicopter environments; improved methods of structural integrity verification; structural weight miniaturization; the development of better mathematical methods for vibration analysis; theoretical and empirical investigation of attenuation mechanisms; nonlinear processes in coherent fibers optics for airborne heterodyne sensors; perceptual investigation of computer-generated topographic symbology for aviation displays. During FY 1983, the development of rotor aerodynamic design methods will continue with emphasis on capability to provide significant increases in speed as well as improved hover performance. Rotor wake theoretical and experimental efforts will be increased with the objective of providing greater interaction between acoustics, dynamic stall, and transonic research programs. The GRASP analysis will be extended to include forward flight conditions. Acoustic research will concentrate on the effects of rotor blade aerodynamic design on noise signatures. The internal flow of the two 4:1 centrifugal compressors having different speeds will be studied utilizing laser instrumentation. Results will be compared with available 3-dimensional viscous codes. The optimized full annular felt-ceramic liner will be evaluated and a comparison of the effectiveness of various advanced liner-cooling techniques reported. Dilution, jet-mixing and high combustion outlet temperature (3000 degrees) performance studies will be initiated, and an elevated bearing temperature study will be completed. Research will be conducted on the long-term durability evaluation of composite material, the development of a comprehensive and reliable fatigue analysis method for composite helicopter structures, and the rapid exploitation of new emerging material-processing technology and structural design concepts. A single-mode fiber optic for airborne heterodyne sensors will be fabricated, and an analysis of computer-generated topographic symbology to estimate degree of enhancement achieved by the use of color will be investigated. In FY 1984 airfoil development for specific mission requirements will continue. Development of improved mathematical models for rotor wakes will continue. Research in fundamental rotorcraft structural dynamics will be expanded to include areas such as rotor/drive-train/engine control dynamics. New insight into internal flow in high-performance centrifugal compressor will permit development of more efficient design concept. The best liner-cooling concept will be further investigated for potential application to a new gas generatory system. Dilution jet-mixing and high combustion outlet temperature performance studies will be completed. Research of the long-term durability evaluation in composite material, the development of a

Project: #AH45 Title: Air Mobility Research
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

comprehensive and reliable fatigue analysis method for composite helicopter structures, and the rapid exploitation of new emerging material-processing technology and structural design concepts will be continued. The programs concerning coherent fiber optics for heterodyne sensors and computer-generated topographic display investigation will be completed. Research on airborne environment sensors, airborne full-color display for computer-generated symbology, and solid state strapdown sensor for magnetic heading reference will be initiated.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5744	6559	8336	8662	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5849	7039	8100	-	Continuing	Not Applicable

The decreases in FY 1981 and FY 1982 are due to reprograming of funds to higher priority Army programs. The increase in FY 1983 reflects more emphasis in fiber optic heterodyne sensors and automation in the helicopter cockpit.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This project supports research to increase knowledge in mathematics and the physical, engineering, biological, and geosciences directly related to national security needs and to the solution of identified military problems. It provides part of the scientific base for subsequent exploratory and advanced developments in defense-related technologies and for new or improved military functional capabilities in the technology areas of Chemical/Biological Warfare Defense, Mobility and Installation Energy, Microelectronics, Millimeter Waves, Adverse Weather Fire Control and Imbedded Computer Software, Gun Propulsion, Explosives and Shock Phenomena, Command, Control, Communications, Intelligence, Surveillance and Target Acquisition, Vertical Lift, Advanced Materials, Air Defense, Armor and Antiarmor, Directed Energy, Human Factors, and Adverse Terrain. The Electronics, Materials, Mathematics, Mechanics and Aeronautics, Physics, and Chemistry programs and a new FY83 Program to support updating US University Research Instrumentation are described in separate Descriptive Summaries. The Army's need for research in Atmospheric and Terrestrial Sciences stems from the impact that the environment has upon virtually all aspects of Army activities; e.g., strategy, reconnaissance, target acquisition, firepower, and air and ground mobility, equipment, logistics and survival. Despite efforts to develop an all-weather/all-terrain capability, environmental conditions continue to put constraints on Army operations. Particularly stressed is research oriented in the context of the realistic battlefield environment including adverse weather conditions, aerosols and gases from screening smokes, chemical and biological warfare agents, dust, combustion products, and adverse terrain conditions. Research in Biological Sciences does not usually lead to developmental items, but rather leads to knowledge resulting in better utilization of man and machine. The best designed military systems will not function if soldiers cannot perform because of physiological, psychological or medical problems or impaired performance of skilled tasks. Spoilage of rations and the need to repair or replace damaged parts of equipment increases logistic burdens. This project is divided into scientific areas as follows: 01-Atmospheric and Terrestrial Sciences; 02-Biological Sciences; 03-Electronics; 04-Materials; 05-Mathematics; 06-Mechanics and Aeronautics; 07-Physics; and 08-Chemistry. These broad groupings of research derive from the strong need of the Army to participate in and sponsor work in the scientific community for the development of new knowledge that contributes to the improvement of Army equipment.

B. (U) RELATED ACTIVITIES: This program is implemented through contracts and grants. It is closely coupled to in-house laboratory work in the Defense Research Sciences, particularly the DARCOM laboratories; close coordination is maintained with the managers and bench scientists in the laboratories. The Navy, Air Force, National Science Foundation, National Aeronautics and Space Administration, Department of Energy, Department of the Interior, National Bureau of Standards,

Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

Department of Health and Human Services, other government agencies, government agencies of allied nations, and the industrial community conduct related research. Coordination to assure that there is no unnecessary duplication is accomplished by program reviews; exchange of program information, research and technology resumes and technical reports; interservice and interagency liaison; and attendance and participation of Army representatives at annual reviews held by the Office of the Under Secretary of Defense for Research and Engineering. Coordination occurs through sponsorship of meetings and conferences, attendance at professional and scientific society meetings, and review of the scientific literature.

C. (U) WORK PERFORMED BY: This program of grants and contracts with academic and not-for-profit institutions and industrial laboratories is managed by the US Army Research Office, Research Triangle Park, NC. The top five contractors are: Massachusetts Institute of Technology, Cambridge, MA; Stanford University, Stanford, CA; University of Wisconsin, Madison, WI; University of Illinois, Champaign, Urbana, IL; and Stanford Research Institute, Menlo Park, CA. There are, in addition, approximately 495 grantees and contractors. The value of the additional grants and contracts is $33,332,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Accomplishments under the Electronics, Materials, Mathematics, Mechanics and Aeronautics, Physics and Chemistry programs are reported in separate Descriptive Summaries. Atmospheric Sciences: A model has been developed of the formation of secondary smoke in rocket plumes, and the attenuation of a laser signal propagating through it. A fast analytical model of the transfer of solar radiation in plane-parallel clouds has been developed which will handle an azimuthally varying radiant field. The computational speed of this model is a few hundred times faster than that of the more precise models, making it well suited for applications involving iteration over spectral intervals, time intervals, and cloud populations in obscuration modeling. In the investigation of microwave absorption in the transmission windows of the atmosphere, a significant quadratic dependence has been found on the water vapor content, as opposed to the linear dependence assumed in the past. This result is important in modeling water vapor absorption experienced by electro-optic and near-millimeter-wave systems, and is also of interest in regard to phase changes involved in fog, cloud, and precipitation formation. Aircraft and radar measurements have revealed that precipitation growth in deep warm-frontal clouds can occur through a complex "seeder-feeder" process, teaching us that predictions of precipitation from such clouds must take into consideration the presence of "seeder" and "feeder" zones in warm-frontal rainbands. Data from the Tropical Environmental Data Base field experiment in Thailand during the 1960's are being analyzed. The results reveal that for a two-tier evergreen tropical forest, two canopy flow indices are needed for a close simulation of the average canopy wind

Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

flow. These findings will provide data for refining models of transport and diffusion of smoke and chemical/biological agents in tropical forested areas. From the same data base, new information has been developed on the reflection of sunlight from both a dense forest and a nearby clearing, under both clear sky and cloudy conditions. The differences in response of vegetation from manmade structures and the differences varying with time of day and with past and present weather conditions will have a bearing in matters of camouflage, remote sensing, and target acquisition. Terrestrial Sciences: A prototype sweep-frequency electromagnetic system for profiling near-surface geologic structure has been developed and field tested. The entire operational cycle is automated and controlled by an on-board computer. Further theoretical and field studies will explore performance over features like tunnels, which have long defied unambiguous detection by remote sensing methods. A viable geochemical technique has been developed which will minimize or eliminate heaving in structures founded on black shale. Biological Sciences: Water activity is more important than water content in determining whether microbial growth (as well as chemical reactions) can occur. A method to find the water activity of a mixture from that of each component has been developed, and it has been found that there are three distinct states of bound water. A simple, cheap apparatus has been developed to measure water activity, replacing a complex machine. Also studied are the effect of water activity on specific organisms and the mechanism by which some bacteria can survive under very stressful temperatures and water activities. Control of bacterial growth by altering water activity will make possible storage of prepared food products in ready-to-eat palatable form. Refrigeration will not be necessary, shelf life will be increased, and the stored products will be much more acceptable to the individual soldier than are currently available freeze-dried foods. New results, from electrophysiological and biochemical studies of the effects of various drugs and toxins on neuromuscular transmission and binding to receptor and ionic channels, will have great value in the study of protection against chemical agent attack.

2. (U) FY 1982-FY 1984 Program: The Army Research Office investment strategy is based on the need to accelerate progress in critical areas and to exploit unique research opportunities which have potential payoff for Army technology. The ultimate objective is to maintain technological superiority and to increase leadtime over potential adversaries. Technological thrusts in the areas of: Very Intelligent Surveillance and Target Acquisition, Distributed Command and Control, Brilliant Munitions, High Mobility, Genetic Engineering and Soldier-Machine Interface are to be emphasized. The Electronics, Materials, Mathematics, Mechanics and Aeronautics, Physics and Chemistry programs are described in separate Descriptive Summaries. The Atmospheric Sciences program is subdivided into three major research areas: atmospheric effects on transmission, small-scale atmospheric processes, and atmospheric sensing and probing. The primary thrust in the Atmospheric Sciences program will be centered on investigations of millimeter and other electromagnetic wave transmission

Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

through the atmosphere, atmospheric limitations on electro-optical system performance, battlefield obscuration effects of smoke, dust, fog, cloud and precipitation, and atmospheric effects on chemical and biological warfare. Remote sensing of wind and aerosol parameters also will be stressed. The Terrestrial Sciences program addressed those areas in which the Army must deal with problems arising from terrain in the context of Corps of Engineers functions and that of the realistic battlefield. Research areas are grouped under three headings, properties of earth materials, earth-fluid dynamic processes, and remote sensing and mapping. Interactions among plant canopy features and the physical environment are of crucial significance to diverse research efforts in fields ranging from micrometeorology and ecology to remote sensing and propagation of electromagnetic radiation. A recent workshop focused on the structure of plant canopies and their effects on the radiation regime. A workshop to be held in FY82 will focus on energy exchange between the canopy and the atmosphere. It is planned to enhance research which examines the processes of formation and dynamics of desert landforms, methodology for detecting shallow potable water sources and the processes and rates of dust formation. The Biological Sciences program includes food and ration research, protection of material from biodegradation, work on environmental quality protection and rehabilitation, defense against chemical and biological weapons, and sensory factors in performance enhancement. The primary emphasis in the Biosciences program will be on chemical and biological weapons defense and deterrence. A strong program in support of the technology base underlying the action of potential chemical agents on the body neurosystems has been established. This will be expanded and strengthened by new project additions. A start has been made in the field of biosagent detection by interaction of infrared light from laser sources with agent materials. Other approaches to detection will be sought. Improvements in human performance in training, testing, and operation of sophisticated military systems will be supported by continued study of the physiology of sight and hearing. The detrimental effects of excessive noise levels, both physical and psychological, will be examined also. The Biosciences program is well balanced in four of the five research areas. This balance will be maintained, while building up the biodegradation work.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

Project: #BH57 — Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	46508	56829	75399	80876	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	46508	62295	74000	-	Continuing	Not Applicable

The reduction in FY 1982 is a result of Congressionally directed cuts and reprogramming to higher priority Army and DOD requirements. The increase in FY 1983 reflects increased emphasis in CW/BW defense research in universities and increases to support university research instrumentation.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #03 Title: Electronics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: Support of basic research in electronics is provided to the most outstanding scientists in universities, research institutes, and industry. Research support leads the state-of-the-art and has the potential to produce significant technological breakthroughs and cost reduction in electronics technology for defense. The principal objective is to provide a technology base in selected areas of electronics, communications, and computers to satisfy present and future Army requirements and to produce significant new capabilities essential to maintaining our technological superiority. Research is supported to produce new and original scientific knowledge which will be applied in the fields of sophisticated communications systems and networks including electronics warfare and data communications; solid state electronics including properties of materials for semiconductors, magnetics and dielectrics; design of advanced integrated circuits including computer-aided design and ultra-small electronics; systems for surveillance, target acquisition, guidance, and observation under adverse battlefield conditions; and computer systems including tactical computers and distributed computing systems.

B. (U) RELATED ACTIVITIES: Extensive coordination is effected within the Army and DOD to assure that research supports Army and DOD needs and goals and that there is no unnecessary duplication of effort within the Army or DOD. An informal group of senior Army research managers meets several times a year at the various Army electronics research activities for familiarization with ongoing research and identification of important research goals. Research proposals considered under this task are also reviewed by all appropriate Army activities. This task includes participation in the management of the Joint Services Electronics Program jointly conducted by the Army, Navy, and Air Force. Each Army Research Office (ARO) staff member continually conducts personal interactions with scientists in the Army and other military and government funding agencies for purposes of coordinating programs and transferring contractually generated basic knowledge to active Army projects. Each year ARO sponsors seminars and workshops with intraservice and interservice participation to disseminate technical results and identify critical needs.

C. (U) WORK PERFORMED BY: This program is managed by the US Army Research Office, Research Triangle Park, NC. The top five contractors are: Massachusetts Institute of Technology, Cambridge, MA, Stanford University, Stanford, CA, University of Southern California, Los Angeles, CA, Georgia Institute of Technology, Atlanta, GA, Columbia University, New York, NY. The total number of additional contractors is 47; the total dollar value of these additional contracts is $3,846,000.

Technical/Scientific Area: #03 Title: Electronics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A reflection mode field assisted photo-emission out to 2.1 microns has been demonstrated from a photocathode constructed from an alloy of Silver and Indium Gallium Arsenide cooled to 125 degrees Kelvin. This is the first demonstration of photocathode photo-emission beyond two microns in wavelength. The potential impact on near-infrared imaging is great. Real Space Transfer of electronics has been modeled and experimentally investigated in Molecular Beam Epitaxy (MBE)-grown layered structures. The observed effects are similar to the ones seen in the momentum-space transfer which gives rise to the Gunn effect. The real space transfer is expected to be the basis for millimeter wave oscillators with greater power output than obtainable in Gunn diodes. Fundamental experiments have been reported which demonstrate and quantify point defect phenomena in silicon for both one- and two-dimensional processing effects. A two-dimensional process simulator was developed which predicts critical dimensional control and electrical performance factors of devices with ever-shrinking dimensions. Moreover, the program predicts factors critical to electrical performance of densely packed devices. One of the primary considerations in spread spectrum systems is the design of an acquisition technique which is relatively easy for a cooperating receiver to carry out and very difficult for an adversary receiver to perform. A new technique for effective acquisition of spread spectrum signals has been developed which reduced the average acquisition time by a factor of 3 to 5. This technique involves optimally setting several thresholds which are employed in a rapid acquisition algorithm to "time-tune" the receiver. This technique can alternatively be used to reduce signal power levels, thereby decreasing the probability of intercept by adversary receivers. A scheme has been studied to double the information rate of a direct sequence spread spectrum communication system without reducing the processing gain or increasing the bandwidth. This technique had previously been confirmed experimentally and consists of spreading independent data sequences by a pseudonoise (PN) sequence and the Hilbert transform of the PN sequence. The entire system is implemented with surface acoustic wave devices. In addition, it was shown that under certain tone-jamming conditions, the performance of the Hilbert spread data stream is superior to that of the standard PN spread data stream. The feasibility of distributed interaction devices at millimeter wavelength has been demonstrated which resulted in nonreciprocal structures suitable for dielectric and planar waveguiding techniques. A distributed isolator utilizing coupled mode techniques has been developed which greatly reduces the stringent requirement on ferrite material quality needed for nonreciprocal action. A multiple control algorithm for the interaction of distributed nodes in a communication network has been developed which is invulnerable to link or center failure although not invulnerable to all failures. This is a substantial achievement and will drastically minimize the number of control processors required.

Technical/Scientific Area: #03 Title: Electronics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Program: The objective of the program is to identify and solve critical Army research problems where progress has been inhibited by a lack of novel concepts or fundamental knowledge in the following areas: Microelectronics: - In this program an understanding is sought of those parameters of electronic, magnetic, and optical materials which potentially affect or determine device performance. Areas such as generation, transport, and control of charge carriers in semiconductors, magnetic phenomena, and electronics contributing to novel optical and electro-optical systems are supported. Studies of the fundamental limitations of the operating ranges of devices will provide directions for potential improvements. Part of this research effort is the evaluation of existing device barrier problems in the fields of generation, detection and processing of electronic signals. Army electronic systems for the 1990's require a five order-of-magnitude increase in realtime signal processing capability. Integrated Circuit devices to satisfy this need must be at least 100 times faster than those targeted for the Very High Speed Integrated Circuit (VHSIC) program. Planned, systematic technological realization of submicron and ultra-submicron devices will be achieved with derivation of the unique, non-classical relationships governing electronic behavior in such small size domains. While programs on millimeter wave sensors and detectors are forthcoming, the state-of-the-art in millimeter wave componentry, particularly that of nonreciprocal devices, requires additional research. Novel approaches in resonant and nonresonant interactions of millimeter wave energy with solid state devices will be supported. In the area of far infrared research, the major effort will be devoted to the understanding and control of mercury cadmium telluride, its metallurgical as well as electronic properties. Computer-aided design of very large scale integrated (VLSI) circuits will lead to completely automated design for custom (VLSI) circuits. The goals of this research are to reduce design time and cost and improve reliability of designs. Specific topics such as multilevel design, on-chip testing and verification, modeling of submicron circuits, process modeling, techniques to increase computational efficiency, transmission line modeling, placement, routing, and mask generation are attacked. Communications/ISTA (Intelligence, Surveillance, and Target Acquisition): This research program is concerned with the application of communications theory, electromagnetic theory, signal processing and mathematics to the fast, accurate, reliable, and efficient transmission and acquisition of information. Since Army digital communications networks are highly dynamic and can have widely varying capacities due to jamming and interference, the network design must consider these dynamics and message priorities in order that the network will continue to function, albeit at degraded levels. Specific interest is in the design of large distributed radio and wire networks including topics such as throughput in packet radio networks, distributed routing and control, and network synchronization. In research in spread spectrum techniques, improvement in the speed of acquisition, synchronization, and coding are sought. Techniques for detection and identification of spread spectrum signals are emphasized. Efficient digital signal processing algorithms and realizations which

Technical/Scientific Area: #03 Title: Electronics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

are amenable to implementation in VLSI circuits used to perform communications, intelligence, surveillance, and target acquisition functions are emphasized. Of particular interest are the use of concurrency to obtain high throughput, improved signal quality, reduced computational complexity, modular structures, and standard cell implementation. Full understanding and efficient use of antennas, atmospheric/ground propagation, and sensitive, optimized detection schemes are sought. Included are studies of the launching of waves in waveguides and propagation for the millimeter optical spectra, radar resolution enhancement and target detection classification in a clutter environment, and electrically small and conformal antennas with emphasis upon proximity effects due to nearby structures. Research is also supported to provide a technology base from which complete low-cost, high-performance millimeter/submillimeter wave integrated systems, including antennas, may be devised. Another important area is optical communications in which the goal is to utilize optical techniques within distributed multichannel, wide-bandwidth communications command and control systems. Computers and Information Processing: The modern Army depends for many of its operations on reliable and efficient computer systems. Novel computer architectures for efficient distributed processing with improved memory-access techniques and reliable digital transmission will contribute materially to the Army distributed Command, Control, and Communications program by providing efficient and secure communications and control. Examples of applications are in direct communications between machines (as in sensors to display consoles), data base computers, and data networks. The high cost of software magnifies the importance of methods for software cost reduction, for increasing software reliability, for more efficient software production, and for decreasing software maintenance costs. New approaches are sought in languages and procedures for improved software quality and in program testing and verification. Research adressing the utilization of powerfully concurrent microcode and restructurable hardware facilitated by VLSI and VHSIC in support of lightweight, low-power tactical and distributed battlefield manpacks will continue.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

Technical/Scientific Area: #03 Title: Electronics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	8758	12241	14301	13919	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	8486	13807	16072	-----	Continuing	Not Applicable

The increase in FY 1981 is a result of reprograming to increase research in electronics. The reductions i FY 1982 and FY 1983 reflect DOD realignment of priority requirements.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #04 Title: Materials
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The scientific area of materials contributes to the science and technology base through the investigation of relationships between the composition, structure, defects, processing, and useful properties of materials in order to help satisfy short- and long-range Army requirements. In order to accomplish this objective, the aims are: to discover the relation between composition and structure of materials and the useful properties of those materials; to learn the principles whereby those properties may be dependably reproduced for application toward solution of Army problems (e.g., improvement of strength and fracture toughness of materials of armaments, armor, aircraft, and vehicles; protection against degradation in service or storage; improvement of electric, magnetic, and optical materials for communication, guidance, and control, and for energy storage or transmission; and discovery of processing techniques that provide improved reliability of materials in components); and to develop simple, reliable, inexpensive procedures for testing and analysis of materials and components. The DARCOM Long-Range RD&A Plan (Science and Technology), FY82-96, frequent coupling with DoD laboratories and agencies, and other Federal agencies including the National Science Foundation, National Bureau of Standards, National Aeronautics and Space Administration, and Department of Energy; participation in technical meetings; foreign intelligence (provided through The Technical Cooperation Program and by the Foreign Science and Technology Center) assist in guiding the selection of topics to be supported in the program.

B. (U) RELATED ACTIVITIES: This program is related to parts of the following projects in Program Element 6.11.02.A: AF22, Research in Vehicular Mobility; AH42, Research in Materials and Mechanics; AH43, Research in Ballistics; AH45, Air Mobility Research; AH47, Electronic Devices Research; AH48, Electromagnetic Propagation and Antenna Research; AH49, Missile and High Energy Laser Research; AH51, Combat Support Research; AH52, Research in Support of Equipment for the Individual Soldier; AH60, Research in Large Caliber Armaments; and AH61, Research in Fire Control and Small Caliber Armament. Close coordination is maintained with the Navy, Air Force, Defense Advanced Research Projects Agency, National Aeronautics and Space Agency, Department of Energy, and the National Science Foundation. Coordination meetings are held on a regular basis (e.g., Interagency Materials Group).

C. (U) WORK PERFORMED BY: This program is managed by the US Army Research Office, Research Triangle Park, NC. The top five contractors are: Massachusetts Institute of Technology, Cambridge, MA; Northwestern University, Evanston, IL; SRI International, Palo Alto, CA; Lawrence Livermore Laboratories, Livermore, CA; and Pennsylvania State University, University Park, PA. The total number of additional contractors is 77. The total dollar value of these additional contracts is $5,433,000.

Technical/Scientific Area: #04 Title: Materials
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Laminate steel composites which offer a potentially new class of armor have been formed by superplastic processing of alternating layers of hard and soft steels, and offer high fracture toughness and impact strengths greatly exceeding those of either component. (Army laboratories are already carrying out ballistic evaluation.) The program of research in hot gas erosion, relevant to armaments, turbines and rocket motor components, has led to the discovery of novel, highly protective multilayered coatings based on layers with appropriately mismatched acoustical impedance to withstand thermomechanical shock. Studies of the mechanisms of undercooling of molten metal alloys during their solidification into powders have resulted in a technique for assessing and optimizing processing procedures for rapid solidification rate (RSR) powders via a controlled method to achieve microstructures identical to those attained at very high quench rates, of interest for aluminum and ferrous alloys in aircraft, armored vehicles and munitions, and for magnetic applications in radar and laser systems. A new electrochemical technique has been devised for complete assessment of moisture degradation of organic matrix composite materials for aircraft, missile, and lightweight vehicle applications. Via this technique, a wide range of fiber loadings and composite designs can be evaluated for resistance to environmental degradation. Research into the role of chemical composition and processing parameters upon new permanent magnets for applications such as microwave and millimeter wave tubes has demonstrated that the magnetic properties are controlled through control of specific metallurgical phases and structure available via heat treatment. Research in dynamic properties of fiber-reinforced concrete under impact loading has shown that fiber-reinforced concrete absorbs about twenty times the impact energy before failure relative to unreinforced concrete, and is insensitive to notches and grooves. Previous to this research, concrete had not been sufficiently characterized with respect to impact and blast to allow designers of structures such as field shelters, hardened missile silos and runways for airfields to analytically determine safety factors or failure criteria. Nondestructive evaluation of the propensity of metal surfaces to corrode and of the ability of protective coatings to provide corrosion resistance has been accomplished via the Corrodescope, an AC-impedance scanning electrode system. This system has been adopted for assessment of coating systems for corrosion protection of munitions through a technology transfer project to develop state-of-science instruments for use in the Army laboratories. Research in electrodeposition has shown that chromium deposition onto metal surfaces such as bore surfaces of gun tubes for erosion resistance can be greatly enhanced by small additions of ethanol to the plating bath, which reduces the oxidation state of chromium from +6 to +3. The black deposit also should enhance laser coupling to metal surfaces during alloying for wear protection, and bearings in helicopters, armored, and mobility equipment.

echnical/Scientific Area: #04 Title: Materials
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Program: During FY 1980-81, several program thrusts were developed which will continue in FY82. These include: 1) nonequilibrium materials--new materials with microstructures and properties hitherto not discovered are being evolved through novel procedures involving high cooling rates from the liquid phase, laser processing, etc., which offer materials with superior magnetic, structural, and corrosion-resistant properties; 2) behavior of materials in structures of ultrasmall dimension--as the dimensions of electronic devices approach submicron scale, it is essential to understand the effect of defects on electronic properties of materials. In order to control properties, reliability and reproducibility of these electronic devices, research on materials processing to control microstructure, chemical composition, stoichiometry, dopant distribution, homogeneity, etc., all of which affect electronic properties; 3) behavior of materials under ultrahigh loading rates--two major efforts were initiated in FY 1981 in conjunction with the mathematics and engineering sciences programs which include experimental and modeling efforts on dynamic failure, shock pulse variables, adiabatic shear, plastic deformation and fracture anc critical conditions for failure under ultrahigh loading rates. These programs are coordinated with Army laboratory scientists studying these effects in armor and armor penetrating materials; 4) novel nondestructive evaluation--a broad range of new initiatives was started in positron annihilation, stress distributions n adhesives by X-ray techniques, ultrasonic techniques for residual stress measurement, magnetic acoustic emission, photoacoustic microscopy, etc. These new concepts are expected to provide new analytical capabilities for the detection of defects, contaminants, and microstructural characteristics which limit the performance, reliability, and reproducibility of advanced materials. The overall program will continue to emphasize the relationships between structure, processing, and properties of materials with programs in degradation, reactivity, and protection of materials in severe use environments, mechanical behavior of materials under complex loadings, synthesis and processing of materials for high performance with reproducible properties and at lower cost, and physical behavior of materials such as the mechanisms and variables which control their electrical, electronic, magnetic and optical behavior. Programs are being initiated in materials for chemical and biological defense, and special attention is being paid to the question of critical and strategic materials. Research will be continued in the areas of processing, structure, and property interactions in gradient materials for unique combinations of properties; i.e., high magnetic coercivity and high impact resistance, novel materials for gradient, etc.; mechanical alloying of metal alloys, potentially useful in diverse systems such as bridging, helicopters, and improved lightweight armor; thermal barriers and/or coatings for protection of materials exposed to complex environments such as hot gas flows with entrained particulates (gun tubes, engines); processing, reproducibility, and stability of materials on ultrasmall scales for electronic applications; studies of substitutes for critical and strategic material constituents. Research will be expanded in areas such as gradient materials for maintaining the properties and integrity of materiel components exposed

Technical/Scientific Area: #04 Title: Materials
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

to severely hostile environments, novel methods for joining of advanced structural materials such as polymer- and metal-matrix composites, ceramics, expansion of the program related to substitutes for critical and strategic materials, and new opportunities in nonequilibrium materials.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	6868	7368	8546	9626	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	7005	7600	10112	-	Continuing	Not Applicable

The reductions in FY 1981, FY 1982, and FY 1983 are a result of reprograming to higher priority DOD and Army requirements.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #05
Project: #BH57
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Mathematics
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The principal purpose of the program is to support the development and acquisition of basic knowledge and research in the mathematical sciences which includes work applicable to such Army programs as chemical and biological defense ballistics, fire control, mechanisms, command and control, guidance and control, field and laboratory testing, and simulation and modeling. The program is designed to account for both long- and short-range Army needs and concentrates on such areas as applied and computational methods, systems theory and control, and statistical methods and applied probability. A secondary objective is to provide technical assistance and advice to Army installations in the application of modern mathematical techniques to the solution of important problems. Briefings on recent mathematical trends and developments are also provided by means of an extensive training and orientation program. In addition, a very successful program of bringing investigators to certain Army laboratories for extended periods has been continued. This program allows for an in-depth introduction to specific Army problems and for significant interactions with Army scientists. A continuous program of Army-wide conferences is sponsored both to promote communication among Army scientists and to foster interchanges between Army and non-Army scientists. Finally, mathematical results of foreign researchers are considered.

B. (U) RELATED ACTIVITIES: The Navy, Air Force, National Science Foundation, and other government agencies and industrial groups conduct related research in the mathematical sciences area. Coordination to assure no unnecessary duplication is accomplished by periodic interagency meetings, program review, exchange of program data sheets and technical reports, and attendance and participation of representatives at annual reviews sponsored by the Office of the Under Secretary of Defense for Research and Engineering. Coordination also occurs through sponsorship of meetings and conferences, attendance at professional and scientific society meetings, and review of the scientific literature.

C. (U) WORK PERFORMED BY: This program of contracts is managed by the US Army Research Office, Research Triangle Park, NC. The top five contractors are: University of Wisconsin, Madison, WI; Stanford University, Stanford, CA; University of California, Berkeley, CA; Brown University, Providence, RI. and Carnegie-Mellon University, Pittsburgh, PA. There are in addition 85 contractors. The value of the additional contracts is $2,938,000.

Technical/Scientific Area: #05 Title: Mathematics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The primary areas of concentration have been on analytical and computational methods for nonlinear, unsteady phenomena, development of reliable mathematical software, and robust statistical procedures. Progress has been made in all of these areas. One of the major limiting factors in the development of a viable technology based on nonlinear optical processes is the occurrence of instabilities in miniaturized optical bistable devices. Such devices are being considered for use as digital memory elements and optical switches. There is, therefore, considerable interest not only in the elimination of undesirable noise in such systems but also a need to better understand the existence of multiple stable modes or transition to chaos. Analytical and numerical results have been derived which adequately describe transition to chaos in such coupled nonlinear oscillators. The approach developed consists of mathematical modeling of period-doubling. This is achieved by analyzing boundary layer solutions of a delay differential equation which in turn is derived from Maxwell's equations describing these devices. Kinetic energy penetrator (KEP) tests are very expensive, and thus provide only small samples of data for analysis. This is complicated by the fact that the experimenters are interested in estimating a certain quantile from a function relating the KEP velocity and the response. This usually requires very large samples. A sequential procedure has been developed for selecting, from a group of KEP types, the one with the lowest penetration velocity. Moreover, it has been shown that this method produces the smallest sample sizes. This result should be of paramount importance in armor penetration studies ongoing at the Ballistics Research Laboratory. A very difficult and important problem facing the military software community is the production of high-quality computer codes for a variety of tasks. Over the last several years a set of powerful software tools which automatically provide significant degrees of testing and analysis of codes has been developed. Such studies have produced tools for static, symbolic as well as dynamic testing, and these have been combined into an integrated system. Due to the advent of significant parallel processing capabilities, it is important (probably more so than in serial processing) to have adequate tools to aid in the process of creating reliable software. Static analysis procedures have been extended to handle concurrency (i.e., parallelism) in the new DOD programing language, Ada.

2. (U) FY 1982-FY 1984 Program: The program for FY82 will be a continuation of efforts begun in FY80 and FY81 in nonlinear analysis, modern statistical data analysis including computational statistics and fast algorithms. In addition, a new thrust in mathematical models of chemical and biological defense problems will be begun. This thrust is motivated by the many unknowns related to the mixing, dispersion, detection and decontamination of chemical and biological agents.

Technical/Scientific Area: #05 Title: Mathematics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

Finally, we will initiate a new program devoted to large-scale scientific computation. This is motivated by the need to develop essentially parallel algorithms to exploit the new microprocessor technology. These programs will be continued in the outyears as they are considered to be long-term thrusts. At the same time, the overall program will be reviewed for opportunities as well as for gaps and saturation of areas. The program will be adjusted as necessary to reflect promising scientific areas with strong potential for Army relevance.

3. (U) Program to Completion: This is a continuing program

4. (U) Major Milestones: Not applicable

5. (U) Resources: ($ in thousands)

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5802	6611	7683	8732	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5411	6965	8742	-	Continuing	Not Applicable

The increase of $391 thousand in the FY 1981 funding level is a result of reprograming by the Army to increase research in mathematics. The decrease in FY 1982 and FY 1983 reflects reprograming to higher priority DOD requirements.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #06 Title: Mechanics and Aeronautics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The major thrust of research activities undertaken in this project encompasses the disciplines of combustion sciences, fluid dynamics and solid mechanics and emphasizes research opportunities in vertical lift technology, small turbomachinery, high strain-rate loading electromagnetic acceleration, kinematics and mechanisms, surface mechanics and flame-wall phenomena. Currently, research supported in the combustion sciences is organized into elements which address engine combustion, fuels, and explosive and propellant phenomena. Fluid dynamics encompasses aerodynamics of rotorcraft, projectiles, and missiles, internal flows in small compressors and turbines, and liquid motion in shells, for example. Solid mechanics research is described by subelements which address the fields of finite deformation of solids, structural mechanics, shock, vibration, wave propagation, surface mechanics, mechanics of composites, and kinematics and dynamics. During FY82, new initiatives are being carried out for establishing centers of excellence in rotary-wing aircraft technology and for establishing a research program on small gas turbine engines. Though this project addresses a broad set of research problems for the US Army in varied scientific fields, the totality of this research effort greatly contributes to the future technology base from which significant improvements in US mobility, firepower, and service support can be made. For example, solid mechanics pervades all Army weapon systems and material and. accordingly, plays a critical role in developing the technology for improved Army weapons, ammunition, aircraft, missiles, ground vehicles, and protection of personnel and structures.

B. (U) RELATED ACTIVITIES: This research project is quite broad in its application and is therefore related to research programs at other Army Laboratories, the other services, and several other Government agencies. As far as the Army is concerned, the related projects of greatest relevance to this task are AH45, Air Mobility; AH60, Research in Large Caliber Armament; AH43, Research in Ballistics; AH49, Missiles and High Energy Laser Research; AF22, Research in Vehicle Mobility; and AH42, Materials and Mechanics. Several mechanisms for information exchange are operative to insure proper coordination and to preclude unnecessary duplication of effort. This is accomplished by periodic assessments of the research programs at the Army Laboratories in which a direct exchange of technical information regarding contracts of common interest, progress in specialized areas and identification of research results having potential application to Army problems takes place. The Army laboratories also frequently jointly support research contracts, workshops, symposia, and conferences, thus insuring timely dispensation of technical information and providing an opportunity for the Army Laboratory scientists to actively participate in the scientific community. The Air Force Office of Scientific Research, the National Aeronautics and Space Administration and the Defense Nuclear Agency are currently jointly supporting research contracts with the Army Research Office requiring

Technical/Scientific Area: #06 Title: Mechanics and Aeronautics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

frequent exchange of reports and other information to keep each organization informed of current developments. Annual reviews by the Department of Defense in materials, mechanics, structures, and aerodynamics provide a forum in which the mechanics and aeronautics program of the Army Research Office is presented and reviewed along with similar programs of the Navy and Air Force. Coordination of related programs at other Government agencies such as the National Science Foundation or the Department of Energy is maintained by frequent exchange of reports, discussions between scientific staff and joint support of research contracts and national or international conferences and symposia. For such conferences, Army or other Department of Defense scientists and engineers usually participate in these meetings at no fee, and several copies of the proceedings are distributed internally within the pertinent Army community.

C. (U) WORK PERFORMED BY: Contracts which are managed by the Army Research Office with universities, industry and non-profit research institutions provide the means by which this research program is executed. The top five contractors are Rensselaer Polytechnic Institute, Brown University, University of Illinois at Urbana, University of Michigan, and Northwestern University. The number of additional contractors is 45. The estimated total dollar value of these additional contracts is $4,284,000

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Several outstanding accomplishments have been documented for FY81 and embrace the full spectrum of research in this project. For example, during the past three years, an extensive study of the many possible mechanisms of high-pressure jet atomization has resulted in a theory for spray formation. As a result, initial fuel spray parameters, such as jet spreading angle, can be predicted, and this capability is already being utilized in both diesel engine and spray modeling computations. A characteristic time model for quantifying the fuel property effects on lean blowoff, ignition, and combustion efficiency in gas turbine engines was developed. This combustor model is of considerable value to the gas turbine community and has been disseminated to a number of turbine engineer manufacturers. A coupled flap-lag equation of motion for an elastic helicopter blade in forward flight including structural coupling parameters has been developed, solved, and implemented at the Army Aeromechanics Laboratory at Moffett Field, CA. Research on the effect of surface curvature of gas turbine blades with thin-film cooling has demonstrated that the curvature effect is important and has to be considered by design engineers in their performance predictions. A correct theory for plastic deformation in metal-forming processes has been developed so that precise definitions of the coupling between elastic and plastic strains and material rotation are accommodated. Such a theory will allow for increase in geometrical capability of forming processes, optimization of cold drawing processes and improved control of microstructure. Also a variational thermodynamic

Technical/Scientific Area: #06 Title: Mechanics and Aeronautics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

theory of plastic deformation has been developed for the coupled analysis of viscoplastic deformation of streamlined dies for 105mm and 155mm shells and a 4.2-inch shell, improvement of 13% in cold drawing efficiency, more accurate prediction of formability limit like punch-through and buckling, and more reliable prediction of metal flow and the load-stroke curve during nosing operations

2. (U) FY 1982-FY 1984 Program: During FY82 and beyond, resources will be focused on those selected areas in solid mechanics, fluid dynamics, and combustion sciences where greatest opportunities exist for significant technological gains. For example, a new initiative in FY82 is the establishment of several centers of excellence in rotary-wing aircraft technology at universities or technical institutions. These centers will have the fourfold objective of establishing comprehensive in-depth research programs relevant to rotorcraft, complementary equipment and/or facilities, curricula for advanced degrees in rotorcraft technology, and a prestigious Army fellowship program in support of this field. A new initiative in this timeframe will emphasize research on aerodynamic components of small gas turbine machinery and novel concepts for electromagnetic propulsion devices with emphasis on fundamental processes of plasma shocks interacting with materials and mechanisms of wear in high-speed sliding elements. In addition, significant progress can be expected in determining high impact loading fracture processes, analytical theory for rotor wakes, ground interference on main and/or tail rotors, effects of catalytic walls on combustion and details of liquid-propellant combustion processes. Improved computational methodology for calculating viscous effects on rotating projectiles will be completed and implemented at the Ballistic Research Laboratory, and improvements for determining effects of missile plumes on aftbody surfaces will be developed and transferred to the Army Missile Command. A thrust area concerned with kinematics and mechanisms will be expanded to include research in stability and control. Research on blasts and blast loading will provide information on blast diffraction patterns over structures and after-blast effects induced by separating boundary layers. Such information is a precursor to determining loads and moments on Army material and structures in blast environments. A model and accompanying computer program describing the ignition and burning of a bulk-loaded liquid propellant will be completed and transferred to the Ballistic Research Laboratory. Research in FY83 and FY84 will be a logical and integrated continuation from FY82 and will be expected to embrace such important topics as rational theory of vibration, beneficial uses of residual stresses in structures, analysis of bank-to-turn missiles, rotor wake effects on performance and stability and control in nap-of-earth environment, combustion chamber design for adiabatic/catalytic walls, and novel nonintrusive diagnostic techniques for high-pressure/temperature environments.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

Technical/Scientific Area: #06 Title: Mechanics and Aeronautics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

5. (U) Resources: ($ in thousands)

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5320	6785	7860	9132	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5615	6670	7064	0	Continuing	Not Applicable

The reduction of $295 thousand in the FY 1981 funding level is a result of reprograming to higher priority Army requirements. The increase in FY 1982 reflects the application of revised inflation and civilian pay pricing indices. The increase in FY 1983 is a result of reprograming by the Army to increase research efforts in mechanics and aeronautics.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #07 Title: Physics
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The past support of physics research has led to significant benefits to Army and DOD technological and operational capability; for example, in identification of targets, in weapons and their precision guidance, and in general combat support technology. This is a continuing component of the Army's investment in science to avoid technological surprise. The program serves as a means of developing a working relationship of the nation's best physics research talent with the Army technical community. The program is also a means of exploiting new physics opportunities, such as was the case with the extensive research in laser physics on which precision weapons guidance is now based. The areas of primary Army impact are intelligence, surveillance and target acquisition; weapons development and guidance; combat support including obscured visibility operations; air and missile defense. The primary subdisciplinary areas contributing to these objectives are atomic and molecular physics; physics of condensed matter; plasma physics; optics and lasers; and cross-disciplinary topics.

B. (U) RELATED ACTIVITIES: This program relates to parts of the following projects in Program Element 6.11.02.A: AH42, Research in Materials and Mechanics; AH43, Research in Ballistics; AH44, Research in Fluidics, Nuclear Effects and Ordnance Electronics; AH46, Research in Combat Surveillance and Target Acquisition; AH47, Electronic Devices Research; AH48, Communications Research; AH49, Missile and High Energy Laser Research; AH60, Research in Large Caliber Armaments; AH61, Research in Small Caliber Armaments; AH63, Research in Electronic Warfare; A31B, Night Vision and Electro-optics Research; and B53A, Research in Atmospheric Sciences. A direct exchange of common interests is accomplished among the Services and other government agencies on a continuing basis to avoid unnecessary duplication of effort.

C. (U) WORK PERFORMED BY: This program of grants and contracts with academic and not-for-profit institutions and industrial laboratories is managed by the US Army Research Office, Research Triangle Park, NC. The top five grantees and contractors are: Massachusetts Institute of Technology, Cambridge, MA; University of Rochester, Rochester, NY; Stanford University, Stanford, CA; University of Arizona, Tucson, AZ; and University of California at Los Angeles, Los Angeles, CA. There are in addition 50 grantees and contractors. The value of these additional grants and contracts is $4,699,000.

Technical/Scientific Area: #07
Project: #BH57

Title: Physics
Title: Research in Scientific Problems with Military Applications

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Significant progress has been made of which the following are only representative. Several accomplishments which bear on the development of near millimeter wavelength techniques for enhancing obscured visibility operations include the development of a synthetic aperture technique for image formation; the development of solid state mitatt oscillators which may serve as transmitters; and the first data base for optical properties of materials for components. Advances in the growth of liquid phase epitaxial growth will affect second-generation focal plane night vision devices. Developments in the area of phase conjugate optics have occurred with potential for application in missile guidance, signal processing and pattern recognition, and tunable filters for optical countermeasures. Considerable progress has been made in the study of radiative collisional processes, which are the basis of short-wavelength lasers, an area recently identified by the Defense Science Board as having exceptional opportunity. Several research advances have been made relating to information display and man-machine interface (plasma panels, photorefractive effects, liquid crystals, electroluminescence) which provide options for fire control computers and signal processing. Fundamental results have been determined relating to the effect of surface roughness on the motion of electrons in solids, which will have bearing on many classes of electronic devices for command, control, and communications.

2. (U) FY 1982-FY 1984 Program: Related to millimeter wave systems for obscured visibility operations, research will include further exploration of concepts leading to high-power, stable, and tunable sources of radiation, continued development of the data base upon which component design is dependent, and with increasing emphasis on concepts which will enhance component integration and signal processing facility. Techniques relating to remote sensing with lasers will be pursued in the context of chemical and biological warfare. Considerable emphasis will be placed on the use of laser optics and display concepts which bear on many issues relating to fire control. Several topics in solid state physics and atomic and molecular process will address the fundamental basis for the mechanisms of explosives, armor, penetrators. Research will be pursued related to the limits of speed of operation and size of electronic devices. Mechanisms for the control of charge in repetitive opening electrical switches will be investigated in view of the need to take advantage of inductive energy storage and several applications such as particle beam weapons, nuclear weapons simulation, high-power lasers, and electromagnetic gun concepts. Solid state physics investigations will be pursued on various advanced electronic materials such as intercalated structures and deep electronic traps in semiconductors. Several efforts will be aimed toward the

Technical/Scientific Area: #07
Project: #BH57

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Physics
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

improved synthesis of advanced electro-optic materials. In Fiscal Year 1983, major emphasis within the program will include the development of near millimeter wave sources for the obscured visibility problem, optical processing for image and signals analysis, attempts to make a major impact on the problem of repetitively switching significant electrical current for prime power control, and efforts connected with ultrasmall electronic devices. Several topics relating to the dependence of major systems on optics will be developed including tunable lasers and detectors, and unique optical processing methods. In Fiscal Year 1984, selected research topics will be pursued in the area of atomic and molecular physics, electronic and structural properties of condensed matter, classical areas of phenomenology, especially optics, and cross-disciplinary topics such as electromagnetic technology and electrical and magnetic devices for their impact on projected Army needs for command, control, and communications; remote sensing; intelligence, surveillance, and target acquisition; electronic warfare, fire control; development of advanced materials; directed energy; armor and penetrators, explosive and shock phenomena; and man-machine interface technology.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	7036	7919	9128	10125	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	7377	9140	9575	-	Continuing	Not Applicable

The reduction of funds in FY 1981, FY 1982, and FY 1983 is a result of reprograming to higher priority DOD and Army requirements.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #08 Title: Chemistry
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: To defend against the pressing threat of the use of chemical agents by an adversary a strong and broad technology base is essential. Fundamental chemical investigations are required to provide for the technology base to meet Army requirements. Through investigation of the molecular structure and interactions we can fulfill mission goals of providing reliable and fast detection and identification methods for chemical agents, novel materials to ward off contamination by agents, and quick and effective means to decontaminate areas affected by chemical agents. Aside from the chemical threat, basic investigations are required in numerous areas vital to Army technologies such as in the combustion of fuels and propellants, behavior and design of explosives, and electrochemical energy conversion. The short- and long-term problems confronting the Army are reflected in the fundamental and applied research plans developed by the Army laboratories and the strategy developed for our program. A close working relationship with laboratory staffs is maintained through working group meetings on topical problems which promote interface with the scientific community from both the Government and private sector. The dialogue established promotes the development of new scientific areas at the laboratories and ensures return transfer of technology to the private sector.

B. (U) RELATED ACTIVITIES: The chemistry program is closely coordinated with and is responsive to the research objectives of the pertinent Army laboratories. This is demonstrated through the close relationship of the program to ten other 6.11.02.A projects. Close coordination and information exchange are maintained with other DoD agencies as well as with the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Science Foundation, the Department of Energy, and the Petroleum Research Fund.

C. (U) WORK PERFORMED BY: This program is managed by the US Army Research Office, Research Triangle Park, NC. The top five contractors are: Colorado State University, Fort Collins, CO; SRI International, Menlo Park, CA; University of Utah, Salt Lake City, UT; University of California (all locations); and University of Colorado, Boulder, CO. The total number of additional contractors is 95. The total dollar value of these additional contracts is $5,382,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: One of the most effective means to destroy chemical nerve agents is by oxidation and hydrolysis. Considerable enhancement of such processes on nerve agent simulants has been achieved in a system using alkaline hydrogen peroxide and a cationic surfactant. A new, general and direct synthesis of polyphosphazenes

Technical/Scientific Area: #08 Title: Chemistry
Project: #BH57 Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

has been discovered. These inorganic polymers exhibit many useful properties including low-temperature flexibility, flame retardancy, and stability to ultraviolet and visible radiation. They have properties which may prove useful in protection against chemical agents. A new fast method to follow polymerization kinetics using, in part, laser light-scattering has been developed permitting one to follow the extent of polymerization, molecular weight distribution and size in an automated manner. Such a capability should result in considerable cost savings in production processes.

2. (U) FY 1982-FY 1984 Program: The expanded FY82 program in the Chemical Defense area will include efforts in rapid detection and identification of agents, protective materials and protection, and decontamination. Studies on ultrasensitive proximate and remote sensing devices including solid state sensors, self-regenerating polymeric films, self-decontaminating films, permeability studies in membranes and fibers are included. Efforts on the combustion of propellants and explosives, and synthesis of new energetic materials will be continued. Continued studies in the combustion of propellants will rely upon the latest sophisticated nonlinear optical techniques and laser diagnostics. The impact of increased availability of novel-boron materials for use as additives to produce low-flame temperature propellants as well as rocket propellants will be assessed. A well-balanced program of polymer studies focused on structure/property relationships will continue with emphasis for new work in the areas of elastomers and high modulus fibers for use in tank track pads, personnel body armor, and other high-stress environments. A strong program in synthetic chemistry will be maintained to yield novel materials with specialized properties. Fundamental studies of processes occurring at electrodes and chemical modification of electrodes will contribute to increased efficiency and reliability of power sources. Continued analysis of Army research and development programs will enable us to maintain cognizance of problem areas as they develop and reorient programs to be responsive to new Army requirements in chemistry. An increased understanding of catalysis will permit additional studies applying such knowledge to ever-increasing complex and practical systems, including new high-energy fuels and propellant molecules, new and less polluting chemical procedures to replace those used in aging munitions plants, more efficient dispersal of propellant energy, and new fuel cell systems. Impressive correlation of the structure/property relationships in polymers will permit synthesis of property-specific materials.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

Technical/Scientific Area: #C8 — Title: Chemistry
Project: #BH57 — Title: Research in Scientific Problems with Military Applications
Program Element: #6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	Fy 1983 Estimate	Fy 1984 Estimate	Additional To Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	6868	9043	10587	11137	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	7051	11849	9246	-	Continuing	Not Applicable

The reduction of $183 thousand in FY 1981 is a result of reprograming to higher priority Army requirements. The decrease in FY 1982 reflects an adjustment in the large increase in funding in this area to higher priority programs. The increased FY 1983 funding is responsive to continued requirements for CW/BW Warfare Defense Research.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #09
Project: #BH57

Title: University Research Instrumentation
Title: Research in Scientific Problems with Military Applications

Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The serious state of the nation's university research instrumentation facilities has affected their ability to conduct high-quality research in support of national security. Current contract programs are not adequate to renew the universities' obsolete research instrumentation facilities. The crisis level of this issue has been documented through several studies organized within and outside of the Department of Defense including the Interagency Working Group on University Research Instrumentation, the 1981 Defense Science Board Summer Study, and an analysis conducted by DOD agencies that fund university research. The concern over the capability of universities to conduct high-quality research in support of national security has also been of concern to both Houses of Congress. This program would make a major impact on reversing the trend of the growing obsolescence of research instrumentation employed to address high-priority Department of the Army research objectives.

B. (U) RELATED ACTIVITIES: This program will offer critical support to the acquisition of knowledge in the physical sciences and engineering that are directly related to long-term Army problems. It is closely related to contract research programs pursued under BH57, Research in Scientific Problems with Military Applications. This project is closely related to efforts by the Navy and the Air Force to upgrade university research instrumentation facilities under grant and contract agreements. There exists a continuing coordination among the scientific program officers of the three Services with regard to the needs of research instrumentation by university grantees and contractors.

C. (U) WORK PERFORMED BY: This will be a program of grants and contracts with academic institutions managed by the US Army Research Office, Research Triangle Park, North Carolina. It is anticipated that the facilities of approximately 125 of the approximately 600 contractors and grantees will be upgraded under this program.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Not applicable since this is a new program in FY 1983.

Technical/Scientific Area: #09
Project: #BH57
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: University Research Instrumentation
Title: Research in Scientific Problems with Military Applications
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

2. (U) FY 982-FY 1984 Program: Research instrumentation will be used to upgrade research grants and contracts in the following areas: Chemical and Biological Defense: chemical sensing, detection, identification, decontamination, protective materials, atmospheric phenomena, biological detection, and neurotransmission. Mobility and Installation Energy: engine combustion, fuels, batteries, surface mechanics and materials. Microelectronics and Opto-electronics: electronic devices, electronic materials, and integrated circuits. Millimeter Waves: sources, passive components, signatures, signal processing, and propagation. Fire control and embedded computer software: laser, electro-optic processing, signal processing, algorithms, and software efficiency. Gun Propulsion: propellants, blast, electromagnetic acceleration, wear and erosion of gun tubes. Command, Control, Communications, Intelligence, Surveillance and Target Acquisition: communications and display technology, surveillance and target acquisition, remote sensing, and mapping. Manufacturing Technology: processing mechanisms, nondestructive evaluation, testing, and quality assurance. Research instrumentation will also provide support for selected topics in the areas of adverse weather research, explosives and shock phenomena, vertical lift, advanced materials, air defense, armor and antiarmor, directed energy, human factors, and the adverse terrain program.

3. (U) Program to Completion: This is a continuing program through FY 1987.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	0	0	10000	10000	30000	50000
Funds (as shown in FY 1982 submission)*						

*Not applicable. This is a new program proposed for FY 1983.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: # AH60 Title: Research in Large Caliber Armaments
Program Element: # 6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: Research in Large Caliber Armaments supports the Army's armament development programs in scientific areas of unique Army need in order to establish a basis for the development of sound future weapons and munitions. It consists of research in the following scientific areas: energetic materials (explosives, propellants, and pyrotechnics) and physics of armament (physics of failure and reliability, armament materials, systems structural analysis, and munitions). In energetic materials, the thrust is toward development of new materials; understanding their behavior upon ignition, initiation, combustion, and detonation; and their effects and degradation to permit safer, more efficient and effective development, manufacture, use, and disposal of munitions. With regard to new energetic materials, emphasis is on the development of explosives and propellants of reduced vulnerability, of explosives for use in munitions of increased capability to penetrate armor, and of pyrotechnics as decoys to defeat heat-seeking missiles. In the area of Physics of Armament, emphasis is upon the synthesis/characterization of new materials for armament, the development of the base technology to extend the life-limiting processes and reliability of armament in such areas as wear and erosion of gun barrels, the development and exploitation of analytical/experimental methods to define the response of armament systems and structures of their environment in order to formulate the basis for new design methodology and principles, and fundamental approaches for enhancing the lifetime and accuracy of gun tubes and for more efficient recoil mechanisms and mounts.

B. (U) RELATED ACTIVITIES: Related research is performed by the Navy, Air Force, National Aeronautics and Space Administration, and the Department of Energy. Coordination is accomplished by program reviews, exchange of program data sheets, research and technology resumes, technical reports, and liaison and attendance at scientific meetings and conferences. At the Office of the Secretary of Defense level, coordination is achieved through active participation in Joint Technical Coordinating Groups and program reviews sponsored annually by the Office of the Under Secretary of Defense for Research and Engineering. Broader, multinational coordination is achieved through joint participation of Australia, Canada, the United Kingdom, and the United States in The Technical Cooperation Program, and by data exchange agreements on various aspects of the program. This project is closely coordinated with Program Element 6.11.02.A, Project AH43, Research in Ballistics; 6.11.02.A, Project AH61, Research in Fire Control and Small Caliber Armament; and Program Element 6.26.03.A, Large Caliber and Nuclear Armaments Technology. The objectives of this project are also supported by contracts and grants placed by the Army Research Office under Project BH57, Research in Scientific Problems with Military Applications, in Program Element 6.11.02.A.

Project: # AH60 Title: Research in Large Caliber Armaments
Program Element: # 6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

C. (U) WORK PERFORMED BY: This project is managed and directed by the Large Caliber Weapon Systems Laboratory at Dover, NJ. The in-house scientific efforts are performed at Large Caliber Weapon Systems Laboratory and Benet Weapons Laboratory at Watervliet, NY. Augmentation of the in-house effort is accomplished through contracts and grants with industry, universities, and other government agencies. The top six contractors that will receive money under this project are: Geo-Centers, Inc., Newton Falls, MA; New York State University, Albany, NY; Iowa University, Ames, IA; General Electric Corporation, Burlington, VT; Stanford Research International, Menlo Park, CA; Princeton Combustion Research, Princeton, NJ; and Rensselaer Polytechnic Institute, Troy, NY. An additional 10 contractors will receive funds totaling approximately $300,000 under this project.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Fundamental research aimed at reducing the sensitivity/vulnerability of explosives/propellants has provided the following information: A molecular modification of cyclotrimethylenetrinitramine (RDX) has been synthesized which is three times as insensitive as RDX at only 1% penalty in output. We are currently assessing the toxicological hazard of this material. If the hazard is tolerable, process development studies will begin. Two patent disclosures were filed on methods of eliminating the phase transition in ammonium nitrate (AN) which leads to dimensional instability in AN-based explosive formulations. Both methods use small percentages of cheap, readily available materials as additives. Calculations have shown that replacing up to 20% of the RDX in Composition B with AN will have no adverse effect on performance, yet will reduce the cost of the fill. BLAKE code calculations indicated that methylglucoside azidonitrates should prove to be highly attractive ingredients in high-force, cool-burning artillery and tank propellants. A new mathematical model of propellant combustion was developed and successfully predicted experimental data obtained at the Naval Surface Weapons Center. In the area of enhanced explosive output for greater armor defeat capability, dinitrocubane and a number of other high-density intermediates were successfully synthesized. These intermediates are milestones along the way to preparation of octanitrocubane, an explosive predicted to exceed the power of HMX by as much as 50%. Experimental techniques were set up to determine the performance of these super-energetic explosives in shaped-charge applications. An atmosphere chamber and a microprocessor-controlled infrared (IR) radiometer were placed in operation for examination of pyrophoric compositions for use in IR decoy systems. Prior efforts have resulted in a new form of ductile chromium and development of a molten salt deposited tantalum coating for enhancing erosion resistance. Both developments have been translated to Advanced Development. In FY81 a new form of crack-free, high-strength chromium was synthesized and successfully deposited by ion sputtering. In the search for high-temperature, wear-resistant coatings, a technique for

Project: # AH60 Title: Research in Large Caliber Armaments
Program Element: # 6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

synthesizing amorphous powders using spontaneous decomposition from electroless baths was developed which is far superior to rapid solidification techniques and recovery temperatures of 1200°K achieved with the presently used tungsten-iron alloy. Exploitation of the principle of laminate materials has resulted in an aluminum titanium material with a 22% increase in effectiveness against ballistic pentration and a 50% increase in residual fatigue strength as compared to rolled homogeneous steel. In search of design methodology to enhance accuracy, the source of the major discrepancy between predicted and measured dynamic muzzle motion has been isolated. A new concept for the handling of residual stresses in fracture mechanics analysis using thermal simulation has been developed. A composite depleted uranium-tungsten filament-reinforced penetrator material with increased dynamic yield strength has been successfully formed by extrusion.

2. (U) FY 1982-FY 1984 Program: Other molecular modifications of existing exposure (RDX and HMX) shall be synthesized and evaluated as to sensitivity, toxicological hazard, and producibility. A detonation calorimeter will be designed, constructed, and calibrated for use in assessing the effectiveness of additives designed to enhance the output of AN-based explosives. Methylglucoside azidonitrates are being synthesized as candidate propellant ingredients and evaluated as to ignitability, vulnerability, and stability. The crystallographic structure of nitrocellulose will be determined. Laser spectroscopy are to be used to investigate the temperature and species profiles of propellant flames. A ballistic compressor shall be used to study the equation of state of propellant gases under high pressure. In the area of enhanced explosive output, 1,3,5,7-tetranitrocubane and several other polynitropolyhedranes will be synthesized as intermediates in the preparation of octanitrocubane. Techniques for study of shaped charge jets are being made operational for use in the study of munitions containing high-density super-energetic explosives. Energetic polymers are to be explored for use with explosive formulations containing super-energetic fillers. Radiation curing of explosive and propellant formulations is to be explored to take advantage of the enhanced dimensional stability and producibility afforded by this process. Work shall continue in order to improve the producibility and safety of Composition B as an explosive fill. For enhancing the erosion resistance of cannon, studies concentrated on current modulation in electroless deposition to form multiplex structures in chromium and characterization of ion-deposited coatings in small samples shall continue. Effects of dissolution of copper in bismuth and lead compounds as more effective decoppering agents, and research into the relationship between friction, material transfer, and wear in sealing materials shall continue to be explored. With the finalization of the characterization of interface properties versus ballistic performance and fatigue behavior, the laminate material technology will be translated to 6.2. The establishment of the relationship between composition, morphology, and exclusion of field for CdS and efforts to increase the Tc of metal hydrides through higher metal alloy content are being pursued. In structural mechanics, efforts continue to isolate the physical variables contributing to dynamic response, to develop a new dynamic

Project: # AH60 — Title: Research in Large Caliber Armaments
Program Element: # 6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

models utilizing Hermite polynomial approaches, and into the modeling of blast using Harten's Method of Artificial Compression. Efforts also continue in the development of a one-dimensional, steady-flow model for recoil orifice design. A new initiative in the development of numerical solutions for large plastic flow involving temperature will be undertaken. Pursuit of enhanced launch integrity and performance of munitions includes initiation of study of the mechanisms of delayed fracture of penetrator materials, the development of the equation of state of depleted uranium, and the indentification of the source of anomalous lattice vibration as a function of pressure in explosives. Characterization of higher volume fraction tungsten filament reinforced with depleted uranium will be undertaken. The detonation calorimeter will be used to evaluate the effect of various additives on the rate of release of explosive energy from ammonium nitrate-based explosive formulations. New ingredients will continue to be synthesized and evaluated as propellant ingredients, and work will continue to develop propellants with lower flame temperatures, signatures, and erosivity. Research into the fundamentals of explosive/propellant initiation/ignition and detonation/combustion will continue using the latest diagnostic techniques. Efforts to synthesize octanitrocubane and related high-density, high-output explosives will continue. A mathematical model will be developed to deacribe the process of casting Composition B into large caliber shells, which will allow optimization of parameters for crack-free casts. Energetic polymers designed for radiation curing of explosive or propellant charges will be developed. The characterization and quantification of parameters for optimal chromium properties under interrupted deposition will be completed and transitioned to exploratory development. The causes and development of a remedy for B phase formulation in tantalum will be undertaken along with examination of ion sputtering of molybdenum and molybdenum alloys, and synthesis of molybdenum alloy liners by rapid solidification technology. Enhancement in wear will be pursued through study of mechanisms of metal transfer as a function of surface protection and alloy content. Design of a carbonate-based decoppering agent will be completed. Coatings synthesized from amorphous powder will be characterized and attempts to extend tantalum continued. Control of morphology to control linear conductivity in cadmium sulfide and high technicium-palladium base hydrides through higher metal and hydrogen control will be attempted. The impact of projectile spin and eccentricity on dynamic response will be quantified, and efforts initiated into the study of intedraction of shock waves and defects. A study will be initiated on the development of numerical methods for elastic-visco-plastic behavior and blast modeling techniques incorporating chemical interaction undertaken. Delayed fracture studies in penetrator materials will concentrate upon species identification, composite technology and the potential of tungsten-alloy high-toughness filaments. Equation of state study of tungsten alloys will be initiated and effects of pressure on thermodynamic and kinetic variables in explosives continued. During FY 1984, the Insensitive High explosives and Propellants program will be brought to a close. Emphasis will shift to formulations designed for improved output and enhanced producibility, which will be based on new materials such as octanitrocubane and cellulose azide or azido-nitrate. Energetic polymers adapted to

Project: # AH60 Title: Research in Large Caliber Armaments
Program Element: # 6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

radiation curing will be developed as binders for such formulations. Work will continue in order to understand the fundamentals of explosive/propellant initiation/ignition and detonation/combustion. Propellants with higher force, lower flame temperatures and signature will also be a major goal. Energetic materials which can serve as structural elements in munitions to save weight will be sought. Study to enhance erosion resistance will concentrate on species additions to chromium and molybdenum alloy-based coatings and liners. Emphasis will be placed on boundary layer lubrication as a means of reducing metal transfer, and theory of amorphous state and characterization of properties of amorphous materials continued. Search for other pressure-synthesized, high-temperature superconducting materials will be pursued. Efforts will be initiated into the principle of optical logic materials/devices as substitutes for electronic circuits and shock wave amplification in semiconducting materials by magnetic fields. Experimental measurement of factors contributing to dynamic response will be completed, and development of a usable design model initiated. Investigation will continue into dynamic behavior of defects and numerical methods for elastic-visco-plastic behavior. Attempts to reduce muzzle blast by energy removal will be initiated along with new data structures of numerical programing and principles of recoil energy absorption and conversion. Efforts on delayed fracture in penetrator materials will emphasize protection approaches. The study of ballistic performance of composite penetrator material will be continued, with new initiatives into high-pressure syntheais of high-energy-density explosives and definition of shock behavior of interfaces in composite materials.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable

Project: # AH60 — Title: Research in Large Caliber Armaments
Program Element: # 6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5069	5652	6729	7252	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5319	6274	7200	-	Continuing	Not Applicable

(1) The decreases in FY 1981, FY 1982, and FY 1983 are due to reprograming of funds to higher priority Army programs.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #BS10 Title: Research on Military Disease, Injury and Health Hazards
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: Basic research on military disease, injury, and health hazards involves a variety of medical research disciplines. Three types of disease severely affect combat effectiveness of the soldier: (1) endemic problems in a deployment area (e.g., malaria); (2) diseases associated with mobilization (e.g., meningitis); and (3) diseases caused by biological warfare (BW) agents (e.g., yellow rain and botulism). Research is required to develop drugs and vaccines. Research on military injury considers that delay in treatment of casualties leads to prolonged shock, progressive infection, intestinal perforation, and subsequent kidney failure. Areas of critical concern are cell energy and oxygen use, hormone alterations, immunity, circulatory regulation and cell structure organization, and disruption following these types of injury; the mechanisms of these alterations must be identified to develop measures to reduce disability and death. Research on health hazards of military materiel and on medical factors which limit soldier effectiveness defines physiological stresses and behavioral decrements resulting from heat, cold, and high terrestrial elevation or from stress (e.g., toxic gases, blast overpressure, vibration, impact, and noise) which accompany the operation of weapons systems. Studies are also conducted on factors which limit soldier performance (e.g., combat stress, continuous operations, rapid translocation) or enhance it (e.g., physical fitness and various forms of exercise). Dental injury research is conducted to identify and investigate methods, materials, and equipment for the prevention and treatment of maxillofacial injury and combat dentistry. Research supported by this project will also provide information required for the development of pretreatment, prophylactic, antidotal, therapeutic, and casualty decontamination compounds for protection from chemical warfare agents.

B. (U) RELATED ACTIVITIES: Research is performed in support of Army Program Elements 6.27.34.A, Medical Defense Against Chemical Agents; 6.27.70.A, Military Disease Hazards Research; 6.27.72.A, Combat Casualty Care Technology; 6.27.75.A, Combat Maxillofacial Injury; 6.27.77.A, Systems Health Hazard Prevention Technology; 6.37.32.A, Combat Medical Materiel; 6.37.50.A, Drug and Vaccine Development; 6.37.51.A, Medical Defense Against Chemical Warfare; 6.37.64.A, Medical Chemical Defense Life Support Materiel; and 6.47.17.A, General Combat Support. Coordination of research programs with the Air Force, Navy, Uniformed Services University of the Health Sciences, and with other governmental agencies, including the National Institutes of Health, and Department of Health and Human Services, precludes duplication of effort through evaluation by the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee.

C. (U) WORK PERFORMED BY: Approximately 81 percent of this research program is conducted by laboratories of the US Army

Project: #BS10 Title: Research on Military Disease, Injury and Health Hazards
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

Medical Research and Development Command: the Walter Reed Army Institute of Research, Washington, DC; US Army Medical Research Institute of Infectious Diseases, Fort Detrick, Frederick, MD; US Army Research Institute of Environmental Medicine, Natick, MA; US Army Aeromedical Research Laboratory, Fort Rucker, AL; US Army Institute of Surgical Research, Fort Sam Houston, TX; Letterman Army Institute of Research, Presidio of San Francisco, CA; US Army Institute of Dental Research, Washington, DC; US Army Medical Research Institute of Chemical Defense, Aberdeen Proving Ground, MD; US Army Bioengineering Research and Development Laboratory, Fort Detrick, Frederick, MD; and overseas special foreign activities of the Walter Reed Army Institute of Research located in Thailand, Malaysia, Germany, Brazil, and Africa. Approximately 19 percent of the research is performed under contracts with universities, nonprofit organizations, and industry. The five top contractors are Lovelace Biomedical and Environmental Research Institute, Inc., Albuquerque, NM; Bio Med, Inc., College Park, MD; IIT Research Institute, Chicago, IL; USEPA Health Effects Research Laboratory, Research Triangle Park, NC; and JAYCOR, Inc., Del Mar, CA. There are 46 other contractors funded by approximately $2,688,282.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: In military infectious diseases, methodology to distinguish the three different organisms that cause leishmaniasis (kala azar or oriental sore) was developed; a nerve cell model was developed to define mechanisms of intoxication by botulism and other neurotoxins of potential BW importance, and the infectious hepatitis virus was successfully grown in culture. In combat casualty care, Thyrotropin Releasing Hormone (TRH) has been shown to be effective in the treatment of septic and hemorrhagic shock; enzyme markers to detect gastrointestinal injury from blast effects have been identified, and models were developed to investigate molecular and cellular changes in acute kidney failure. In systems health hazard research, short-term tumor toxicity tests were developed to sensitively and accurately predict the tumor-producing potential of militarily relevant chemicals; a blast overpressure dose response curve of laryngeal injury in an animal model was completed, and the relationship between peak pressure and number of exposures from blast-producing weapons was evaluated. In maxillofacial injury, a strong inhibitor of bone dissolution was detected and partly characterized, and a surface application of microencapsulated antibiotic formulation successfully controlled immediate post-trauma wound infection for 14 days in experimental animals. In medical chemical defense, tentative evidence was found that nerve agent causes nerve degeneration in specific areas of the brain, and the central nervous system centers involved in respiration were found to be more sensitive to nerve agent poisoning than the peripheral respiratory centers, indicating that nerve agents are more centrally active than previously believed.

Project: #BS10 Title: Research on Military Disease, Injury and Health Hazards
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Program: Research on medical defense against biological toxins and microbial agents of BW importance will be expanded. Techniques for growing organisms, mechanisms of transmission of biological agents, and physical/chemical properties of toxins will be determined. Rapid identification techniques and diagnosis for a wide range of BW agents and/or diseases will be developed. Identification of components of high-hazard viruses will be done as groundwork for future drugs and vaccines. The actions of experimental antiparasitic liposomes as drug carriers and their effects on parasite metabolism will be further elucidated. Research will continue on defining genes of enteric bacteria which cause dysentery. Personnel to be utilized: 149 professional and 216 support. Basic information to develop improved techniques for patient resuscitation, stabilization, healing, and treatment will be determined. Methods of prevention or reversal of shock and attendant renal failure will be continued. Personnel to be utilized: 83 professional and 104 support. In weapon systems health hazard research, electrophysiological studies of mechanisms of injury from low-frequency noise will be completed. The auditory and nonauditory effects of blast overpressure will continue to be studied. Basic microwave and laser radiation investigations will be continued. The impact of climatic stresses and fatigue on psychological functions in military tasks such as, vigilance, computation, fine motor coordination, and sensory perception will be assessed. Relationships between stress, aggression, and fatigue on soldier/military unit breakdown will be examined. Personnel to be utilized: 94 professional and 117 support. Efforts in maxillofacial injury will concentrate on laboratory and clinical studies in: development of biocompatible, biodegradable, and nonbiodegradable materials for repair of maxillofacial wounds and hollow-organ replacement. Personnel to be utilized: 8 professional and 14 support. In the chemical defense area, major scientific thrusts will be in: neuropathologic, pharmacologic, physiologic, and biochemical effects of chemical warfare agents in the central nervous system to understand both their incapacitating and lethality mechanisms. Personnel to be utilized: 38 professional and 61 support.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

Project: #BS10 Title: Research on Military Disease, Injury and Health Hazards
Program Element: #6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	22723	35764*	44112**	50702	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	22273	39922	32600	-	Continuing	Not applicable

* The reduction in funding is due to Congressional decrements.
** Increase of $11.5 million due to the FY 1982 Budget Amendment to the Expansion of Chemical Warfare/Chemical and Biological Defense (CW/CBD) Basic Research and to the consolidation of the Army and Navy infectious disease research programs as directed by Congress.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #AO Title: Military Disease Hazards Research
Project: #BS10 Title: Research on Military Diseases, Injury and Health Hazards

Program Element: 6.11.02.A Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This technical area provides the science base upon which the Army medical research program in infectious diseases is founded. Basic investigations are conducted in a broad range of medical sciences designed to result in control or elimination of infectious disease as military mobilization and deployment problems. Those diseases which most severly affect the combat effectiveness of the soldier receive priority. This technical area also includes the science base necessary to develop adequate medical defense against biological warfare (BW) agents.

B. (U) RELATED ACTIVITIES: Research projects in the science base normally progress into Program Element 6.27.70.A, Military Disease Hazards Technology (which consists of two projects: A870, Risk Assessment of Military Disease Hazards, and A871, Prevention of Military Disease Hazards). From there, promising technology moves into Program Element 6.37.50.A, Drug and Vaccine Development (which consists of the single project D808, Drug and Vaccine Development). Coordination of projects among the program elements is achieved by the Commander and staff of the US Army Medical Research and Development Command (USAMRDC). Army representation on Department of Defense (DOD) coordinating committees and other government agency councils insures that the Army's medical research program complements the work of other Federal medical institutions. Overall review and control of DOD's medical research was brought under centralized management in FY 1981 by the formation of the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee. Joint Technology Coordinating Groups (JTCG) were established to insure effective management at the investigative level. Two JTCG review research within the Army's Military Disease Hazards Research Program. They are the JTCG for Infectious Diseases of Military Relevance (JTCG/IDMR) and the JTCG for Medical Biological Warfare Defense (JTCG/MBWD). The mission of these JTCG has been established; it is to: (1) assess and prioritize disease threats, recommend research efforts to counter identified threats, and analyze the resources available to meet these research requirements; (2) recommend interservice distribution of responsibility for program execution, changes in program direction or emphasis, new initiatives, and other matters dealing with program requirements and relevance; and (3) review and coordinate disease research and development programs. Duplication of effort is avoided. The World Health Organization (WHO) serves as the de facto international clearinghouse for medical information; Army scientists serve as consultants to WHO and have ready access to its studies, reports, and publications. In addition, other coordination is accomplished through normal, routine means, such as exchange of reports among staff and laboratory organizations, site visits by project officers, distribution of research and technology resumes, etc.

Project: #AO — Title: Military Disease Hazards Research
Project: #BS10 — Title: Research on Military Diseases, Injury and Health Hazards
Program Element: #6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activity: # 1 - Technology Base

C. (U) WORK PERFORMED BY: Approximately 67 percent of the research program is conducted by four Army laboratories: Walter Reed Army Institute of Research, Washington, DC; the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, Frederick, MD; the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Frederick, MD; the Letterman Army Institute of Research, Presidio of San Francisco, CA. The remaining 33 percent of the work is conducted under contracts with industries, universities, and nonprofit organizations. The top five contractors are the University of Alabama, Birmingham, AL; the University of Maryland, Baltimore, MD; Baylor University, Houston, TX; Harvard University, Cambridge, MA; and the University of Oregon, Portland, OR. Nineteen other contractors also are funded in the amount of $1,033,876.

D. (U) PROGRAM ACCOMPLISHMENTS:

1. (U) FY 1981 and Prior Accomplishments: A method to separate and identify the three different organisms that cause leishmaniasis (kala azar or oriental sore), a threat to troops deployed in the Middle East, Southwest Asia, and Africa, was developed. A new essay procedure for quantification of viral antigen and antibodies was developed. A nerve cell model was designed that makes it possible to study botulism toxin and other neurotoxins of potential BW importance. The virus that causes infectious hepatitis was successfully replicated in cell cultures. Several different monoclonal antibodies were prepared which have specificities for group B meningococci, a bacteria that frequently cause meningitis in recruits; this will greatly increase the reliability of diagnosis. New techniques of culturing animal intestine cells provided a better understanding of the pathogenesis of diarrheal disease. A new toxin was isolated from Legionella pneumophila, the causative organism of Legionnaires' disease.

2. (U) FY 1982-FY 1984 Program: Research will be expanded on medical defense against biological agents and toxins of potential BW importance. Major emphasis will be placed on rapid identification and diagnosis. Other expanded areas in BW defense will include techniques for growing organisms, physical and chemical characterizations, and mechanisms of transmission. New studies will characterize fully the infectious hepatitis virus using monoclonal antibodies to identify viral antigens for use as potential vaccines. The Legionnaires' disease bacteria's toxin will be isolated and purified to determine the toxin's role in various forms of the disease. Research will continue on bacterial plasmids aimed at defining genes of enteric bacteria which cause disease. The genes which code for the antigens which induce protective immunity in malaria,

Project: #AO — Title: Military Disease Hazards Research
Project: #BS10 — Title: Research on Military Diseases, Injury and Health Hazards
Program Element: #6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activity: # 1 - Technology Base

African trypanosomiasis (sleeping sickness), and Leishmaniasis will be cloned within bacteria or other microorganisms. Personnel to be utilized: 149 professional and 216 support.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	10637*	14600	18643	21490	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	10263	14880	14040	-	Continuing	Not Applicable

* The increase in funding for FY 1981 is a result of reprograming to higher priority Army requirements.
** The decrease in funding for FY 1982 is due to the amended budget request.
*** The increase in funding for FY 1983 is due to the Expansion of the CW/CBD Research Program and to the consolidation of the Army and Navy infectious disease research programs as directed by Congress in the FY 1982 Appropriations Bill.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #CO
Project: BS10

Title: Systems Health Hazard Research
Title: Research on Military Disease, Injury, and Health Hazards

Program Element: 6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: Basic research focuses on health hazards of military materiel, extreme environments, combat and training operations, and on medical factors which limit soldier effectiveness. The goals are to identify factors which cause stress, to define and model specific physiological and psychologic mechanisms that translate environmental stress into physical or behavioral manifestations, and to identify elements in the individual or his environment which can reduce stress or prevent performance decrements and/or psychiatric breakdowns. Studies define physiological stresses and behavioral decrements resulting from adverse environments (heat, cold, and high terrestrial elevation) and from toxic gases, blast overpressure, vibration, impact, and noise. Studies are also conducted on physical fitness and on factors which limit soldier and unit effectiveness (e.g., continuous operations, rapid translocation). Such research is critical because: (1) conventional battle scenarios are expected to have three to five times the intensity of World War II and will expose soldiers to excessive numbers of unusual stresses; (2) there are likely to be unprecedented numbers of psychiatric battle casualties (some estimates up to 50%); and (3) many of these casualties are preventable and soldiers so exposed represent the largest recoverable pool of replacements on the battlefield. Assessment of Army-unique toxic chemical hazards (e.g., smokes/obscurants and propellant exhaust gases) and specialized technologies for microwaves, millimeter wave, and laser research are also supported at a basic science level.

B. (U) RELATED ACTIVITIES: This research provides the basic science core to support exploratory development for Program Element 6.27.77.A, Systems Health Hazard Prevention Technology; Project 878, Health Hazards of Military Materiel, and Project 879, Medical Factors Limiting Soldier Effectiveness, and is closely associated with efforts in Project BS04, Identification and Health Effects of Military Pollutants, and Project 835, Military Medical Environmental Quality. Duplication of effort is avoided by intramilitary and intermilitary service agreements, exchange of data with nonmilitary agencies, and publication of significant findings in technical reports and scientific journals.

C. (U) WORK PERFORMED BY: In-house research is conducted by the Walter Reed Army Institute of Research, Washington, DC; US Army Aeromedical Research Laboratory, Fort Rucker, AL; US Army Research Institute of Environmental Medicine, Natick, MA; Letterman Army Institute of Research, Presidio of San Francisco, CA; and US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Frederick, MD. The top five contractors are: Lovelace Biomedical and Environmental

Technical/Scientific Area: #CO
Project: BS10

Title: Systems Health Hazard Research
Title: Research on Military Disease, Injury, and Health Hazards

Program Element: 6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

Research Institute, Inc., Albuquerque, NM; JAYCOR Inc., Delmar, CA; IIT Research Institute, Chicago, IL; USEPA Health Effects Research Laboratory, Research Triangle Park, NC; and the University of Western Ontario, London, Canada. Four additional contracts totaled $157,447.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Research in this project investigated the thermoregulatory response under various environmental conditions. Animal models of heat stress were developed to assess the role of dehydration in heatstroke and to evaluate the value of plasma volume expansion in preventing heat illness. Investigation of the pathophysiology of heat and cold injury by studying structural changes in selected organs was continued. It was determined that freezing followed by thawing of tissue disrupted the cells lining the blood vessels and that platelets adhere to the disrupted surface, thus removing them from the bloodstream. Studies were conducted to investigate high-intensity physical performance, fatigue, and the recovery process under various environmental conditions. A study of the effects of hypoxia on night vision was initiated. An isolated liver perfusion system for the study of heat-induced liver damage was developed. Auditory studies demonstrated that high-frequency hearing losses can result from exposure to low-frequency noise sources. Short-term immunotoxicologic assays predictive of long-term tumor-producing potential in man were investigated. Efforts to develop neurobehavioral toxicity tests to assess the effects of combined stresses (chemical, physiological, and environmental) were initiated. A mechanism by which gastrointestinal dysfunction could disrupt the execution of skilled movement was described, and a means to pharmacologically alter the response was demonstrated. An animal model was developed to evaluate the components of performance in continuous operations. A millimeter wave anechoic chamber was designed and constructed. Initial experiments to measure the effects on vision in primates of exposures to lasers were completed. Studies were conducted to determine the mechanisms of injury of new Army lasers. A dose response curve of laryngeal injury from blast overpressure in an animal model was completed. New candidate biochemical markers of early lung injury in relationship to blast overpressure were evaluated. A three-dimensional model of blast-producing weapons was completed, and the relationship between peak pressure and number of blast exposures was evaluated.

2. (U) FY 1982-1984 Program: Studies on the effects of alcohol, phenothiazine drugs, and infection that predispose to heat injury will be completed, and agents used to protect against heat-induced liver damage evaluated. Animal models and

Technical/Scientific Area: #CO
Project: BS10

Title: Systems Health Hazard Research
Title: Research on Military Disease, Injury, and Health Hazards

Program Element: 6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

therapeutic techniques for cold injuries (trenchfoot, frostbite, hypothermia) will be defined and assessed. Animal models of high-altitude pulmonary edema and acute mountain sickness will be developed. Pharmocological agents to enhance tissue nutrition (oxygen transport) at high altitude and thereby reduce work decrements will be identified. Studies which explain the physiological and biochemical control mechanisms of ventilatory adaptation to high terrestrial elevations will continue. Biochemical and hormonal changes leading to heat acclimatization will be identified. Methods will be evaluated to improve muscular strength and to define mechanisms of muscular fatigue and recovery. The impact of climatic stress and fatigue on psychological functions in Army field tasks such as vigilance, computation, fine motor coordination, and sensory perception will be assessed. Studies of retinal mechanisms involved in light-dark adaptation will continue. The interactive effects of noise and vibration on hearing and pharmacologic agents for the prevention/treatment of auditory injury will be investigated. Efforts to develop immunotoxicologic assays that predict long-term tumor-producing potential will continue. Development of behavioral tests to assess the effects of multiple toxic gas exposures upon soldier performance will be initiated. Mechanisms regulating neuroendocrine responses involved in adaptation to stress will be examined. A basic data base will be developed to interpret the factors associated with psychiatric breakdown of soldiers during military operations to identify methods of prevention and treatment. Development of a prototype telemetric gut pressure sensor for use in field studies will continue. A technology base in millimeter wave biophysical research will be established. Millimeter wave exposure systems will be developed for use with biological specimens under conditions of continuous wave and high peak power operations. Studies on millimeterwave biohazards to the eye (i.e., direct heating action on the cornea and production of thermoacoustic expansion of the cornea, lens, and retina) will be conducted. Animal studies will continue on the biochemical effects of low-level laser exposure and evaluation of the effects of repeated and chronic exposure will be expanded. Studies of brief low-level laser flashes on visual function in primates will be initiated. Investigation of the biomedical effects of near infrared, near ultraviolet, short infrared, and other new laser systems will be initiated. Development and validation of small animal models for the assessment of blast injury will continue. Water jet impulse instrumentation for laboratory simulation of blast overpressure and procedures for the study of pulmonary function in exposed unanesthetized animal models will be initiated. Implantable instrumentation and techniques for telemetry of tissue response to blast and biochemical markers of blast lung injury and blast gastrointestinal injury will be developed. Personnel to be utilized: 94 professional and 117 support.

3. (U) Program to Completion: This is a continuing program.

Technical/Scientific Area: #C0 — Title: Systems Health Hazard Research
Project: BS10 — Title: Research on Military Disease, Injury, and Health Hazards
Program Element: 6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
RDTE						
Funds (current Requirements)	5537	6249	6916	8113	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5790	7361	8478	-	*Continuing*	Not Applicable

Reductions in funding in FY 1981 - FY 1983 are the result of reprograming to higher priority Army requirements.

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DESCRIPTIVE SUMMARIES OF THE RESEARCH DEVELOPMENT TEST & EVALUA--ETC(U)
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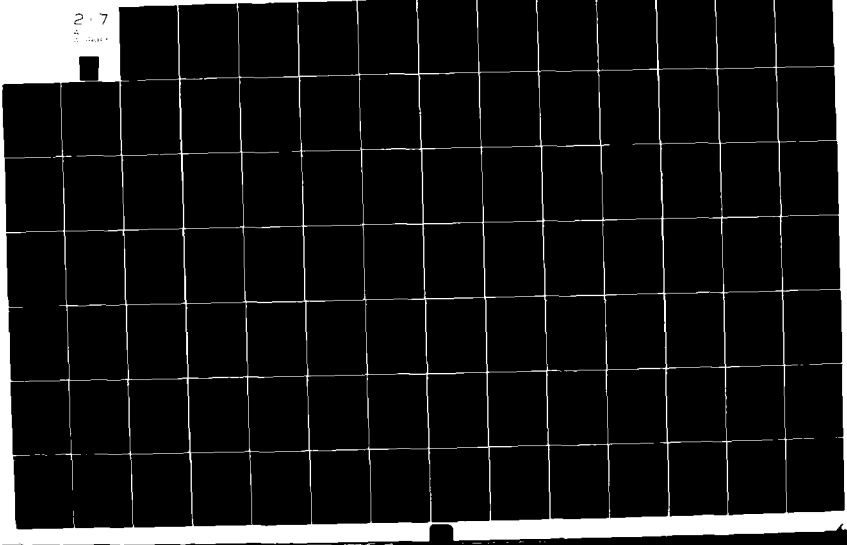

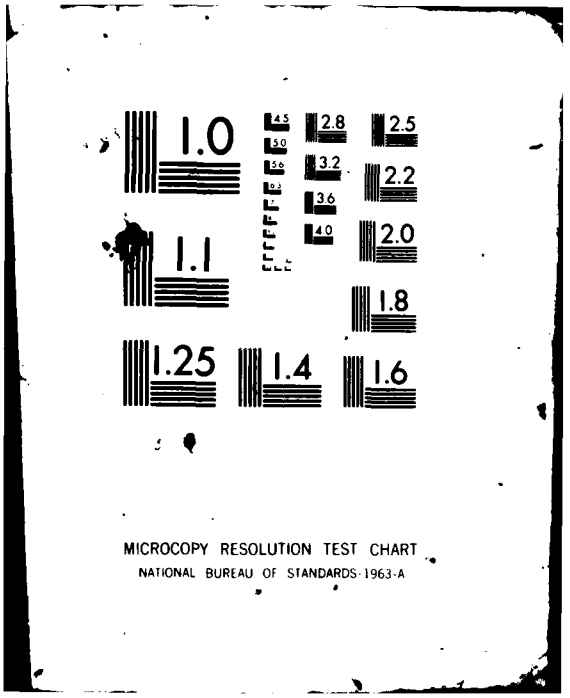
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FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: Technical/Scientific Area: #EO — Title: Medical Chemical Defense Science Base/Mechanisms of Action of CW Agents and Antidotes

Project: #BS10 — Title: Research on Military Disease, Injury and Health Hazards

Program Element: 6.11.02.A — Title: Defense Research Sciences

DOD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The overall objective of this basic research effort is elimination of major gaps in scientific knowledge resulting from a decade of research inactivity. Research supported by this scientific area will provide, over time, the critical information required for the development of pretreatment, prophylactic, antidotal, therapeutic, and casualty decontamination compounds for protection of US Forces against the Warsaw Pact arsenal of chemical warfare agents. With the Army designated the executive agent for this research, this scientific area represents the major DOD research effort on medical chemical warfare defense and supports the requirements of the other services. Recognition of the criticality of a significantly expanded basic science effort is reflected in the substantial increases in programed funding. The research focuses on the definition of mechanisms of action of threat chemical warfare agents and drugs with life-saving potential with the ultimate goal of developing protective drugs with maximum efficacy and minimum performance-degrading side effects. Research thrusts of this effort include: determination of the physiological sites and mechanisms of action of threat chemical warfare agents; determination of the sites and mechanisms of action of candidate pretreatment, prophylactic, antidotal, therapeutic, and casualty decontamination compounds, exploitation of intrinsic body mechanisms to defend against chemical warfare agents; determination of the efficacy, excretion, metabolism, and biological fate of current and candidate antidotes; determination of neurotoxicologic symptomatology of nerve agents and differentiate between hypoxia and neural effects; use of immunologic techniques to locate sites of action; definition of dynamics of skin contamination, by chemical warfare agents, by determining the metabolism, penetration rates, and desposition of agents in skin; and exploration of means to enhance intrinsic protective ability of skin.

B. (U) RELATED ACTIVITIES: This scientific area supports Program Element 6.27.34.A, Project A875, Medical Defense Against Chemical Agents; Program Element 6.37.51.A, Project D993, Medical Defense Against Chemical Warfare, and Program Element 6.37.64, Project D995, Medical Chemical Defense Life Support Materiel. Duplication of effort within the Army is avoided by central management of the program on Medical Aspects of Chemical Defense by the US Army Medical Research and Development Command. Duplication of effort across the services is avoided by coordination and collaboration with the Air Force and Navy, as required by the Army as the Executive Agency for the DOD chemical defense effort. A Memorandum of Agreement has been finalized with the Air Force and a Joint Technology Coordinating Group, consisting of Army, Navy, and Air Force has been formed. All work is coordinated with quadripartite and NATO nations through meetings and Data Exchange Annexes.

Project: Technical/Scientific Area: #E0 Title: Medical Chemical Defense Science Base/Mechanisms of Action of CW Agents and Antidotes

Project: #BS10 Title: Research on Military Disease, Injury and Health Hazards

Program Element: 6.11.02.A Title: Defense Research Sciences

DOD Mission Area: #510 - Defense Research Budget Activity: #1 - Technology Base

C. (U) WORK PERFORMED BY: Five contractors are supported by this effort: Iowa State University, Ames, IA; Army Research Office, Research Triangle Park, NC; Ash Stevens, Inc., Detroit, MI; Bio Med, Inc., College Park, MD; and Optical Sciences, Inc., San Rafael, CA. In-house research is funded at the US Army Medical Research Institute of Chemical Defense (formerly the US Army Biomedical Laboratory), Aberdeen Proving Ground, MD; the Walter Reed Army Institute of Research, Washington, DC; and Letterman Army Institute of Research, Presido of San Francisco, CA.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: An initial study has suggested that nerve agent lethality may vary as a function of the body's physiological cycles. This information may be useful in designing therapeutic strategies to capitalize on the body's ability to detoxify itself. Tentative evidence was found that a nerve agent causes neural degeneration in specific areas of the brain. These data are important to understanding the mechanisms whereby nerve agents poison and the pharmacologic mechanisms that could be used to interfere with the poisoning process. Also important to the understanding of the mechanisms of nerve agent poisoning was the finding that changes in aldolase enzyme in nerve and muscle were observed following nerve agent exposure. It was also determined that nerve agents may have long-term effects on brain functions when hypoxia is involved as a mechanism of action. The central nervous system centers involved in respiration were found to be much more sensitive to nerve agent poisoning than the peripheral respiratory centers, further indicating nerve agents are much more centrally active than previously believed. These data are important because they indicate that antidote compounds must be centrally active to provide protection. The results above were products of the in-house research programs. The contract program was expanded in this area from two to five contracts.

2. (U) FY 1982-FY 1984 Program: The overall efforts in this basic science area will be significantly expanded through enhanced in-house programs and extramural contracts, with the greatest increase occurring in the extramural contract program. Efforts initiated in FY 1981 to enlist the assistance of the civilian scientific sector in this problem will be continued. Major scientific thrusts/emphasis will be in the areas of: the neuropathologic, pharmacologic, physiologic, and biochemical effects of chemical warfare agents in the central nervous system to understand both the incapacitating mechanism and mechanism(s) whereby the threat chemical warfare agents are lethal; the effects of chemical warfare agents on neurotransmitters, cyclic nucleotides, and behavior will be studied; determination will be made of the biological distribution of

Project: Technical/Scientific Area: #EO — Title: Medical Chemical Defense Science Base/Mechanisms of Action of CW Agents and Antidotes

Project: #BS10 — Title: Research on Military Disease, Injury and Health Hazards

Program Element: 6.11.02.A — Title: Defense Research Sciences

DOD Mission Area: #510 - Defense Research — Budget Activity: #1 - Technology Base

atropine analogs and metabolites in biomedical models; interactions between candidate nerve agent antidotes and nerve agent aging will be examined; initial phase of investigating nerve agent metabolic effects will be completed; acetylcholinesterase levels in specific brain areas in response to nerve agent poisoning will be determined as well as the relationship between these levels in blood and brain; sites of action of chemical warfare agents and candidate antidotes will be identified; skin permeabilities of the chemical warfare agents will be determined; studies will be completed on identifying the best way to enhance natural skin detoxification and/or protection against chemical warfare agents; blister agents distribution, metabolism, and intoxication studies will be completed; studies on the effects of chemical warfare agents on neurotransmitter systems other than the cholinergic will be conducted; and the physiological tracts responsible for control of respiratory and cardiovascular system and the effects of agents and antidotes on them will be determined. Personnel to be utilized: 38 professional and 61 support.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	2662	10528	13426	-	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	2352	13678	5456		Continuing	Not Applicable

Increase in FY 1981 is the result of reprograming $229 thousand from Program Element 6.27.34.A, Project A875, Medical Defense Against Chemical Agents, and $81 thousand from OSD deferrals. Decrease in FY 1982 is the result of repricing the budget on decreased inflation factors and the OSD Program Budget Decision. Increase in FY 1983 is the result of approval of the Chemical Warfare and Chemical and Biological Defense Technological Base Enhancement Program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A31B
Title: Night Vision and Electro-Optics Research
Program Element: #6.11.02.A
Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The Army must improve its ability to fight at night and under conditions of limited visibility. The objective of this project is to exploit new concepts for passive and active infrared detectors and imagers, new lasers, smart sensors, digital image processing, target signature processing, and atmospheric modeling. The promising results of this project will be shifted to exploratory development of day/night vision and tracking systems. Research on low-cost, uncooled thermal imaging concepts is conducted to permit electro-optical target acquisition device solutions to such diverse high-volume Army requirements as day/night riflesights, crew-served weapon sights, infrared drivers' and pilots' viewers and terminal homing seekers. This research emphasizes studies of lasers, pyroelectric materials, charge coupled device imagers and thermo-optical imaging concepts. Research on monolithic elements for far infrared focal plane arrays is directed at low-cost, high-performance thermal imaging requirements such as long-range surveillance, forward looking infrared devices and fire-and-forget autonomous seekers. Research addresses materials studies of 3-5 micron and 8-10 micron monolithic mercury cadmium telluride focal plane arrays. The 1-2 micrometer image intensifier program contemplates a ten- to twenty-fold improvement in photosensitivity over third generation image intensifiers. This program capitalizes on the high levels of night sky glow emission in the 1-2 micrometer region and the high level of target contrast available. 1-2 micron imagers have the further important characteristic of providing more effective target camouflage penetration. Smart sensors and autonomous seekers are technology areas of intense military interest and importance. Research is required on automatic target acquisition algorithms applicable to imaging seekers and multispectral cuers. Research is also required as a basis to advance critical military areas such as advanced target trackers and very high bandwidth compression for data links. The program on near millimeter wavelength lasers is directed toward the eventual development of laser radars and imagers operating near one millimeter to provide all-weather battlefield surveillance and target acquisition capability.

B. (U) RELATED ACTIVITIES: Close coordination is maintained with the Navy, Air Force, and Marine Corps, other government agencies, academia, and industry to avoid duplication. Through the Joint Logistics Commanders, coordinating groups have been established to ensure that maximum use is made of limited assets, e.g., Navy is developing 3-5 micron second-generation infrared detectors, while the Army is developing infrared detectors sensitive to 8-14 micron energy and uncooled detectors. The Air Force is working on extrinsic silicon technology of infrared detectors. The Army has responsibility for the configuration management of the first-generation thermal imaging common modules used by all services. In addition, an active international program of technical cooperation is maintained with many countries, particularly those of NATO and the Quadripartite countries.

Project: #A31B
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Night Vision and Electro-Optics Research
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

C. (U) WORK PERFORMED BY: This work is performed by the Night Vision and Electro-Optics Laboratory, Ft Belvoir, VA. The eight largest contractors are: Rockwell International, Thousand Oaks, CA; Hughes Research Corp., Malibu, CA; Honeywell Incorporated, Minneapolis, MN; Texas Instruments, Dallas TX; Stanford University, Palo Alto, CA; University of California, Los Angeles, CA; Raytheon Corp., Sudbury, MA; and GTE-Sylvania, Waltham, MA. There will be 10 additional contractors receiving approximately $3,500,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A revolutionary uncooled imaging approach was conceived; theoretical analysis predicts performance levels potentially equivalent or superior to cooled thermal system now going into production. Experiments have demonstrated the key components. Integration of these components into a single detector capable of demonstrating feasibility has been initiated. Uncooled systems offer the advantage of considerable reductions in systems cost and size by virtue of the elimination of cooling requirements. Research on photovoltaic (PV) mercury cadmium telluride (HgCdTe) on cadmium telluride (CdTe) had been interrupted at the end of FY 1980 to address the problem of photoconductive (PC) HgCdTe as a joint research and development program. Progress on this research has demonstrated high-quality CdTe substrate materials, and several research samples of PC HgCdTe layers epitaxially grown on this CdTe have been fabricated. Several improved techniques for passivation of PC HgCdTe have been conceived, and research has been initiated on them. A prototype, mechanically tunable, 8-14 micrometer, spectral filter was developed which met program goals and was transitioned to development. Advanced, frequency agile laser materials in the .4 to 12 micrometer spectral range have been identified. Most of the carbon dioxide (CO_2) laser work related to isotopes and isotopic mixtures for continuous wave and pulsed applications has been completed and transferred to exploratory development. Feasibility assessment of advanced electro-optic source concepts applied to near millimeter wave (NMMW) Army requirements for missile and fire-and-forget systems has been completed, and important results have been obtained. A pattern-matching process based on the most distinctive objects in images from two sensors was developed. Algorithms for multiple simultaneous target tracking, acquisition, and critical aimpoint maintenance were developed. Bandwidth reductions techniques capable of 10,000:1 antijam protection have been simulated. An extensive series of search experiments have shown how target acquisition time for electro-optical viewers depends upon environmental factors such as target signature and background complexity and on viewer characteristics such as resolution and field of view. Investigations of the target-recognition capabilities of staring arrays indicate that these arrays are fundamentally limited by sampling effects. Initial schemes have been developed that explore the capability of smart sensors to detect simpler targets.

Project: #A31B
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Night Vision and Electro-Optics Research
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Program: Feasibility of the new uncooled imager approach will be demonstrated with a single-element detector. Experiments to demonstrate small-area uncooled viewers will be performed to determine if staring system performance is significantly less than conventional system performance as prior evidence suggests. A preliminary autocuer model will be developed and used to analyze existing autocuer techniques. A prototype, small-area, uncooled array (thermo-optical) will be completed and evaluated. Based on results, a development program will be initiated for development while research for optimizing fundamental performance characteristics will continue. Molecular Beam Epitaxially (MBE) grown HgCdTe graded to CdTe layers will be grown for monolithic staring sensors. Techniques for forming stable electron-hole (n-p) junctions in HgCdTe will be investigated for hybrid photovoltaic focal plane arrays. The relationship between passivation techniques and photodiode n-p junction leakage will be identified. Research on electro-optical modulators will continue. Electro-optic (E-O) modulators used in conjunction with infrared imagers will provide smart sensor capability by detecting and recognizing unique spectral characteristics. New high-efficiency tunable laser materials will be sought to cover the 0.4-14 micrometer spectrum. Advanced nonlinear optical materials will be identified for frequency-doubling inserts to the new tunable laser materials. New concepts for integrating multifunctional infrared (IR) laser devices with second-generation forward-looking infrared (FLIR) sights and advanced fire control systems will be investigated. A tunable near millimeter wave source feasibility assessment will be initiated. Research on quasi-optical elements with emphasis on staring passive arrays for millimeter wave passive target acquisition and fire-and-forget applications will continue. Performance prediction methods for evaluation of smart sensors and bandwidth reduction techniques will be completed. The use of context-dependent methods for cueing, including spatial and temporal, will be tested in computer simulation. Methods for utilization of dual sensor inputs will be investigated. Investigations will continue on autocuer models and tracker models. Concepts for evaluating smart sensors and multispectral systems in the laboratory will be explored. Investigations will be performed to expand the search model, in particular to include effects of operator task loading. The effect of high image noise levels and partial target obscuration on target detection and recognition criteria will be established. A passivation technique and junction formation technique for hybrid mercury cadmium telluride (HgCdTe) focal plane arrays will be established. Work will be extended to passivation and junction formation in cadmium telluride (CdTe) for image processing in monolithic "smart" focal plane array. Charge transfer efficiency of a Schottky-type Charge Coupled Device (CCD) in CdTe of .9999 will be demonstrated. Charge transfer from a HgCdTe absorber, through an upgraded barrier layer to a CCD layer, will be demonstrated for monolithic focal plane arrays. Research on electro-optical arrays and assessment of cross-talk in the sensing and readout mechanisms will be initiated. The research portion of the research and development on liquid phase epitaxial HgCdTe will be completed. Passivation techniques applicable to photoconductive HgCdTe by plasma anodization, laser-annealed CdTe and molecular beam epitaxially (MBE) grown CdTe will be assessed. Passivation techniques applicable to

Project: #A31B
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Night Vision and Electro-Optics Research
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

photovoltaic HgCdTe will continue. The PV HgCdTe research postponed in FY 1980 will be resumed both for hybrid and monolithic sensor arrays. Research will continue on electro-optical materials and electrically controlled optical phenomena for fast spectral and spatial modulators and shutters. Frequency doubling improvement material/techniques in the near/far IR will be aggressively pursued. Quasi-optical elements previously explored theoretically will be realized with emphasis on staring passive arrays for MMW passive target acquisition and fire-and-forget applications. Algorithms for Intelligent Target Tracking and 10,000:1 bandwidth reduction will be completed and transitioned to prototype hardware. In-house development and testing of cueing algorithms will be facilitated by delivery of a Flyable-Programmable Algorithm Demonstrator (F-PAD) and an Image Processing and Digitization Facility (IPDF). Investigation of context-dependent cueing will be initiated and incorporate the results of the internal study on array detection for infrared point targets. Investigation will continue on the development of methods for algorithm evaluation. Laboratory experiments shall be performed to quantify search strategy and efficiency while field experiments will be pursued to confirm a search rate/field of view relationship previously established in the laboratory. A detailed comparison of staring and conventional materials for adaptive spatial filtering techniques (adaptive optics) will be initiated to solve the problems of image degradation by atmospheric turbulance and image vibration, and to enhance low-contrast imagery associated with poor atmospheres such as fogs and smokes. Investigation of macro-integration techniques for multifunctional CO2 lasers will continue. Investigation of fast-tuning devices for far IR and remote sensor lasers will be completed. Context-dependent cueing algorithms will be tested and evaluated with the results of the study incorporated into the multisensor investigation. The Multi-Sensor Target Acquisition Program will be extended to include integration of results from more than two types of sensors. Formulations of models for cuers and trackers will be completed. Concepts for automatic target recognizers and other advanced sensors will be investigated. Efforts to further expand, update, and validate static and dynamic performance models for electro-optical sensors will continue including development of techniques to evaluate observer/smart sensor interactions. Smart-sensor modeling efforts will continue by addressing advanced fire-and-forget concepts and camouflaged target detection capabilities.

3. Program to Completion: This is a continuing program.

4. Major Milestones: Not applicable.

Project: #A31B
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Night Vision and Electro-Optics Research
Title: Defense Research Sciences
Budget Activity: #1 - Technology Base

5. Resources ($ in thousands): The resources requested under this project will serve the basic object ve of providing the Army with the capability of conducting combat operations under conditions of limited or obscured visibility, or at night.

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	7358	7166	9726	10395	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6767	7938	9500	-	Continuing	Not Applicable

The increase of $591 thousand in the FY 1981 funding level is a result of reprograming to increase research in target acquisition techniques using electro-optics. The reduction in the FY 1982 funding levels reflects Congressionally directed cuts and reprograming to higher priority DOD requirements. The increase in FY 1983 reflects increased emphasis in research in very intelligent surveillance and target acquisition systems.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A71A
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Research in Chemical/Biological Warfare Defense
Title: Defense Research Sciences
Budget Activities: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This program provides fundamental information and new concepts in support of new or improved defensive systems against the chemical and biological (CB) warfare threat and a sound deterrence system of chemical munitions. It also provides research in aerosol and obscuration sciences in support of the Army smoke mission. The development of an integrated CB defense system is required to cope with the hazards of any potential CB threat environment. New concepts and a stronger scientific basis are needed from which to establish novel approaches to exploratory development related to individual and collective protection, detection and warning, decontamination and contamination avoidance, and training systems. Research is also needed in chemical deterrence to examine new agents, both lethal and incapacitating, and to evolve new concepts for delivery of chemical agents from a variety of munition systems. Improvements in smokes are required, including obscuration in infrared and millimeter wavelength regions of the spectrum, faster emplacement for quick-reaction protection, reduced toxicity, methods for eliminating smokes, and improved logistics of smoke agents and dissemination devices.

B. (U) RELATED ACTIVITIES: Close coordination is maintained with the Army Research Office, Office of the Project Manager Smoke/Obscurants, Army Medical Research and Development Command Laboratories, and other Army laboratories as well as the Navy, Air Force, Marine Corps, other government agencies, academia, and industry to avoid duplication, foster cooperation, and employ existing expertise wherever it can be found. Coordination is accomplished through program reviews, exchange of technical reports, interchange of seminars, inter-Service liaison, formal briefings, and regularly conducted working-level scientific conferences on the national scale. Informal coordination occurs through visits to governmental, industrial, and academic laboratories, and review of scientific journal articles and government in-house reports. Contact is also kept with the outside research community through university sabbaticals under the Intergovernmental Personnel Act of 1970 and in-house research appointments under the National Research Council Research Associateship Program.

C. (U) WORK PERFORMED BY: This work is performed by the Chemical Systems Laboratory (CSL), US Army Armament Research and Development Command, Aberdeen Proving Ground, MD. The largest contractors in FY81 were: Johns Hopkins University, Southern Research Institute, University of Texas, Boeing Aerospace, AD Little, University of Miami, Worcester Polytechnic Institute, and Drexel University. The total FY81 contractual effort was $887K. Also, $617K was sent to other Government Laboratories to support CSL research programs.

Project: #A71A
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Research in Chemical/Biological Warfare Defense
Title: Defense Research Sciences
Budget Activities: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Chemical Systems Laboratory successfully collaborated with the Electronics Research and Development Command Night Vision Electro-Optics Laboratory in ultraviolet laser studies specifically tailored for improved fluorescence excitation of aerosolized biological materials. A methodology was devised for enzymatic release and conversion of tissue cell constituents to fluorescent or colored products. The detection of tissue cell fragments was demonstrated for a peroxidase linked specific antibody technique. The experimental investigation and characterization of surfaces in terms of surface energetics, morphology, texture, etc., to assess wetability and interactions with jets and sprays was initiated. Research on microemulsions for spontaneous solubilization and reaction with agents resulted in the preparation and transfer to exploratory development of a candidate emulsion. In the area of individual and collective protection, research on the fundamental chemical processes occurring in the reaction of carbon monoxide with Whetlerite charcoal has shown that the carbon monoxide reacts with the chemisorbed oxygen on the Whetlerite and is useful in residual life determination. Research related to chemical detection, identification and alarms has proven that oriented aminoanthraquinone dye molecules are less reactive to alkylating agents in comparison to those that are randomly oriented. This finding leads the way for solid state chemical agent detectors. Studies were started on solubility and permeability of liquids and vapor in polymeric materials in order to predict the properties when the polymers are in contact with chemical agents and decontaminants. In training systems research, chemometrics analysis of a data base on molecular association effects which produce fluorescence response was completed. Research in chemical deterrence in the area of chemical agent viscoelastic behavior produced dielectric constant values for various binary components using a novel method involving nuclear magnetic resonance. The method was transferred to the exploratory development program, where it will be used to monitor the agent reactions and will be important in selecting polymers for thickening agents. In-house capability in physicochemical techniques has been expanded to allow high-temperature viscoelastic measurements. Organophosphorus chemistry research was directed to the synthesis of novel compounds and the investigation of their stereochemistry. These chemicals are important as intermediates, especially as potential binary components. A general equation describing broad-absorption due to convex particles of random orientation was derived and applied to the selection of new, improved infrared smoke materials. An improved theory for infrared screening by finite cylinders was developed and successfully applied to the analysis of exploratory development experiments on multispectral screening. The optical constants of a number of powdered forms of carbon were measured in the 3-14 micrometer region. A Fourier Transform Interferometer was developed, which will be of great value in assessing candidate multispectral agents in the exploratory development program. Growth properties of phosphorus smoke particles were measured, and a theory for predicting the behavior of this important screening material was verified. A theory

Project: #A71A — Title: Research in Chemical/Biological Warfare Defense
Program Element: #6.11.02.A — Title: Defense Research Sciences
DOD Mission Area: #510 - Defense Research — Budget Activities: #1 - Technology Base

for the evaporation of multicomponent oil drops was developed along with experimental methods for validation measurements. Good agreement was obtained. A theory of droplet evaporation within open air plumes was developed to predict plume lifetime dependence on plume diameter. A theory of coagulation and competing condensation droplet growth in laminar jets was developed along with experimental apparatus. An experiment and a simplified theory were established for turbulent jets of oil vapor which show a linear relationship between mass concentrations in the jet and resulting median particle diameter. Experiments on aerosol scavenging by a variety of designs of falling collectors show mesh-type particles most efficient. This research may have application in the quest for smoke removal techniques. A new nephelometry laboratory was established in-house with equipment for measurement of all elements of the Mueller matrix in the visible wavelength region, adding significantly to our capability to characterize the optical properties of candidate aerosols.

2. (U) FY 1982-FY 1984 Program: Research will be conducted to find new approaches to highly sensitive and pathogen specific detection methods. The survey and research for biochemical and instrumental methods for virus detection will be continued. Micro-optical pattern recognition approaches will be studied, as well as means for selectively detecting pathogenic microorganisms. Research will be initiated on fractionation to separate viruses from other materials. Basic properties of biological toxins most likely to be used in biological warfare will be determined for rapid methods of detection and hazard assessment. Research on new biological detection and warning concepts will center on the derivation of second-generation remote and point sampling detection approaches. Microwave studies with interferometry and Fourier Transform spectroscopy studies of interference materials will be continued. Pattern differential absorption and scatter studies for remote detection use will be completed. Fundamentals of laser mass spectrometry identification of particles and Raman spectrometry for analyzing single particles will be continued. The optical rotary dispersion research will be carried forward as a concept for simplified remote and point biodetection. Measurements of acoustic reflection and absorption by biologicals at various wavelengths will be made to include tissue culture, spores, and toxin simulant materials. Antimicrobial effects of chemically modified fabrics and paints will be examined for application to contamination avoidance. In chemical defense, research will be conducted to determine fundamental properties of thickened liquids which would control physical behavior in decontamination and contamination avoidance. Models of the mechanics of the physical removal of surface contamination at high-pressure jets and sprays will be developed and validated. Agent-surface studies will be extended to include development of simulants that mimic fundamental characteristics of agent-surface interaction. A parametric study of factors affecting reaction rates of chemical agents in microemulsions will be completed. Microemulsions will be designed for optimal decontamination with special attention to thickened agents. New research will also be performed with hydrolytic and oxidative catalysts bound on ion-exchange resins for chemical decontamination. In the area of

Project: #A71A
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Research in Chemical/Biological Warfare Defense
Title: Defense Research Sciences
Budget Activities: #1 - Technology Base

individual and collective protection, research will be conducted to establish novel conceptual approaches to the development of improved methods of air purification, new sorbents, and residual life indicators. Workable models of air purification systems based on principles of heterogeneous catalysis will be developed. The fundamental parameters which control detoxification of contaminated air by microwave plasma discharge will be determined. Absorption-desorption kinetics will be studied with mixed gases on absorbent beds. In the area of chemical detection and alarms, research will be performed to provide the scientific base on which to focus development of new detectors and alarms and new methods of identification. New concepts in mass spectrometry such as multiphoton ionization will also be examined. Techniques such as laser-induced volatilization and pyrolysis will be studied to improve agent identification and analysis. Mechanisms of gas-solid reactions and interactions will be elucidated to serve as a basis for design of detectors. The miniaturization of gas chromatograph and mass spectrometry techniques will be continued. For the materials research area, the studies of polyurethane elastomers will be extended to obtain a complete mapping of the sorption and diffusion processes for comparison with current theories. Research will be performed on the role of polymer composition and structural variables on the transport behavior. Training systems research will concentrate on establishing scientific criteria for development of models to design simulants and training chemicals of mission interest. In the area of chemical deterrence, research will continue on the basic chemistry, stereochemistry, and the reactions of organophosphorus compounds. Development of mathematical models for the neurosystem will be completed and toxicology of compounds predicted by the model will be performed. Another area will involve extending studies of chemical reaction mechanisms that interact with biochemical systems other than the cholinergic one. The in vivo activation of pharmacological effects by externally induced stimuli will be studied. Research on chemical agent viscoelastic behavior will be extended to develop an understanding of the fundamental intermolecular properties of chemical agents which influence the viscosity of thickened agent solutions. An investigation of viscous liquid fill-induced flight instabilities will be initiated to extend the experimental and theoretical data base relating to flight instability affecting spinning projectiles having viscous fluid fills. The aerosol/obscuration science program will be expanded to include electro-optics research in CB defense. New research will be undertaken in establishing techniques for measuring the optical constants of CB materials and in the theory and measurement of light-scattering properties of these materials. Elastic light-scattering (nephelometry) will examine all properties of airborne particles and contaminated surfaces which may be used to determine size, shape, structure, and chemical composition. Research on optical properties of nonspherical particles will be extended to include the effects of corners, irregular edges, and fibers whose axes wander instead of being perfectly straight cylinders. The emphasis in studies of physical properties will shift from previous research on the properties of liquid systems (e.g., fog oil, diesel fuel, phosphorus smoke) to support the new thrusts in nonspherical particles. In the area of aerosol characterization methods, using the new techniques developed, an experiment will be designed

Project: #A71A
Program Element: #6.11.02.A
DOD Mission Area: #510 - Defense Research

Title: Research in Chemical/Biological Warfare Defense
Title: Defense Research Sciences
Budget Activities: #1 - Technology Base

and conducted to test the value of optical inversion methods for measuring smoke particle distributions. The goal is discovering a rapid, automated method to replace the slow, labor-intensive impactor methods presently used in the exploratory development program. An experimental capability will be established for conditions, and initially a study of scaling laws appropriate to the simulation of open-air plumes will be undertaken. A new area of research will be initiated to understand the dispersion properties of powders. Understanding in this area is required to assist the smoke technology program in its task of militarizing a new generation of obscurants based on dry powders, which present a very different set of dissemination problems from all previous smokes.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	2498	6399	5076	3776	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1948	7422	3100	-	Continuing	Not Applicable

The increase in funding for FY 1981 is a result of increased emphasis in research in Chemical/Biological Warfare Defense systems. The decrease in FY 1982 is a result of the application of revised inflation rates and civilian pay pricing indices. FY 1983 increase is to maintain emphasis in Chemical/Biological Warfare Defense research.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.21.05.A Title: Materials
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activty: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11719	10450	9615	11551	Continuing	Not Applicable
AH84	Materials	11719	10450	9615	11551	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Work in this program element is directed toward satisfying specific Army needs. Key examples follow: Laminate materials armor systems are being developed to defeat conventional high-density, long-rod penetrators and shape charge munitions threats and to provide significant reduction in weight for a comparable thickness of conventional steel armor. These new armor systems will provide much greater protection than is currently available and also the lightweight, highly mobile capabilities required for advanced fighting vehicles. Work is being done to test and evaluate new equipment. Advanced metal matrix composites are being developed for CH-47D-type helicopter transmission housings. The improved housings will have a mean time between removal greater than 3000 hours and will provide a reduction of 25% in operating costs and reductions in noise and vibration. Advanced metal-matrix composites are also being developed for Army mobile bridging. This work will provide reinforcing kits to eliminate sag in mobile bridging for spans up to 52 meters. These metal-matrix composite kits will result in weight savings of over 50% with attendant increases in deployability, transportability, and emplacement effectiveness. materials structures capable of withstanding high-energy fluence levels in excess of at engagement times in excess of 5 seconds have been developed. These materials will be applied to the Advanced Attack Helicopter and Cobra-type aircraft to provide laser protection in critical and vulnerable areas. Advanced gear and bearing materials are being developed to provide increased speed and higher payloads required for CH-47D-type helicopters. For optimum performance, these helicopters must have advanced gear materials that can withstand high torque at higher revolutions per minute and effectively operate at temperatures up to 600°F. Closely related to the above are programs on rapid solidification technology applied to advanced

powder metal alloys and the advanced surface processing methods of ion implementation to manufacture gears and bearings for highly stressed components in tanks and aircraft. Another critical mission program is the work to develop a systematic base on chemical warfare agents and associated decontaminants interactions with materials to support development of better equipment for the chemical, biological, and radiological environment. The approach involves tests in the laboratory and tests with chemical warfare agents to provide an accurate reference base. Specifications on the absorption, diffusion, and transmission properties of chemical warfare agents on materials for the XM-30 gas mask and other equipment are being developed.

C. BASIS FOR FY 1983 RDTE REQUEST: Ground combat vehicle armor requirements will be met by development of combinations of armor laminate systems. Requirements for improved munitions will be addressed by the fabrication and evaluation of composite penetrator munitions and performance of three-dimensional analyses of armor penetration, fragmenting rounds, and launch conditions using hydrodynamic computer codes. Metal-matrix composite transmission housings for helicopters will require specifications for fiber-matrix wetting and bonding, improved fiber coatings, and joining and fabrication techniques. Laser hardening requirements generate the need for low-expansion or partially absorbing glass, photochromic glass, and fast-acting switching materials to provide personnel protection against laser threats. These classes of glass will be developed and evaluated. Work will be conducted to provide and evaluate prototype bearings using the greatly improved properties obtainable from rapid solidification of metal powders for tank and aircraft transmissions and power train applications. An expanded program will be conducted to evaluate the effects of chemical warfare agents and decontaminants on polymer materials such as the XM-30 gas mask.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	11719	10450	9615	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	11394	11182	12557	Continuing	Not Applicable

Program Element: #6.21.05.A Title: Materials
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activty: #1 - Technology Base

Increase of $325 thousand in the 1981 funding level is a result of reprograming to fund high-priority work in materials processing research and development. The funding decrease of $732 thousand in FY 1982 is a result of program realignment to fund programs with higher Army priority. Reduction of $2897 thousand in the FY 1983 funding level is a result of program realignment to fund programs with higher Army priority.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.21.05.A Title: Materials
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activty: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The principal goals of this program are to produce new and improved materials that will withstand increased loads, and satisfy the environmental and structural performance requirements unique to Army weapon systems and equipment. Exploratory development is conducted in the following areas: Metallurgical techniques and alloy improvements: organic materials, ceramic materials, composite materials, machanics of materials, , failure analysis, and test evaluation methods. All of these projects are aimed at producing materials specifications for use in Army systems and equipment to satisfy increased performanc requirements, and to reduce the cost of weapon systems acquisition and lifetime ownership cost.

G. (U) RELATED ACTIVITIES: The Navy, Air Force, other Government agencies, and Allied Nations have complementary programs in one or more of these materials areas. Coordination within the Department of Defense is achieved through the Office of the Deputy Under Secretary of Defense Annual Apportionment Reviews and meetings of the Office of the Deputy Under Secretary of Defense Research and Engineering Ad Hoc Services Materials Laboratories Council. Coordination with the nonmilitary federal agencies is effected through participation in activities of the National Materials Advisory Board of the National Academy of Sciences--National Academy of Engineering and the Interagency Council on Material coordination meetings and the Department of Defense Biannual Materials and Structures Briefings for Industry. International coordination is effected through the Technical Cooperation Program with Australia, Canada, New Zealand, and the United Kingdom, and the Structures and Materials Panel of the Advisory Group for Aerospace Research and Development of the North Atlantic Treaty Organization.

H. (U) WORK PERFORMED BY: Approximately 80% of the development work on this program will be accomplished in-house at Army Materials and Mechanics Research Center, Watertown, MA; Army Armament Research and Development Command, Dover, NJ; Army Missile Command, Huntsville, AL; Army Mobility Equipment Research and Development Command, Fort Belvoir, VA; Army Natick Laboratories, Natick, MA; Army Aviation Research and Development Command; Applied Technology Laboratory, Fort Eustis, VA; and the Army Test and Evaluation Command, Aberdeen Proving Ground, MD. The five primary contractors are: Garrett Turbine Engine Company, Phoenix, AZ; Parker Hannifin, Irvine, CA; Brown University, Providence, RI; Ford Motor Company, Dearborn, MI; and Massachusetts Institute of Technology, Cambridge, MA. There are five additional contractors and a total dollar value of $100,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (C) FY 1981 and Prior Accomplishments: Advanced laminated armor systems were developed for the operator's compartment of the new M9 armored combat earthmover and the ground-launched cruise missile transporter/erector. Ballistic

spall suppression liner systems of were developed, evaluated, and successfully fabricated for the M113 armored personnel carrier infantry vehicle. Tests confirmed improved survivability of personnel against ballistic and radiological threats. advanced kinetic energy tank munition was greatly improved through advanced materials processing methods. Improved composite helicopter tailcone structures were developed and tested and withstood multihit 23mm . Determined causes of unacceptable variability of tungsten core kinetic energy munition and fabricated and tested improved munition cores. Completed baseline flight test of metal-matrix composite reinforcement plates for satisfying vibration, wear, and noise reduction requirements of the CH-47 helicopter forward transmission. The general reduction of noise was 3 to 5 decibels over the entire frequency spectrum. Developed harder, more abrasion-resistant coatings for military kevlar cable. Demonstrated new joining concepts for sandwich panels and initiated a contract for fabrication of low-cost silicon carbide/aluminum metal-matrix composites for bridging. Developed materials specimen capable of withstanding high-energy laser fluence level in excess of for engagement times over 5 seconds. These materials were developed for the Advanced Attack Helicopter or Cobra-type aircraft . Established laser damage threshold levels for optical materials used in windshields, vision blocks, and optical gun sights. Determine mechanism and developed specifications for highly effective laser barrier action of and developed improved glass compositions that provide superior resistance .

2. FY 1982-FY 1984 Program: Develop procurement specifications for electroslag remelt steel which include engineering and ballistic property requirements for the Advanced Attack Helicopter. Develop and evaluate laminate armor systems, that provide a reduction compared to the same thickness of conventional steel armor, for highly mobile lightweight tanks and infantry fighting vehicles. These new armor systems will provide the required greater protection from penetrator munitions. Pursue developments to improve performance of new tungsten alloys and optimize stabelloy processing as high-density materials for kinetic energy penetrators. Conduct realistic computer modelling of armor penetration rounds, fragmentation rounds, and of launch conditions to guide armament materials developments. Test and evaluate new composite designs for armor to defeat Soviet advanced threats. The Army metal-matrix composite thrusts on helicopters will focus on fiber-matrix wetting and bonding, improved fiber coatings, welding, joining and fabrication, and broadening the data base on mechanical properties. The metal matrix bridging thrust will include completion of design trade-off studies, surface treatment for bonding, fabrication of low-cost silicon carbide/aluminum composite, and initiation of contracts on design optimization, joining concepts, and automated metal-matrix production techniques. Increased joining requirements of advanced military systems will be satisfied through work on structural adhesives that will be evaluated along with metal components to optimize strength, fatigue, and environmental durability. Work will be increased on metal

component replacement in ground combat systems to enhance agility and mobility and respond to Rapid Deployment Force need. Work will proceed to complete development of noncharring, ablative advanced radome materials and host materials. Work will continue to establish the data base on effects of radiation on missile nose cone materials and windshields, canopy and optical materials and on textiles required for personnel protection. Further develop and evaluate fast-acting switching materials for personnel protection. Work to develop improved materials for ground combat vehicle armor will be conducted. Continue program to develop, test, and evaluate gear and bearing materials for tanks and aircraft using advanced processing techniques. Conduct measurements of effects of chemical warfare agents wetting and spreading on Army equipment with polymer surfaces and develop methods for decontamination and protection. Establish a centralized corporate Army rubber-processing and characterization facility for satisfying increasing requirements for elastomers and rubbers in Army systems. This program to expand and accelerate work in this area will initially focus on the development and tri-Service application of natural and synthetic rubbers. Work will be started to establish a long-range program to develop new competitive materials processing methods program for lighter weight and higher performance materials unique to Army needs to offset escalating production costs of future weapons systems. The program will focus on new, lightweight composites, metals, and polymer for combat systems, higher efficiency adiabatic engines, less labor-intensive composite aircraft structures, and on surface treatments incorporating protection against contaminating/decontaminating chemical agents.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.21.11.A Title: Atmospheric Investigations
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6208	5534	5045	6995	Continuing	Not Applicable
AH71-A	Battlefield Environments	509	540	750	1452	Continuing	Not Applicable
AH71-B	Atmospheric Effects on HEL	665	555	595	600	Continuing	Not Applicable
AH71-C	Millimeter Wave Propagation	451	890	1230	1760	Continuing	Not Applicable
AH71-D	Atmospheric Sensors	1160	1677	1112	603	Continuing	Not Applicable
AH71-E	Battlefield Obscuration Effects	1193	789	880	1135	Continuing	Not Applicable
AH71-F	Artillery Meteorology	811	811	198	1140	Continuing	Not Applicable
AH71-G	Atmospheric Assessment for Army Programs	1419	272	280	305	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Mission needs respond to: (1) Requirements contained in the Department of Defense (DOD) Atmospheric Transmission Plan, 7 Jul 81, which obligates the Army to satisfy responsibilities to all three services (Army, Navy, Air Force); (2) requirements from the Deputy Under Secretary of Defense for Research and Engineering, 1 Feb 79, for the Army to take the lead providing meteorological support, both technology base (6.2) and meteorological operational support (6.5), to the Department of Defense National High Energy Laser Test Range at White Sands Missile Range, NM; (3) requirements contained in Fire Support Mission Area Analysis, Phase I Report, 31 Jan 80, and from the United States Army Field Artillery School, 23 Jun 80, to provide improved long-range artillery effectiveness; and (4) a requirement for the Army to provide its own weather support forward of Division for weapon systems, and for hydrologic and flood forecasting. This program addresses the urgent need to develop meteorological techniques and equipment essential in the planning and support of combat operations. The impact of weather and battlefield conditions (dirty battlefield) on sophisticated weapon systems employing electro-optical, millimeter, and microwave devices must be determined. Adequate

Program Element # 6.21.11.A Title: Atmospheric Investigations
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

knowledge of meteorological effects and adequate procedures and equipment to compensate for them are essential for artillery fire control accuracy and tactical operations. Near-realtime weather intelligence is essential in planning combat operations and direct support of weapons systems. Remote wind sensors are required to increase the standoff range and survivability of battle tanks. Specific objectives are to: (1) develop meteorological techniques and equipment for direct and indirect support of electro-optical and target acquisition systems, armor, smoke, high-energy laser, and artillery precision-guided munitions; (2) establish and correct deficiencies in existing capability to assess and simulate, through models, the effects of dirty battlefield environment on performance of current and future electro-optical and near millimeter wave weapon systems; (3) provide quantification of potential battlefield at wavelengths from visible to near millimeter; and (4) develop remote atmospheric sensors to increase armor and artillery fire control accuracy increasing the probability of first-round hits.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Updating of battlefield obscuration models (EOSAEL 82) to include the Mideast and Persian Gulf. These will give the Army well-documented, validated computer simulations of dirty battlefield environmental effects on the performance of electro-optical, millimeter, and microwave weapon systems for use by weapons designers, war-gamers, testers, and tactical commanders. BATTEL 83 (models addressing obscuration effects of dust/smoke under realistic terrain/vegetative conditions) will be updated and documented. Interpreted meteorological displays for intelligence training simulators, chemical analyses, and artillery support requirements will be developed. Atmospheric effects on High Energy Laser propagation will be determined for self-defense and support scenarios, and a climatology handbook will be developed for tri-Service users of the White Sands Missile Range Department of Defense National High Energy Laser Test Range. Development of a smoke munitions expenditures model will be developed to describe atmospheric limitations on near millimeter wave and infrared Surveillance Target Acquisition Radar for Tank Location and Engagement (STARTLE) concepts. Field measurements will be conducted to determine visible and infrared transmission in the SNOW-TWO and BICT III tests. An assessment on the effectiveness of obtaining target area meteorology to improve long-range artillery effectiveness will be made. Techniques for extending meteorology above 20 kilometers will be determined. Procedures will be verified to incrementally send and merge meteorological messages and to detect rapid meteorological changes.

Program Element: # 6.21.11.A Title: Atmospheric Investigations
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	6208	5534	5045	Continuing	Not Appl cable
Funds (as shown in FY 1982 submission)	5671	6747	6900	Continuing	Not Applicable

The FY 1981 total dollars for the Millimeter Wave Propagation Program element include an additional funding of $81 thousand for CRREL support; also, the total for the Atmospheric Assessment for Army Program task element includes an additional funding of $450 thousand for LEMON TREE support. FY 1982 and FY 1983 funding was decreased to accommodate higher priority Army programs.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.21.11.A Title: Atmospheric Investigations
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Develop techniques and equipment for meteorological support of Army battlefield operations and for the design, development, operation, and employment of: weapon systems that use electro-optical, millimeter, and microwave sensors, high-energy lasers, artillery, smoke, armor, target acquisition systems, and Precision Guided Munitions. Quantify battlefield obscuration conditions and effects for electro-optical systems under realistic battlefield atmospheric conditions for weapons designers and war gaming. Quantify propagation environment for millimeter and microwave propagation and the effects of realistic battlefield environments on millimeter/microwave systems to improve acquisition, tracking, and destruction of targets under low-visibility battlefield conditions. Develop and evaluate new techniques to analyze/interpret/and predict critical atmospheric conditions and develop new measurement techniques applicable to field testing high-energy laser weapon systems at the Department of Defense High Energy Laser Systems Test Facility. Improve long-range artillery effectiveness by improving quality and extending the range of atmospheric measurements, and by integrating modern equipment and techniques into user applications. Develop remote atmospheric sensors to increase armor and artillery fire control accuracy. Provide software for the weather intelligence function of the Army's All-Source Analysis System to include hydrology/mobility/and operations as influenced by tactical scale weather conditions. Develop high-frequency direction-finding technique to improve location accuracy of high-frequency sources based on increased understanding of atmospheric (ionospheric) effects leading to lessening of basic atmospheric constraints.

G. (U) RELATED ACTIVITIES: Program Elements 6.11.01.A, Atmospheric Sciences; 6.27.30.A, Cold Regions Engineering Technology; 6.37.41.A, Meteorological Equipment; and 6.57.02.A, Support of Development Testing. Work is coordinated within the Department of Defense by the Under Secretary of Defense for Research and Engineering (USDRE). Direct coordination is maintained with Project Manager, Smoke/Obscurants; Project Manager, Control and Analysis Centers (CAC); Army Materiel Systems Analysis Agency/US Army Training and Doctrine Command; Harry Diamond Laboratories; High Energy Laser Systems Project Office/Missile Command; Test and Evaluation Command, White Sands Missile Range (WSMR); Dugway Proving Ground; Air Force; Navy; National Oceanographic and Atmospheric Agency; Environmental Protection Agency; Panel IV of the NATO Research Study Group 15 (Action Committee 243); Panel XII (Meteorology) of the NATO Army Armaments Group and the US Army European Mesometeorology Advisory Panel to exchange information and preclude duplication of effort.

H. (U) WORK PERFORMED BY: The Atmospheric Sciences Laboratory, White Sands Missile Range, NM, is the in-house developing organization responsible for the program. Of the $4.542 million program in FY 1982, approximately 77% is in-house and 23% is contractual. Contracts totaling $986 thousand exist with the following: Physical Science Laboratory, New Mexico State University, Las Cruces, NM; Optimetrics, Ann Arbor, MI; Science Applications, Inc., Ann Arbor, MI; Oregon Graduate Center, Beaverton, OR; National Research Council, Washington, DC; OAO Corp., Ft. Worth, TX; University of Dayton, Dayton, OH; and Lockheed, Houston, TX.

Program Element: # 6.21.11.A Title: Atmospheric Investigations
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Documented and distrubuted Electro-Optical Systems Atmospheric Effects Library (EOSAEL) 80 providing user-oriented models for quantifying obscuration effects of the dirty battlefield. Characterized atmospheric effects on High Energy Laser (HEL) at White Sands Missile Range Department of Defense National High Energy Laser Test Range and evaluated new sensors. Conducted a slant path visibility field experiment at Meppen, Federal Republic of Germany, to determine effects of fog on slant path transmission for precision guided munitions. Successfully characterized atmospheric conditions during Battlefield-Induced Contamination Field Tests for electro-optical and near-millimeter waves. Completed and successfully tested crosswind integrated concentration (KWIK), a realtime smoke munitions expenditure model; developed smoke coverage displays. Exploratory hardware development completed for the tank crosswind sensor. Provided improved meteorology for artillery to increase long-range artillery effectiveness. Developed analysis and display techniques for realtime prediction of toxic corridors associated with chemical spills. This technique was used by White Sands Missile Range in support of the National Aeronautics and Space Administration. Documented and distributed automated digital analyses of smoke and dust clouds in support of Project Manager, SMOKE, Atmospheric Sciences Laboratory experiments; expanded technique to quasi-three-dimensional time sequences of time, size, and location of clouds. Prepared and distributed interpreted climatological information to over 25 Army requestors. FY81: In-house, $4.147 million; contractual, $2.061 million.

2. (U) FY 1982 Program: Validate KWIK (Phase II), a smoke munition expenditure model for visible, infrared wavelengths and smoke-producing munitions. Develop technique to measure near field optical turbulence; complete investigation of variability of optical turbulence associated with natural thermal plumes applicable to field tests of high energy laser weapons systems at White Sands Missile Range Department of Defense National High Energy Laser Test Range. Modify radar performance model to permit evaluation of 10.6 micrometer infrared system. Complete tank crosswind sensor qualification tests (ability to correct main gun firing errors); a demonstration test will be conducted to determine the effects of atmospheric refraction on the pointing errors for M1 main gun. Evaluate 1.06 micrometer ceiling and visibility sensor. Complete, document, and distribute EOSAEL 82 updating adverse weather effects, battlefield dust models including additional battlefield effects (optical turbulence, fire products, cold weather effects). Determine best procedures for merging and incremental sending of meteorological messages and analysis procedures to identify rapidly changing meteorological conditions for artillery applications. Develop dynamic weather scenarios and tailored statistical climate products for Army users. Provide atmospheric characterization during field tests to determine realistic battlefield atmospheric effects on Army near-millimeter wave and infrared systems. Determine quantitatively the atmospheric limits to performance for the next

Program Element: # 6.21.11.A Title: Atmospheric Investigations
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

generation of surveillance and target acquisition sensors. Provide multispectral digital analyses of smoke and dust clouds in support of Army experiments, Smoke Week III and Battlefield-Induced Contamination Tests. Promising cost effective sensors for the remote weather station will be developed and feasibility demonstrated. Meteorological techniques will be developed to improve artillery effectiveness, and meteorological data will be accumulated for high-trajectory artillery. New techniques will be developed for new smoke delivery in tactical environments. Field measurements will be make on aerosol density and absorption. Field measurements will also be made to validate a vertical structure model. Work on an improved antenna which will significantly improve the low-angle tracking accuracy for the AM/TMQ-31 radar will continue. FY 1982: In-house, $3.920 million; contractual, $1.708 million.

3. (U) FY 1983 Planned Program: Initiate development of a smoke munitions expenditure model for multispectral obscurants. Determine need for a smoke deployment meteorological message. Determine atmospheric effects on propagation for self-defense and support scenarios and prepare climatology handbook for tri-Service users at White Sands Missile Range Department of Defense National High Energy Laser Test Range. Develop user-oriented models to describe atmospheric limitations on near millimeter wave and infrared concepts. Update EOSAEL 82 (user-oriented models quantifying the obscuration effects of the dirty battlefield) to address Mideast/ Persian Gulf. Develop and document Battlefield Atmospheric Transmission and Terrain Effects Library (BATTEL 83) (models addressing obscuration effects of dust/smoke under realistic terrain/vegetative conditions). Verify procedures to incrementally send and merge meteorological messages; detect rapid meteorological changes. Determine techniques for extending meteorology above 20 km. Assess effectiveness of obtaining target area meteorology to improve long-range artillery effectiveness. Develop tailored climate products for several Army systems. Conduct field measurements of visible and infrared transmission. Develop interpreted meteorological displays for intelligence training simulators and chemical analysis. Complete three-dimensional (3 instrument) multispectral measurement capability and associated analysis software. FY 1983: In-house $2.874 million, Contractual $2.186 million.

4. (U) FY 1984 Planned Program: Develop and evaluate techniques for atmospheric problems encountered in HEL field tests. Determine effects of rain, snow, and explosion debris on doppler signature classifications and identification. Interface ceiling/visibility sensor with automatic meteorological station, AN/TMQ-30 radar; configure system to automatically sense battlefield contaminants in four wavelengths. Complete, document, and distribute EOSAEL 84 (user-oriented models for quantifying obscuration effect of the dirty battlefield), which extends geographical coverage to Mideast and Tropics. Distribute BATTEL 83. Complete sensors that can be added to remotely piloted vehicles to measure for artillery target area meteorology. Develop climate models for Israel/Jordan. Incorporate foreign and new smoke source characteristics in munition expenditure model; complete XM825 munition expenditure model. Develop and evaluate techniques for

Program Element: # 6.21.11.A Title: Atmospheric Investigations
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

atmospheric problems encountered in field tests of high-energy Lasers at White Sands Missile Range Department of Defense National High Energy Laser Test Range. Quantitatively assess atmospheric limitations for selected Army systems. FY 1984: In-house, $5.038 million; contractual, $2.025 million.

5. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.21.20.A Title: Nuclear Weapons Effects; Fluidics
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5783	5225	6532	11381	Continuing	Not Applicable
AH25	Nuclear Weapons Effects Research, Near Millimeter Wave Technology, Fluidics Technology	5783	5225	6532	11381	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army urgently requires battlefield equipment that is survivable in a nuclear environment. The soldier can be effective in the battle even after being exposed to severe nuclear environments. Equipment must be as survivable as the soldier if the Army is to avoid the potentially disastrous situation of having soldiers who are willing and able to fight after surviving a nuclear attack but are unable to do so because combat systems fail to withstand the hostile nuclear environments. A survivable Army force provides a strong nuclear war deterrent. Environmental definition, vulnerability assessment, development of hardening fixes, and evaluation of the nuclear survivability of operational forces are parts of the Nuclear Weapons Effects research program. The approach is to develop, maintain, and transfer to the materiel developers the technology for balanced hardening of fielded and developmental systems. Near Millimeter Wave (NMMW) radars offer a potential way to see through the smoke and obscurants of the modern battlefield. This capability is critical to the Army when fighting outnumbered against forces heavily reliant on obscurants for cover in the attack. The fluidic technology program provides a coordinated, Army-wide program for the design, development, testing, and feasibility demonstration of fluidic activated control systems for use in Army materiel. Compared to electronic systems, fluidic systems offer the potential for greatly improved reliability, availability and maintainability, and reduced life-cycle costs while providing improved end item performance. This is a Single Program Element Fund (SPEF) wherein a single Army laboratory is funded in one Program Element (PE).

Program Element: #6.21.20.A Title: Nuclear Weapons Effects; Fluidics
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Continue blast-thermal simulator design efforts and air defense system vulnerability assessments. Continue source region Electromagnetic Pulse (EMP) studies. In the Near Millimeter Wave (NMMW) program, equipment capable of operating in a limited visibility environment is to be designed, and target/background signatures, measurement techniques, radars, and collection receiver technology will be investigated for NMMW all-weather Army systems. The fluidics program will continue efforts to develop and demonstrate high-reliability control systems and environmental sensing devices.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5783	5225	6532	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5994	5840	9765	Continuing	Not Applicable

In FY 1981, the program was decreased $241 thousand because of reprograming to higher priority Army programs. The decrease of $615 thousand in FY 1982 is a result of the amended budget request and the application of revised inflation and civilian pay pricing indices. The $3233 thousand decrease in FY 1983 reflects a realignment in the nuclear survivability program pending development of an action plan to better link the technology base with development and product improvement programs.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.21.20.A Title: Nuclear Weapons Effects; Fluidics
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION:

1. (U) The Nuclear Weapons Effects (NWE) research program is an integral part of the Army Nuclear Survivability Program. The NWE research program is structured to provide adequate environmental definition for all nuclear weapon effects, to develop appropriate hardening fixes, and to provide technology for including nuclear survivability hardening during design and testing of systems in development or that are being product-improved. This is the Army's only program to provide the technology that enables development of equipment that will be survivable on the tactical nuclear battlefield.

2. (U) Near Millimeter Wave (NMMW) systems can provide better resolution of military targets than longer wavelength microwave systems. They are less affected by smoke and fog than electro-optic systems. The NMMW Technology Program will fill existing data gaps, develop NMMW measurement standards, and investigate new NMMW all-weather systems.

3. (U) Fluidics offer low-maintenance, high-reliability, intrinsically safe control systems that can operate in harsher environments than other types of controls, and are adaptive particularly to controls for missiles and remotely piloted vehicles, gas turbine fuel controls, and turret stabilization systems for armored vehicles. This program explores the applicability of fluidics to candidate systems sufficiently to demonstrate the feasibility of transferring technology to system development as cost-effective improvements.

G. (U) RELATED ACTIVITIES: Nuclear weapon effects research is part of a tri-Service effort in coordination with the Defense Nuclear Agency. It is related to Program Element (PE) 6.36.04.A, Nuclear Munitions and Radiacs, which provides for technological assistance to materiel development agencies. All appropriate Army programs for missiles, combat vehicles, communication systems, and battlefield intelligence systems are supported by these efforts. The NMMW technology program is coordinated with research activities in PE 6.11.02.A, Defense Research Sciences, and other US Army Electronics Research and Development Command programs. Fluidic technology follows up on research in PE 6.11.02.A, Research in Fluidics, Nuclear Effects, and Ordnance Electronics.

H. (U) WORK PERFORMED BY: Harry Diamond Laboratories, Adelphi, MD; Ballistic Research Laboratory, Aberdeen Proving Ground, MD; US Army Electronics Research and Development Command, Fort Monmouth, NJ; US Army Missile Command, Redstone Arsenal, AL; White Sands Missile Range, NM; Air Mobility Research and Development Laboratory; Fort Eustis, VA; US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA. Contractors include General Electric, Schenectady, NY; University of Florida, Gainsville, FL; Shock Hydrodynamics, Ventura, CA; Physics International, San Leandro, CA; GTE

Program Element: #6.21.20.A Title: Nuclear Weapons Effects; Fluidics
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

Sylvania, Needham, MA; Science Applications, La Jolla, CA; Kaman Sciences Corporation, Colorado Springs, CO; Mission Research Corporation, San Diego, CA; Kaman Avidyne, Boston, MA; Braddock, Dunn and McDonald, Albuquerque, NM; Unidynamics, Phoenix, AZ; Northrop Corporation, Hawthorne, CA; Denver Research Institute, Denver, CO; Lovelace Foundation, Albuquerque, NM; AiResearch Manufacturing Company, Phoenix, AZ; TriTec, Inc., Columbia, MD; and Applied Physics Laboratory, Laurel, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments:

a. (U) Continued the electromagnetic pulse (EMP) program to determine vulnerabilities of Army single-channel and multichannel radios, repeaters, and telephone terminals and initiated product improvements in coordination with Project Managers to make hardware survivable. Supported certification testing of high-altitude electromagnetic pulse (HAEMP) product improvement designs for the AN/VRC-12 single-channel systems and the AN/TRC-112/121 and the AN/TRC-138 multichannel systems. Developed hardness assurance/hardness maintenance (HA/HM) tester to support fielded AN/TRC-145 HAEMP fix. HAEMP current injection tests were carried out on the XM-2 tracked armored vehicle and the M-74/M-75 mines. Completed transient radiation (neutron and gamma ray) assessments of TACFIRE and Missile Minder, and selected mobile electric power (MEP) units for multichannel communication systems. Experimentally verified neutron susceptibilities of standard voltage regulators used with Army 3, 5, and 10kW generators. Scoped EMP burnout and upset problems for tactical computers and continued development of electrical method of determining transistor radiation damage for HA/HM purpose. Continued to determined nuclear radiation vulnerabilities of microprocessor/large-scale integrated devices to be used by Army systems. Continued efforts on selective shielding of armored vehicles and balanced hardening of fiber optics.

b. (U) The design and construction contract of the MMW Mobile Measurement Facility (MMF) with the Georgia Institute of Technology was completed. The mobile measurement facility was used to characterize target and background signatures in realistic battlefield environments and adverse weather conditions at 94, 140, and 220 GHz. Measurement procedures were formulated, and a detailed schedule for diverse sites was developed. The system parameters and configuration of a lightweight handheld radar were defined. Multipath measurements at 94 GHz were made over water, gravel, and grassy terrains.

c. (U) Fluidic stabilization on helicopters and tank turrets, fluidic control of shock absorbers in automotive suspensions, and fluidic gas turbine fuel controls have been successfully demonstrated. In FY 1980, fluidic rate

Program Element: #6.21.20.A Title: Nuclear Weapons Effects; Fluidics
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

sensor/amplifier (rate gyro) circuits demonstrated superior accuracies. These circuits are being developed for heading reference units for navigation systems and as rate gyros for missile and remotely piloted vehicle controls. Temperature-sensor hardware was successfully installed at an Army ammunition plant for long-term evaluation.

2. (U) FY 1982-FY 1984 Planned Program:

a. (U) High-altitude electromagnetic pulse (HAEMP) and balanced vulnerability analyses will be performed on the Improved Hawk and Patriot air defense systems. Efforts to quantify the incidence and efforts of tree blowdown and fires in forests will be completed. Vulnerability and hardness assessments will be initiated for automatic data processing systems and will be continued for emerging semiconductor technologies. Source region EMP simulator and combined blast-thermal simulator design analyses will continue. Balanced hardening fixes will be developed for multichannel communications systems and for mobile electric power units. A program to develop hardening techniques for the Ballistic Missile Defense System will be initiated. Programs will continue to develop techniques for hardness assurance during manufacture and hardness maintenance of systems in the field.

b. (U) The near-millimeter wave mobile measurement facility, which began operation at 94, 140, and 220 gigahertz (GHz) in FY 1981, will make transmission and target and clutter/background measurements in adverse environments. In Vermont, Western Europe, and other locations, a model of a very lightweight handheld 94 gigahertz (GHz) ground surveillance radar will be made. A prototype near-millimeter wave collection receiver will be assigned; multipath measurements will be continued at 94 GHz. MMW antenna technology will be investigated.

c. (U) Development of fluidic rate gyros for heading reference units and remotely piloted vehicles will be completed. Work on a no-moving-parts servovalve and an optical to fluidic interface will continue. Development of dynamic laminar proportional amplifiers will begin. Technology coordination will continue.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.01.A
DOD Mission Area: #523 - Engineering Technology (ED)
Title: Aircraft Weapons Technology
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1666	2094	2492	3303	Continuing	Not Applicable
DH96	Aircraft Weapons Technology	1666	2094	2492	3303	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops and evaluates concepts and demonstrates the technical feasibility of advanced aircraft armament techniques and weapons for delivering ordnance to destroy, neutralize, or suppress enemy targets in the conduct of the land combat campaign. The objective is to provide the greatest possible weapons effectiveness at affordable costs in order to multiply the value of a single system through technology and compatibility with other systems.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Investigation of new concepts to improve the mission effectiveness of armed Army aircraft, initiated in FY 1982, will be continued and hardware developed. Areas to be addressed include target-sensing munitions to enable helicopter weapon subsystem to defeat point targets at extended ranges; self-defense air-to-air fire control to expand present helicopter air-to-ground capability to include defense from airborne threats; passive range-finding to improve effectiveness of automatic target cueing; magneto-electric turret controllers which provide the potential for a lighter weight and more accurate weapon turret system; interferometer technology to enable rapid and accurate acquisition of radar-directed defense systems.

Program Element: #6.22.01.A Title: Aircraft Weapons Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1666	2094	2492	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1666	2290	2955	Continuing	Not Applicable

The funding decreases in FY 1982 and in FY 1983 are the result of the amended budget request and the application of revised inflation and civilian pay pricing indices.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.22.01.A Title: Aircraft Weapons Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #2 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Development efforts are directed toward strengthening the technology base of aircraft weaponry to provide the Army with lighter weight, more effective and reliable aircraft weapons and munitions with improved lethality. Effort is directed towards generating concepts and advancing technology necessary for improved performance and extended life. There are four areas of research and development: weapons system concepts, fire control, aerial munitions, and aerial rockets.

G. (U) RELATED ACTIVITIES: Close liaison is maintained with the other military services and industry to avoid duplication of effort. The Army participates in the Tri-Service Joint Technical Coordinating Group for Air Launched Non-Nuclear Ordnance, an organization chartered at the major field command level. This group provides a medium for exchange of technical information and determination of joint use implications and to minimize duplication of effort. An Army representative serves on the Air Munitions Requirements and Development Committee, an organization within the Office of the Secretary of Defense. One of the functions of this committee is the establishment of joint service requirements and development of air munitions. Related Advanced Development work is conducted under Program Element 6.32.06.A, Aircraft Weapons, and Engineering Development is under Program Element 6.42.02.A, Aircraft Weapons.

H. (U) WORK PERFORMED BY: Aviation Research and Development Command (AVRADCOM), St. Louis, MO; Armament Research and Development Command (ARRADCOM), Dover, NJ; US Army Missile Command (MICOM), Huntsville, AL; US Army Materiel Systems Analysis Activity (AMSAA), Aberdeen, MD. Contractors: General Electric, Binghampton, NY; Westinghouse, Baltimore, MD; Ford Aerospace, Inc., Detroit, MI; Boeing Aerospace, Seattle, WA; Texas A&M University, College Station, TX; Martin Mariettta, Orlando, FL.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: High Impulse Gun Airborne Demonstration (HIGAD) project was completed. This project showed the feasibility of mounting a high-impulse weapon system on an Army helicopter. Included in this effort was the integration of new technology fire control features such as constant recoil, closed-loop fire control, improved stabilization, and precision aiming. Processing schemes have been formulated for millimeter wave radar to allow acquisition and tracking of fixed ground targets in a clutter environment. This evaluation established the ground rules regarding radar use on rotary-wing aircraft for both air-to-air and air-to-ground application. Optical sight model validation was performed which established a basis for comparison of advanced target acquisition methods with known optical capabilites. Analysis of helicopter air-to-air ballistic dynamics was completed. A firing test using the Multiweapon Fire Control System (MWFCS)

Program Element: 6.22.01.A Title: Aircraft Weapons Technology
DOD Mission Area: 6525 - Engineering Technology (ED) Budget Activity: 61 - Technology Base

with a dual-rate-of-fire turreted 20mm weapon was completed at Fort Bliss. Four contenders for a second-generation area weapon were evaluated and the Xm230, 30mm chain gun was selected. Studies were conducted to determine aerial weapon system reaction forces and blast effects on helicopters. Simulation models were developed to evaluate gun-type weapons with respect to weight, rate of fire, cost accuracy, and reliability. Additionally, concepts for a helicopter-launched antiradiation missile were evaluated. Fire control parameter analyses related to extending the range capabilities of ballistic and rocket weapons, remote control (drone) delivery systems, and night/all-weather systems were conducted. Firing tests with turreted and wing-mounted guns on the AH-1G attack helicopter were conducted to identify the different variables contributing to total firing error and magnitude of each error source. The spin insensitivity and penetration potential of a shallow cone-shaped charge warhead were also demonstrated. Firing tests of 2.75-inch rockets with submunition warheads were conducted to investigate the sensitivity of submunitions deployment variations in rocket trajectory. Design efforts for mass focus fragmentation and secondary trajectory stabilization for a submunition and a fuze wave shaper for small caliber ammunition were initiated. Automatic target-cueing methodology was evaluated for television and FLIR (Forward Looking Infrared) sensors. A prototype autotarget-cueing system to provide a target detection capability for use with remote view imaging sensors was fabricated and flight testing planned. This effort establishes the basis for the fabrication of a fully operational airborne autotarget-cueing system. Initial work on smooth-bore concepts for the high-impulse gun, capable of defeating enemy armor, was initiated. A precision point fire weapon concept using armed Remotely Piloted Vehicles in providing long-range standoff capability against enemy armor and hostile aircraft was pursued. A feasibility demonstration of low-cost radio frequency (RF) target marking system to allow integrated use of cannon and rockets on selected targets was initiated.

2. (U) FY 1982-FY 1984 Planned Program: Efforts initiated in FY 1981 will be continued. These include: - Analysis of weapon system precision performance concepts with respect to fire control functions and more accurate lightweight gun requirements. This effort will be expanded by conducting feasibility examinations to determine the possible use of magneto-electric (M-E) technology for precision dynamic control of turreted weapons and by actually testing breadboard magneto-electric turret system. - Analysis of air-to-air targeting concepts including algorithms for engagement strategies, ballistic motion, target lock-on functions, and target state predictor techniques with a view toward multiple weapon application. - Analysis of results from an analytical evaluation of helicopter weapons technology with a view toward defining the most cost effective weapons suits for the LHX aircraft and current helicopters leading to formulation of future weapon programs. - Continuation of efforts to obtain acoustic target signature data in order to develop the processing techniques and algorithms needed for target detection and classification. New tasks to be initiated during this program period include: - Evaluation of low-cost smart projectile concepts and breadboarding most promising concepts with a view

Program Element: #6.22.01.A Title: Aircraft Weapons Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

toward rotary wing application. - Evaluation of an air-to-air low-altitude proximity fuze for possible use on an air-to-air missile. - Initiate breadboarding of a variable stiffness pylon to define concepts that will reduce motion and vibrations transmitted to pylon external stores. - Investigation of on-line fire control solution for employing realtime, on-board solution of ballistic diffential equations for turreted guns to eliminate the errors inherent in the present method of ballistic curve fitting.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.02.A
Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5475	5967	8389	9404	Continuing	Not Applicable
AH85	Aircraft Avionics Technology	5475	5967	8389	9404	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Army aircraft must have the capability and flexibility necessary to perform a variety of missions in day, night, and adverse weather. In addition, the increasing lethality and number of Warsaw Pact and Soviet client states' antihelicopter systems require enhanced survivability measures for new Army aircraft and for retrofit to existing aircraft. This program provides the exploratory development technology base for intended Army avionics systems and related equipment for air-to-air and air-to-ground communications, environmental sensing, improvement of the helicopter man-machine interface, digital avionics, nap-of-the-earth navigation, air traffic management, tactical instrument approaches, and command and control. Implementation of these integrated avionics systems will improve navigation, command and control, and reduce pilot workload. This permits greater concentration on mission tasks, threat detection, and evasive maneuvers. The key to providing this improved mission capability, survivability, and flexibility is implementation of a standard multiplexed data bus interface (defined now as MIL-STD-1553) and design of a modular, integrated, digital avionics system. These improvements will allow use of integrated controls and displays, plus automation of routine functions to allow aircrews to concentrate on the tactical mission. Finally, lower cost and weight should result from these developments and provide benefits in improved aircraft performance, increased reliability, and lowered life cycle costs.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The FY 1983 program will concentrate on exploratory development for: voice recognition and response equipment, standard communication modules, multicolor Thin-Film Electroluminescent (TFEL) displays, improved navigation sensors, multifunction NOE sensors, air traffic management equipment, command and control, and digital avionics. Emphasis will be placed on reducing pilot workload, integrating cockpit systems, readying new subsystems for aircraft block improvements, and defining system architectures for future Army aircraft.

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in Thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5475	5967	8389	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5598	6507	8155	Continuing	Not Applicable

Changes in FY 1981 and FY 1982 were adjustments made due to updated estimates of program cost. In FY 1983 the $235K increase is only a 3.0% change in the total and can be attributed to somewhat higher costs of material than previously estimated.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program explores new concepts and techniques in aviation electronics. The objective of the program element is to determine the feasibility of applying new aviation electronics technology to Army aircraft and related ground equipment. Particular emphasis is placed on helicopter operations and crew workload at night, in adverse weather, and at low-level/nap-of-the-earth (NOE) altitudes. Technology transfer of work previously accomplished in this project had large impact on Army Helicopter Improvement Program (AHIP) system design, allowed response to 9WW requirements, led to our new TEMPEST-qualified intercoms and headsets, and insured efficient integration of doppler navigation systems into helicopters.

G. (U) RELATED ACTIVITIES: Interservice programs exist in the areas of Communications, Controls and Displays, and Air Traffic/Airspace Management. Other related programs are monitored to avoid duplication of development efforts with the other services. Resources are concentrated on problems which are Army unique and not addressed by other development activities. This program element leads to developments in Program Elements 6.32.07.A, Aircraft Avionics Equipment, and 6.42.01.A, Aircraft Avionics. In addition, AVRADA acts in a consulting role in applying technology to ground systems with similar problems; i.e., heading reference, navigation, etc. As there is a growing interest in this area, consideration is being given to establishing a separate Program Element.

H. (U) WORK PERFORMED BY: US Army Avionics Research and Development Activity, Fort Monmouth, NJ. Contractors include: American Electronic Laboratory, Wall, NJ; Raycomm, Freehold, NJ; Airborne Instrument Laboratory, Farmingdale, NJ; Sperry Rand, New York, NY and Phoenix, AZ; Singer/Kearfott, NJ; Litton Guidance/Control, Hawthorne, CA; Lear Siegler, Grand Rapids, MI; United Technology Research Center, East Hartford, CT; Analytical Sciences Corp., Reading, MA; General Electric, Binghamton, NY; Hazeltine, Greenlawn, NY; MITRE Corp., Washington, DC; Harris Corp., Melbourne, FL; Independent Scale Model Corp., Warminster, PA; ITT, Fort Wayne, Ind.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Digital Avionics - In FY79 the US Army initiated an exploratory development program with the goal of applying digital system architecture to an entire aircraft system. This system of the future is called ADAS (Army Digital Avionic System). Sperry Flight Systems was competitively selected to develop the hardware for ADAS. The exploratory program for digital avionics has four phases. During the now-completed first phase, Sperry completely defined and characterized the ADAS (with assistance from Bell Helicopter). During this first phase, a system architecture was developed for the UH-60A STAR (System Testbed for Avionics Research) based upon the output of the

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Sciences (ED) Budget Activity: #1 - Technology Base

Bell human factors engineering effort and a detailed analysis of the electronic sensors and subsystems on board the aircraft. Multiplex data bus controller hardware was designed, fabricated, and delivered along with appropriate software support in order to obtain an early start on the development of operational bus controller software for a bench verification phase and the aircraft demonstration phase. The display subsystem which was fabricated in FY81 will provide fully integrated control and display capabilities for both pilots of the UH-60A STAR. The Night Navigation/Pilotage System (NNPS) effort was continued, and the results of a contract completed in FY81 (Phase II) indicate that terrain-correlation-aiding of doppler radar navigation will produce mean location errors of 50 meters in NOE flight. A contract for development of the digital map generator portion of the NNPS was initiated with the Harris Corporation, and delivery of hardware is planned for 1982. Installation and operational tests of a cockpit simulator using conventional instruments driven off a data bus were completed. An Avionics System Engineering investigation for the Advanced Scout Helicopter was completed in FY80, and a system architectural study of the future flight helicopter was completed in FY81. Aviation Communications - In FY81 the communications program was restructured to address three major thrusts: Digital Multiplex Audio System (DMAS), Distributed Airborne Communications System (DACS), and Voice Interactive System Technology Avionics (VISTA). Coordination was initiated with the Navy and Air Force for possible tri-Service application with the Army DACS and DMAS programs. As a result of information gathered it was decided to participate with the Air Force in development of their Integrated Communications Navigation Identification Avionics (ICNIA) program to accomplish the DACS function. The DMAS program will be a tri-Service effort in 6.3A or 6.4 starting in FY83. A contract was awarded to procure 6.2 DMAS hardware for evaluation in the audio/acoustic facility. A specification was published defining improved test procedures for Headset/Microphones. Noise canceling microphones using Polyvinyldene Fluoride (PVF2) technology were evaluated with the aim of decreasing the noise level entering the pilot's ear. Fabrication of five exploratory development models of a zero dbi antenna was completed. Environment Sensing - The primary thrust in this area is centered on providing a multifunction CO2 nap-of-the-earth sensor to simultaneously perform wire detection terrain sensing and three-axes doppler velocity sensing. This program consists of a two-phase effort, with Phase I begun in FY79. During 1980, the Multifunction (MF) CO2 Sensor Phase I design was initiated, and a contract was awarded for Phase II hardware to explore tactical target discrimination and other nap-of-the-earth tasks. In FY81 a pod design was finalized for the Phase I flyable MF CO2 heterodyne sensor. Ground tests were also completed demonstrating vibration signatures of stationary and moving targets and heterodyne three-dimensional imaging of stationary tactical targets. Controls and Displays - There are two areas in this task: The Electronic Master Monitor Advisory Display System (EMMADS) and Thin-Film Electroluminescent Display. During FY81 EMMADS hardware was delivered and accepted. Initial in-house testing was begun with the evaluation to be completed under the advanced development effort. Program was transitioned to 6.3.A. The feasibility of using color in Thin-Film Electroluminescent Displays will be an FY82 start. Improved Navigation - Three separate areas are continued in this effort; these are Navigation Systems, Navigation Sensors,

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Sciences (ED) Budget Activity: #1 - Technology Base

and Navigation Hybrid/Position update. Prior year accomplishments include Special Electronic Mission Aircraft Navigation Analysis, Heading Reference Self-Calibration/Improved Dynamic Accuracy, Dead Reckoning Position Update Analysis, and two NAVSTAR/Doppler Patent Applications. In FY81 a general overview of the extended range navigation scenario was conducted, and a matrix of potential candidate systems was structured. Efforts pertaining to hybrid navigation include the completion of software coding and bench and van tests of the NAVSTAR/Doppler configuration. Two flight tests were also conducted using actual satellites; however, the flight test program was halted after these two flights due to loss of satellite window during the day. Four Advanced Heading Reference System (AHRS) devices were installed in aircraft and flight tested. Analysis of this data will form the baseline for development of performance characteristics for a form, fit, function (F3) AHRS specification. Air Traffic/Airspace Management - Incorporated advanced features into the experimental Very Lightweight Air Traffic Management Equipment and conducted quantitative system accuracy flight tests using the Federal Aviation Agency (FAA) Technical Center's measurement range. Applied in-house technical expertise by participation in USMC flight tests of scanning beam landing system and in FAA's Helicopter Flight Research Program. Prepared in-house simulator for investigation of the unique problem involving very close spacings of helicopters performing decelerated instrument landings. A joint FAA/AVRADA (Avionics Research and Development Activity) Helicopter Instrument Meteorological Conditions (IMC) flight research program was started in FY81 using a UH-1H helicopter equipped with a dual-panel, 4-cue, Decelerated Steep Approach and Landing (DSAL) Flight Director Landing System and Army instrumentation. Command and Control - Established a program approach to assessing aviation C2 development needs. The FY81 portion of the ongoing MITRE contract included the development of methodology for analyzing C2 impacts on Army aviation, definition of an antiarmor mission baseline, and initiation of an analysis of C2 contributions on the antiarmor mission.

2. (U) FY 1982-FY 1984 Programs: Digital Avionics - During FY82 Phase II hardware fabrication will be completed. In Phase III, the hardware and Army in-house-developed software will be evaluated on a digital hot bench to insure that all functions required can be performed. The flexible ADAS architecture will allow changes necessary to be incorporated by software modification. Following the hot bench evaluation (approximately one year) installation of ADAS into the UH-60A System Testbed for Avionics Research (STAR) will begin (see DB97). Development of the Night Navigation Pilotage System (NNPS) will continue with emphasis on improved navigation algorithms, to include a contractual effort to improve convergence of the correlation algorithm. The Digital Map Generator (DMG) will be incorporated into the Phase III system integration configuration for simulation evaluation. A contract will be initiated for an Integrated Mission Planning Station (IMPS) to support NNAPS. Documentation of LHX (Light Helicopter Experimental) study will be completed. Software development and functional verification of ADAS will be completed in FY83. The Phase IV ADAS effort will be accomplished under project DB97 (6.3) and consists of the integration and test of ADAS in the UH-60A Systems Testbed for Avionics Research (STAR). This

Program Element: 6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: 521 - Electronic & Physical Sciences (ED) Budget Activity: 1 - Technology Base

vehicle will serve as a valuable system integration tool and will provide Army pilots an opportunity to fly an integrated digital aircraft and provide valuable feedback. Through its bus-oriented architecture, ADAS possesses a flexibility which promises major benefits to Army operational aircraft avionics systems. The contract for an Integrated Mission Planning Station (IMPS) will be completed, and the hardware will undergo simulation evaluation of mission planning activities. A contract will be initiated to develop Phase IV NNAPS sets of airborne-qualified hardware based on specification resulting from Phase III NNAPS simulation efforts. An assessment will be made of Military Computer Family (MCF) hardware and software applicability to airborne electronic systems. Maintain software for FY84 flight testing of ADAS in UH-60 STAR aircraft and the digital Integration and Simulation Facility. Initiate effort to expand ADAS software to incorporate voice interactive technology. Accept delivery of first model of Phase IV NNAPS and initiate flight test of NNAPS in STAR aircraft supported by IMPS. Initiate contractual effort to build hardware implementation of topographic datacompression algorithms. Continue Military Computer Family (MCF) assessment and initiate architectural studies of aircraft identified by the Directorate for Advanced Systems. Aviation Communications - Exploratory development contract for DMAS will be completed, and the hardware will be integrated and tested in AVRADA's acoustic facility. VISTA hardware will be integrated and tested in the hot bench. Air Force ICNIA contracts for system definition will be augmented to accommodate Army-peculiar requirements. The zero dbi antenna will undergo laboratory and flight tasks. Develop tailored speech-understanding algorithms for Army aircraft environments for use with VISTA hardware and continue VISTA testing in the hot bench. Continue system definition development of Army-peculiar requirements in conjunction with Air Force ICNIA program and procure early ICNIA hardware if/as appropriate. Award contract flyable VISTA hardware containing tailored algorithms. Continue exploratory development of DASC program in conjunction with the Air Force. Environment Sensing - Complete fabrication of Phase I flyable hardware models of the Multifunction (MF) CO2 NOE sensor and initiate flight test in STAR aircraft. Complete initial data reduction efforts to assess tactical signature performance and optimize Phase II hardware design of MF CO2 NOE Sensor. Finalize design of Phase II flyable hardware with short-pulse programable transmitter and initiate study to assess techniques for providing weapons guidance information. Multifunction CO2 NOE Sensor will begin Phase II program consisting of flight tests in STAR aircraft and data analyses. Prepare design concept and preliminary subsystem design of a Hybrid Multispectral Sensor which will combine CO2 laser radar and millimeter wave radar technology into an optimum hybrid configuration. Also prepare a design concept, subsystem integration analysis, and preliminary subsystem design of an Advanced Pilotage Sensor System (APSS). This system will optically integrate a coherent CO2 laser radar capability into a Pilot Night Vision Sensor (PNVS) and provide an eye-safe rangefinding capability. Complete fabrication of subsystem/components of the Hybrid Multifunction/Multispectral Sensor and verify hybrid capability (signal processing for multispectral data). Complete subsystem fabrication and test of the Advanced Pilotage Sensor System (APSS) and perform initial system integration. Controls and Displays - Initiate contract for a feasibility investigation of multicolor Thin-Film Electroluminescent (TFEL) displays. Participate in

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Sciences (ED) Budget Activity: #1 - Technology Base

tri-Service program for multicolor display development. Continue feasibility investigation of multicolor TFEL displays and develop single-color samples for single-color displays. Start development of multicolor samples for multicolor display. Navigation - Develop standard set of Position/Navigation (POS/NAV) computer algorithms critical to Army tactical operations. Develop computer simulation model of high-performance attitude and heading reference systems and analyze means to provide rapid-reaction capability through in-air alignment. Investigate specific Army airborne antenna issues in reception of satellite signals from external references such as Global Positioning System (GPS), Position Location and Reporting System (PLRS), or other Line of Sight (LOS) data. Prepare Program Work Directive (PWD) for multisource solicitations for brassboard hardware to demonstrate technical feasibility of a conformal antenna. Award FY83 contract for the design, fabrication, and test of a conformal doppler antenna. Brassboards will be built and tested in a development/production Doppler System on the bench and in a UH-1 helicopter. Initiate contract for a strapdown Attitude Heading Reference System (AHRS) using Ring Laser Gyros (RLG) as the basic sensor for use on Army rotary- and fixed-wing aircraft. Conduct analysis and simulation of alternative navigation configurations employing doppler, high-performance AHRS and GPS. Initiate computer simulation modeling of ground vehicle dynamics for use in POS/NAV analysis. Integrate a development prototype of the conformal Antenna into the STAR avionics suite in FY84. Flight test the RLG AHRS and complete data analysis. Complete final specification and ROC for the RLG AHRS. Conduct analysis and simulation of advanced POS/NAV configuration and land, air, and waterborne vehicles. Command and Control - Continue MITRE contract to define C2 baseline for other aviation missions and analyze effects of existing and emerging technologies on established baselines. Identify aviation initiatives as part of Army C2 Master Plan. Initiate contract to perform Army aircraft mission analysis in order to identify information transfer requirements. Air Traffic/Airspace Management Control - Conduct joint FAA/AVRADA flight tests on FAA helicopter IMC flight research programs. Conduct AVRADA flight tests of precision C-Band Distance Measuring Equipment (DME) and Doppler Navigation Systems to assess adequacy for Decelerated Steep Approach and Landing (DSAL). Integrate DSAL into ADAS. Continue flight test programs started in FY82. Define DSAL hardware requirement follow-on criteria for DSAL investigative efforts. Perform tests to determine minimum bus requirements for DSAL. Conduct simulations of helicopter terminal area traffic patterns to solve problem of maintaining precise closing spacings between helicopters preparing for steep, decelerating instrument approaches into confined landing sites at the high landing rates which are a tactical necessity. Develop and fabricate a system testbed to explore the feasibility of applying emerging ICNI developments to new aviation ATC/C2 systems. Initiate development of PLRS and PJH interface equipment and plan for ATC/PLRS/PJH feasibility test. Continue DSAL criteria technology base efforts in response to new DSAL technology developments. Continue updated simulations of multiple helicopter approach capabilities based on prior year's results. Complete initial system testbed tests. Integrate PLRS/PJH interface equipment and conduct preliminary tests. Plan for FY85 field feasibility tests of ATC/C2 testbed with full-up PLRS system. Obtain hardware for ATC data link tests.

Program Element: #6.22.02.A Title: Aircraft Avionics Technology
DOD Mission Area: #521 - Electronic & Physical Sciences (ED) Budget Activity: #1 - Technology Base

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.22.09.A
Title: Aeronautical Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	18208	18044	24349	27642	Continuing	Not Applicable
AH76-A	Aerodynamics	1857	1865	2401	2701	Continuing	Not Applicable
AH76-B	Structures	2362	2262	3244	3559	Continuing	Not Applicable
AH76-C	Propulsion	3145	3011	4120	4700	Continuing	Not Applicable
AH76-D	Reliability & Maintainability	1857	1864	2477	2860	Continuing	Not Applicable
AH76-E	Safety & Survivability	2640	2519	3362	3895	Continuing	Not Applicable
AH76-F	Mission Support	1074	1107	1466	1655	Continuing	Not Applicable
AH76-G	Aircraft Systems Synthesis	1270	1297	1719	1941	Continuing	Not Applicable
AH76-H	Aircraft Subsystems	879	920	1213	1370	Continuing	Not Applicable
AH76-J	Helicopter Analysis	1270	1197	1718	1943	Continuing	Not Applicable
AH76-K	R&D Flight Simulation	683	730	961	1084	Continuing	Not Applicable
AH76-M	Man-Machine Integration	488	542	708	850	Continuing	Not Applicable
AH76-N	Advanced Systems Concepts	683	730	960	1084	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The work performed under this program element is essential to permit Army aviation to maintain a technology advantage and to sustain the operational effectiveness and mission capability of future Army aviation systems integral to the conduct of land battle. The objective of this program is to conduct exploratory development and expand scientific knowledge in the field of aeronautical technology and to exploit this knowledge within the various technical areas/disciplines indicated. The results of these efforts will increase operational effectiveness, enhance battlefield sustainability, reduce life cycle costs, decrease dependence on mechanical components, and improve helicopter dynamic analysis, system integration and flight simulation capabilities, using both in-house and contract research efforts. Technical areas are as indicated above. These technologies are continuously being developed for

Program Element: #6.22.09.A Title: Aeronautical Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

application to all current as well as future Army Aircraft Systems, including the Advanced Helicopter Improvement Program (AHIP), The UH-60A Blackhawk Helicopter, the AH-64 Apache, the CH-47 Medium-Lift Helicopter, and product improvement programs of other aviation systems (UH-1, OH-58, AH-1).

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The FY 1983 program provides for the continuing development of the aeronautical technology base with particular emphasis directed toward filling technological voids and deficiencies identified by the Aviation Mission Area Analysis (AMAA) and the Science and Technology Objectives Guide (STOG). Deficiencies being focused upon include: desert operations; ability to withstand the nuclear/biological/chemical/laser threat and operate effectively; weapon systems effectiveness during night/adverse weather and obscurants; battlefield sustainability; strategic deployability; and inadequate helicopter availability due to an aging fleet. These deficiencies necessitate an increased investment in aeronautical technology. Areas of effort will include reliability and maintainability improvements, development of diagnostic condition-monitoring capabilities; reduction of visual, acoustic, radar, and infrared signatures; development of nuclear, biological, chemical and laser protection concepts; improved ballistic tolerance and crashworthiness; development of day/night terrain flying capability for tactical and cargo transport missions; development of adverse weather mission capability; development of helicopter ground movement system; development of R&D simulators with analytical analysis capability; and reduced pilot workload through research in man-machine integration. Aerodynamics, structures, and propulsion technology efforts will be conducted in the areas of rotor flow fields, dynamic stall, helicopter drag, rotor/fuselage interaction, influence of ground effects on helicopter dynamics, dynamics of advanced rotors, vibration reduction stability control, handling qualities, design criteria, advanced structural materials (composites) for rotors and airframes, and small gas turbine engine components.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	18208	18044	24349	Continuing	Not Applicable

Program Element: #6.22.09.A
Title: Aeronautical Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

	FY 1981	FY 1982	FY '983	Additional To Completion	Total Estimated Cost
Funds (as shown in FY 1982 submission)	19572	18886	25585	Continuing	Not Applicable

The decrease in funding, $1364 thousand in FY 1981, reflects transfer of funds to higher priority Army programs. The decrease in funding, $842 thousand in FY 1982, is attributable to the application of revised inflation and civilian pay pricing indices. The decrease of $1236 thousand in FY 1983 is a result of program restructuring to fund higher priority Army programs.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.22.09.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Aeronautical Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The purpose of this program is to ensure a vital and sound technical base for advanced and engineering development programs leading to Army Aviation Systems improvements in the operational effectiveness and mission capability; e.g., higher tactical mobility, increased strategic mobility, improved firepower, and increased combat sustainability. This is absolutely necessary so that a helicopter technology edge can be achieved and continually maintained for the United States. Areas of investigation within the technology disciplines previously indicated consist of the following: fluid mechanics, dynamics, flight control, acoustics, design criteria, weight prediction, material engineering, internal/external loads, fatigue and fracture mechanics, structural concepts, small air flow gas turbines including thermodynamics and controls, engine accessories, thrust producers, high-temperature materials, mechanical drive systems, diagnostics and prognostics, maintenance and support, survivability through reduced detectability and aircraft and aircrew individual protection, nuclear/biological/chemical/laser protection, flight safety, cargo-handling systems, ground support equipment, secondary power systems, environmental control systems, flight simulation, and aviation human engineering. These technologies are being developed for application to all current as well as future Army aircraft systems, including the UH-60A BLACK HAWK Utility Helicopter, the AH-64 Apache Advanced Attack Helicopter, the CH-47 Medium-Lift Helicopter, the AH-1 Cobra Attack Helicopter, and preplanned product improvement programs (P3I) of these aviation systems.

G. (U) RELATED ACTIVITIES: Related programs are performed by the National Aeronautics and Space Administration (Low Speed Aircraft Research and Technology - 505-42-XX), Navy (Program Element # 6.22.41.N - Aircraft Technology), Air Force (Program Element # 6.22.01.F - Flight Dynamics), and the Federal Aviation Agency (FAA) of the Department of Transportation. Coordination to eliminate unnecessary duplication is accomplished by: interagency agreements, Memorandums of Agreement/Understanding, letters of agreement, joint program reviews, exchange of program data sheets, research and technology resumes, technical reports, interservice liaison, attendance at scientific meetings and conferences and joint participation in The Technical Cooperation Program, NASA Research and Technology Committees, and the North Atlantic Treaty Organization (NATO) Advisory Group on Aerospace Research and Development. This program element is included in the Tri-Service Aeronautical Vehicle, Structures and Aircraft Propulsion Technology Coordinating Papers. Efforts conducted under this program element lead into Advanced Development under Program Elements 6.32.01.A, Aircraft Powe. Plants and Propulsion; 6.37.11.A, Aircraft Electronic Warfare Self-Protection Equipment; 6.32.09.A, Air Mobility Supp rt; and 6.32.11.A, Rotary Wing Controls, Rotors, Structures.

H. (U) WORK PERFORMED BY: The in-house portion of this program is accomplished at the US Army Research and Technology Laboratories, Moffett Field, CA; through the Aeromechanics Laboratory, Moffett Field, CA; Applied Technology Laboratory, Fort Eustis, VA; Structures Laboratory, Langley Research Center, VA; and Propulsion Laboratory, Lewis Research Center, OH.

Program Element: #6.22.09.A Title: Aeronautical Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

For FY 1983, 54 percent, or approximately $15 million, of the budget for this program is contracted. The principal contractors are Boeing Vertol Company, Philadelphia, PA; Sikorsky Aircraft, Stratford, CT; Pratt and Whitney Aircraft, West Palm Beach, FL; Bell Helicopter Textron, Fort Worth, TX; Air Research Manufacturing Company, Torrance, CA; Detroit Diesel Allison, Indianapolis, IN; Hughes Helicopter, Culver City, CA. At least twelve other contractors will share in this program. Many contracts are still open and will be awarded on a competitive basis.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Design and fabrication of a flightworthy Higher Harmonic Control (HHC) system were completed and installed on a helicopter for flight test/evaluation. HHC has potential for reducing rotor vibratory loads by 70-90% for less than one-half the weight penalty of current vibration control devices. Simulator studies of control-display interaction were continued with emphasis on control system aids for possible application to attack helicopter mission tasks including hover and bob-up performance. Helicopter composite structure joints and attachment concepts were designed and proof-tested. Exploratory Development was initiated on a high-pressure ratio compressor, a high work supersonic turbine, and continued on an adaptive fuel control to significantly improve aircraft handling characteristics. Investigations were completed to determine the optimum combinations of centrifugal and/or axial compressors for an optimum range of airflows and pressure ratios. Numerous Army Helicopter Improvement Program (AHIP) design concepts were generated and evaluated for application to future AHIP efforts. An aerosol program established the feasibility of a helicopter-mounted smoke/aerosol system to countermeasure the visual rangefinder/designator threat. A generic inflight fuel fire suppression system was designed to significantly reduce helicopter vulnerability to the 23mm HEI round. An internal cargo-handling system (ICHS) concept for increased resupply capability was demonstrated on the CH-47 medium-lift helicopter. The ICHS permitted loading 40' X 48' standard loaded pallet in 10 minutes versus 1-1/2 to 2 hours without the ICHS. ICHS permits loading a 463L pallet in 5 minutes; without the ICHS this pallet cannot be loaded on the CH-47. A super hard transparent coating was developed and flight-tested under operational conditions. Several abrasion-resistant coatings for windshields were tested, showing significant improvements. Battle damage repair methods were identified for structural applications which will permit continued battlefield operations after sustaining ballistic damage, thereby increasing aircraft availability and easing logistics/spare parts requirements. A new diagnostic method named LOG-MOD was evaluated. A new model named Advanced Design and Diagnostic Evaluation Model was developed, and the concept determines to have the potential to reduce diagnostic troubleshooting time by 90%. Main and tail rotor ice phobic coating flight tests were conducted as part of a larger de-icing program conducted behind the Helicopter Ice Spray System (HISS) aircraft. The Second-Generation Comprehensive Helicopter Analysis System (SGCHAS) analysis was completed, and architectural design of the system was

Program Element: #6.22.09.A Title: Aeronautical Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

initiated. New software for man-machine research was also developed to provide a basis for helicopter man-machine interface simulations to determine methods to reduce pilot workload.

2. (U) FY 1982-FY 1984 Program: Systematic assessment of the impact of new technology developments on the next-generation family of light helicopters as well as future Preplanned Product Improvements (P^3I) for BLACKHAWK and APACHE will continue. Testing and analysis of the crash impact characteristics of helicopter composite primary structures will be completed to demonstrate that composite structures can provide the same level of crash impact protection as current crashworthy metal structures. Investigation of variable area turbines will continue to explore their potential for fuel consumption reductions on the order of 10-20%. A single-stage centrifugal compressor with a 15:1 pressure ratio and an attractive level of efficiency will be investigated to assess its potential to reduce engine complexity and parts with a corresponding reduction in acquisition and maintenance costs. Abrasion-resistant coatings of windshields and erosion protection surfaces will be tested and evaluated for improved performance in the desert operational environment. Environment control technology development will concentrate on the development of both microwave and vibratory rotor blade ice protection concepts. A joint effort with the Navy will be completed to demonstrate the compatibility of candidate decontaminants with helicopter materials. The preliminary design of the Low Visibility Load Acquisition System (LOVLAS) and Helicopter External Cargo Snubbing System (HEXCSS) will be initiated. The advanced technology sling system with a potential to provide strong, lightweight (50% weight reduction) slings will be investigated. LOVLAS, HEXCSS, and the advanced technology sling system will significantly improve aircraft productivity and operational effectiveness by permitting quicker external load pickup, reduced ground crew requirements to accomplish hookup, and ability to acquire external loads at night and during adverse weather. FY 1983: An empirically modified prescribed wake program will be evaluated using flight data from several full-scale and model tests to more accurately predict hover performance for advanced rotor concepts. An analytical, experimental, and flight test program on rotor blade erosion will be initiated to determine rotor blade leading edge erosion-resistant materials which will more effectively resist sand, dust, rain, and hail damage. The preliminary design and critical element tests of a composite rotor hub will be completed in preparation of fabrication and flight testing. Composite hub construction will substantially reduce the weight and cost of helicopter rotor hubs while improving their structural integrity and maintenance. The LOVLAS and HEXCSS concept investigations will be conducted in FY 1982, will be completed and transitioned to 6.3A. The MIL-H-8501 helicopter handling qualities specification will be updated for the first time in over 20 years. This update effort will be a joint Army/Navy endeavor. The design of a large aeroelastically tailored main rotor blade which will induce minimal vibration levels in the helicopters and not degrade performance will be completed. This will reduce the need for other vibration control devices and their high weight penalties. Helicopter battle damage repair work will continue to include fuel cell repair, special tool design for effecting battle repair, and also

Program Element: #6.22.09.A Title: Aeronautical Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

new methods for inspecting and repairing aircraft wiring. A parametric evaluation and assessment of the low observables helicopter program will be conducted. Predesign trade-offs/impact on survivability will be performed. Airframe chemical and biological warfare vulnerability investigations will be performed for the AH-64, UH-1, and CH-47D. Laser hardening analysis of the UH-60, AH-1S, AH-64, and UH-1H helicopters will be completed. Conceptual ground support equipment (GSE) efforts for combat repair will be initiated. GSE improvements are essential to replace current unreliable, unsupportable GSE and will provide multifunction equipment to replace current single-purpose GSE and air/ground mobility for use in the austere sites, and high-threat environment of the Air/Land Battle 2000. An advanced rotor ice protection concept will be initiated which offers an alternative to power, weight, and cost penalties associated with the use of electrothermal blade de-icing. Design studies and sustainability trade-offs for significant new aviation programs will continue. Adaptive fire control, high work turbine efforts will be continued. Studies of variable area turbines will continue. Development of executive summary and technology modules for Second-Generation Comprehensive Helicopter Analysis System (2GCHAS) will continue, and integration of modules will be initiated to permit significant improvement in performance and loads evaluation of advanced helicopter configurations and product improvements.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.22.10.A
Title: Airdrop Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1188	1540	1688	2144	Continuing	Not Applicable
D283	Airdrop Technology	1188	1540	1688	2144	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element supports basic airdrop technology. The technological output is critical in fielding new airdrop systems and equipment that provide and upgrade the US capability to employ and rapidly resupply airborne and conventional combat units. The goals of the technology are identification of concepts/means to improve strategic airlift and to solve the
to drop large fire and combat support material. New airdrop concepts are evaluated which have potential for increasing mission capabilities of airdrop/airlift operations and for reducing the costs of acquisition, use, and logistics support of airdrop systems and equipment. Thirteen efforts comprise the Airdrop Technology project which supports all of the military services and are the bases for the two related airdrop projects in advanced and engineering development.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The major thrust in FY 1983 will be in the areas of Soft Landing Concepts and Rigging Technology. Both of these areas are designed to increase the efficiency associated with the airdrop of heavy cargo loads; e.g., reduced material costs and time required to prepare (rig) and derig airdropped loads. Lower levels of effort are planned in Glider Decelerator Technology, High-Speed Airdrop Technology, Parachute Technology, engineering support and assistance to the USAF for airdrop aircraft work, and High-Level Airdrop Technology. Specific work planned for increasing

Program Element: # 6.22.10.A Title: Airdrop Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

the efficiency of heavy-drop loads includes identification of mechanical devices to facilitate soft landings, completing of fragility tests at US Army Tank and Automotive Command (TACOM) on selected vehicles, and the initiation of tests for soft landing platforms. Other work planned for FY 1983 that corresponds with the other project element efforts follows: initiate testing of a 3200-square-foot glider-parachute system; conduct flight tests of an airdrop platform capable of being dropped from an aircraft at speeds up to 200 knots; proceed with interactive studies and experiments between parachute performance and characteristics of aircraft wake-turbulence; continue monitoring aircraft developments and rendering engineering support for airdrop aircraft; and transition the high-altitude (up to 25,000 feet) platform concept to advanced development.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST ($ in thousands):

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1188	1540	1688	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1467	1543	2009	Continuing	Not Applicable

The decrease in funding (FY 1981, $279 thousand; FY 1982, $3 thousand; and FY 1983, $321 thousand) reflects the transfer of funds to other higher priority Army projects and a decrease in the inflation indices.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: # 6.22.10.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Airdrop Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Major areas of the program effort are: (1) the study of concepts for the airdrop of personnel at low altitudes for mass tactical assault; (2) the development of criteria for the design and use of airdrop/air transport aircraft; (3) exploring feasibility of airdrop at higher aircraft speeds and altitudes; (4) the identification and development of practical concepts for the guidance/control of airdrop systems for supplies and equipment; (5) the development of new airdrop rigging concepts to lessen logistics and training burdens; (6) the study of retrorocket and airbag impact-attenuating systems; and (7) updating of parachute technology for all airdrop applications, particularly for heavy outsize loads, high rates of descent, and high aircraft drop speeds. The specific objectives are: increase airdrop operational capabilities at all altitudes, at higher air speeds and in all weather and geographical environments in order to improve strategic airlift capabilities; increase airdrop accuracy; reduce drop-zone dispersion; provide the technology base for advanced airdrop systems; eliminate technical barriers hindering attainment of new airdrop capabilities; and reduce the costs of developing and maintaining airdrop components and systems.

G. (U) RELATED ACTIVITIES: Program Elements 6.32.18.A, Airdrop Equipment and Techniques, and 6.42.18.A, Airdrop Equipment Development; Joint Technical Airdrop Group; North Atlantic Treaty Organization, and Air Standardization Coordinating Committee (ASCC/WP44); Mutual Weapons Data Exchange Agreements with France, Germany, and Korea; United States/Germany nonmajor items meetings. International and interservice agreements and boards are used to exchange information on gains in airdrop technology, to avoid duplication of effort through joint and combined efforts, and to promote and attain the objectives of US Rationalization, Standardization, and Interoperability (RSI) policies and programs.

H. (U) WORK PERFORMED BY: AAI Corporation, Baltimore, MD; Bertin & Cie, Plaiser, France; US Army Yuma Proving Ground, AZ; and US Army Natick Research and Development Laboratories, Natick, MA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: In-house design and preliminary testing of deployment concepts to prevent line twists in personnel parachutes were conducted. The concepts will be applied to the engineering development of a new low-altitude personnel parachute for elements of the Rapid Deployment Forces. An engineering test report on airdrop capabilities of the C141B aircraft was completed. The first phase of wind tunnel tests to determine the character of the air flow behind Air Force cargo aircraft and to measure the behavior of extraction parachutes in the aircraft wake was completed. The model of the C141 aircraft was obtained on loan from the Lockheed-Georgia Co., and the wind tunnel tests were conducted by the David W. Taylor Naval Ship R&D Center. Feasibility flight tests of the High Level Platform Airdrop System

Program Element: # 6.22.10.A Title: Airdrop Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

were conducted and revealed that the techniques developed to stabilize the loads were fully effective. As a follow-on to the test program, a contract study was initiated to determine means to introduce a controlled slow roll into the system to further reduce inaccuracies. The contract effort for the development of an on-board guidance and control system for gliding canopies was completed and experimental prototype items delivered. Microcomputer programing is currently being developed to simulate the characteristics of the 200-square-foot glider canopies on hand. To date preliminary flight test measurements of the performance of the gliding canopies have shown excellent agreement with the computer simulations. The development, under contract, of a 3200-square-foot glider canopy was initiated. A materials evaluation for the Free-Drop Water Container was completed. Tests were completed on the French airbags to evaluate their potential for achieving a soft landing. The data show a wide variation in deceleration performance; further studies of the airbag concept are indicated. A statistical model to simulate the loading interface of aircraft roller system and airdrop platforms was completed and a report published. Results show that experimental methods rather than analytical methods are the better approach. The FY81 reduction in funds resulted in the cancellation of studies to develop feasible concepts for airdrop on wate drop zones and airdrop of large containerized loads.

2. (U) FY 1982-FY 1984 Program: Complete in-house testing of the new deployment concept for Rapid Deployment Forces' low-altitude personnel parachute. Incorporate this concept, if successful, into the engineering development program for the parachute. Complete concept refinements and feasibility testing of the High-Level Platform Airdrop System and transition to Advanced Development. The work in High Level Airdrop Technology will be expanded to include study of concepts for airdrop of personnel at altitudes between 25,000 and 50,000 feet. Initiate and complete studies to identify and evaluate simplified and rapid methods to rig and derig heavy equipment for airdrop. Also, develop optimum methods for rigging weapons and equipment on individual parachutists. Continue to provide airdrop engineering support to developers of Air Force airdrop aircraft. Analyze wind tunnel test results of model extraction parachutes deployed behind model airdrop aircraft. Develop analytical methodology to predict extraction parachute forces and conduct full-scale flight tests to verify analysis. This methodology will be used to reduce the cost of flight testing when new extraction parachutes or new airdrop aircraft are developed. Demonstrate, through testing, the feasibility of an automatic guidance system for gliding canopies. Evaluate alternative guidance schemes to determine which scheme provides optimum accuracy under a variety of environmental conditions. Demonstrate the feasibility of deploying large gliding canopies and experimentally verify the flight performance. Integrate guidance system and large canopy into a prototype glider system and demonstrate the feasibility of the operational concept. Design and fabricate large-capacity soft landing airbags and conduct laboratory tests. Also, design and fabricate a compatible airdrop platform and conduct necessary flight tests. Continue to update theoretical work in parachute technology and conduct related experimental tests. Reinitiate exploratory development of High-Speed Airdrop System through design

Program Element: # 6.22.10.A Title: Airdrop Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

of prototype components and conduct flight tests at speeds up to 250 knots. Twelve professional and five support personnel are involved in the program.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.23.03.A
Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	25922	30041	37651	37575	Continuing	Not Applicable
A214	Missile Technology	25922	30041	37651	37575	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the Army exploratory development work for improvement in fielded Army missile and rocket components and technical options for use in future tactical missile systems in response to user prioritized science and technology objectives and mission area analyses. These needs are addressed through work in applied research, laboratory hardware development, and limited technology demonstrations in the areas of Close Combat, Fire Support, and Air Defense. This program is needed to achieve and protect technological leads in tactical missile and rocket technology, and provides the Army a critical capability to: (1) acquire the best missile/rocket systems at the least life cycle costs; (2) provide for technological advancement in areas where there is little or no industry incentive due to lack of commercial applications; (3) provide a quick-response capability in time of crisis; and (4) preclude technological surprises by potential enemies. Efforts in this program are focused on technologies that will enhance the capabilities of missiles to operate effectively in adverse battlefield environments, improve the survivability of missile and rocket launch platforms, make our systems more effective against hard targets, provide affordable but necessary sophistication to overcome enemy numerical advantages, and provide near-term insertion in fielded and developing systems.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: This request is for the continuation of exploratory development in the application of the growth potential of sensors, control devices, propulsion units, airframes, target detection/acquisition units, and materials in missiles and rockets. Principal products under investigation are: an active radio frequency seeker for the air defense and close combat roles, millimeter and laser command guidance and beamrider guidance for the close combat role, guidance algorithms for autonomous target acquisition in close combat and fire support roles, dual-mode lightweight air defense suppression seeker, digital beamforming radar for air defense, radio frequency environmental modeling and simulation techniques, antitactical ballistic missile concept definition, minimum signature propulsion low-cost light artillery rocket, volume-constrained hypervelocity missile for close combat, secure missile guidance links, a lightweight fire-and-forget antitank concept demonstration, and composite missile structures.

Program Element: #6.23.03.A Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	25922	30041	37651	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	26288	30634	42075	Continuing	Not Applicable

The decrease in the FY 1983 funding between the FY 1983 and the FY 1982 Congressional Descriptive Summaries is due to adjustments to the technology base in compliance with guidance for reductions for efficiencies and inflation. The decreases in the FY 1981 and 1982 funding are also reductions for efficiencies and inflation.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.23.03.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Missile Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program provides for the integration of domestic and foreign technological innovations and advancements into Army missile and rocket components. Principal products under investigation emphasize autonomous target acquisition technology, cost reduction techniques, missile operation in adverse natural and artificial environments, survivability enhancements, man-weapon interoperability improvements, and the exploitation of technological opportunities which may counter new threats and improve the force multiplier ratio of Army combat forces. The broad objectives of the program are to: (1) Develop guidance and control and terminal homing systems having multimode and autonomous target acquisition capabilities, reduced vulnerability to antiradiation missiles, and the capability for operation in adverse weather and countermeasures environments; (2) develop minimum signature propulsion systems and low-cost missile/rocket components with improved service life; (3) reduce development costs through simulation; (4) reduce risk in new system development. These objectives involve most of the scientific and engineering disciplines related to missile and rocket development. The program consists of 10 technology areas with work areas described as follows: Sensors - radio frequency guidance; advanced radar development; millimeter and laser guidance; beamrider guidance; infrared homing; sensor design and signal processing; digital beamforming for advanced air defense radars; and terminal homing measurements. Guidance - automatic multitarget correlation handoff; inertial guidance components and systems; control systems; and missile tactical software. Simulation - radio frequency simulation technology; infrared/electro-optical simulation technology; hybrid computer simulation technology; and millimeter simulation. Technology Integration - integration of technologies for demonstration of air defense, close combat and field artillery missile and rocket concepts. Aerodynamics - advanced missile interceptor aeroballistics; tactical missile plume/guidance signal attenuation technology; submissile aerodynamics; and advanced rocket aerodynamicce. Propulsion - minimum signature propulsion; quantification of propulsion signature impact; prediction/extension of useful life of propellants; and noise reduction. Airframe and Ground Equipment - missile system structures; low cost radomes; helicopter launcher improvements; and optimized design of antiarmor missile systems. Technology Planning - conduct overall planning and management of program element to include utilization and evaluation of industrial independent research and development. Applications and Analysis - conduct antitactical ballistic missile system concept definition analysis and generate concepts for affordable future missile systems which can defeat the evolving threat.

G. (U) RELATED ACTIVITIES: Efforts in this program relate closely to science and technology programs conducted by the Defense Advanced Research Projects Agency (PE #6.27.11.E, Tactical Technology), the US Navy (PE #6.23.32.N, Strike Warfare Weaponry Technology), the US Air Force (PE #6.26.02.F, Conventional Munitions, and 6.36.01.F, Conventional Weapons), and the Army (PE #6.33.06.A, Terminally Guided Projectiles). Duplication is precluded by active participation by Laboratory personnel in interagency working groups and deliberate structuring of the program to concentrate on the Army's unique need in

Program Element: #6.23.03.A Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

tactical missiles. Where areas of potential unwarranted duplication or opportunities for cooperation have been identified, appropriate aggreements have been effected with the command/agency concerned. Membership exists in working groups of the Joint Services Guidance and Control Committee, The Joint (tri-Service) Technical Coordinating Group for Munitions Development (Missiles and Rockets), the Joint Army/Navy/NASA/Air Force Propulsion Committee, and North Atlantic Treaty Organization Panels.

H. (U) WORK PERFORMED BY: The US Army Missile Command, Redstone Arsenal, AL, has primary responsibility for execution of this program. Approximately 45 percent of the dollars are contracted out to more than 109 contractors and universities. The top five contractors include Hughes Aircraft Corporation, Computer Science Corporation, Boeing Company, Sperry Support Services, and Martin Marietta Corporation. Approximately $7 million is contracted with 104 other contractors.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Completed data analysis on initial tests of multienvironment active radio frequency seeker and initiated a modification program; completed forward looking infrared (FLIR) video missile-tracking concept; developed two candidate submunitions for ASSAULT BREAKER; developed technical requirements for millimeter and radio frequency adverse weather seeker design alternatives; successfully completed initial flight tests of a fly-over, top-attack antiarmor missile concept; established feasibility of using fiber optics guidance for missile application via flight test; demonstrated feasibility of a minimum signature motor for possible application to HELLFIRE; conducted world's first successful flight test of a solid propulsion integral rocket/ramjet for application to the antiarmor role; completed initial series of 25 flight tests to investigate accuracy improvement of free flight rockets by dynamic aiming; and completed the first phase of an unguided, kinetic energy penetrator rocket flight test program by firing 42 rockets.

2. (U) FY 1982-FY 1984 Program: FY 1982: Complete demonstration of an air defense track-while-scan quiet radar in a realistic hostile environment; complete the development of an infrared seeker with low-cost strapdown or body-fixed options for application to artillery and close combat terminally guided weapons; prove feasibility of using a millimeter wavelength seeker for artillery missiles operating in adverse environments; complete flight testing, evaluate sensors countermeasures performance, and complete lightweight sensor design for a fly-over antiarmor missile concept for efficient attack of armor targets; complete proof-of-principle flight tests on the fiber optics guidance missile and investigate seeker requirements and missile launch from a helicopter for subsequent advanced development project; complete feasibility demonstration of

Program Element: #6.23.03.A Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

integrating an infrared terminal capability into an existing radio frequency homing interceptor; continue integration and accuracy demonstrations on a single penetrator kinetic energy rocket; and demonstrate the feasibility of a dynamically aimed artillery rocket system concept. FY 1983: Complete feasibility tests and evaluations on a multienvironment active radio frequency seeker having a fire-and-forget capability against stationary or moving ground targets; complete design studies to develop lock-on-before-launch and lock-on-after-launch alternatives for an adverse environment millimeter or radio frequency seeker; complete subsystem tests on a radio frequency target designator for air defense suppression; conduct concept definition for an antitactical ballistic missile; demonstrate feasibility of a minimum signature motor for a potential product improvement to STINGER; demonstrate noise reduction of close combat weapons by tailored thrust shaping or by use of mufflers; demonstrate hypervelocity launch techniques for helicopters and demonstrate burning time control technique for minimum smoke motors; demonstrate feasibility of maintaining a carbon dioxide laser data link through the minimum signature propellant exhaust plume; complete feasibility demonstration of a dynamically aimed artillery rocket system concept; begin integration and feasibility demonstrations on a multisensor air defense acquisition system, a guided hypervelocity missile, secure guidance links between ground and missile, and a lightweight fire-and-forget antitank missile using inertial guidance. FY 1984: Adapt the Joint Navy/Air Force Medium-Range Air-to-Air Missile (AMRAAM) seeker design for potential Army air defense application; complete feasibility demonstration of a single penetrator kinetic energy rocket; demonstrate feasibility of a two level of thrust, minimum-signature motor for short-range air defense; complete feasibility demonstration of a multisensor air defense acquisition system; complete feasibility demonstration of a beamrider-guided, volume constrained, hypervelocity missile; complete demonstration of a secure microwave link between a missile and the ground; prove the feasibility of fire-and-forget inertial guidance for antitank application; begin feasibility demonstrations on automatic multitarget handoff, low-cost terminally guided submissiles, a stationary charge antitank missile concept, and an infrared detection and acquisition concept. Approximately 200 in-house laboratory personnel support this program. The technical efforts are generally conducted in the facilities and test ranges of the Army Missile Command; White Sands Missile Range, NM; and Eglin Air Force Base, FL.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: # 01 Title: Sensors Technology
Project: # A214 Title: Missile Technology
Program Element: # 6.23.03.A Title: Missile Technology
DOD Mission Area: 523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This program provides the technology base in electromagnetic sensors for precision guidance of Army missiles. Principal products under investigation include missile seekers compatible with off-line-of-sight guidance to enhance launch platform survivability; seeker designs employing cost reduction techniques; sensors/seekers able to operate in adverse natural environments and countermeasures, man-weapon interoperability improvements; and the exploitation of technological opportunities which will counter new threats and improve the force multiplier ratio of Army combat forces. The program consists of advanced air defense radar technology; sensor design and associated signal processing development for seekers operating in operationally useful areas of the electromagnetic spectrum such as millimeter and infrared, to include necessary supporting efforts in terminal homing measurements, imaging seeker target acquisition, recognition and classification techniques, and radio frequency target modeling for recognition and classification.

B. (U) RELATED ACTIVITIES: Efforts in this program are closely related to the science and technology programs conducted by the Atmospheric Sciences Laboratory, Electronic Warfare Laboratory, Electronics Technology and Devices Laboratory, and the Night Vision and Electro-optics Laboratory, all of the Electronics Research and Development Command (ERADCOM). Aviation-related programs are coordinated with the Aviation Research and Development Command (AVRADCOM) and armaments programs are coordinated with the Armaments Research and Development Command (ARRADCOM). Efforts in this program are also related to other technology base programs as follows: Defense Advanced Research Projects Agency (DARPA) (PE #6.27.11.E, Tactical Technology), the US Navy (PE #6.23.32.N, Strike Warfare Weaponry Technology), the US Air Force (PE #6.26.02F, Conventional Munitions, and PE #6.36.01.F, Conventional Weapons) as well as to other programs within the Army (PE #6.33.06.A, Terminally Guided Projectiles). Duplication is precluded by exchange of planning data, active participation by laboratory personnel in interagency working groups, liaison visits to agencies/activities involved in missile-related science and technology work, and deliberate structuring of the program to concentrate on the Army's unique needs in tactical missiles. Work is coordinated with the Air Force Armaments Laboratory under a Memorandum of Agreement. Active participation exists in working groups of the Joint Services Guidance and Control Committee (JSGCC), the Joint (Tri-Service) Technical Coordinating Group for Munitions Development (Missiles and Rockets), and North Atlantic Treaty Organization Panels. JSGCC working groups are structured in the areas of millimeter guidance, midcourse guidance, active/passive RF guidance, infrared guidance, and countermeasures/counter-countermeasures.

Technical/Scientific Area: # 01 Title: Sensors Technology
Project: # A214 Title: Missile Technology
Program Element: # 6.23.03.A Title: Missile Technology
DOD Mission Area: 523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

C. (U) WORK PERFORMED BY: Approximately 50 percent of the dollars are contracted out to more than 50 contractors and universities. The five major contractors are Hughes Aircraft Corporation, Fullerton, CA; Teledyne-Brown Engineering, Huntsville, AL; Sperry Microwave, Clearwater, FL; Texas Instruments Incorporated, Dallas, TX; and Martin Mariette, Orlando, FL. The remaining 45 contractors, including many universities, receive approximately $1.5 million. The US Army Missile Command (MICOM), Redstone Arsenal, AL, has primary responsibility for execution of this program.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Brassboard Quiet Radar fabrication was on schedule; development of brassboard eight-element digital beamforming radar array was initiated; data analysis for initial tests of an adverse environment active radio frequency seeker was completed and modification program initiated; carbon dioxide laser beamrider was designed for a planned flight demonstration; imaging data base was generated for use in developing seekers capable of automatically acquiring targets in flight; two candidate submunitions for ASSAULT BREAKER were developed; a model for assessing millimeter beamrider guidance developed; flight hardware modifications for millimeter drop test demonstration began; millimeter data were collected from towers for evaluation of signal processing algorithms; the effects of turbulence on laser beams were evaluated; detection and discrimination techniques for smoke, dust, and clutter environments were developed; synthetic infrared target-background models were developed.

2. (U) FY 1982-FY 1984 Program: FY 1982: Quiet Radar fabrication will be completed and performance begun; experimental digital beamforming array will be completed and brassboard radar development begun; laser signatures of ground vehicles will be defined; improved missile tracking techniques for carbon dioxide laser beamrider will be evaluated; a coordinated Army/Air Force imaging infrared seeker design program will be initiated; a low-cost body-fixed infrared sensor development will be completed, flight tests of millimeter seekers for terminally guided submissiles will be conducted, and the associated signal processor will be tested. FY 1983: Ground-based long-range measurements of the adverse environment active radio frequency seeker will be completed and helicopter-carried testing begun; adaption of the Joint Navy/Air Force Medium-Range Air-to-Air Missile (AMRAAM) radio frequency seeker technology to Army surface-to-air applications will be analyzed; development of an automatic target identification for carbon dioxide laser beamrider will be initiated; brassboard hardware for improved target tracking will be fabricated; tower and captive tests of adverse weather seekers will be conducted. FY 1984: All tests and data analysis on the adverse environment active radio frequency seeker will be completed and performance

Technical/Scientific Area: # 01 Title: Sensors Technology
Project: # A214 Title: Missile Technology
Program Element: # 6.23.03.A Title: Missile Technology
DOD Mission Area: 523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

established for potential application to heliborne missiles. Active array seeker development will be initiated, and development of an automatic target identification system for carbon dioxide laser beamrider will be completed.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	6781	7473	8706	9978	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	7958	7998	11216	----	Continuing	Not Applicable
Sensors	(4433)	(4528)	(6100)			
Terminal Guidance	(3525)	(3470)	(5116)			

Terminal Guidance Technology has been incorporated into Sensors Technology to simplify the management of these technology areas. The current funding is lower than that shown in the FY 1982 submission because critical Technology Integration effort is being conducted in lieu of some of the originally planned sensors effort.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical/Scientific Area: #06 Title: Technology Integration
Project: #A214 Title: Missile Technology
Program Element: #6.23.03.A Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: Technology Integration is to prove through limited field or laboratory testing that specific exploratory development missile/rocket concepts are ready to be moved to advanced development or can be inserted directly into developmental or fielded systems. Technology Integration during exploratory development provides the link between component feasibility and nonsystems advanced development on selected products for Army missiles and rockets. The major thrust is directed at the development of technologies and system concepts that permit a radical advance in weapon capability by providing equivalent or greater capability than existing systems but with much lower manning levels for operation, maintenance, and logistic support. These efforts are particularly applicable to the need of the light division and the Rapid Deployment Force. Specific examples are: (1) fiber optics guidance technology permitting standoff, lightweight missile systems with inherent target acquisition capability and pinpoint accuracy that will be able to perform many functions currently requiring main battle tanks, attack helicopters, and fire support artillery; (2) lightweight kinetic energy missile technology providing greater range, accuracy, and striking energy than tank guns and permitting development of antiarmor ground systems that are many times lighter in weight than present-day main battle tanks and providing logistics benefits and transportability improvements for Rapid Deployment Force use; and (3) lightweight, high-accuracy rocket technology having equivalent accuracy and greater range than cannon artillery for more suitable use with terminal homing, mobility denial, and area denial munitions.

B. (U) RELATED ACTIVITIES: Efforts in this program relate closely to science and technology programs conducted by the Defense Advanced Research Projects Agency (DARPA) (PE #6.27.11.E, Tactical Technology), the US Navy (PE #6.23.32.N, Strike Warfare Weaponry Technology), the US Air Force (PE #6.26.02.F, Conventional Munitions, and 6.36.01.F, Conventional Weapons) as well as to other programs within the Army (PE #6.33.06.A, Terminally Guided Projectiles). Duplication is precluded by active participation by laboratory personnel in interagency working groups, liaison visits to agencies/activities involved in missile-related science and technology work, and deliberate structuring of the program to concentrate on the Army's unique needs in tactical missiles. Where areas of potential unwarranted duplication have been identified, appropriate agreements have been effected with the command/agency concerned. Membership exists in working groups of the Joint Services Guidance and Control Committee, The Joint (tri-Service) Technical Coordinating Group for Munitions Development (Missiles and Rockets), Joint Army/Navy/NASA/Air Force Interagency Propulsion Committee, and North Atlantic Treaty Organization Army Armaments Group (NAAG) Panels.

Technical/Scientific Area: #06 Title: Technology Integration
Project: #A214 Title: Missile Technology
Program Element: #6.23.03.A Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

C. (U) *WORK PERFORMED BY:* The US Army Missile Command (MICOM), Redstone Arsenal, AL, has primary responsibility for execution of this technical area. Approximately 50 percent of the dollars are contracted out to about 25 contractors. Major contractors include Martin Marietta, Orlando, FL; Hercules, Cumberland, MD; Teledyne-Brown, Huntsville, AL; Sperry Support Services, Huntsville, AL; and Honeywell Incorporated, Hopkins, MN. The total amount awarded to the 20 or so additional contractors is about $2 million.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Five Technology Integration programs were being conducted in FY 1981. (1) In a fly-over top-attack antiarmor missile concept, two in-house-designed magnetic/optical sensors installed on TOW testbed missiles were successfully flight tested against tank targets. (2) Initial feasibility of using fiber optics guidance for missile application in close combat was established with a flight test which successfully demonstrated critical technologies on payout of a high-strength fiber from a missile and simultaneous two-way data transmission via a single fiber. (3) The world's first successful flight test of a solid propulsion integral rocket/ramjet for application to the antiarmor role was conducted. (4) Equipment for mapping radio frequency guidance errors induced by incorporating an infrared adjunct guidance apparatus in an air defense interceptor radome was designed and checked out. (5) Improvements in rocket motor performance and system accuracy for urban warfare weapon concepts were demonstrated.

2. (U) FY 1982-FY 1984 Program: FY 1982: Complete flight testing, evaluate sensors countermeasures performance, and complete lightweight sensor design for a fly-over, antiarmor missile concept using a self-forging-fragment warhead. FY 1982-FY 1984: Complete flight demonstrations of a single penetrator kinetic energy rocket concept, and complete ground firings from a helicopter airframe to assess effects on the helicopter and rocket accuracy. FY 1982: Complete proof-of-principle flight tests on the fiber optics guidance missile concept, and investigate seeker requirements and missile launch from a helicopter to prepare for an FY83-FY85 advanced development project. FY 1982-FY 1983: Complete evaluation of the compatibility between a carbon dioxide beamrider guidance system and the exhaust plume of a rocket propelled at high supersonic velocities. FY 1982: Complete technical feasibility demonstration of integrating an infrared homing capability into an existing radio frequency homing interceptor. FY 1982-FY 1983: Complete design, fabrication, testing, and evaluation of a dynamically aimed artillery rocket concept. FY 1983-FY 1984: Initiate and complete testing of an infrared search set combined with a track-while-scan radar and a passive radio frequency sensor for short-range air defense

Technical/Scientific Area: #06 Title: Technology Integration
Project: #A214 Title: Missile Technology
Program Element: #6.23.03.A Title: Missile Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

target acquisition providing improved electronic countermeasures, survivability, and positive target identification. FY 1983-FY 1984: Design and demonstrate the technology of a beamrider-guided hypervelocity missile concept designed to the constraints of multiple sequential launch from inside an armored vehicle. FY 1983-FY 1984: Demonstrate a secure radio frequency link between a helicopter-carried sensor and the ground. FY 1983-FY 1984: Demonstrate feasibility of lightweight, low-cost fire-and-forget inertial guidance for antitank application. FY 1984: Initiate demonstrations on an automatic multitarget *acquisition-system-to-seeker handoff concept and a* low-cost terminally guided submissile. Approximately 85 in-house laboratory personnel support this technical area. Experiments associated with these efforts are conducted in the Army Missile Command facilities and test ranges and Eglin Air Force Base, FL, test ranges.

3. (U) Program to Completion: This is a continuing program.

4. *(U) Major Milestones: Not applicable*

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3165	8750	9344	10255	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	2400	4876	6556	-	Continuing	Not Applicable

The funding profile was increased from the FY 1982 to the FY 1983 Congressional Descriptive Summary because the program was restructured to shorten the time period for completion of the various products in order to meet availability times recommended by the Army user community and because two products were added in FY 1981 and one was added in FY 1982.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.23.07.A
DOD Mission Area: #521 - Electronics and Physical Sciences (ED)

Title: Laser Weapons Technology
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	18759	22926	31327	34096	Continuing	Not Applicable
A139	Laser Weapons Technology	18759	22926	31327	34096	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army needs rapid fire laser weapons systems for employment against the large quantities of used on the weapons and support systems of potential enemies. Emphasis is being placed on improvements and advancements in laser components, subsystems, concept development, damage/vulnerability data base, and risk reduction tasks in support of laser weapon demonstrators and verification efforts. Laser weapon systems, with their large magazines, low cost per shot, and instant delivery, can have significant, possibly unique, capabilities against a target-rich environment of large numbers of sophisticated weapons and of future battlefields. Potential Army mission applications include the attack of ground targets in the close combat role.

This program is needed to provide the Army a critical capability to: (1) Establish and maintain expertise to be a smart buyer; (2) provide for technological advancement in areas where there is little or no industry incentive due to a lack of commercial markets; (3) provide a quick response in time of crisis; and (4) determine potential technological surprises by potential enemies.

Program Element: # 6.23.07.A
DOD Mission Area: #521 - Electronics and Physical Sciences (ED)

Title: Laser Weapons Technology
Budget Activity: #1 - Technology Base

C. BASIS FOR FY 1983 RDTE REQUEST: The major efforts will be: (1) Integration of power conditioning, gas handling, and laser device hardware to demonstrate the performance of an ultraviolet-preionized, repetitively pulsed electric laser of weapon size for Army applications;

(3) integrated demonstration tests of an intermediate-scale advanced chemical laser gain generator, chemical pump, and solid reactants; (4) investigation of performance capabilities and scale-up potential of pulsed chemical lasers using Army gas mixture and seedants; (5) expanded digital fire control simulation effort to include both the operator and hardware-in-the-loop analysis; (6) initiation of a field demonstration program for validation of an integrated fire control/beam control subsystem; (7) examination of mission requirements for a High-Energy Laser to defend

and (8) the advancement of the technology base through the development of promising laser device approaches, and the development of large rugged optics to survive on the battlefield while withstanding high-energy densities.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	18759	22926	31327	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	18759	24956	32077	Continuing	Not Applicable

The two laser system programs (Forward Area Laser Weapon, FALW, and the Close Combat Laser Assault Weapon, CCLAW) which were initiated under this project in FY 1981 have been transferred to PE Number 6.33.14.A, High Energy Laser Components, in FY 1983. The decrease in FY 1982 is due to a Congressional reduction and reduction for inflation.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.23.07.A
DOD Mission Area: #521 - Electronics and Physical Sciences (ED)

Title: Laser Weapons Technology
Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objectives of the Army High Energy Laser Technology Program are to develop the laser weapons technology base to permit future laser weapon system developments, develop laser weapon system concepts for viable Army missions, demonstrate the capabilities of laser systems, and explore the possible utility of unconventional beam technologies. A laser has several unique features which could make it a highly effective weapon in a target-rich environment: Instant delivery of destructive energy; agile beam; short engagement time; large target-handling capabilities; and low cost per shot. Laser weapons technology areas supporting eventual weapon system development include: laser devices and components; acquisition/fire control; beam control/optics/propagation; effects and vulnerability; and concept development/validation. The Army's laser weapons technology program concentrates on developments in these technology areas for the two leading candidate laser approaches, the continous-wave deuterium fluoride laser and the repetitively pulsed carbon dioxide laser. Other emerging promising laser approaches, such as pulsed chemical lasers, which show potential for radiation weaponry are also pursued. As a result of the Army Laser Weapon Technology Assessment (ALAWTA), which was completed in FY 1980, this program was redirected to concentrate on concepts and technology that will provide near-term payoff. laser weapons demonstrator efforts were initiated in FY 1981 for

G. (U) RELATED ACTIVITIES: In FY 1981, the Army High Energy Laser Program was funded at $18,759,000 in this Program Element. In FY 1980, the Army High Energy Laser (HEL) Program was funded at $20,320,000: $1,320,000 in Program Element (PE) #6.23.07.A, High Energy Laser Technology, and $19,000,000 in PE #6.33.14.A, High Energy Laser Components. In FY 1978 and FY 1979, exploratory development of High Energy Lasers (HEL) was conducted as a task in PE #6.23.03.A, Missile Technology. From FY 1975 through FY 1979, nonsystems advanced development of HEL was conducted under PE #6.33.14.A, High Energy Laser Components. From FY 1977, research in HEL has been conducted under PE #6.11.02.A, Defense Research Sciences. Other HEL development is being accomplished by the Navy (PE #6.37.35.N, High Energy Laser, and PE #6.27.68.N, Directed Energy), the Air Force (PE #6.36.05.F, Advanced Radiation Technology, and PE #6.26.01.F, Advanced Weapons), and the Defense Advanced Research Projects Agency (PE #6.27.11.E, Experimental Evaluation of Major Innovative Technologies, and PE #6.23.01.E, Strategic Technology). Different battle environment and system platform requirements for the different Services require significantly different high-energy laser technology approaches for each. The Service programs are closely coordinated by the Office of the Under Secretary of Defense (Research and Engineering) to preclude duplication of effort. A number of work efforts in the Department of Defense High Energy Laser Program are jointly funded and performed. In years prior to FY 1975, Army High Energy Laser development was funded under a series of Program Elements--PE #6.21.39.01.A, High Energy Laser Research, PE #6.23.03.A, High Energy Laser Research, PE #6.26.03.A, High Energy Laser Research, PE #6.26.09.A, Project

Program Element: # 6.23.07.A
DOD Mission Area: #521 - Electronics and Physical Sciences (ED)

Title: Laser Weapons Technology
Budget Activity: #1 - Technology Base

EIGHTH CARD, PE #6.26.12.A, Project EIGHTH CARD, PE #6.27.03.A, High Energy Laser Research, PE #6.27.05.A, High Energy Laser Research, PE #6.26.21.A, Laser Technology and Applications, and PE #6.36.11.A, Higher Energy Laser Development, Advanced Laser Development, and Project EIGHTH CARD.

H. (U) WORK PERFORMED BY: The top five contractors are: Hughes Aircraft Co., Culver City, CA; TRW Defense and Space Systems Group, Redondo Beach, CA; AVCO Everett Research Labs, Everett, MA; United Technology Research Center, E. Hartford, CT; and Westinghouse Research Labs, Pittsburgh, PA. There are approximately 60 additional contractors with an estimated total contract value of $19 million in FY 1982. The US Army Missile Command, Redstone Arsenal, AL, is the in-house developing organization.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1981 and Prior Accomplishments: Technologies necessary for Army High Energy Laser weapon system applications have been identified and partially developed through research, subscale demonstrations, and selected scaling experiments. Repetitively pulsed carbon dioxide electric lasers and both continuous-wave and repetitively pulsed deuterium fluoride chemical lasers using Army-required solid fuels and chemical pumps are being developed along with the necessary components and subsystems for acquisition, fire control, and beam control in close combat and air defense scenarios. Continued improvements in performance and reliability of large pulsed electric lasers have been accomplished through subscale technology demonstrations of electron-beam and ultraviolet preionized lasers. Improved performance of chemical lasers is being accomplished through high-efficiency nozzles, advanced chemical pumps based on liquid lithium absorbent, higher hydrogen yields from solid reactants, and oxidizer gases obtained from solid propellants. Damage thresholds for have been estsblished and an vulnerability assessment was completed. A ground radar was demonstrated proving feasibility for the vital asset defense fire control acquisition concept. Test plans for the Joint Army/Navy Hot Spot Tracking Field Test Program (HOST II), using an Army-developed advanced brassboard tracker, were finalized. Solid window materials for chemical lasers were successfully tested. The preliminary design of Forward Area Laser Weapon-Demonstrator (FALW-D) was initiated. Proposals were received for the preliminary design of a Close Combat Laser Assault Weapon demonstrator (ROADRUNNER). Competing contracts were awarded for a Forward Area Laser Weapon fire control system design.

Program Element: # 6.23.07.A
Title: Laser Weapons Technology
DOD Mission Area: #521 - Electronics and Physical Sciences (ED)
Budget Activity: #1 - Technology Base

2. FY 1982-FY 1984 Planned Program: The overall thrust of the program is to advance the state-of-the-art of laser technology so that at the completion of weapon demonstration and | verification programs, the technology will support fabrication of full-up prototypes in engineering development for Army mission areas. Approximately 60 in-house professional/supporting personnel and 120 contract personnel are supporting this project. The preliminary design contract will be awarded in FY 1982 for the brassboard system (ROADRUNNER) to demonstrate the ability of currently available lasers for . The preliminary design of the | Forward Area Laser Weapon Demonstrator (FALW-D) will be completed in FY . FALW-D and ROADRUNNER efforts will be transferred to PE Number 6.33.14.A in FY 1983. User interaction and computer modeling will continue to insure that viable concepts and those driving the technology needs are being pursued. Issues concerning atmospheric propagation in a dirty battlefield environment, optics survivability, target signatures, and target vulnerability will continue to be researched and modeled. Digital computer fire control simulation efforts will continue to analyze laser weapon susbystems interactions during engagements, to explore operator performance capabilities through operator and hardware-in-the-loop analyses, validate contractor designs, provide data sets for demonstrations, explore alternate missions, and optimize resource allocations. Continued improvements in chemical and electric laser technology will be pursued to develop lasers having higher efficiency, lower operating cost, and reduced weight, volume, and field supportability. Concept validation field demonstration programs will be initiated for an integrated fire control/beam control subsystem suitable for use in the forward battle area. Individual technology efforts will continue for new laser devices, improved optical components, and improved processes in kill assessment and target tracking. Mission requirement and system concepts will be established for a high-energy laser system for .

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.01.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Tank and Automotive Technology
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	11441	14648	19925	26500	Continuing	Not Applicable
AH91	Tank and Automotive Technology	11441	14648	19925	26500	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this program is: (1) to advance the state-of-the-art of tank and automotive technology to allow development of Combat/Tactical systems which can defeat the anticipated threat in a battlefield environment; (2) to conduct product line planning and develop technology to improve the cost and combat effectiveness of tank-automotive systems; (3) to improve mobility through the development of improved engine, transmission, and supporting tank-automotive components; (4) to produce total system concepts to meet user needs; and (5) to enhance vehicle survivability against current and anticipated threats through the integration of vehicle design, active and passive countermeasures, and composite materials.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Supports continuation of over fifteen tasks begun in prior years and the initiation of several new tasks including some that were delayed due to the general Congressional reduction to this program in FY 1981. All tasks for which funds are requested offer significant potential improvements in the performance of ground combat and tactical vehicles; objectives include improved fuel economy, increased track and suspension life, improved fire detection and suppression, a better quality of ride, improved electrical/electronic subsystem intergration, enhanced diagnostic/prognostic techniques and increased survivability among others. The large increase in funding for FY83 over FY82 is reflective of the recent introduction of new close combat vehicle systems into the Army and a redirection of emphasis within the Close Combat Mission Area from Engineering Development back to Exploratory Development. A more detailed discussion of the basis for the FY 1983 request can be found in paragraph I.3.

Program Element: #6.26.01.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Tank and Automotive Technology
Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	11441	14648	19925	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	12909	15785	19939	Continuing	Not Applicable

FY 1981 decrease attributed to a general reduction for inflation and a general Congressional reduction resulting in reduction in scope of several ongoing tasks and cancellation of some initiatives. FY 1982 decrease due to change in scope and goal support for higher priority Army near-term readiness goals. FY 1983 decrease due to revised inflation and civilian pay pricing indices.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.26.01.A Title: Tank and Automotive Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This Program Element provides funds to advance the state-of-the-art in tank and automotive technology, eventually leading to the development of ground combat and tactical vehicle systems and componentry which improve the Army's ability to operate against the anticipated threat. The program is divided into four areas: mobility, systems integration, survivability, and support. The Mobility effort provides for exploratory development of improved propulsion systems, track and suspension systems, structures/chassis, and components/materials. Systems Integration explores development of advanced concepts for future ground combat and tactical vehicle systems, methodologies for optimizing total system designs, and examination of new techniques to assist the designer in creating an optimized design. Survivability addresses the means by which a vehicle and its crew can best be protected from enemy detection and if detected, measures to be taken to improve survivability and armor/hardening. The Support area addresses human factors engineering, reliability, availability, and maintainability, training, and integrated logistics support.

G. (U) RELATED ACTIVITIES: Specific programs related to the technical areas of this program element are: PE 6.11.02.A, Defense Research Sciences; PE 6.21.05.A, Materials; PE 6.26.03.A, Large Caliber and Nuclear Technology; PE 6.27.33.A, Mobility Equipment Technology; PE 6.26.18.A, *Ballistics Technology*; PE 6.31.02.A, Materials Scale-Up; PE 6.32.01.A, Aircraft Power Plants and Propulsion; PE 6.36.08.A, Tank Gun Ammunition; PE 6.36.21.A, Combat Vehicle Propulsion Systems; PE 6.36.31.A, Combat Vehicle Turret and Chassis; PE 6.36.24.A, Mobility; PE 6.23.79.A, Test Measurement and Diagnostic Equipment; PE 6.36.02.A, Advanced Land Mobility Systems Concepts; and PE 2.37.35.A, Combat Vehicle Improvement Program. A close relationship is maintained with other services and government agencies through regular conferences and coordination meetings to preclude duplication of effort. Research and development information concerning respective allies' tank-automotive technology is being shared via data exchange agreements.

H. (U) WORK PERFORMED BY: US Army Tank-Automotive Command, Warren, MI, has the responsibility for the implementation of this program. Other Army in-house organizations that support this program are: US Army Armament Research and Development Command, Dover, NJ; Waterways Experimental Station, Vicksburg, MS; and Cold Regions Research and Engineering Laboratory, Hanover, NH. Major contractors participating in the program are: Stevens Institute of Technology, Hoboken, NJ; Garrett Corp, Phoenix, AZ; Northrup Corp, Ventura, CA; Hamilton Instruments, Houston, TX; Optimetrics Inc, Ann Arbor, MI; Keweenaw Research Center, Houghton, MI; Environmental Research Institute, Ann Arbor, MI; Battelle Laboratory, Columbus, OH; and Williams International Inc., Walled Lake, MI.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

Program Element: #6.26.01.A Title: Tank and Automotive Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

1. (U) FY 1981 and Prior Accomplishments: Established the Tank Science and Technology Base Program as the framework for future tank development efforts. Completed initial systems-level concept design for an advanced main battle tank using existing M1 Abrams Tank Components package into an innovative, inherently more survivable configuration. Completed a feasibility study of an adiabatic diesel engine, advanced turbine components, mine-resistant track system, nonmetallic composites for components, protection from overhead submunitions and run-flat bonded tire. Verified the feasibility of 10-ton heavy expanded mobility tactical trucks based on commercial components. The Advanced Techniques for Electrical Power Management, Control and Distribution Systems (ATEPS) task completed fabrication and installation of hull prototype system hardware in an M1 baseline tank. Under the noise reduction effort, an anechoic chamber and a reverbe-ation room were fabricated for baseline measurement and quantification of future accomplishments. For Weapon Station Integration, a breadboard of the pneumatic rate sensor has been developed and in laboratory operational characteristics tests conformed to M1 tank stabilization specification which led to a current phase two brassboard development. Fire Survivability accomplishments include procurement of mid-infrared band sensing system and leak-free valves. (1) Completed design of a Vehicle Effectiveness model and initiated its use as a concept analysis tool. (2) Completed design of secure interior light for combat vehicle application. (3) Evaluated Advanced concepts for reduction of detection. (4) Analyzed projected threat, future armor options, tactical weight and firing stability contraints which led to the determination of future combat vehicle survivability criteria. (5) Demonstrated technical feasibility of a kinesthetically controlled individual lift device.

2. (U) FY 1982-FY 1984 Planned Program:

a. (U) FY 1982 Program: 1) Continue advanced adiabatic component exploratory investigations to allow the development and refinement of friction reduction techniques to improve performance and eliminate the oil system of high-temperature diesel engines. (2) Advanced turbine-combustor components will be designed and evaluated to determine fuel system management techniques, compatibility of alternate fuels against petroleum baseline for performance, lubrication/wear, efficiency impact on durability and reliability emissions and signature; turbine high-temperature ceramic coatings will be investigated as well as a ceramic recuperator. (3) Advanced engine intake air filtration self-cleaning systems will be evaluated; this approach promises to reduce maintenance and increase filter life; also, the Tank-Automotive Command will evaluate dust detector technology with the idea of providing a signal when excessive dust is being ingested by an engine. (4) Transmission oil seriation problem will be studied in an attempt to eliminate the present performance limitations it caused in some hydromechanical transmissions; development effort will be undertaken to extend the operational capability of transmission clutches, brakes and hydrostatic pumps and motors. (5) Specific concepts of a bidirectional suspension system will be analyzed for operational and cost effectiveness; the selected concept will be pursued to incorporat desired

Program Element: #6.26.01.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Tank and Automotive Technology
Budget Activity: #1 - Technology Base

modification in a specific design. (6) Track-rubber processing techniques to improve quality and reduce cutting/chunking in the field will be investigated. (7) ATEPS hull hardware will be tested in the baseline M1 tank and turret hardware design/fabrication initiated. (8) Prototype nonmetallic components will be fabricated and tested as well as continued evaluation of newer composite systems. (9) In Weapons Station Integration, a displacement sensitive trackball control system was developed, and the evaluation of the position-vs-rate technology is scheduled for FY 1982. Plans for FY 1982 include development and demonstration of a prototype tracker and a sight and fire control system compatibility study. (10) Techniques for protection of vehicle crew and components against laser damage will continue to be explored. (11) Countermeasure concepts against infrared, millimeter wave, and acoustic sensors will be designed and evaluated for effectiveness. (12) Assess the in-house and contractor-developed Future Close Combat Vehicle concepts to determine the critical issues and most promising technical options which will lead to a new generation of combat vehicles having the capability to effectively engage, survive, and win land battles in the 21st century. (13) Initiate combat vehicle critical subsystem design analysis in such areas as propulsion system compartments, weapon station integration and signature suppression techniques to guide future subsystem requirements. (14) Evaluate the military potential of individual lift devices and their operational envelope.

b. (U) FY 1983 Program: Mobility: (1) Continue development and refinement of component development for minimum friction high-temperature diesel engines and initiate system integration of components into a minimum friction, adiabatic engine. testing for application in future advanced turbine engines; gas turbine ceramic coating investigation will be concluded; and ceramic recuperator investigation will continue; (2) characteristics of candidate high-energy power systems will be evaluated, and a breadboard system will be developed; (3) alternate fuel work will continue to determine design changes required to enable efficient operation of selected fuels; (4) the Tank-Automotive Command (TACOM) will investigate state-of-the-art equipment, formulate concepts, and establish technical requirements for available auxiliary power systems; (5) TACOM will also initiate evaluation of electrostatic repulsion of dust from engine intake system as well as dust separator technology and advanced inertial separator concepts; (6) transmission concepts will be investigated which will have the potential for a drastic reduction in the power-train envelope; (7) TACOM will continue to develop new track/rubber processed compounds and the bidirectional suspension unit, complete analysis of track retention and control systems, and prepare data for a prototype fixed-pitch positive guided system. Efforts will include initiation of concept design for a terrain compliant suspension system; (8) field testing of on-vehicle components will be completed, data will be analyzed, and a report prepared; and (9) higher strength requirement components will be evaluated for composite material substitution. System Integration: (1) For Weapon Station Integration, the concept study for specfic applications of an all-pneumatic stabilization system for the M1 was completed, and the follow-on design concept phase will be undertaken in FY 1983; (2)

Program Element: #6.26.01.A Title: Tank and Automotive Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

participation in lightweight combat vehicles design and analysis will continue; (3) system integration analysis will be performed concerning missile applications for close combat vehicles; (4) development of magnetic bearing indicators will continue; (5) a brassboard pneumatic gyro rate sensor will be integrated into a technology demonstrator, and an all-pneumatic stabilization system prototype will be developed; (6) for Weapon Station Integration, the brassboard pneumatic rate sensor will be integrated into a technology demonstrator and into the M1 tank for test and evaluation, design study of the all-pneumatic stablization system will be undertaken, and a new task will be undertaken involving microprocessor application to gun/turret position control encoders, control data processing and target position reference information; (7) integrate the best features from the in-house and contractor future close combat vehicle options into optimal concept configurations and vehicle team; (8) continue combat vehicle critical system design analysis and assessment by addressing NBC and improved closed hatch vision; and (9) initiate the VETRONICS program which will project into individual combat vehicles intelligence and other information which can be of help to the vehicle commander. VETRONICS will be to ground vehicles as AVIONICS is to aviation. Survivability: (1) modification of thermal sources on ground combat vehicles for alteration of image cues in target selection will be undertaken; (2) track and engine silencing techniques and components will be integrated and evaluated for effectiveness; (3) control of vehicle-generated dust will be achieved by design of necessary components; (4) total vehicle lighting system will be modified to enhance security against image intensifiers; (5) sensitive components will be evaluated for susceptibility to laser damage; (6) evaluation of ammunition fire suppression systems through large-scale ballistic tests will be made, signatures of penetrating rounds will be obtained, and fire-suppressant toxicity will be determined; (7) laboratory evaluations of methods for using vehicle engine air filters and primary dust separators for crew nuclear, biological, and chemical protection will be made; (8) fire survivability includes completion of exploratory development work on the suppression of ammunition propellant fires, completion of a penetrating munitions electromagnetic signature measurement program, and the writing of a design handbook covering all aspects of combat vehicle fire survivability systems designs; (9) continue development of laser-hardened vehicle optics; (10) incorporate and assess techniques for combat vehicle track and engine silencing; and (11) investigate methods for reducing identification by altering image cues. Support: (1) fabrication, installation, and test of the ATEPS prototype hardware system in an M1 will be completed; reliability and cost effectiveness assessments will be completed; (2) develop noncontact and minimal-contact sensors and Advanced Diagnostic techniques applicable for use with general-purpose (standardized) test equipment.

c. (U) FY 1984 Program: (1) Continue optimization of advanced high-temperature adiabatic components with new emphasis in the valve, manifolding, cylinder block and cylinder head areas, turbine engine components; will initiate design of a broad-range compressor, concept work for alternate fuels, advanced air filtration systems, long-life track and NBC-tolerant rubber for roadwheels; final work will result in minimum friction, adiabatic diesel engine incorporated into

Program Element: #6.26.01.A Title: Tank and Automotive Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

future generation of highly efficient high-temperature diesel engines; (2) pursue development of novel transmission concepts; (3) conduct analysis of track retention and fixed-pitch track and coordinate bidirectional and adaptive data into terrain-compliant suspension; (4) explore new technology in area of fire-resistant materials; (5) evaluate new extinguishing agents; (6) investigate integration of previous test set functions into current vehicle diagnostic equipment; (7) continue development of NBC-materials and techniques; (8) explore technology to develop high-energy power source in burst power concept and conduct fuel tolerance investigations to widen spectrum of fuels for use in advanced engines; (9) total vehicle lighting system will be assessed and modified for photometric security; (10) millimeter and radar countermeasure techniques will be incorporated and assessed for effectiveness; and (11) development of techniques to reduce detection and identification will continue.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.03.A
Title: Large Caliber and Nuclear Armaments Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	26521	19750			Continuing	Not Applicable
AH18	Large Caliber and Nuclear Armaments Technology	26521	19750			Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Large Caliber and Nuclear Armaments Technology program performs exploratory systems development and necessary supporting research to further the state-of-the-art in weapons, munitions, and their interfaces. The output of this program is used in defining promising revolutionary systems as well as product improvements associated with evolutionary development. The program scope includes development of armored fighting vehicle armament (105mm and 120mm), infantry armament systems (indirect and remote fire systems and 81mm recoilless gun for Military Operations on Urban Terrain), artillery armament systems (target-seeking munitions, howitzer testbeds, and combat engineer support (mines and demolition systems). Project scope also emphasizes support technologies in the areas of improved sensing munitions (MMW and IR sensors), long-standoff warheads and search, point, and fire mechanisms, energetic materials (explosives, propellants, and pyrotechnics), weapons, munitions, weapon/munition interface, nuclear technology, fuze technology, and training munition technology. These efforts form the foundation for subsequent weapon and munition advanced developments, engineering developments, and many product improvement programs. A fundamental commitment has been made to address requirements and priorities as defined in the Science and Technology Objectives Guide, with concentration of effort and resources on those objectives having the highest priority and highest potential payoff.

Program Element: #6.26.03.A Title: Large Caliber and Nuclear Armaments Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

C. (U) BASIS FOR FY 1983 RDTE REQUEST: This program will support exploratory development of large caliber weapon systems, infantry armament systems, and combat engineer armament systems. This also encompasses the exploratory development of technological opportunities in the areas related to propellant explosive charges/fillers, cannons, projectiles, ammunition fuzes, and other types of munitions.

D. COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (*current requirements*)	26521	19750		Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	24646	26691		Continuing	Not Applicable

The increase in FY 1981 funding over the FY82 submission is due to increased funding of the fuze technology areas of automated auto-setting and multioption fuzing and development of air burst and fuzing for tank ammunition. The funding decrease in FY82 is a result of the amended budget request and the application of revised inflation and civilian pay pricing indices. The FY83 decrease is a result of program realignment.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.26.03.A Title: Large Caliber and Nuclear Armaments Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objectives of this program element are to develop and to maintain the advanced technology and exploratory development thrusts for improved major caliber nonnuclear and nuclear weapon systems. The program is divided into two major categories: technical areas dedicated specifically to systems that will enhance the capabilities of the Army branches that comprise the combat arms structure; i.e., armor, infantry, artillery, air defense, combat aviation and combat engineers; and generic (application nonspecific) basic technologies of energetic materials, munitions, weapons, weapon-munition interface, and nuclear munitions. Of paramount importance in structuring the program is the requirement for responsiveness to the objectives set forth in the Science and Technology Objectives Guide (STOG), and the recognition that only those Exploratory Development efforts that offer the highest potential payoff and that will clearly meet Army needs are transitioned to Advanced Development. Construction of the program envisioned the required efforts to support the need, the high priority of critical tasks commensurate with the austere program necessary to meet funding constraints.

G. (U) RELATED ACTIVITIES: Technical Areas of this program are related to Program Element 6.26.17.A, Small Caliber and Fire Control Technology, 6.26.18.A, Ballistics Technology, and numerous advanced and engineering development projects. Coordination of similar efforts conducted by the Air Force and Navy is accomplished by visits of technical personnel, interagency meetings, and tri-Service reviews and workshops to encourage cross-fertilization and preclude duplication.

H. (U) WORK PERFORMED BY: In-house efforts are conducted at the US Army Armament Research and Development Command facilities located at Dover, NJ, Aberdeen, MD, and Edgewood, MD. Contract support is provided by Motorola Government Electronics Division, Scottsdale, AZ; Florida University, Gainesville, FL; Honeywell, Minneapolis, MN, Norden Systems, Norwalk, CN; Firestone Tire and Rubber, Akron, OH; Westinghouse Electric Corporation, Pittsburgh, PA; General Electric, Burlington, VT; MIT, Boston, MA; and numerous other small contractors.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: During FY79, successful concept feasibility demonstrations were conducted of prototype Top Attack Smart Target Activated Fire and Forget (STAFF) and Sense and Destoy Armor (SADARM). These efforts have led to the transition of the technology to advanced development projects. Howitzer Test Beds I and II were tested in the Human Engineering Laboratory Battalion Artillery Test (HELBAT VII) exercise. Results indicated reduced response time and crew size and improved pointing accuracy. During FY80, precision firings in the High Mobility and Agility (HIMAG) stationary testbed vehicle in single-shot and burst fire produced excellent results. Limited three-round burst firings from a

Program Element: #6.26.03.A Title: Large Caliber and Nuclear Armaments Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

stationary HIMAG against moving targets and a moving HIMAG against stationary targets demonstrated satisfactory growth potential. High Survivability Test Vehicle - Lightweight (HSTV-L) single-shot dispersion tests, conducted at 1000 meters, yielded results comparable to HIMAG. A number of explosive and propellant formulations are under consideration for vulnerability reduction. The most promising is NEAK (NQ/TNT, EDDN, AN, and KNO_3). This formulation is castable, and preliminary data show a 50% reduction in sensitivity over Comp B. An overall concept for a ramjet-powered projectile was defined, and the preliminary design that incorporates the ramjet, seeker, and payload has justified the transition of this technology to the advanced development phase during FY81. Flight tests of the 51mm Lightweight Recoilless Gun demonstrated this weapon to be highly successful in defeating a complete range of urban targets. Fabrication of a self-contained, fully automated weapon control system for a 155mm Howitzer (HTBIII) was completed. HTBIII was shipped to Ft. Sill, OK, for testing in HELBAT VIII during 1QFY82. Technical progress in the Electromagnetic Propulsion program surpassed reasonable predictions made 3 years ago. Substantial advances were made in mass accelerators, energy storage, switching and guidance configurations. A 15-MJ homopolar generator with rail gun has been fabricated and is to be installed at the Dover site during FY82.

2. (U) FY 1982-FY 1984 Planned Program: Highlights of this program include the Lightweight Recoilless Gun as a candidate MOUT assault weapon in a competitive shootoff in March 1982; Howitzer Test Bed III will be tested in HELBAT VIII; the installation of a 15-MJ homopolar generator with rail gun at the Dover, NJ, site will expedite progress of the Electromagnetic Propulsion program; continue efforts to develop and characterize explosive, propellant, and pyrotechnic formulations for various classes of ammunition. Continue efforts that will provide new concepts in cannon, cannon mounts, and recoil systems. Improvement goals include greater muzzle energy and firing rates per unit weight, better accuracy and precision, and longer weapon life. Continue technology efforts in support of standard and future munition systems encompassing technology related to munitions, munitions and propulsion interface, nuclear munitions, and ammunition fuzes. Technology base efforts required to provide the highest probability of kill against armored vehicles and secondary targets, through establishing significant improvements in firepower capability. Investigations to determine the future threats and define the future battlefield of the 1990's will be conducted and the results incorporated into the program as appropriate. Advance the technology base in warheads, target acquisition, and aerodynamic devices by supporting evaluations concerned with system analysis target vulnerability and countermeasures to optimize munition performance in the combat environment. Continue to develop the technology and/or explore evolving technologies to provide the basis for design of lighter weight, more effective infantry armament systems. Continue efforts to provide the technology base required to enhance the firepower capabilities needed to achieve improved artillery systems. The attack and neutralization of targets both in close proximity to the forward edge of the battle area (FEBA) and those in assembly or second-echelon areas out of direct observation range are the primary thrusts. Continue the technology to provide new, innovative subsystems and component technology into

Program Element: #6.26.03.A Title: Large Caliber and Nuclear Armaments Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

advanced artillery testbeds. Included will be innovative techniques for automatic ammunition handling and loading recoil mechanisms, new cannon and breech mechanisms, cased propellant charges, automated weapon loading and position location and azimuth referencing subsystems that permit more autonomous operations. Conduct exploratory development to evolve new concepts, apply new materials, and investigate specific techniques that have potential for providing to the user more cost-effective, more countermeasure-resistant, and more rapidly emplaced mine systems. Efforts will continue for nonsystem-related development programs at a reduced level of effort which results from reduced funding in FY 1983. Programs affected include: energetic materials, weapons technology, munitions technology, munition/propulsion interface technology, nuclear munitions technology, ammunition fuze technology, and training munitions for application to future munitions systems. The conduct of these exploratory developments requires 126 professional and 26 technical support personnel.

3. (U) Program to Completion: This continuing technology program will demonstrate innovative munition concepts and define ways of product-improving the current systems to extend their useful life. Continuation of exploratory development efforts for artillery components and techniques for existing and future munition systems.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.17.A
Title: Small Caliber & Fire Control Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	12117	11470	9902	12216	Continuing	Not Applicable
AH19	Small Caliber & Fire Control Technology	12117	11470	9902	12216	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: There is a major need to improve the probability of hitting enemy targets on the first round and successive rounds, as well as increasing the effectiveness of small caliber ammunition. Fire control components for gun systems offer a significant potential for improving gun accuracy through the application of advancements in electronic devices and new sensors. There has also been a longstanding need to consolidate Department of Defense research and development efforts in small arms. Since small caliber ammunition and guns are high-volume items, there is a continuing need in the areas of cost reduction, reduced logistic burden, and improved weapon system producibility and useful life. This program is to develop the technology base, exploit new findings and conceptualize and demonstrate innovative improvements in fire control, automatic cannon weapons, and small arms weapons and munitions systems to meet the mission need. Material applications and processes for improving current systems producibility and useful life, reducing logistic burden, and improving weapon features such as reducing weight and cost are a significant portion of this effort. The scope of the program emphasizes the system-oriented areas of combat vehicles, aircraft, infantry and short-range air defense armaments, as well as developing the basic technology areas of fire control, armaments, and material applications. The specific investigations develop both hardware and analytic tools necessary to assess system performance, identify problem areas, and address resolution of these problems. The resulting data base forms the foundation for all subsequent fire control and small caliber weapon and munition advanced and engineering developments.

Program Element: #6.26.17.A Title: Small Caliber & Fire Control Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The funds will support the development and maintenance of a small caliber and fire control technology base encompassing the technical areas related to armament and fire control for combat vehicles, aircraft, light weapons, and air defense, and to further investigate the broad areas of fire control and small caliber armaments.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	12117	11470	9902	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	12477	9316	12780	Continuing	Not Applicable

FY81-83: Net decreases of 360K and 1,078K for FY81 and FY83 respectively are part of a general decrease. Reduction was absorbed basically by reductions to the system-oriented technical areas, Short-Range Air Defense, Aircraft Armament, and Combat Vehicle Armament. The net increase of $2154K in FY82 was the result of a Congressional increase to be used to enhance the Joint Services Small Arms efforts. The Joint Service Small Arms Program (JSSAP) was separated from this program element in FY83 to provide better visibility for this important effort. Beginning in FY83, funds for the JSSAP program are found in program element #6.26.23.A, project AH21.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.26.17.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Small Caliber & Fire Control Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective is to develop and maintain a technology base upon which advanced development of fire control for all gun systems, future automatic cannons, and future small arms for all the services, improved small caliber munitions, and innovative materials applications for gun systems can be initiated to improve existing weapon systems and/or to develop new systems. Current emphasis includes improved infantry fighting vehicle armament, lightweight armament for rapid deployment capability, lightweight air defense gun systems, all-weather fire control, improved helicopter armament for survivability and standoff, and tank fire control for improved hit probability. A primary goal is to improve and to resolve critical problems in fire control, automatic cannon weapon systems, and small arms. The approach is to assure effective operation, while seeking to improve reliability, maintainability, and durability. In addition, program objectives emphasize cost reduction processes, new material applications, alternatives for critical materials, and solution of production and field problems for all calibers of gun armament systems. The approach is an integrated program of analysis, experimentation, and test demonstration that advances the state-of-the-art and leads to concept validation.

G. (U) RELATED ACTIVITIES: The technical areas in this program are related to the following program elements: 6.26.23.A, Joint Service Small Arms Program (JSSAP); 6.36.07.A, Joint Service Small Arms Program (JSSAP), 6.26.03.A, Large Caliber and Nuclear Technology (AH18); 6.26.18A, Ballistic Technology (AH80); 6.22.03.A, Space Aircraft Weapons Technology (DH96); 6/21/05.A, Materials Technology (AH84); and numerous other advanced and engineering development projects. The coordination of similar efforts conducted by the Air Force and the Navy is accomplished by interagency meetings and triservice reviews and workshops to encourage information exchange and preclude unnecessary duplication. A Joint Services Small Arms Program has been chartered with membership from the Army, Navy, Air Force, Marine Corps, and Coast Guard, to coordinate development of all small arms weapons. The Laboratory director chairs the Army fire control technology base planning group which includes active members from all development and readiness commands to assure full coordination and prioritization of activity and the most effective utilization of resources. The Laboratory director also chairs the Joint Services Working Party for Guns, which reviews, assesses, and coordinates all gun activities, principally automatic cannons, for all the services. In close cooperation with the US Army Aviation Research and Development Command, a fully integrated helicopter armament technical base program has been developed.

H. (U) WORK PERFORMED BY: The In-house work is conducted at the US Army Armament Research and Development Command facilities located at Dover, NJ. The five largest contractors are the Northrup Corp., Anaheim, CA; Area Corp., Port Clinton, OH; World Metals, Chester, OH; Magnavox Corp., Mahwah, NJ; and Analytic Sciences, Redding, MA. In addition, there are small contracts with 13 other vendors with a total value of $420,000.

Program Element: #6.26.17.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Small Caliber & Fire Control Technology
Budget Activity: #1 - Technology Base

1. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1981 and Prior Accomplishments: The potential of a 25mm long-rod, heavy-metal projectile for the Infantry Fighting Vehicle has been successfully demonstrated and transitioned to 6.3. Developed design requirements for an improved combat vehicle armament system that will enable a product-improved Infantry Fighting Vehicle to out-shoot the projected 1990's threat vehicle. For infantry light vehicles and tank secondary armament, a general-purpose heavy machine gun was designed in caliber .50, tested, and transitioned to 6.3a following user concept demonstration. A user demonstration of competitive 9mm submachine guns, selected to provide a spectrum of design characteristics, was completed. Completed the concept development of advanced close assault ammunition and quantified antipersonnel terminal effects. Completed the combat rifle study as directed by Congress. Established system parameters for a multifunctional processor for high-speed, realtime calculation in response to requirements for advanced fire control systems. Designed and demonstrated thin-film optical filters which permit normal viewing through fire control optics

. In cooperation with the Aviation Research and Development Command, an air-to-air self-defense capability for helicopters was demonstrated in flight tests, the feasibility of acoustic target acquisition demonstrated, a mast-mounted sight was demonstrataed, an airborne fire control radar was designed, and a capability to fire high-impulse automatic cannon (Air Force GAU-8) from a helicopter using a force optimized recoil-controlled turret was demonstrated. Low-drag air defense projectile configuration was defined and demonstrated. A vapor-deposited coating for solving the tank ammunition corrosion problem was demonstrated. Significant manufacturing cost savings for fuzes and small caliber gun components, by the definition of an application of powder metallurgy techniques and rapid solidification technology, were demonstrated and documented.

2. (U) FY 1982-FY 1984 Programs: In FY 1982, the potential of caseless small arms ammunition and the development of an advanced combat rifle to offer revolutionary changes to infantry weapons is a major part of the Joint Services Small Arms Program. This effort will emphasize definition of a caseless system, including weapon, propellant, multiple flechette projectiles, and ancillary technology efforts. Additional efforts will be undertaken to develop a combat shotgun and an advanced long-range rifle system. In developing fire control systems for ground and airborne combat vehicles, emphasis is placed on simplicity of operation and maintenance and/or reducing the rapidly escalating costs of new systems multifunctional use of instruments and exploitation of advances, in electronics, devices, and new sensors. Integrate the discrete video autotracker in the M60 testbed and complete test and evaluation of the fast Fourier transform tracker. Complete design for an in-flight corrected trajectory projectile system emphasizing tracking requirements analysis, projectile selection/modification, and complete six-degree-of-freedom simulation model. Complete algorithms for tracking ballistic trajectory and relating location to miss distance for the M1 tank ballistic computer. Completed dual-frequency millimeter wave track radar acceptance tests and evaluate performance versus maneuvering targets. The initial design layout for the airborne

Program Element: #6.26.17.A Title: Small Caliber & Fire Control Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

high-impulse precision armament system will be completed. Trade-offs and options to meet the requirements for both the advanced attack and new light helicopter will be completed. Data from flight tests of an acoustic sensor and processing system will be evaluated to determine potential of this technique for extending the range of acquisition of threat vehicles in ground clutter or while in defilade. Use of these passive sensors could provide low-cost acquisition and tracking assistance and greatly enhance system survivability. The potential of rapid solidification techniques for achieving major improvement in material properties and the resulting increased performance of weapon systems will be evaluated. Concept options will be developed for liquid propellant traveling charge propulsion as well as simulation models for both bulk-loaded and regenerative systems. In FY 1983, hardware fabrication and components tests will be completed for a conceptual armament system for a future light combat vehicle. This will provide a future infantry fighting vehicle with the capability to outshoot the projected 1990's threat. The Airborne acoustic sensor system breadboard will be updated, and through additional flight tests, a set of system specifications developed. A dual-role gun armament system will be tested to generate data on air-to-ground and air-to-air capabilities to obtain trade-off data for future needs. Hardware fabrication will be completed for the in-flight corrected trajectory projectile system for future main battle tanks. This system would significantly increase both the effective range and hit probabilities of main battle tank guns. An initial experimental fixture for a liquid propellant automatic cannon system will be completed. The development of the plasma arc melting technique for the production of tungsten and tungsten alloy penetrators will be completed. Techniques to reduce the probability of enemy intercept of acquisition and track radars will be demonstrated. The requirements and the system design for the Light Air Defense System will be finalized. In FY 1984, integration of the gun, ammunition, and fire control into a modified Infantry Fighting Vehicle turret will be completed. The capability of this vehicle to meet the future light armored threat will be demonstrated. Design of acoustic signal processors, sensors, and beamformers for air defense application will be completed, and the subsystem will be integrated into a air defense vehicle for testing. The integration and user demonstration of the dual-frequency millimeter wave track radar in an air defense vehicle demonstration will be completed. Development of short-time-of-flight subcaliber ammunition for a division air defense system will be completed and transitioned. Fabrication of a radar brassboard to demonstrate the capabilities of very high-speed integrated circuits will be completed as well as a laboratory evaluation. The in-flight corrected trajectory projectile system will be integrated into the M60 tank testbed for demonstration in the next fiscal year. Evaluation of the potential application for gun-launched maneuvering munitions for helicopter and air defense roles will be completed. Development of nickel alloy alternate materials to eliminate the need for cobalt liners in current machine guns will be completed. Development of advanced coating to protect depleted uranium penetrators from corrosion will be demonstrated. This effort involves 82 professional and 21 support personnel.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.18.A
Title: Ballistics Technology
DOD Mission: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY1984 Estimate	Additional To Completion	Total Estimated Costs
	Total For Program Element	19606	21841	21637	25234	Continuing	Not Applicable
AH80	Ballistics Technology	19606	21841	21637	25234	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The efforts within the technical areas of this program element are dedicated to satisfaction of specific objectives in the Army Science and Technology Objectives Guide, which serves as the basis for structuring research and development programs at the entry level of the materiel development cycle. The Guide formulates and prioritizes user-oriented requirements for the Army's mid-to-long-range planning periods. Results from Ballistic Technology work are used in the development of weapon systems or other materiel to provide Army-required capabilities in close combat, fire support, air defense, and other combat support. Hardware constructed within this program is limited to proof-of-concept laboratory prototypes. The program is needed as a primary source of technological innovations and improvements providing initial definitions of concepts which can be exploited in system development under advanced development (6.3) and engineering development (6.4).

C. BASIS FOR FY 1983 RDTE REQUEST: Funds are needed to support a long-range ballistics technology program responsive to long-term combat capabilities of the Army. During FY83, emphasis will be placed upon exploratory development efforts in Interior Ballistics, Launch and Flight Dynamics, Ballistic Protection, Lethal Mechanisms and Vulnerability/Survivability/Lethality. Specific efforts will focus on high-impetus propellants for use in traveling charge hypervelocity gun concepts, reduction of muzzle blast overpressures and signatures from modern high-performance artillery firing at high charge zones, techniques to desensitize ammunition against the effects of fire and shock.

Program Element: #6.26.18.A
DOD Mission: #523 - Engineering Technology (ED)

Title: Ballistics Technology
Budget Activity: #1 - Technology Base

and techniques to increase survivability of Army equipment.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	19606	21841	21637	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	17733	23912	28790	Continuing	Not Applicable

The increase in FY81 resulted from enhanced Army support of Armor/antiarmor efforts. The decrease in FY 1982 is a result of program realignment. The decrease in FY83 is a result of decrease in requirements, thereby reducing efforts in the areas of interior ballistics, warhead mechanics, terminal effects, and ballistic protection.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.26.18.A
IOD Mission: #523 - Engineering Technology (ED)

Title: Ballistics Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program element is to develop and maintain ballistic technology which insures a solid foundation upon which advanced and engineering development of weapon systems can be initiated and sustained. The Ballistics Technology Program focuses on describing closed system ignition and combustion processes (interior ballistics), interactions between high-pressure gases with the atmosphere (interior ballistics and launch and flight dynamics), dynamics of projectile flight (launch and flight dynamics), delivery of projectile energy to a target (lethal mechanisms and techniques and materials to defeat penetrators (ballistic protection). The capability to describe ballistic phenomena in a comprehensive manner is critically important to the successful prosecution of advanced and engineering development of weapon systems. Through that capability, state-of-the-art concepts can be identified, developed, and evaluated with a minimum of costly and time-consuming trial and error experiments. In addition, the Ballistics Technology Program develops vulnerability assessment techniques which are used Army-wide by development and analysis agencies to identify system weaknesses and appropriate design changes before production. This formalized vulnerabili y assessment/reduction effort has increased survivability of recently developed Army materiel. Equally important the effort pinpoints and quantifies weaknesses in enemy equipment, weaknesses that can be exploited by weapons designers and military doctrine analysts.

G. (U) RELATED ACTIVITIES: Ballistic Technology Programs are related to development activity in Large Caliber and Nuclear Technology, 6.26.03.A; Small Caliber and Fire Control Technology, 6.26.17.A; and Tank and Automotive Technology, 6.26.01.A. Also, Ballistics Technology Research is related to efforts conducted by the Air Force and the Navy. Visits by service technical personnel and interagency transfers of knowledge preclude unnecessary duplication of efforts.

H. (U) WORK PERFORMANCED BY: Approximately 85 percent of the work will be performed in-house at the U. rmy Armament Development Command facilities at the Ballistic Research Laboratory, Aberdeen Proving Ground, MD. Other participating Army facilities include major system commands of the Materiel Development and Readiness Command, among which the Test and Evaluation Command, Aberdeen Proving Ground, MD, will be the major participant. Major contract support will be provided by the New Mexico Institute of Mining and Technology, Socorro, NM.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1981 and Prior Accomplishments: Demonstrated feasibility of the Precision Aim Technique (PAT), which provides extraordinary accuracy when firing a weapon from a vibrating platform. The laboratory prototype PAT is a computer-controlled firing circuit that controls the time of firing of a gun subjected to internal and external forces and

torques. Techinque will improve accuracy of guns on rotary-wing and armored vehicles. The armor program focused on development of technologics to defeat advanced threat penetrators. Significant results have been attained in the short-term, intensive program designed to close the technology gap between kinetic energy (KE) threats and US heavy armor performance. This program continues to proceed ahead of schedule.

Thirty-three firing tables and one hundred twenty-two other documents containing aiming data were developed and published. The first version of ACE--the Artillery Control Experiment--has become operational. ACE is a medium-scale "man in the loop" computer simulation of the command and control structure of a field artillery unit. In its present form it comprises computer-based software that emulates one or more digital message devices and simulates reponse of battery computer unit as well as respective communication links.

2. (U) FY 1982-FY 1984 Planned Program: Determine burning rates of high-force nitrogen-boron-hydrogen propellants. Provide propellant design information for traveling charge hypervelocity gun. Exploit ignition system design parameters to enhance performance and safety of top-zone propelling charges for artillery. Conduct field and heliborne evaluations of the Precision Aim Technology, which provides extraordinary accuracy when firing a weapon from a vibrating platform. Complete design of small and medium caliber prototype tubular ramjets for training round uses. Formulate and provide firing tables for all US land combat weapons and provide data for field artillery computers and the NATO interoperability program. Modify mechanical microscopic behavior of multicomponent explosive systems to improve resistance to ignition/spread of reaction. Complete intensive, short-term armor program designed to close technology gaps between kinetic energy (KE) threats and US heavy armor. Initiate full-scale tests damage confinement and structural integrity for reactive armors. Exploit materiel developments and tailor High Explosive Antitank (HEAT) warhead jet energies to target requirements. Evaluate candidate composite KE penetrators for antiarmor use. Determine thermal/blast effects from High Explosive (HE) and nuclear weapons and their impact on materiel. Provide guidelines for incremental modifications to enhance survivability of fielded and developmental materiel. Implement interactive computer graphics for vulnerability assessments and target descriptions. Evaluate the Artillery Control Experiment concept in the Human Engineering Laboratory Battalion Artillery Test (HELBAT) 8 exercise. Exploit state-of-the-art technology to reduce time-of-flight of gun launch air-defense projectiles. Evaluate millimeter wave components for warhead sensor use. Evaluate deterred propellants for tank gun use. Demonstrate and compare performance of low cost and ultra-leightweight sabot options for tank gun ammunition. Characterize compression sensitivity of selected liquid propellants. Design and fabricate solid-fuel ramjet vehicles for air defense rounds. Evaluate

Program Element: #6.26.18.A
DOD Mission: #523 - Engineering Technology (ED)

Title: Ballistics Technology
Budget Activity: #1 - Technology Base

prototypes in full-scale firing demonstrations. Characterize and reduce muzzle blast effects from artillery. Formulate and provide firing tables for all US land combat weapons and provide data for field artillery computers and NATO interoperability program. Develop quick-acting fire detection techniques and exploit for protection of armored vehicles. Develop advanced armor technologies at one-quarter-scale select candidates for prototype evaluation. Complete full-scale damage confinement and structural integrity evaluations of reactive armors. Evaluate the effectiveness of tandem HEAT warheads. Conduct terminal ballistic evaluation of advanced materiel KE penetrators. Characterize thermal environment of BRL thermal/blast simulator. Conduct vulnerability assessments to determine optimum armor configuration for light and heavy armored vehicles. Assess and identify methods to enhance the lethality of fielded and developmental weapon systems. Through rationalization of combat supply, determine critical materiel and operations to maximize weapons system availability and minimize logistic burden. Develop concepts and subsystems for future air defense artillery system. Develop and apply analytical techniques to assess emerging technologies for armored combat vehicles. Develop technology for SMART air defense bullet sensor. Determine combustion characteristics, mechanical properties and sensitivity of superburning rate propellants for traveling charge gun demonstrator. Provide guidelines for Low Vulnerability Ammunition (LOVA) use in artillery. Determine the source of gun tube "jump." Determine relevant processes, flow parameters and scale for three-dimensional, two-phase flow analytical simulation of the interior ballistics cycle. Determine effects of loose and rotating liquid payload on flight stability of shell. Obtain experimental data on projectile flight dynamics. Formulate and provide firing tables for all US land combat weapons and provide data for field artillery computers and the NATO interoperability program. Evaluate combined active and passive fire suppression techniques to techniques to extinguishing munition fires in armored vehicles. Conduct full-scale tests of reactive armors and integrated design passive armors. Provide ballistic protection technology for modern weapons systems. Exploit applications for tandem HEAT warheads. Evaluate novel alloys for use in KE penetrators. Determine thermal/blast effects on Army systems components. Quantify critical components for charged particle beam and microwave damage mechanisms. Establish threat materiel capabilities and develop technical assessments for use by weapons developers and evaluators. Develop concepts for SMART gun-launched air defense projectile. Conduct proof-of-concept firing demonstration. Provide technology for achieving particle acceleration devices with weight and size compatible with tactical Army applications. Provide technology for application of millimeter wave components in 217-GHz beamrider systems. The conduct of these exploratory development efforts requires 419 professional and 77 technical support personnel.

3. (U) Program to Completion: This is a continuing program of exploratory development to develop and maintain a ballistics technology base assuring a solid foundation upon which advanced and engineering development and product improvement programs of weapon systems can be initiated and sustained.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.22.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Chemical and Smoke Munitions
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING). ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	7279	18468	14829	16810	Continuing	Not Applicable
A552	Chemical Munitions	-0-	-0-	5060	5023	Continuing	Not Applicable
A554	Smoke and Obscurant Munitions	7279	18468	9769	11787	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Soviet Union has long acknowledged and appreciated the attributes of chemical weapons to create casualties, degrade combat effectiveness, and disorient the battlefield. Consequently, the USSR has continually maintained and is constantly improving its already formidable chemical warfare capabilities. These capabilities represent an unacceptable threat to the survival of US forces and those of its allies. The US needs to sustain a program designed to deter and/or counter that threat by exploiting new and novel concepts emanating from basic research and exploratory development and enhancing significantly a broad technology base to support the follow-on development of improved chemical munitions (lethal and incapacitating) and chemical combat support materiel (smoke and civil disturbance/tactical irritants). Specifically, efforts in this project apply the outputs of basic research to the exploratory development of new, improved and/or novel chemical and chemical combat support systems as required by US forces. Toward this end, the Army has been designated the Executive Agent of DOD for all basic research, exploratory development, advanced development, and for engineering development of those items/systems that satisfy Army requirements or the joint requirements of more than one or all of the other Services and for the development of all chemical agents for military purposes. As such, there is the requirement for a continuing project to support DOD-wide chemical weapons systems development. This project provides the only source for such support, and also provides the only deterrent capability in the Free World.

Program Element: #6.26.22.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Chemical and Smoke Munitions
Budget Activity: #1 - Technology Base

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The funding level of this program will expedite the enhancement of the technology base upon which to build a chemical warfare deterrent posture sufficient to close the capability gap between the US and Soviet/Warsaw Pact nations. The FY 1983 program will continue to accelerate the development of a chemical munitions family incorporating new munitions concepts with binary intermediate volatility agent (IVA) fills. This is essential for timely attainment of a credible deterrent/retaliatory capability. Those systems to be investigated include missile and rocket warheads, remotely piloted vehicles (RPV), artillery projectiles, and bombs. Proportionate increases in funding will be required and programed in FY 1984 and beyond to sustain the impetus of this effort initiated in FY 1982. Additionally, multispectral smoke and aerosol screening concepts are being applied to deep target, and ballistic and guided munitions systems. Toxicological evaluation of candidate infrared (IR) and multispectral smoke and obscurant agents will continue, as will technical support of munitions development efforts to assure low risk, efficient designs, and scale-up parameters for the weaponization of IVA or other agents. Efforts will continue on the development of the data base on candidate obscurants with emphasis on environmental effects, screening characteristics, and toxicity. Work will also continue on the development of new incapacitation and civil disturbance agents which are effective through the skin as well as via inhalation. New and improved methods and models for estimating the probability of incapacitating trauma from penetrating and blunt impacts will continue to be provided.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	7279	18468	14829	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5280	20528	7012	Continuing	Not Applicable

The funding increase of $1999 thousand in FY 1981 and $7817 thousand in FY 1983 is the result of an Army commitment to provide increased funding to support a critically needed expansion of the US chemical warfare deterrent/retaliatory

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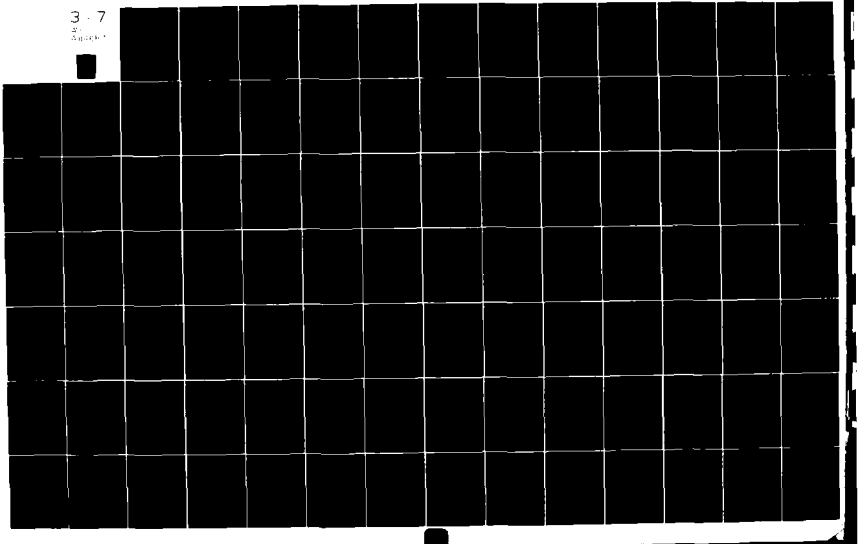

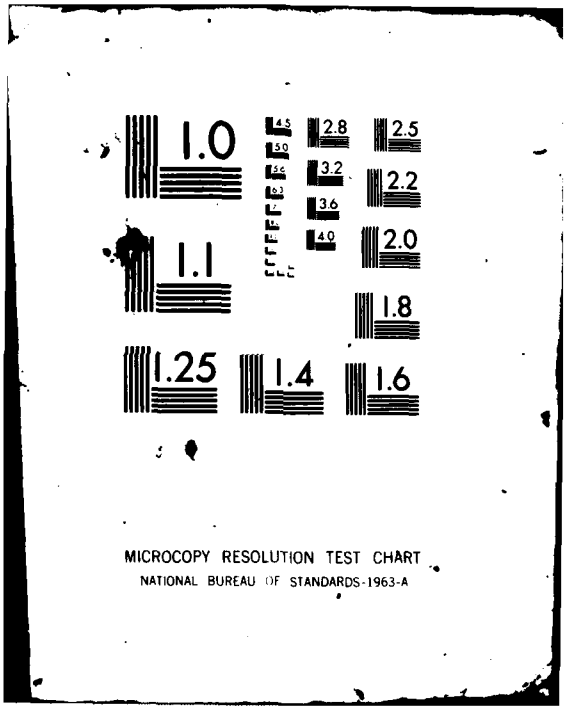
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Program Element: #6.26.22.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Chemical and Smoke Munitions
Budget Activity: #1 - Technology Base

technological base in order to counter an ever-increasing Soviet/Warsaw Pact threat. The funding decrease of $2060 thousand in FY 1982 is a result of a Congressional decision.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.26.22.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Chemical and Smoke Munitions
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program supports the entire Department of Defense (DOD) chemical technology investigations in the following areas: (1) Lethal Chemical Agents/Weapons: Encompasses applied research activities associated with physical and analytical chemistry of potential lethal chemical systems; exploratory development of binary lethal chemical agents of various degrees of volatility to be used with a variety of munition types with a resultant capability for air or ground delivery using standard and advanced weapons systems; and applied research leading to an understanding of phenomena which enhance the threat and effectiveness of these agents; (2) Incapacitating Chemical Agents/Weapons: Includes searches for new, more potent, shorter onset time, shorter effects duration, percutaneously active, and very safe to handle incapacitants; developing effective means for exploitation of these agents; and identifying the physical and chemical characteristics of these agents; (3) Chemical Combat Support Systems: Includes accelerated search for improved multispectral smoke/obscurant screening materials and delivery systems to cover visual through microwave regions of the electromagnetic spectrum; and provides for large-area screening capability with minimum logistics burden. Also included are the development and evaluation of new chemical compounds for civil disturbance control and tactical irritant agents, development of concepts for their use, and the establishment of feasible and responsive munitions.

G. (U) RELATED ACTIVITIES: In executing the Army's executive agent responsibilities as assigned by DOD Directive 5160.5, investigations under this project provide the essential exploratory effort in lethal, incapacitating, and civil disturbance control agents and munitions, smoke and multispectral obscurant agents and munitions, and the total technology base for the entire Department of Defense. No comparable work is done by the other Services, and coordination is maintained with them to assure provision of the technology essential to their development needs. Close coordination is maintained between the investigative groups to preclude duplicative effort through joint working and coordinating groups. Coordination and cooperation is maintained with the international community. Related technical investigations are conducted under PE 6.27.06.A, CB (Chemical-Biological) Defense and General Investigations. The projects provide direct technical support to Program Elements 6.36.15.A, Lethal Chemical Munitions Concepts; 6.36.27.A, Combat Support Munitions, 6.36.14.A, Incapacitating Chemical Munitions Concepts; 6.46.10.A, Lethal Chemical Munitions; 6.46.09.A, Combat Support Systems; and 6.46.13.A, Incapacitating Chemical Munitions.

H. (U) WORK PERFORMED BY: Contractors - ASH Stevens, Inc., Detroit, MI; Batelle, Columbus, OH; Brunswick Inc., Marion, VA; Southern Research Institute International, Birmingham, AL; Barnes Engineering, Stanford, CT; Aerodyne Research, Burlington, MA; R&D Associates, Santa Monica, CA; Rahtech, Madison, WI; American Histological Laboratories, Bethesda, MD; and Stanford Research, Menlo Park, CA. In-house developing organization is the US Army Chemical Systems Laboratory, Aberdeen Proving Ground, MD.

Program Element: #6.26.22.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Chemical and Smoke Munitions
Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Over the past 20 years, a variety of flame and incendiary, lethal chemical, tactical riot control, and civil disturbance control agent munition systems have been developed and fielded. To enhance safety and security, the binary concept has been successfully applied to the development of two artillery chemical projectiles. This concept is also being applied to the search for new dual-purpose agents having enhanced percutaneous and inhalation effectiveness and in the design of extended-range artillery projectiles, rocket warheads, and aerial-delivered munitions. A continuous effort is being made in the search for new intermediate volatility incapacitating agents which are effective both by inhalation and by absorption through the skin. Based on an assessment of the expected threat, a high urgency was placed on the development of new multispectral large-area smoke/obscurant systems. A five-year program was initiated in FY 1977. All US standard smoke formulations and numerous foreign formulations have been characterized for their screening capabilities. The search for the testing and evaluation of new candidate materials are continuous efforts. Field characterization and evaluation of candidate materials is accomplished during an annually scheduled Smoke Week where both electro-optical devices and smoke-obscurant systems are employed in a simulated realistic battlefield environment. Smoke programs have in the past utilized approximately 75 percent of the dollars allocated to the Program Element. This trend will be reversed in FY 1982, and a near equal distribution will occur in subsequent outyears. Accomplishments during FY 1979 included: (1) completion of exploratory development on the manportable large-area screening system, 2) continued development on two infrared screening agents which showed good potential in Smoke Week II, (3) demonstrated that the approved training agent polyethylene glycol 200 will produce a good smoke screen in the large-area screening system, (4) characterized several candidate obscurants and battle-induced dust for spectral attenuation properties, particle size distribution and chemical composition, (5) added methodology for munitions expenditure requirements to the Smoke Obscuration Model, (6) completed construction of full-scale 8-inch projectile reactant chamber and conducted tests to evaluate reaction kinetics, temperature, and stoichiometry of binary reactions. Results of the chamber tests helped resolve the cause of malfunctions of simulant-filled XM736 binary projectiles. During FY 1980 the program accomplished the following: (1) completed technology support for the XM736 Binary VX Projectile; (2) selected and evaluated binary warhead concepts for the Multiple Launch Rocket system, 81mm binary mortar cartridge [illegible] 2-inch binary mortar cartridge; (3) initiated toxicology studies for binary intermediates; (4) continued bulk mixing [illegible] and developed standards for new binary intermediates for better munition evaluation and quality control and starting [illegible] (5) initiated remotely piloted vehicle binary concept evaluation; (6) finalized the design of high flow generation fo[illegible]-area screening with multispectral smoke agents; (7) completed modifications to the Large-Scale Decontamination Device (Jet Exhaust) to add rapid, large-area smoke-generating

Program Element: #6.26.22.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Chemical and Smoke Munitions
Budget Activity: #1 - Technology Base

capability; this dual capability will reduce logistic burden and provide protective cover for decontamination operations; (8) sixty candidate smoke agents have been characterized and nine have been recommended for use in 6.3 developments; and EA 5752-filled XM76 Infrared Smoke Grenade demonstrated design feasibility of that concept at Smoke Week III. During FY 1981 exploratory development on binary concepts for the 155mm and 8-inch intermediate volatility agent (IVA) projectiles were completed. Potential dual-purpose (inhalation and skin penetration) chemical agents were evaluated with an emphasis on their adaptability to the binary mode for several candidate munition systems (e.g., missile and rocket warheads, drones, and modular munitions). A search continued for safe reactive simulants for binary agents and practical means for field assessment of these simulants in lieu of open-air testing of toxic agents. New improved multispectral screening compounds and compatible dissemination systems were investigated. Smoke aerosol characterization studies were continued on candidate materials. Concept formulation for improved infrared screening munitions and the initiation of concept studies for battlefield smoke elimination were accomplished. Toxicity evaluations for candidate smoke materials and an evaluation of EA 4923 as a potential civil disturbance and tactical irritant were conducted. Studies were continued to evaluate the effectiveness of EA 1834 as a percutaneous incapacitating agent. New and improved methods and models for estimating the probability of incapacitating trauma from penetrating and blunt impacts were developed.

2. (U) FY 1982-FY 1984 Program: Exploratory development will be completed on the binary concept for a chemical warhead for the Corps Support Weapon System and a lightweight mobile binary lethal agent munition system. Investigations will evaluate potential dual-purpose lethal agents adaptable to binary delivery, weaponization concepts for remotely piloted vehicles, air-deliverable mines, Ground-Launched Cruise Missile, lightweight portable rocket warheads, and extended-range artillery projectiles. Weaponization concepts, toxicology, and use scenarios for potential incapacitating agents will be studied. Technology base studies will continue to evaluate candidate multispectral obscurant materials with an emphasis on environmental effects, toxicology, elimination techniques, and optical characteristics. New methods and models for estimating the probability of incapacitating trauma from penetrating and blunt impacts will be developed. Efforts on such systems are incapacitating air scatterable mines; semipersistent lethal agent warhead for the Corps Support Weapon System (CSWS); incapacitating agent 155mm projectile; various chemical fills for ground-launched cruise missile (GLCM) and remotely piloted vehicles (RPV); lightweight and long-range mortars, etc., will continue and/or be intitiated in support of Army and/or tri-Service requirements. Evaluation of environmental control mechanisms will continue. Weaponization concepts, toxicology and use concepts for new incapacitating agents will be studied. The program employs a total of 77 personnel: 66 professional and 11 support.

Program Element: #6.26.22.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Chemical and Smoke Munitions
Budget Activity: #1 - Technology Base

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A552 Title: Smoke and Obscurant Munitions
Program Element: #6.26.22.A Title: Chemical and Smoke Munitions
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The primary objective of smoke employment is to increase the effectiveness of US operations while reducing the vulnerability of US forces. Smoke/aerosols can be used in self-protecti n, screening, or "blinding" the enemy. Typical uses of smokes/aerosols include: denying information to the enemy; reducir the effectiveness of enemy target acquisition devices; disrupting enemy movement, operations, command control, and deception and attenuating potentially disastrous effects of nuclear and laser weapons. Current munitions, which are basically of World War II vintage, adequately attenuate visible and near infrared radiation. The usefulness of these munitions in the far infrared and millimeter portions of the electromagnetic spectrum is extremely limited or nonexistent. High-technology threat systems currently fielded or estimated to be fielded by the mid-1990's include: optically tracked wire-guided anti-tank missiles (ATGM's), infrared and millimeter ATGM's, infrared target acquisition systems, and low- and high-energy/power laser systems. This program is required for exploratory development of smokes/aerosols to counter the proliferation of such threat weapons systems. The Army has been designated the Executive Agent for RDTE of smoke/aerosol technology for the Department of Defense (DOD). As such, there is a need for a project to support DOD-wide requirements in smoke/aerosol development. This project provides the only source for such support.

B. (U) RELATED ACTIVITIES: In executing the Army's executive agent responsibilities as assigned by DOD Directive 5160.5, investigations under this project provide the essential exploratory effort in smoke and multispectral obscurant agents and munitions. No comparable work is done by the other Services, and coordination is maintained with them to assure attainment of the technology essential to their needs. Duplication of effort is precluded through joint working and coordinating groups. Coordination and cooperation is maintained with the United Kingdom, Canada, and Australia. Related technical investigations are conducted under Program Element 6.27.06.A, Chemical-Biological Defense and General Investigations. This project provides direct technical support to Program Element 6.36.27.A, Chemical Support Munitions; and 6.46.09.A, Combat Support Systems.

C. (U) WORK PERFORMED BY: Contractors: Brunswick Inc., Marion, VA; Barnes Engineering, Stanford, CT; Calspan, Buffalo, NY; R&D Associates, Santa Monica, CA. In-house developing organization is the US Army Chemical Systems Laboratory, Aberdeen Proving Ground, MD.

Project: #A552 — Title: Smoke and Obscurant Munitions
Program Element: #6.26.22.A — Title: Chemical and Smoke Munitions
DOD Mission Area: #522 - Environmental and Life Sciences (ED) — Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: During FY 1981 and prior years, exploratory development on smoke/obscurants technology was reported under project A554, Chemical Munitions and Chemical Combat Support. The effort has successfully characterized the infrared (IR) screening capabilities of a large number of materials and has subsequently evolved new materials and techniques for practical IR screening. One of the key results of the work has been in defining the appropriate directions of material search and in determining which factors can lead to improvement of aerosol influence on electro-optical probabilities. A system for explosive dissemination of material in an IR screening grenade has been successfully accomplished and the item transferred to advanced development. Techniques for improved large-area screening have been evolved. Means of generating practical, safe training smokes, usable without significant toxicological and environmental constraints, have been found. With respect to toxicology, both short-term and long-term data have been established on existing systems, and preliminary means have been investigated for multispectral screening, clearing of aerosols, and for methods of countering battlefield lasers.

2. (U) FY 1982-FY 1984 Program: During FY 1982, smoke/aerosol efforts will continue to be funded as a part of Project A554. In FY 1983 and subsequent years, smoke/aerosol efforts will be funded under this restructured Project A552. New infrared (IR) screening materials will be evaluated considering the use of enemy emitting aerosols in contrast to the current absorbing aerosols. Studies will be completed on systems for an IR vehicle engine exhaust and techniques investigated for an IR defeating smokepot. Full-scale efforts will continue on multispectral screening and means of advanced laser weapons defeat and smoke elimination. Infrared systems will be devised for projected munitions such as projectiles and mortar rounds to provide a tactical IR obscurant capability. Acute and long-term health hazard evaluation of systems will be generated. Techniques for training in smoke on the total battlefield, including IR smoke and mixed fires, will be promulgated. Methods for incorporation of multispectral screening into large-area screening systems and tactical munitions will be in vestigated.

3. (U) Program to Completion: This is continuing project.

4. (U) Major Milestones: Not Applicable.

Project: #A552 Title: Smoke and Obscurant Munitions
Program Element: #6.26.22.A Title: Chemical and Smoke Munitions
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	0	0	5060	5023	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	-	-	-	-	Continuing	Not Applicable

The FY 1983 submission is the first submission for this project and represents a restructuring of the overall PE. During FY 1982 and prior years, all smoke/obscurant effort was funded under PE 6.26.22A, Chemical and Smoke Munitions, Project A554, Chemical Munitions. The funding requirements for FY 1983 and FY 1984 do not reflect a new program initiative, but instead represent a split-out of planning requirements resulting from the restructuring.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A554 Title: Chemical Munitions
Program Element: #6.26.22.A Title: Chemical and Smoke Munitions
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This effort is to identify, characterize, synthesize, and evaluate the properties of uncovered and/or discovered chemical compounds of military interest which may pose a potential threat to the US defensive posture; maintain an up-to-date technology base in support of chemical defense investigations; determine and evaluate the toxicities of agents and various chemicals of mission interest; address and resolve the technology knowledge gaps reactive to agent interactions, methods of delivery and dissemination, and the environment in which it is employed through investigations of the mechanisms that control the operational performance of chemical systems; determine the potential foreign chemical warfare threat and vulnerability and identify the needs for improved US capabilities; evolve lethal and incapacitating chemical agent/munition system concepts and supporting concepts to provide a credible deterrent and retaliatory capability; evolve processing concepts for agents/intermediates in support of lethal, binary, incapacitating and riot control areas and pursue agent/munition concepts through feasibility determination. This effort is essential to obtain parity and keep pace with Soviet initiatives in this area so as to provide a credible deterrent to Soviet employment of chemical weapons and a punishing retaliatory capability should the deterrent fail. In addition, this provides a source of expertise to assess vulnerabilities and assist the intelligence community in the interpretation of their efforts. The project is structured to accomplish the Army's DOD mission for chemical weaponization/exploitation, and represents the only substantive program of its kind in the Free World.

B. (U) RELATED ACTIVITIES: In executing the Army's responsibilities as executive agent under DOD Directive 5260.5, investigations under this project provide the essential exploratory efforts in lethal, incapacitating and civil disturbance control agents and munitions, and the total technology base for the entire DOD. No comparable work is performed by the other Services, and coordination is effected with them to assure provision of the technology necessary to satisfy their requirements. Close coordination between investigative groups precludes duplication. Cooperation and coordination are maintained with the international community. Related technical investigations are conducted under Program Element 6.27.06.A, CB (Chemical-Biological) Defense and General Investigations. The projects provide direct technical support to Program Elements 6.36.15.A, Lethal Chemical Munitions Concepts; 6.36.27.A, Combat Support Munitions; 6.37.14.A, Incapacitating Chemical Munitions Concepts; 6.46.10.A, Lethal Chemical Munitions; 6.46.09.A, Combat Support Systems; and 6.46.13.A, Incapacitating Chemical Munitions.

Project: #A554 Title: Chemical Munitions
Program Element: #6.26.22.A Title: Chemical and Smoke Munitions
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

C. (U) WORKED PERFORMED BY: Contractors - American Histological Laboratories, Bethesda, MD; Stanford Research, Menlow Park, CA; Aerodyne Research, Burlington, MA; Ash Stevens, Inc, Detroit, MI; Batelle Memorial Institute International, Columbus, OH; Southern Research Institute, Birmingham AL. In-house work is performed by Chemical Systems Laboratory, Aberdeen Proving Ground, MD.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Over the past 20 years, a variety of lethal chemical agent/munition systems has been developed and fielded. To enhance safety and security, the binary concept has been successfully applied to the development of two artillery chemical projectiles. A binary intermediate-volatility agent (IVA) was selected for weaponization. Studies to expand the technological base were initiated, including small-scale laboratory binary chemical reactions, warhead concepts for Multiple-Launch Rocket System (MLRS), binary chemicals toxicological aspects, etc. Design analysis and static tests of a binary 155mm IVA projectile continued, and preparation for a confirmatory test was completed. A preliminary technical data package (TDP) was completed for the MLRS, and static tests were conducted. reliminary concepts for a binary warhead for the Corps Support Weapon System (CSWS) were developed. A multipurpose artillery projectile study was completed. Concepts for binary air-scatterable mines were developed, and concepts/effectiveness studies for binary payloads in various missile/rocket warheads were conducted. Engineering development of the XM736 VX-2 8-inch projectile was stopped in favor of proceeding with the binary IVA 8-inch projectile. Two approaches to providing an incapacitating agent that would be effective by inhalation as well as percutaneously were pursued. Binary warhead concepts were evaluated for the 81mm mortar cartridge and 4.2-inch mortar cartridge. Toxicity studies were initiated for binary intermediates. Bulk mixing studies were continued, and standards developed for new binary intermediates for better munition evaluation and quality control. Remotely Piloted Vehicle (RPV) binary agent dissemination concepts were initiated. Potential dual-purpose (inhalation and skin penetration) chemical agents were evaluated with an emphasis on their adaptability to the binary mode for several candidate munitions systems. Efforts continued to find safe reactive simulants for binary agents and practical means for field assessment of these simulants in lieu of open-air testing of toxic agents. The evaluation of EA4923 as a potential civil disturbance and tactical irritant was conducted. Studies were continued to evaluate the effectiveness of EA1834 as a percutaneous incapacitating agent. New and improved methods and models for estimating the probability of incapacitating trauma from penetrating and blunt impacts were developed.

Project: #A554 Title: Chemical Munitions
Program Element: #6.26.22.A Title: Chemical and Smoke Munitions
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Program: Exploratory development (XD) will be completed on the binary concept for a chemical warhead for the Corps Support Weapon System (CSWS) and a lightweight mobile binary lethal-agent munition system. Evaluation of potential dual-purpose lethal agents (IVA) adaptable to the binary mode of delivery will be expanded and accelerated. Application of IVA technology to a family of ground, missile, rocket and aerial-delivered munition concepts will be investigated. Manufacturing processes for both lethal and incapacitating chemical agents will be investigated. Technology support to advanced development (6.3) and engineering development (6.4) programs will continue to be enhanced. Investigations will include weaponization potential of air-delivered mines, ground-launched cruise missile (GLCM), lightweight portable rocket warheads and extended-range artillery projectile. Efforts will continue on a 155mm incapacitating agent projectile, various chemical fills for remote piloted vehicles (RPV), lightweight and long-range mortars, etc., in support of tri-Service requirements. Evaluation of environmental control mechanisms will continue.

3. (U) Program To Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	7279	18468	9769	11787	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5280	20528	7012	-	Continuing	Not Applicable

The increase of $1999 thousand in FY 1981 is a result of reprograming to support a critically needed expansion of the US chemical warfare deterrent/retaliatory technology base. The funding decrease of $2060 thousand in FY 1982 is a result of a Congressional decision. The funding increase of $2757 thousand in FY 1983 is a result of program realignments to support expanded technology base effort in chemical warfare deterrence/retaliation. It must be noted that the figure of $18468

Project: #A554 Title: Chemical Munitions
Program Element: #6.26.22.A Title: Chemical and Smoke Munitions
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

thousand from the FY 1982 estimate includes funding of the smoke/aerosal munitions program. Beginning in FY 1983, the smoke/aerosal munitions program will be funded under a new project A552, Smoke and Obscurants, as a result of restructuring of the Program Element.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.26.23.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Joint Service Small Arms Program (JSSAP)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0*	0*	3706	2113	Continuing	Not Applicable
AH21	Joint Service Small Arms Program (JSSAP)	0	0*	3706	2113	Continuing	Not Applicable

*FY 1981 and FY 1982 effort was a portion of Program Element #6.26.17.A, Fire Control and Small Caliber Armaments Technology, Project #AH19, Small Caliber and Fire Control Technology, Tech Area A, JSSAP. This new, separate Program Element #6.26.23.A, JSSAP, Project #AH21, JSSAP, initiates in FY 1983 for this effort.

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This effort provides a coordinated program for the exploratory development of small arms weapons required by all Services in meeting the current and future battlefield threat. In the face of new and changing threats, maintaining a credible capability to respond effectively at any level of conflict requires continuing advancement of the small arms technology and its supporting sciences. This program will insure that the US fighting man is adequately armed on the modern battlefield.

C. (U) BASIS FOR THE FY 1983 RDTE REQUEST: Current Small Arms Weapon Systems are aging and are based on outdated technology. Increased capability must be pursued because of the high probability of a threat numerical advantage, of continuous technological advances in threat equipment, and because of continual changes in our operational modes; i.e., Rapid Deployment Force, Military Operations in Built-Up Areas, mobile armored battlefield, and improvements in personal protection. The Joint Service Small Arms Program Management Committee provides the mechanism to assure overall harmonization, coordination, and control of this effort. The program facilitates consideration of diverse joint service needs, optimum utilization of limited resources (funds, facilities, and small arms expertise in government and industry), and accurate prioritization of tasks to best counter threat advances and changes in operation modes. The funds will provide for exploratory development of the Advanced Combat Rifle alternatives, improved individual fire control for effective target

Program Element: #6.26.23.A Title: Joint Service Small Arms Program (JSSAP)
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

engagement, high-performance projectiles for light armor penetration, lightweight advanced gun mechanisms for more versatile medium and heavy class machineguns, man-portable grenade launcher with substantially improved antipersonnel and armor effects, and special-purpose weapons and ammunition.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands): Not applicable. This is the first descriptive summary for this effort.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.26.23.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Joint Service Small Arms Program (JSSAP)
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The Joint Service Small Arms Program Management Committee was chartered as directed by a memorandum from the Deputy Under Secretary of Defense for Research and Engineering (Research and Advanced Technology) designating the Army as Executive Agent to establish exploratory development/nonsystem advanced development (6.2/6.3A) program elements and program funds. The Management Committee, chaired by the Army, has a voting member from each of the Military Services (Army, Navy, Air Force, Marine Corps) and a representative of the Coast Guard (Department of Transportation). This joint service program was created to provide the means to assure that there is no duplication of effort in small arms research and development within the Department of Defense. The basic approach is to use: Joint Service Memorandum of Agreement, Joint Service Science and Technology Objectives, Joint Service Operational Requirements, frequent meetings, and continuing liaison to assure complete interservice awareness of the total research and development program in the area of small arms and related technology, and also provide a focal point for contact with the private sector. This effort provides exploratory development of enhanced performance weapon systems for small operating units and individual combatants of all services in concert with the demands of the modern and projected battlefield. Weapon systems involved are all types of small arms to include individual and crew-served weapon systems used to defeat existing and projected improvements in body armor and related hard targets expected on the modern battlefield. Also under this project is the development of low signature weapons, improved individual fire control for effective target acquisition and engagement, application of modern lightweight/high-strength materials, high-performance light armor penetrators, and application of newly developed weapon technologies. The work contributes to modernization of this class of weapon system leading toward the immediate objectives of sustainability and survivability. The program addresses deficiencies and shortcomings in current small arms weapon systems being identified in ongoing user mission analyses.

G. (U) RELATED ACTIVITIES: This effort was funded through FY 1982 under Program Element #6.26.17.A, Fire Control and Small Caliber Armaments Technology, Project #AH19A, Small Caliber and Fire Control Technology. This program is also related to Program Element #6.36.07.A, Joint Service Small Arms Program (JSSAP), Project #D627, Joint Service Small Arms Program. As detailed in paragraph F. above, the Joint Service Small Arms Program (exploratory development - 6.2/nonsystem advanced development - 6.3A) was created to provide the means to assure that there is no unnecessary duplication of small arms efforts within the Department of Defense.

H. (U) WORK PERFORMED BY: This program of 6.2 Exploratory Development is under the management of the Joint Service Small Arms Program. The prime in-house developing organization responsible for the program is the US Army Armament Research and Development Command, Dover, NJ, with other major efforts at: The Naval Weapon Support Center, Crane, IN, Air Force Armament Technology Laboratory, Eglin AFB, FL.

Program Element: #6.26.23.A Title: Joint Service Small Arms Program (JSSAP)
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: This is a new start supportive of the Joint Service Small Arms Program (JSSAP). Prior work was funded under PE 6.26.17.A, Project AH19A.

2. (U) FY 1982-FY 1984 Planned Program: The Advanced Combat Rifle (ACR) components will be identified through breadboard design and testing. Such components will address substantial improvement in hit capability, target defeat, and acquisition. Advances in caseless ammunition, projectile design, and gun mechanism will be applied to improving the versatility of medium- and heavy-class machineguns to engage modern and projected threat targets at extended ranges. Technology base effort will be established to address on a component basis alternative projectiles, high-performance caseless ammunition, sighting/ranging, and materials leading to capability advancements in lethality, versatility, hit/kill, range, and individual battlefield survivability/sustainability. Special weapon needs will be addressed to include improved long-range sniper effectiveness, extended range grenades with antiarmor and structure defeat capability. High-technology areas will be assessed for revolutionary breakthrough in such areas as: liquid propellants, hypervelocity, and nonkinetic defeat devices. Final work will be completed on Personal Defense Weapon special-purpose ammunition. Approximately eighteen professional-level personnel are involved in this program.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.01.A
Title: Communication/Technology
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8067	7545	9719	8931	Continuing	Not Applicable
AH92	Communication Electronics	8067	7545	9719	8931	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The next generation of evolving weapon and fire control systems has urgent needs for communication capabilities which the current inventory of fielded equipment cannot provide. The heavy emphasis of digital and mixed analog/digital data in these systems creates serious problems in areas of information distribution, signal processing, signal quality, electromagnetic compatibility (EMC), propagation, spectrum management, and system interoperability. Only the application of new technologies such as fiber optics, millimeter waves, spread spectrum, data distribution, and very high speed integrated circuits (VHSIC) will begin to solve these problems. These problems cover tactical communications needs for: improved mobility, reliability, and survivability; reduced vulnerability to enemy electronic countermeasures (ECM) and nuclear blast impact; reduced cost for communications security; low probability of interception; dispersed command posts (CP); and communications hardware. To support the combat user, the tactical communications system must provide rapid operational response via automated message and voice switches, improved teleprocessing centers which automatically relay data, teletype, voice, and facsimile messages from the sender to the intended receiver(s). This requires terminal devices which match the system to the man more efficiently. This program must develop the required technologies which will produce affordable systems with the required capabilities. Exploratory development work in command, control, and communication (C3) systems is essential to develop the advanced concepts required to offset enemy manpower advantages through effective use of high-technology systems. This work also provides input for the continuing improvement of current and near-term system capability and survivability. This work must also develop the specialized system engineering tools and assessment methodologies specifically designed to enable competent and decisive analysis of competing high-technology approaches.

Program Element: #6.27.01.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
Budget Activity: #1 - Technology Base

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Continue the development of the millimeter wave (MMW) wireless command post system for survivable communications in the dispersed CP. Complete the multiwavelength fiber optic coupler and integration of this module into investigations of optical systems using wavelength division multiplexing for Tri-Tac systems. Develop fiber optic cable whose fibers are hermetically coated, nuclear resistant, low loss, and have long shelf life. Expand in-house expertise in all phases of fiber optic testing, including mechanical, environmental, and optical. Continue development to provide improved counter-countermeasures for digital microwave radio (DMR) program. Continue support to packet radio testbed and net management distribution architecture concepts. Complete wideband propagation measurement system development and start experiments. Continue realtime frequency management work for field use. Continue optical telephone development and integration of fielded and development communication systems into the communications systems design center. Start exploratory development of frequency hopping multiplexer and Electronic Counter-Countermeasure Electronic *Counter-Countermeasure* (ECCM)) for High Frequency (HF) radio. Continue development, evaluation, and demonstration of distributed processing command and control (C2) systems and complete functional analysis of C2 subordinate systems (CS2). Complete installation of four echelon Army tactical frequency engineering systems (AFTES) and implement second phase. Develop comprehensive models/data bases and identify resources for computer modeling in the survivable enhancement area. Study and develop alternative for presentation aids and decision graphics.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirement)	8067	7545	97.9	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	8418	7567	8975	Continuing	Not Applicable

The decrease in FY 1981 was the result of general programed reductions. The decrease in FY 1982 is a result of application of revised civilian pay and inflation pricing indices. The increase in FY 1983 will permit expansion of the urgently needed propagation/electromagnetic compatibility technology program which supports all developing communications-electronics systems.

Program Element: #6.27.01.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
Budget Activity: #1 - Technology Base

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.27.01.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Automation and communication are rapidly becoming significant facets of almost every Army defense system. The project goals are to provide technologies that will reduce the cost of development and support of tactical automation and communication functions and to accelerate the fielding and improve the survivability of all Army systems in which automation and communication play major roles. Present communications technology does not meet today's Army needs. Problems of excess weight, size, power drain, cross-talk, electromagnetic pulse, Electronic Countermeasures (ECM) threat (both passive and active), reliability, and low channel capability require application of advanced technology. The approach to solving these problems is to develop new methods and techniques needed for future Army Communication-Electronic (C-E) systems. This effort requires exploration of the following: fiber optic and millimeter wave (MMW) communication; radio wave generation, amplification, and modulation for line of sight and troposcatter; techniques for handling, multiplexing, and storing information; electromagnetic compatibility; system technology, radio wave propagation, net communications to exploit the latest state-of-the-art with emphasis on antennas and HF communications; packet radio and related technologies for the evolving Army Digital Distribution System (ADDS); switching technology and spectrum optimization. These techniques will form the basis for system and subsystem design for effective integration and transition planning. Successful prosecution of the air/land battle depends upon a high degree of survivability and continuity of operations of C2 systems which will be addressed by concepts developed in the distributed processing area of this program. Battlefield spectrum management efforts will address the problems of mutual interference which is detrimental to C3 in the overcrowded frequency environment. A survivability trade-off data base will permit analysis and validation of new techniques as they are conceptualized. Development of presentation aids and decision graphics methods will provide commanders with interactive facilities. These will reduce their paperwork, increase reactive speed, increase decision accuracy, allow them to factor in judgemental values via interactive modes, and give them the capability to cope effectively with the increased speed and sophistication of modern warfare.

G. (U) RELATED ACTIVITIES: This program provides the exploratory development needed to support the following: Program Element 6.37.01.A (Communications Development), Project D246 (Tactical Communications Systems Development), and Project D437 (Tactical Communciations Development); Program Element 6.37.23.A (Command and Control), Project D180 (High Technology Test Bed); Program Element 6.47.01.A (Communication Engineering Development), Project D487 (Tactical Multichannel Communications) and Project D488 (Tactical Net Radio Communications); Program Element 2.80.10.A (Joint Tactical Communications Program (Tri-Tac)), Project D104 (Tri-Tac Office), Project D107 (Mod to Army Tri-Tac Interface), Project D110 (Mobile Subscriber Equipment), Project D119 (Modular Record Traffic Terminal), Project D222 (Automatic Communications Central Office, AN/TTC-39); Program Element 6.47.79.A (Joint Interoperability of Tactical Command and Control Systems - JINTACCS), Project

Program Element: #6.27.01.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
Budget Activity: #1 - Technology Base

D309 (JINTACCS Army); Program Element 6.47.12.A (US Army Tactical Command, Control, and Communications Systems Engineering), Project D323 (Systems Engineering for Army Tactical C3 Systems); Program Element 6.32.07.A (Aircraft Avionics Equipment). Program Element 6.11.02.A (Defense Research Sciences), Project AH48 (Communications Research) provides the basic research support for AH-92. There is no unnecessary duplication of effort within the Army or Department of Defense. Duplication is avoided by attendance at military and scientific conferences.

H. (U) WORK PERFORMED BY: Signatron, Inc., Lexington, MA; Harris Corp., Melbourne, FL; Hazeltine Corp., Greenlawn, NY; Mitre Corp., McLean, VA; SRI International, Menlo Park, CA. Seventeen other contracts will be awarded during FY 1983 with a total value of $5,601,000. In-house developing organizations are US Army Communications-Electronics Command, Ft Monmouth, NJ, and DOD Electromagnetic Compatibility Analysis Center (ECAC), Annapolis, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Transitioned the long-haul Fiber Optic (FO) System to engineering development. Transitioned Millimeter Wave (MMW) multichannel command post radio into advanced development. Developed a new prototype MMW radio (tested at 9th Division field exercises, Yakima, WA). Developed a family of MMW mobile intercept-resistant radios (MISR) for tank platoon communications and performed joint tests with Marine Corps. Started development of baseline adaptive-tuned covert radios for communications remoting/dispersal. Fiber Optic Missile System moved to advanced development and was successfully tested in a missile at Missile Command (MICOM). Air-layable FO was successfully demonstrated at Fort Campbell, KY. Started work on digital microwave radio which will meet the UHF jamming threat. Integrated packet radios into the Battlefield Information Distribution System (BID) Corps-level testbed to provide field/mobile operation and completed preparations to use packet radio to provide data distribution for Helbat-8 exercises at Fort Sill, OK. Continued support of packet radios in BID Corps-level testbed for operational concept development. Completed first phase of wideband propagation measurement and received industry proposals to develop wideband propagation measurement system. Started development of ground network communication modeling capability. Conducted preliminary measurements and continued analysis of spread spectrum Electromagnetic Capability (EMC) with tactical narrowband radios. Started evaluation of intrasystem EMC analysis program with application to the M1 tank. Provided EMC guidance to project managers (SINCGARS, JTIDS, PLRS, PJH, MSE, etc.), and continued work on EMC standards. Started programs in tactical antenna development. Determined that advances in digital technology will allow for high data rate transmission at HF and optimum channel selection. Completed the design assessment for HF radio communications, initiated the development of an ECCM

Program Element: #6.27.01.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Communication/Technology
Budget Activity: #1 - Technology Base

capability for HF radios, and started work on the multielement VHF antenna (transition from 6.1 development). Completed initial systems architecture concepts document for distributed processing of Command Control, and Communication (C^3) systems to support Cellular Command Post and Operational Facility CONOPS Model. Completed software design for initial demonstration of cellular CP and completed analytical model of the air defense functional segment of CCS2. Installed AFTES software and first of four USAREUR ADP systems in Germany. Completed initial study of Communications Electronics Operating Instructions (CEOI) automated preparation, distribution, and integration. Completed plan to integrate battlefield spectrum facilities with Satellite-Automated Frequency Engineering System (SATFES), and performed initial studies to integrate spectrum management concepts. Completed technology methodology for survivability assessment and described analytic models related to C3 survivability. Completed initial studies on specialty distributed antenna strategies, studied variable antijam (AJ) concepts, and compared various implementations of spread spectrum techniques for comparative effectiveness.

2. (U) FY 1982-FY 1984 Planned Program: Develop a family of Fiber Optic systems which will reduce reliance on costly, Electromagnetic Pulse (EMP)-vulnerable, heavy, breakable metal cables. This includes the transitioning of wavelength division multiplex systems for long-haul and local distribution into advanced development and intrusion-resistant systems. These systems will achieve interface compatibility with Army Tactical Communications Systems (ATACS) and TRI-TAC equipment. The Millimeter Program will develop a family of radios and systems (e.g., wireless command post) to increase tactical command post mobility/survivability and reduce visual/Radio Frequency (RF) signatures and provide covert jam-resistant battlefield C3. The digital microwave radio program (DMR) will define signal methodology and hardware (adaptive model) to provide compatibility between the DMR and higher level switching equipment under ECM conditions. The DMR program will also include a coding technique investigation, a null steering antenna development, a system design effort, and a phased array antenna development. Develop a wideband measurement system and conduct propagation measurements for UHF spread spectrum applications tc support survivable C3. Continue support to Packet Radio testbed and develop concepts and technology for an integrated multiaccess, secure, near-realtime, jam-resistant, survivable data distribution management architecture. Investigate new concepts for spread spectrum low-probability-of-intercept (LPI) techniques for application to BID. Complete ground network communications model development and application, and start frequency band selection. Compete millimeter wave electromagnetic measurement techniques contract. Continue development and field evaluation of HF frequency management.

3. (U) Program to Completion: This is a continuing program, with regular transition of portions to advanced and engineering development.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.03.A

Title: Combat Surveillance, Target Acquisition and Identification

DOD Mission Area: #521 - Electronics and Physical Science (ED)

Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5097	2214	2918	4883	Continuing	Not Applicable
DH93	Combat Surveillance, Target Acquisition and Identification	5097	2214	2918	4883	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the technology base for new concepts and advanced systems for the solution of presently unsolved surveillance, target acquisition, and identification requirements. These include developing modular radar componentry to reduce size and cost and to increase performance and reliability; noncooperative battlefield identification friend or foe; radar techniques to identify stationary and moving targets, penetrate foliage, and provide an all-weather capability; passive acoustic techniques to rapidly locate hostile artillery; and integrating surveillance and target acquisition sensors to provide fused output. It also identifies the most promising alternatives to fill existing operational gaps in the Army's integrated surveillance, target acquisition, and identification capability. Exploratory development is performed in the following technological areas: Personnel and vehicle detection identification; weapons location; detection and measurement of nuclear radiation and bursts; and the integration of surveillance and target acquisition sensors.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Results of ongoing efforts to develop lightweight, modular radar componentry amenable to low-cost quantity production will be integrated into a testbed remotely piloted vehicle radar system for flight testing. Work will continue on stationary and moving target detection and identification; noncooperative battlefield identification; multistatic radar, electronically steerable antenna technology for intelligence, surveillance, and target acquisition; and the detection and measurement of nuclear radiation. Fabrication of prototypes for the dosimeter section of a miniature, multipurpose radiac device will be initiated. Testing of low-cost prototype radiation dosimeters and

Program Element: #6.27.03.A Title: Combat Surveillance, Target Acquisition and Identification

DOD Mission Area: #521 - Electronics and Physical Science (ED) Budget Activity: #1 - Technology Base

radiacmeters will continue. Acquire data base for a passive acoustic artillery weapons locating system. Data Transmission efforts have been dropped since the technology effort is being transferred to CECOM.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (Current Requirements)	5097	2214	2918	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	3588	2617	4590	Continuing	Not Applicable

The FY 1981 increase was used to fund a Netted Radar Demonstration at Fort Sill. The FY 1982 and FY 1983 decrease is attributable to reprogramming to higher priority Army requirements.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.03.A

Title: Combat Surveillance, Target Acquisition and Identification

DOD Mission Area: #521 - Electronics and Physical Science (ED)

Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This project funds the exploratory development performed by the Combat Surveillance and Target Acquisition Laboratory. Major areas are reducing radio frequency spectrum requirements, eliminating relays, and reducing size, weight, and cost; development of radar techniques for the detection, classification, and identification of stationary nonfiring targets under all visibility conditions; development of radar techniques for the classification and identification of moving targets under all visibility conditions; development of lightweight, low-cost, common radar modules which will lower life cycle costs of future radar systems due to reality in logistics, maintenance, and training requirements; development of a low-cost, multipurpose, tactical radiation measurement device which will perform the functions presently requiring several separate devices; investigation of noncooperative battlefield identification friend or foe; development of multistatic radar technology to enhance sensor coverage and survivability on the battlefield and weapons location technology with emphasis on a passive, automated, linear base, acoustic artillery target location system to replace the current manual system.

G. (U) RELATED ACTIVITIES: Related development is performed by the Navy and Air Force. Work is coordinated during reviews conducted by the Office of the Under Secretary of Defense for Research and Engineering, through interlaboratory visits and communication, attentance at specialized scientific meetings and conferences, interservice liaison, technical reports, and the Annual Tri-Service Radar Symposium.

H. (U) WORK PERFORMED BY: In-house work is performed by the US Army Electronics Research and Development Command at Ft Monmouth, NJ, and at Adelphi, MD. Contractors include Georgia Institute of Technology, Atlanta, GA; RCA, Princeton, NJ; Hughes Aircraft Company, Culver City, CA; Malibu Research Associates, Santa Monica, CA; Lincoln Laboratories, Bedford, MA; Radiation Measurement Devices Inc., Watertown, MA; Science Applications Inc., San Diego, CA; and Nuclear Research Corporation, Denville, NJ.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Prior technological efforts have resulted in or contributed to type classification and procurement of the AN/PPS-5, AN/PPS-15, AN/TPQ-36, and AN/TPQ-37 radars; initiation of advanced development of the Surveillance and Target Acquisition Radar for Tank Location and Engagement, and full-scale development of the Modular Integrated Communication and Navigation System. The feasibility of lightweight, efficient, low-cost gallium aresenide Ku

Program Element: #6.27.03.A

Title: Combat Surveillance, Target Acquisition and Identification

DOD Mission Area: #521 - Electronics and Physical Science (ED)

Budget Activity: #1 - Technology Base

band radar transmitter/receiver has been demonstrated. Stationary target detection and classification techniques were successfully demonstrated. Demonstrated feasibility of identifying moving tracked vehicles by analysis of doppler frequency signatures. Completed development of hardware for noncooperative identification of hostile aircraft through analysis of radar signatures, and initiated testing with improved HAWK. Completed assembly of low probability of intercept ground surveillance radar, utilizing tilted beam antenna and coded transmitter waveform and ultra-low lobe antenna preparation for field evaluation.

2. (U) FY 1982-FY 1984 Program: Continue technological support to ongoing developmental programs. A ground radar testbed will be completed and tested which uses solid state transmitter-receiver, charge-coupled device radar signal processor, and tilted-beam antenna. Vehicular-mounted low-probability-of-intercept (LPI) locators will be tested against emitter locators and jammers. An airborne radar testbed will develop and evaluate technology for airborne radars such as RPV, SOTAS, OV-1, and SEMA-X to improve target detection, identification, tracking, and acquisition capabilities. Stationary target classification efforts will emphasize improving the present 5-target algorithms, and applying them to both moving and stationary targets. Work will continue on temperature-stable solid-state ratemeter detector, and stable glass fiber and leuko dye gamma dosimeters. Feasibility tests of multistatic radar hardware will continue. Initiate investigation for acoustic array signal processing techniques.

3. (U) Program to Completion: This is a continuing level-of-effort program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.04.A Title: Military Environmental Criteria Development
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2319	2755	2584	3378	Continuing	Not Applicable
AF 25	Military Environmental Criteria Development	2319	2755	2584	3378	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program was established in FY 1977 to provide exploratory development of new technology in support of the Project Manager for Chemical Demilitarization and Installation Restoration. The current priority emphasis of the program is directed toward supporting prevention of contamination migration from the Rocky Mountain Arsenal, Denver, CO, and providing technology support to the treatment of other installations determined to have contamination problems. The technical thrusts of the program are: development of analytical techniques for identification and quantification of contaminants; research to characterize contaminants, determine their toxicities and provide data for the development of technology which will support containment/decontamination efforts at Army and other Department of Defense installations as problems are identified and remedial action plans are approved.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Requested FY 1983 funds are required to develop analytical methodology for identification and quantification of contaminants found in soil, water, process disposal facilities, and biological tissues in support of contamination surveys scheduled at eighteen Army installations; to perform hazard analyses, toxicity screens and toxicological studies for development of environmental levels for contaminants moving across Army installation boundaries or existing at facilities scheduled for excessing action; to develop soil and water treatment processes to eliminate or reduce the concentration of contaminants to environmentally acceptable levels; and to develop techniques to decontaminate facilities and equipment which are excess to Army needs.

Program Element: #6.27.04.A Title: Military Environmental Criteria Development
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	2319	2755	2584	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	3075	2763	2900	Continuing	Not Applicable

In FY 1981 the decrease of $756 thousand was due to reprograming to higher priority Army programs.

In FY 1982 a decrease of $8 thousand is due to the application of revised inflation and civilian pay pricing indices.

In FY 1983 a decrease of $316 thousand is due to reprograming to higher priority Army programs.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.04.A Title: Military Environmental Criteria Development
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Increasing public concern and national interest in the environment, coupled with the progressive encroachment of civilian communities to the borders of previously isolated Army installations, have created growing concern about the potential threat posed by the movement of ground water contaminants to the borders of the installations and beyond. As a result of military, Congressional, and public interest in such contamination at Rocky Mountain Arsenal, direction was provided by the Assistant Secretary of the Army for Installations, Logistics, and Financial Management (ASA(IL&FM)) to establish a comprehensive program for correcting the total Army problem. Responsibility for this program was assigned to the Project Manager for Chemical Demilitarization and Installation Restoration (PM CDIR), and a charter was approved by the Secretary of the Army on 22 August 1975. Effective 1 October 1978, PM CDIR was redesignated the US Army Toxic and Hazardous Materials Agency (USATHAMA). An overall plan of approach to the problem was developed which involves three principal phases; namely: Installation Assessment, Technical Systems Development, and Decontamination Operations. The RDTE-funded part of this plan applies primarily to the Technical Systems Development phase. The other phases of the plan are accomplished with Operations and Maintenance, Army (OMA) and Military Construction, Army (MCA) appropriations. The technology effort consists of three areas: Analytical Systems Technology, Contaminant Level Criteria Development (establishment of environmentally acceptable levels of tolerance for each contaminant), and Decontamination Technology. Technology, efforts are toward: establishing acceptable environmental levels for concentrations of pollutants by performing chemical and toxicological studies of Army-peculiar pollutants when such levels are not available; evaluation of existing technology and development of new technology as necessary to control migration of pollutants and providing analytical methods and decontamination techniques.

G. (U) RELATED ACTIVITIES: Conduct of the Installation Restoration (IR) Program and efforts to preclude duplication of effort involves extensive interface with a significant number of other Government agencies. These include: the Departments of State, Health and Human Services, Agriculture, Transportation, Interior, US Nuclear Regulatory Commission, Environmental Protection Agency, National Academy of Sciences, Department of Defense (DOD) Explosives Safety Board, and state and local governments. On 23 July 1976, the Department of the Army was designated as the lead service for the compilation and refinement of applicable technology, and the development of new or improved technology and criteria or standards for the DOD installation restoration program as it relates to all contamination, including chemical, biological, and radiological. This mission is the assigned responsibility of USATHAMA. This program is related to Program Element 6.27.20.A, Environmental Quality Technology, concerned with providing technology support to Army efforts to comply with Federal, state, and local pollution control requirements. In May 1981, a Memorandum of Understanding was signed between the Department of the Army and the Environmental Protection Agency to formalize cooperation and coordination in research and development and demonstration of remedial actions for clean-up of hazardous and toxic materials.

Program Element: #6.27.04.A Title: Military Environmental Criteria Development
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

H. (U) WORK PERFORMED BY: In FY 1983 approximately 10% of the funding will be assigned to the US Army Medical Bioengineering Research and Development Laboratory, Ft Detrick, Frederick, MD, for toxicology testing of chemical contaminants leading to the establishment of environmental levels. Approximately 30% of the dollars will be assigned to the Chemical Systems Laboratory, Product Assurance Directorate, and the US Army Armament Research and Development Command, Aberdeen Proving Ground, MD, for contractual efforts to assist in developing advanced techniques for sampling, analyzing, handling, and storing contaminated samples. The balance of the RDTE program resources (60%) will be used for development of decontamination process technology. It is estimated that approximately 90% of the total program in FY 196 will be in contracts; 3% will be assigned to Government agencies outside the Army, and 7% will be used for in-house efforts. Principal current contractors include: Environmental Science and Engineering, Inc., Gainesville, FL; Battelle Laboratories, Columbus, OH; and Engineering Science, McLean, VA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: This program Element was established in FY 1977 to prevent hazards to the public health and safety from contamination migrating off DOD installations to surrounding communities and from release of previously contaminated property to the public. The program is divided into three areas of emphasis: (a) Analytical Systems (development of methods to determine levels of trace contaminants in soil and water); (b) Contaminant Level Criteria Development (determine environmentally safe levels of chemical contaminants in the environment and subsequent presentation to the regulatory agencies); (c) Decontamination Technology (develop systems to contain, reduce, or eliminate contamination). From FY 1977 through FY 1981 accomplishments in each of these technical areas are described as follows:

(a) (U) Analytical Systems: Qualitative analytical techniques were developed to quickly screen contaminated waters to establish a baseline of compounds present on an installation. These techniques include gas chromatograph/mass spectrometry and high-pressure liquid chromatography. Valid quantitative analytical methods were developed at the low detection levels required by environmental standards to the part per trillion range. A Quality Control Program was established and implemented to ensure consistency and reliability of data from various in-house and contractor laboratories. "Standard Analytical Reference Materials" traceable to the National Bureau of Standards were developed for contaminants of concern. To date, 86 analytical methods and 47 standard analytical reference materials have been developed in direct support of the installation contamination surveys.

(b) (U) Contaminant Level Criteria Development: Environmental levels do not exist for many contaminants found

Program Element: #6.27.04.A Title: Military Environmental Criteria Development
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

during installation surveys. The Army Surgeon General has been tasked to screen these contaminants in a problem definition study and select specific contaminant compounds for toxicological studies from which environmental levels can be recommended to the regulatory agencies. Problem definition studies have been performed on 65 contaminants and follow-on toxicity work was conducted on twelve of the compounds found at Rocky Mountain Arsenal and other installations. Environmental levels have been recommended for all seven compounds.

(c) (U) *Decontamination Technology:* This technical area involves the development of water and soil treatment processes for large areas, secondary waste elimination, subsurface water management techniques and control of contaminant transport phenomena. During the period, a pilot containment/treatment system was installed and operated at Rocky Mountain Arsenal. This system consists of a series of dewatering wells, a 1500-foot bentonite clay barrier anchored into an impermeable strata some 23 feet below the surface, a granular carbon absorption system, and a series of recharge wells. Contaminated groundwater is removed from the aquifer, treated and then reinjected into the aquifer downstream of the barrier. This system has successfully processed over 20 million gallons of contaminated groundwater since installation. Design criteria were also developed for a system to isolate the sources of contamination at Rocky Mountain Arsenal. Water treatment studies were performed involving both organic and inorganic removal techniques. Granular carbon absorption and ultraviolet ozonolysis processes were tested using waters at the sources of contamination at Rocky Mountain Arsenal. Studies were performed on methods to remove fluoride from groundwater in support of the pilot containment/treatment system at Rocky Mountain Arsenal. Development efforts were conducted to identify treatment methods for wastewater lagoon sediment contaminated with explosives. Several containment and groundwater control alternatives were evaluated and assessed for immediate application to installation problems.

2. (U) FY 1982 Program: Increased effort is being directed toward the development of analytical methods for the identification and quantification of approximately 7 chemical compounds found in the soil, water, and process waste disposal facilities. Methods for extraction and preservation of samples, as well as the development of standard analytical reference materials for use in laboratory quality control and measurement are being developed. In the Contaminant Level Criteria Development area, problem definition studies, toxicity screening and follow-on toxicity studies are being performed on chemical compounds found in the soil, water, process waste disposal facilities, and biological tissues at the Army installations undergoing contamination surveys. Additionally, 7 candidate compounds are undergoing hazard analysis and 3 toxicity screens are being conducted. The primary development effort for decontamination/containment technology is involving the development of a treatment method for explosive contaminated lagoon sediment. In addition, techniques that apply in situ and excavated processing, such as soil activation, chemical fixation and chemical neutralization/vegetative uptake, are being screened for

Program Element: #6.27.04.A Title: Military Environmental Criteria Development
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

applicability. Methods for decontaminating buildings and equipment are under evaluation and will be tested. Water treatment systems are being developed to remove suspended solids, organics, inorganic salts and metals.

3. (U) FY 1983 Planned Program: Analytical methods will be developed for identification and quantification of approximately eight additional chemical compounds found in soil, water, process waste disposable facilities and biological tissues of organisms from five Army installations scheduled for contamination surveys. In addition, development of analytical methodology for detection and quantitative analysis of degradation and process byproducts from developmental decontamination processes will be initiated. In the area of Contaminant Level Criteria Development, problem definition studies, toxicity screening and follow-up toxicity studies will be continued on chemical compounds found in soil, water, process waste disposal facilities and biological tissues. Some 5 new compounds will undergo hazard analysis, five toxicity screens and one full-scale toxicity study using vegetation, mammals, wildlife, domestic, and aquatic animals. Limited laboratory studies of in situ containment/treatment techniques will be initiated. Water treatment studies will build upon the technical data base from ongoing comprehensive surveys. Building and equipment decontamination techniques will be investigated in the laboratory. Treatment systems will be field-tested at two installations. Development work for treating explosive-contaminated lagoon sediment will be completed. Number of personnel supported with requested FY83 funds: professional 18, support 2.

4. (U) FY 1984 Planned Program: Analytical methods will be developed for the identification and quantification of approximately eight chemical compounds found in soil, water, process waste disposal facilities, and biological tissue from five Army installations scheduled for contamination surveys. Approximately six compounds will undergo hazard analysis, one toxicity screen, and one full-scale toxicity study. Preliminary design criteria for final containment or treatment measures resulting from five environmental surveys will be finalized. Field and pilot water treatment studies will be conducted as input to the technology base development for contaminated installations. New decontamination techniques for chemical agent or explosive contaminated building will be piloted. In situ leaching methods to treat contaminated soil will be investigated.

5. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	15135	15275	17725	18613	Continuing	Not Applicable
AH9401	Elect and Electronic Devices	15135	15275	17725	18613	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This exploratory development program in electron devices and related materials technologies is resolving critical component barrier problems which are preventing performance, cost, size, weight, and reliability improvements in Army electronic equipment to meet specific enemy threats. This project will provide required increases in electron device performance; on this base, critical new and improved electronic systems concepts are being developed to provide the technological superiority of our forces. Specifically, the program encompasses the development of selected basic electronic building blocks which pace the development of approximately 50 Army systems concepts; included are integrated circuits, solid state devices, microwave tubes, power sources, millimeter components, frequency control, and display devices. These device developments are directly coupled to systems objectives in electronic warfare, night vision, communications, avionics, data processing, combat surveillance and target acquisition, guidance and fire control, navigation and position location, and missile technology.

C. (U) BASIS FOR FY 1983 REQUEST: The FY 1983 program in electron devices is aimed at developing: (1) low-cost, compact, ruggedized solid state transmitter/receiver components for 94, 140, and 220 GHz millimeter wave radars for target acquisition, detection, tracking and terminal homing systems for penetrating adverse weather and battlefield obscurants; (2) higher power, coherent 220 GHz transmitter sources (pulsers, tubes, duplexers) for increased angular and range accuracy for all-weather, smoke penetration, target acquisition and track radar; (3) signal-processing technology to provide an ECCM capability in data links for the Joint Tactical Information Distribution System (JTIDS) and the capture, correlation, and targeting of new Electronic Warfare (EW) threats; (4) high-efficiency, small-size GaAs FETs and InP Gunn devices for

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

broadband frequency agile amplifiers for secure data links and expendable jammers and broadband limiters for sensitive, burnout-proof, intelligence-gathering receivers; (5) surface acoustic wave devices for intercept receivers, jam-resistant data links and Command, Control, and Communications systems and acousto-optic devices for intercepting, sorting, identifying, and locating enemy emitters; (6) high-rate, high-energy-density, low-cost nickel-zink batteries with 2-1/2 times the energy density of present secondary batteries used in the XM1 and M60 tanks and the Advanced Attack Helicopter; (7) high jammer-to-signal, efficient infrared (IR) sources for protection of Army aircraft; (8) increased system capabilities through technology insertion of advanced signal processing and memory using computer-aided design for hybrid and monolithic circuits; (9) affordable high-precision quartz oscillators for frequency synthesizer references and clocks in secure, nonjammable communications, navigation and surveillance systems; (10) interactive sunlight-legible, low-power, rugged, hand-held/manportable vehicular and airborne displays required for timely, effective decisionmaking in automated communications, Combat Support and Program-Wide Support systems and transparent graphic displays operable directly over standard Army maps automatically displaying realtime communications, electronic, and imagery intelligence information.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	15135	15275	17725	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	14309	15298	18236	Continuing	Not Applicable

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

(U) Funding differences between Congressional Descriptive Summaries submitted last year (1982) and this year (1983) are as follows:

1. (U) FY 1981 funding increase was applied to the Army's infrared microwave program. This is an Office of the Secretary of Defense (OSD) designated Special Interest item.
2. (U) FY 1982 decrease results from increased efficiencies and general inflation reductions.
3. (U) FY 1983 decrease is a a result of funding being directed to higher priority Army programs.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program represents the Army's prime source of funds for solving critical electronic component deficiencies in combat equipment/systems. The program developments are designed to insure superiority of our combat forces. The technological gap between the US and the Communist Bloc has been closing very rapidly over the past several years. It is imperative that the funding for this Program Element be increased in order to exploit new breakthroughs and maintain our lead in key device technologies. Specifically, the program encompasses the development of the basic building blocks of all electronic equipment/systems including integrated circuits, solid state devices, microwave tubes, power supplies, frequency control, display devices, and the development of electronic materials and processing innovations. Needed for these development objectives are devices for the Army that are economical to produce, durable, and simple to operate, adjust, and maintain. The program objective is to establish cost and performance feasibility of new device concepts by extension of the state of the art to form a basis for advanced system development and higher reliability. Device feasibility thereby established is basic to orderly development planning, and the expanded technology base provides systems designers with the necessary new technical guidance and risk assessments to configure improved electronic systems for minimum total life cycle cost of ownership. Such coupling is provided for specific system needs in the application areas of electronic warfare, night vision, communications, avionics, data processing, combat surveillance and target acquisition, guidance and fire control, navigation and position location, and missile technology.

G. (U) RELATED ACTIVITIES: Coordination is achieved with other government agencies through the Department of Defense (DOD) Advisory Group on Electron Devices (AGED) and the interagency Advanced Power Group to preclude any duplication of effort. Related PE 6.37.42.A, Advanced Electron Devices.

H. (U) WORK PERFORMED BY: The Electronics Technology and Devices Laboratory (ET+DL), Fort Monmouth, NJ. This Army laboratory is scheduled to use approximately 50% of the program funds contractually. Principal contractors are: P. R. Mallory, Burlington, MA; Watkins-Johnson, Palo Alto, CA; Radio Corporation of America, (RCA), Burlington, MA; Somerville, Camden, Princeton, NJ; TRW, Redondo Beach, CA; Hughes Aircraft Co., Fullerton and Torrance, CA; Northrop, Roll Meade, IL; EG&G, Salem, MA; Raytheon, Waltham, MA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS

1. (U) FY 1981 and Prior Accomplishments: In FY 1981 the program was very successful in developing critically needed electronic devices which will improve the Army's capability to see, track targets, and communicate on the battlefield.

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

a. (U) Microwave/Millimeter Wave Device - Started development of 20-40 GHz efforts to increase power output 2 times to provide effective jamming. Started contract for new low-cost tubes with improved power and efficiency for PATRIOT and FIRE FINDER program improvements. Developed second-generation prototype infrared source for the AN2-141 to protect rotary- and fixed-wing aircraft against heat-seeking missiles.

b. (U) Microelectronic Device - Developed 4k bit militarized memory for SINCGARS. Developed powerful automated systems for low-cost, fast-turnaround design of custom modules for Army use.

c. (U) Frequency Control - Tactical miniature crystal oscillator delivered to Ground Positioning Systems and SINCGARS allowing for generation in a jamming environment.

d. (U) Tactical Power Sources - Second-generation lithium cells demonstrated for high-power laser operation. Demonstrated feasibility of high-capacity, first-generation NiZn cells for M1 tank and other vehicles. Started contract for development of a thermopile for 1.5kW thermoelectric generator and consolidated support unit. Develop high-frequency (50KHz) power conversion techniques for portable displays.

Program Element: #6.27.05.A
DOD Mission Area: #521 - Electronics & Physical Sciences (ED)

Title: Electronics and Electron Devices
Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Program: Start program to develop low-cost ruggedized 94 GHz transceiver modules for terminal guidance and radar systems. Start first-generation, low-cost 140 GHz trabsceuver for Command guidance and all-weather target acquisition system. Evaluate reliability of semiconductor nonvolatile memories. Complete low-power 16k-bit military memory for Battlefield Data System (BDS). Develop 500 MHz bandwidth realtime electronic intelligence receiver processor. Start development of microprocessor-compensated clock for extended radio silence and frequency hopping SINCGARS. Start contract for first multicolor computer graphics displays for distributed battlefield use. Complete failure analysis of ultra high speed arrays and develop high-density, high-speed hybrid microcircuits. Demonstrate 1M-bit bubble memory for TRAILBLAZER II and start modules for M1 tank fire control system. Continue program to enlarge size and demonstrate feasibility of second-generation 18-inch color graphics and video displays for tactical system. Fabricate initial practical manportable flat-panal display with 8 times weight and size reduction and 32 times power reduction. Demonstrate 18-inch touch interactive display in CECOM terminal, deliver vibration-resistant oscillator to Battlefield Data System for locating slow-moving targets. Develop VLSI hybrid modules with fault detection for reliable Eletronic Counter-Countermeasures (ECCM). Design 24M-byte bubble memory. Start second-generation ultra low-cost rugged transceiver modules at 94 GHz for active ordnance and missile guidance. Start contract for a 95 GHz eletron beam amplier. Complete 20w, 20-40 GHz and begin 40w, 18-50 GHz jammer module.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.06.A Title: Chemical Biological Defense and General Investigations
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	13169	22899	29589	48316	Continuing	Not Applicable
A553	Chemical/Biological (CB) Defense and General Investigations	13169	22899	29589	48316	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army, as the Department of Defense (DOD) Executive Agent, has responsibility for conducting a Research, Development, Test and Evaluation (RDTE) program coordinated with all the Services to provide the essential technology base upon which the Services can develop deterrent/retaliatory chemical warfare and chemical and biological defense (CW/CBD) systems on an individual or joint basis to meet their military operational needs. This program provides the interservice chemical/biological (CB) defense technology base. Exploratory Development is conducted to provide the technological base to counter the threat posed by potential enemy agents/munition systems; to enhance all aspects of physical defense including warning, detection, identification, decontamination, individual and collective protection; to investigate chemical compounds of military interest; to evaluate protection countermeasures, avoid technological surprise, and uncover leads for new simulant agents; and to study training agents and methodologies for the training of soldiers. The output is knowledge leading toward improvements in CB defense. This knowledge is also usable in advancing the retaliatory chemical agents/munitions technology.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The program will include significantly expanded efforts with academia and industry to broaden the technology base required to support chemical-biological defense materiel requirements. Specifically, the program will include the continuation of the assessment of the effectiveness of protective, detection, identification, and decontamination systems against all threat agents, including toxins, in the integrated battlefield environment. Specific efforts will be directed toward: continuation of exploratory development on innovative means of chemical, thermal, and radiative decontamination as well as mechanical removal; protective masks, garments, and gloves that provide agent

resistance, field durability, and extreme environment operational capability. Additionally, exploratory development will be conducted on new innovative detection and alarm devices to improve response time and sensitivity and reduce logistics burden.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	13169	22899	29589	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	11411	22970	14390	Continuing	Not Applicable

The increase of $1758 thousand in FY 1981 was a result of reprograming to support the enhancement of CB defense technology base. The decrease of $71 thousand in FY 1982 is the result of the amended budget request and the application of revised inflation indices. The $15,199 thousand increase in FY 1983 supports the required enhancement of the CB defense technology base to avoid technological surprise and assure survivability of US forces on a chemical battlefield.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.06.A Title: Chemical Biological Defense and General Investigations
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program supports the entire Department of Defense chemical and biological defense technology base and in-depth exploratory activities in the development of a broad spectrum of equipment concepts for: point sampling and area chemical agent warning systems and detection, sampling and identification equipment; individual and collective protection against respiratory and percutaneous chemical agent hazards; filtration and purification of air and water; personnel and equipment contamination prevention and decontamination; chemical defense training; improvement of safety in military chemical industrial-type operations; airborne biological agent sampling, fractionation, and concentration for point sampling and area scanning-type agent detection and alarm systems; physical protection against and decontamination of biological agents. Program also includes investigations supporting both defensive and offensive development in chemical dispersion and dissemination techniques, chemical agent systems process chemistry and pilot operations; and searches for potential chemical agents and toxicology of chemical agents.

G. (U) RELATED ACTIVITIES: No comparable work is done by the other Services. Coordination is maintained with the other Services to assure provision of the technology base except unique requirements in order to meet their advanced and engineering development needs, adoption of joint Service requirements where practicable, and preclusion of duplicative efforts. Coordination and cooperation is maintained with allied countries via Data Exchange Agreements, and with the North Atlantic Treaty Organization (NATO). Related technical investigations are conducted under Program Element 6.26.22.A, Chemical Munitions and Chemical Combat Support. The technology developed under Program Element 6.27.06.A, Chemical Biological Defense and General Investigations, progresses into Program Element 6.37.21.A, Chemical Defense Materiel Concepts, and subsequently into Program Element 6.47.25.A, Chemical Defense Materiel.

H. (U) WORK PERFORMED BY: In-house by United States (US) Army Chemical Systems Laboratory, Edgewood, MD. Contractors include Shock Hydronamics, Sherman Oaks, CA; Honeywell Corporation, St. Petersburg, FL; Ash Stevens Incorporated, Detroit, MI; Batelle, Columbus, OH; Brunswick Corporation, Marion, VA; Southern Research Institute, Birmingham, AL; Mine Safety Appliance, Pittsburgh, PA; Midwest Research Institute, Kansas City, MO; and Bendix Corporation, Towson, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) *FY 1981 and Prior Accomplishments:* During 1978, the following were accomplished: completed exploratory development (XD) on the detector kit for chemical agents in water and the ionization detector which enhances the sensing capability of the M8 Chemical Alarm System. Additionally, the feasibility of laser remote sensing techniques was completed; and conceptual studies for simplified collective protection for field shelters and residual gas-life indicator for large

Program Element: #6.27.06.A Title: Chemical Biological Defense and General Investigations
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

area filters were completed. In FY 1979, the following were accomplished: completed exploratory development on the decontamination apparatus for vehicles (DAV), and the Automatic Liquid Agent Detector (ALAD); completed evaluation of the German 7-ton decontamination unit; and completed construction of prototype for rapid decontamination system (jet exhaust decontamination system). Exploratory development on the simplified collective protection equipment was initiated. During FY 1980, the following was accomplished: (a) completed investigation and drafted report on facemask filter plugging by battlefield particulates; (b) completed exploratory development of simplified collective protection equipment and transferred to advanced development based upon approval Letter of Agreement (LOA); (c) completed exploratory development on Automatic Liquid Agent Detector and M8 Chemical Alarm Simulator; (d) established feasibility of ionization detector for small handheld contamination monitor and jet exhaust techniques for large scale vehicle decontamination; (e) continued exploratory development on the Advanced Chemical Agent Detector and Alarm with emphasis on blister and nerve agent detection as well as surface surveillance for contamination or completeness of decontamination; (f) also, continued exploratory development of second generation remote detection system using differential absorption and scattering laser techniques for detecting a broad spectrum of agents in all physical states. In addition, the search was initiated for new, improved protective materials for use in masks and overgarments that will satisfy requirements for operation at environmental extremes, resistance to field solvents, and durability. The FY 1981 program included: (a) completion of exploratory development (XD) of the Advanced Chemical Agent Detector Alarm (ACADA); (b) implementation of research on facemask filter plugging by battlefield particulates; (c) completion of investigation of the flow characterization and measurement of thickened liquids to describe their behavior in defensive and deterrent/retaliatory systems; and (d) continuation of investigation of innovative means of chemical, thermal, and radiative decontamination techniques, as well as mechanical removal of contamination. Laser photolysis, microwave, and high-intensity infrared are examples of innovative decontamination concepts. Identification and assessment of candidate persistent and nonpersistent training and trialing simulant agents continued. The exploratory development of an improved personal decontamination kit was initiated. Studies were initiated on charcoal regeneration concepts to increase useful field life of filters, overgarments, and other charcoal-bearing chemical protection materials. Studies were also initiated to evaluate potential threat of plugging large collective protection filters by battlefield particulates. Number of personnel supported: professional 133; support 45.

2. (U) FY 1982-FY 1984 Program: The FY 1982 program will include significantly expanded efforts with academia and industry to broaden the technology base required to support chemical-biological defense materiel requirements. Specifically, the program will include improvements in the chemical warfare total threat model; completion of the Materials and Design Requirements Handbooks for chemical and biological contamination avoidance; completion of exploratory development for a protective mask for high performance aircraft, vehicle mounted nuclear, biological, and chemical reconnaissance

Program Element: #6.27.06.A Title: Chemical Biological Defense and General Investigations
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

system, and biological agent verification kit. Existing materials will be evaluated for effectiveness against toxins to assess gaps in material and data to counter the toxin threat. Existing toxin defense technology will be adopted to Service's requirements. Exploratory development will continue on innovative means of chemical, thermal and radiative decontamination as well as mechanical removal; protective materials for masks, gloves, and garments that provide agent resistance, field durability, and extreme environment operational capability; identification and verification of candidate persistent and nonpersistent training and trialing simulants; charcoal regeneration and residual life monitors to increase useful life of filters, overgarments, and other charcoal-bearing protection materials. Additionally, exploratory development will be initiated on a combined nuclear, biological, and chemical detection/alarm system to reduce the logistics burden; advanced collective protection systems for vehicles and shelters; detector/alarm integration into combat vehicles for automatic sensing/activation for collective protection equipment, potential techniques such as mass spectrometry, pizoelectric crystals, and liquid crystals for detection and identification; and laser, microwave, ion mobility spectrometry and photoacoustic techniques for a new-generation biological alarm. During FY 1983, the effectiveness of protective and detection systems against all potential threat agents, including toxins, in tri-service environments will continue to be assessed. Exploratory development will continue on new innovative concepts such as laser photolysis, microwave, and high-intensity infrared for decontamination; differential absorption and scattering laser techniques for remote detection and monitoring; and mass spectrometry, pizoelectric crystals, and liquid crystals for detection and identification. Identification and assessment will continue on candidate persistent and nonpersistent training and trialing simulants. Exploratory development will be completed on a decontamination station kit and improved personnel decontamination kit. In FY 1984, major emphasis will be placed on new or novel decontamination concepts, e.g., low pressure thermal energy rapid decontamination of sorbed agents in lightweight fragile materials, self renewing films impremeable or reacting with chemical agents and photoinduced reactions. Emphasis will continue on the utilization of ionization principles in detector alarms and monitors because of the high nerve agent sensitivity and potential sensitivity of other agents. Laser applications for both chemical and biological agent detection, decontamination, and monitoring will be exploited. New initiatives in individual and collective protection will include carbon fibers research to provide selective permeation of air and agents, aerosol filtration mechanisms of fibrous mats and use of ion exchange resins and other non-carbonaceous sorbents. Efforts will continue to acquire safe training agents with maximum simularity of response to new agents.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.07.A Title: Mapping and Geodesy
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5020	5750	6830	8962	Continuing	Not Applicable
A855	Topographic/Geodetic Technology	5020	5750	6830	8962	Continuing	Nc Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Army and DOD tactical operations and strategic planning require rapid access to precise position, azimuth, and elevation data and to descriptive terrain information. The Mapping and Geodesy Program investigates and develops responsive and cost-effective means for meeting these requirements. Methods and equipment for collecting, processing, displaying, and disseminating geodetic, topographic, and military data and products are developed within this program.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The requested funding for FY 1983 is required to continue work on specific needs of the Field Army and the Defense Mapping Agency. Field Army needs include: gyroscopic azimuth devices for artillery survey application, low-cost optical/inertial techniques for rapid position determination, improved map designs and production procedures, and terrain analysis focused on intervisibility and mobility. Defense Mapping Agency needs include the development of digital and interactive techniques for imagery data extraction and elevation determination and the use of hybrid electro-optical and digital techniques for imagery data extraction. Defense Mapping Agency (DMA) also requires a high order positioning and gravity determination system to support advanced strategic missile systems.

Program Element: #6.27.07.A Title: Mapping and Geodesy
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5020	5750	6830	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5020	6058	6924	Continuing	Not Applicable

Differences between the FY 1982 submission and the current request are as follows: In FY 1982 a decrease of $308 thousand is a result of recalculation of inflation and civilian pay pricing indices. In FY 1983 a decrease of $94 thousand is due to reprograming to higher priority Army requirements.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) Not Applicable.

Program Element: #6.27.07.A Title: Mapping and Geodesy
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The Mapping and Geodesy Technology Base Program develops new or improved means for rapid acquisition, processing, and dissemination of positional information, mapping data, and military geographic information. End items directly support future map production and topographic support activities affecting strategic and tactical deployment of forces and weapons systems. The program covers areas of Geodesy and Point Positioning, Mapping and Geographic Analysis, and provides the exploratory development portion of the technology base for both the Army and Defense Mapping Agency (DMA). Techniques and equipment developed include: (a) improved position-location data for long-range weapons employment; (b) improved mapping of critical world areas; and (c) mapping, Military Geographic Information (MGI) and terrain analysis for Army tactical operations to include contingency, limited war, general war, and rescue operations. The program addresses science and technology objectives in the Army Science and Technology Objectives Guide (STOG).

G. (U) RELATED ACTIVITIES: This Program Element applies results of basic research performed under Program Element 6.11.02.A, Defense Research Sciences, Project B52C, Mapping and Geodetic Research. Both the Air Force and Navy have related mission-oriented research, which is coordinated with the Army's program by the Defense Mapping Agency (DMA) and the Under Secretary of Defense for Research and Engineering (USDRE). Advanced and engineering development of techniques and equipment resulting from this program is accomplished under the following program elements: DMA Program Element 6.37.01.B, Mapping, Charting, and Geodesy Investigation and Prototype Development; DMA Program Element 6.47.01.B, Mapping, Charting, and Geodesy Engineering Development and Test; duplication of effort is avoided by annual DOD Apportionment and Budget Reviews, DMA Technology Base Reviews, periodic DOD Topical Reviews, and technical coordination among the Service research laboratories.

H. (U) WORK PERFORMED BY: Approximately 65% of the work is performed in-house at the US Army Engineer Topographic Laboratories, Ft. Belvoir, VA. The balance is performed by commercial contractors or other government agencies. Total contracted effort for FY 1983 will be $2,400,000. The major contractors are: Ampex Corp., Redwood City, CA; DBA, Orlando, FL; The Analytical Science Corporation, Reading, MA; SRI, Menlo Park, CA; and General Electric Space Division, Philadelphia, PA. There are eleven additional contractors with contracts in this program totaling $1,100,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A miniature Gyro Compass was developed to provide a lightweight instrument for use by Field Artillery Forward Observers. A Laser Survey Instrument for low-visibility operation was assembled and tests initiated. Modifications to the Inertial Positioning System were determined to meet the Defense Mapping Agency's strategic geodetic requirements. The Digital Terrain Analysis System was upgraded, and software for preparation of terrain

Program Element: #6.27.07.A Title: Mapping and Geodesy
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

analysis production installed. Hardware modifications were made to the Digital Image Analysis Laboratory (DIAL), and application software installed to demonstrate the feasibility of interactive digital image processing in support of Defense Mapping Agency (DMA) and Army needs. The Field Exploitation of Elevation Data (FEED) system, which provides terrain perspective views, radar masking, and flight path overlay for tactical planning and operation was demonstrated at various military installations. Radar parameters and instrumentation for a Radar Image Analysis system have been determined and a Radar Recognition Testbed defined. Several terrain analysis procedure guides were prepared. Hardware and software modifications have been added to the Computer-Assisted Photo Interpretation (CAPIR) to provide a flexible, versatile research instrument to support the Defense Mapping Agency (DMA) feature extraction Engineering Development.

2. (U) FY 1982-FY 1984 Program: Complete Exploratory Development of a Survey Instrument for low-visibility operations. Evaluate the Rapid Geodetic Survey System for meeting Defense Mapping Agency requirements for strategic missiles. Evaluate the Variable Geometry Laser Printer and define parameters and capability for Advanced and Engineering Development. Complete interface of Parallel Transfer Disk to Digital Image Analysis Laboratory and develop application software for interactive digital feature extraction. Design system for Multi-Image Automated Photo Interpretation. Develop initial knowledge base systems for Artificial Intelligence investigation. Prepare specification and cost data for Advanced Development of an Interactive Terrain Analysis module. Complete additional Terrain Analysis and Synthesis Guide. Investigations to define positioning and attitude components for self-propelled weapons and combat vehicles will continue. Development and testing of interactive techniques of digital image feature extraction will continue. Techniques and instrumentation for Vertical Obstruction Data Collection will be defined to support the Cruise Missile. A system for Multi-Image Automated Photo Interpretation will be developed, and software and methodology for terrain analysis will be demonstrated. Standards for electronic display symbols will be published and integrated into prototype field system development. A Radar Recognition Testbed will be assembled, and image analysis software development will continue. Several guides in a continuing series of terrain analysis procedure guides will be prepared. Guides for predicting minefield locations, based upon terrain factors, will be completed. Personnel supported by this program include 66 professional and 4 support. Positioning- and attitude-determining modules will be developed and tested for application to self-propelled weapons and other combat vehicles. Investigation will continue in the development and testing of interactive digital feature extraction techniques. Feasibility of a Multi-Image Automated Interpretation System will be demonstrated. Software and methodology will continue to be refined for terrain analysis application. Terrain graphic display and presentation in a tactical operation mode will be investigated. Vertical obstruction Data Collection investigation will be evaluated and will support Advanced and Engineering Development instrumentation. Radar image analysis technology will be evaluated and will progress to Advanced and Engineering Development.

3. (U) Program to Completion: Continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.09.A
Title: Night Vision Investigations
DOD Mission Area: #521 - Electronics & Physical Science (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	12673	13154	14101	13934	Continuing	Not Applicable
DH95	Night Vision Investigations	12673	13154	14101	13934	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army has a need for a cost-effective means to fight during periods of darkness and limited visibility with a relative combat capability that is equal to that of day. This program element supports the development of technology to ensure the United States (US) maintains its lead in the ability to acquire and engage targets under all battlefield conditions. This combat capability is required to counter the threat of a foe who plans and trains to continue combat operations during periods of darkness and limited visibility. Using advanced technologies and new concepts in the field of electro-optics, this program develops new techniques, components, and devices that will result in significant cost reductions and performance improvements for night vision devices.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Funds requested provide for research and exploratory development to improve performance effectiveness, simplify, and reduce life cycle costs of future night vision systems. Major efforts will be in the areas of Visionics, Thermal Imaging, and Lasers. VISIONICS - New initiatives will be undertaken to develop analytic tools and image evaluation techniques for analysis and design of new families of autonomous sensors. These models and the existing models for man-in-the-loop systems will be continually improved to include new technology advances, adverse battlefield environmental effects, and countermeasures based on data from field and laboratory experiments. THERMAL IMAGING - Continue to develop high-density detector arrays and autonomous target enhancement aids which will double the viewing range of thermal imagers when operating under adverse environmental conditions; e.g., fog, smoke, dust. Develop class of compact, low-cost, infrared sensor modules for self-guidance and terminal homing of missiles and munitions. LASER - Continue development of laser sources for target acquisition and integrated engagement systems. Includes the integration of these laser with heterodyned forward-looking infrared sensors to form an all-weather imaging system, as well as new precision laser designator. These efforts are pointed toward improving the Army's ability to acquire and engage targets under all

Program Element: #6.27.09.A Title: Night Vision Investigations
DOD Mission Area: #521 - Electronics & Physical Science (ED) Budget Activity: #1 - Technology Base

weather conditions. Continue development of optical countermeasures as a means of denying enemy use of target acquisition and engagement systems.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	12673	13154	14101	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	10674	13490	15019	Continuing	Not Applicable

Increase in FY 1981 ($1999) was for work on a compartmented project. The FY 1982 decrease ($336) reflects the application of an inflation index reduction. Decrease in FY 1983 ($918) was due to program realignment and reprograming to higher priority projects.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.09.A
Title: Night Vision Investigations
DOD Mission Area: #521 - Electronics & Physical Science (ED)
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The total effort covers exploratory research and development of components, techniques, man/machine models, smart sensor models, and environmental data bases essential for both significant cost reductions and performance improvements in night vision electro-optical devices. The Visionics program is concerned with development of system performance models, tactical effectiveness models, acquisition of data bases for target signatures and sensor field performance, and establishment of new techniques for specification of advanced sensors. The performance of sensors used in target acquisition, surveillance, navigation, fire control, and damage assessment is studied using analytic models. Results of analytic studies are used to recommend optimum sensor designs and area of highest payoff of R&D dollar investment for the Army in sensor development. Models are used to portray realistically the performance of the various sensors on the active battlefield against various threat weapons systems. These models include both man-in-the loop sensors and new advanced autonomous smart sensors operating in one or several spectral regions. Far infrared thermal imaging technology is directed toward fabrication and initial testing of second-generation Forward Looking Infrared (FLIR) imagers. A new generation of high-performance IR sensors is being developed which uses high-density, Charge-Couple Device (CCD) focal plane arrays (FPA). This FPA sensor will double the standoff range of present FLIRs in airborne applications and greatly enhance the performance of combat vehicle FLIR under conditions of poor visibility. Increased search effectiveness is provided by automatic target-cueing and image enhancement provided by automatic target-cueing and image enhancement techniques. Large two-dimensional staring focal plane arrays which use CCD signal processing to electronically scan the detector array offer significantly improved system sensitivity while reducing mechanical and optical complexity. For Lasers, the concept of a "common module" carbon dioxide laser and definition of a family of compact modular elements compatible with FLIR is being developed. Applications of this laser family include Identification Friend or Foe, beamrider missile guidance, target designators, and wind sensors. Common modules and interface elements for interaction with a FLIR are constructed and tested. Optical countermeasures are being developed to deny the enemy use of target acquisition and engagement systems. Because of the noncommercial aspects of night vision and electro-optical technologies, it is essential to maintain internal research and development activity.

G. (U) RELATED ACTIVITIES: Close coordination is maintained with the Navy, Air Force, and Marine Corps to avoid duplication. Through the Joint Logistics Commanders (Army, Navy, and Air Force), coordinating groups have been established to ensure that maximum use is made of limited assets; e.g., the Navy is developing 8-14 micron second-generation infrared detectors, while the Army is developing those sensitive to 3-5 micron energy. The Army has responsibility for the Configuration Management of the first-generation Thermal Imaging Common Modules used by all Services. In addition, an active international program of technical cooperation is maintained with many countries, particularly those of the North Atlantic Treaty Organization (NATO) and the Quadripartite countries (America, Britain, Canada, and Australia).

Program Element: #6.27.09.A Title: Night Vision Investigations
DOD Mission Area: #521 - Electronics & Physical Science (ED) Budget Activity: #1 - Technology Base

H. (U) WORK PERFORMED BY: Night Vision Laboratory, Fort Belvoir, VA. Representative contractors are: Philco Ford Corporation, Aeronutronics Division, Newport Beach, CA; Martin Marietta, Orlando, FL; Hughes Aircraft, Culver City, CA; and Texas Instruments, Dallas, TX.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Second-generation image intensifier tubes have been developed and are now in production. Gallium arsenide photo cathode technology for third-generation intensifiers with greatly increased sensitivity and reliability has been developed and is now in night vision goggles in Engineering Development. Programs were initiated to develop a flat-panel, helmet-mounted display for use by helicopter pilots, and a miniature camera tube for possible use in Remotely Piloted Vehicles (RPV's). A second-generation Thermal Imaging program to demonstrate high-density detector focal planes, up to 5000 detectors, was initiated. A second-generation thermoelectrically cooled focal plane array was developed and demonstrated for a new class of lightweight thermal weapons sights. Prototype Thermoelectrically (TE) cooled, staring focal plane arrays were fabricated for possible application in automatic tracking imaging for smart munitions in the mid-1980's. Development of 10.6 micron laser and heterodyned forward-looking infrared systems (FLIRs) which will be integrated into an all-weather target-sensing system was initiated. In the Visionics area, models of laboratory and field performance and tactical effectiveness have been developed for imaging systems operating in the visual through far IR spectral regions, including the effects of smoke and target signature variation.

2. (U) FY 1982-FY 1984 Program: Complete development of second-generation forward-looking infrared (FLIR) with improved performance for aircraft missile and combat vehicle application. Continue work on staring thermal imagers for low-cost, lightweight system requirements. Initiate reliability/producibility program for integrated focal plane arrays. Continue development of laser sources in the .5-3 and 3-20 micron bands for target acquisition and integrated engagement systems. Continue development of Laser/Electro-Optic sources for target acquisition and integrated engagement systems. Continue development of Optical Countermeasures (OCM) as a means of countering enemy target acquisition and engagement systems. Complete development of analytic models for autonomous systems, especially trackers and autocuers operating in the visual through millimeter wave regions. Establish image evaluation facility for advanced autonomous sensors for laboratory evaluation and specification acceptance of such devices.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED) Budget Activity: #1 - Technology Base

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	8554	9707			Continuing	Not Applicable
A042	Tactical Electronic Warfare Techniques	5702	6505			Continuing	Not Applicable
A904	Tactical Electronic Warfare and Intelligence Techniques	2852	3202			Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supplies the exploratory development technology in support of all Army Electronic Warfare (EW) programs. The effective use of EW will be one of the most important combat multipliers on the modern battlefield. The ability to reduce the enemy's command and control by disrupting his communications and to protect our forces from detection and radar, electro-optical, and infrared guided weapons may spell the difference between victory and defeat in any future conflict. The efforts of this program are coordinated with the intelligence community to identify foreign technological advancements and develop countermeasures to these advancements. The rapidly increasing use of precision-guided weapons necessitates a corresponding effort in the detection and countering of such threats. Investigation and development is continuing to insure that the latest developmental US missiles, communications, electronics, and night vision systems will function satisfactorily in a hostile countermeasures environment.

C. BASIS FOR FY 1983 REQUEST: Continue developments to protect Army aircraft. These include signal processors to improve radar warning capabilities, devices to detect and techniques to detect the techniques for detecting on antiair weapons. Continue

developments on the Air Defense Electronic Warfare System (ADEWS), which and enhances the effectiveness of Army Air Defense Systems. Continue development of miniaturized receiving and direction-finding devices which will substantially reduce weight and power requirements. Continue signal sorter development for use with radar jammers and conduct testing of a for expendable jammers. Expand steerable null antenna processor technology to the ranges. Initiate an program to defeat Continue to defeat by developing an advanced signal processor with complex detection and recognition algorithms, developing a completing development of electronics to and completing development of a mobile high frequency antenna and beginning work on a Continue efforts to exploit receivers, and develop jamming techniques for. Continue improvement of the by lowering the frequency capability of the system.

D. COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	8554	9707		Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	8272	9735		Continuing	Not Applicable

Decrease in FY82 due to adjustments to inflation indices. Increase in FY81 due to internal reprograming to A904 to conduct a distributed signal processing effort. Decrease in FY83 due to reprograming to higher priority Army projects.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED) Budget Activity: #1 - Technology Base

F. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is the exploratory development of tactical electronic warfare (EW), to include electronic countermeasures (ECM) and electronic counter-countermeasures (ECCM) techniques, components and equipment to be targeted against enemy communications and noncommunications systems associated with hostile weapon systems and units. As methods of communications/electronics become more sophisticated, equipment must also become more sophisticated if we are to adequately counter new threats. Technology development is also required to minimize the total cost of development, acquisition, and operation of electronic warfare equipment.

G. (U) RELATED ACTIVITIES: This work is in direct support of program elements 6.37.45.A (Tactical ESM Systems), 6.37.55.A (Tactical ECM Systems), 6.47.45.A (Tactical ESM Systems), and 6.47.50.A (Tactical ECM Systems). Work on the development of electronic counter-countermeasures (ECCM) technology supports numerous Army electronics systems in the area of communications and noncommunications. Tri-Service technical efforts in electronic warfare receive extensive review as a result of participating in Joint-Service Technical Programs, Electronic Counter-Countermeasure Workshops and Joint Technical Coordinating Groups which reduce duplication among the Services. Coordination is also furthered through Tri-Service preparation of a Technology Coordinating Paper on Electronics and the annual reviews by the Under Secretary of Defense for Research and Engineering (USDRE).

H. (U) WORK PERFORMED BY: The US Army Electronics Research and Development Command (ERADCOM), Adelphi, MD, consisting of the Electronic Warfare Laboratory (EWL), Fort Monmouth, NJ; US Army Signals Warfare Laboratory (SWL), Warrenton, VA; Office of Missile Electronic Warfare (OMEW), White Sands Missile Range (WSMR), NM; Harry Diamond Laboratories (HDL), Adelphi, MD; and Electronics Technology and Devices Laboratory (ETDL), Fort Monmouth, NJ. Supporting efforts are provided by the Letterman Research Institute, San Francisco, CA; Naval Weapons Center, China Lake, CA; Pacific Missile Test Center, Point Mugu, CA; Air Force Avionics Laboratory, Wright Patterson Air Force Base, OH, and Rome Air Development Center, Griffiss AFB, NY. The top five cont..actors are RCA Corporation, Princeton, NJ; Sanders Associates, Nashua, NH; Hazeltine Corp., Greenlawn, NY; Parkin-Elmer Corp., Wilton, CN, and Scientific Technical Associates, Arlington, VA. There are 36 other contractors with a total contract value of $3207 thousand.

Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED) Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY81 and Prior Accomplishments: In the area of survivability and vulnerability Special Chaff has been fabricated and a Chaff
Measurements were conducted on the aerodynamic and electromagnetic properties of special
Radar warning developments including testing Radar Warning system was accomplished, and development of a radar warning receiver subsystem was initiated. The subsystem was integrated with the AN/APR-39 for tests. Flight tests against radars were conducted utilizing the with favorable results, demonstrating a definite potential for use against radars. Successful field testing has proved the validity of using expendable repeaters in Radar Targeting. Radar jamming sorter/tracker algorithms were developed, and analysis of active/passive decoys was initiated. Laser efforts have included completion of a countermeasures analysis, and decoy countermeasures techniques were demonstrated. Development was started on designed to protect US Army aircraft from Air Defense EW System (ADEWS) threat analysis and effectiveness/survivability measurements were completed, and the ADEWS prototype was successful testing against Efforts were initiated to build
and develop radio frequency (RF) circuits and processing of
Wideband preamps for were fabricated and a high-power jammer amplifier was designed utilizing
Initial investigations in the ESM area demonstrated the feasibility of
A continuous wave (CW) heterodyne receiver/transmitter has been developed and tested to define limitations of Preliminary antenna design concepts were investigated for both broadband transmit and Ultra High Frequency (UHF) antennas. Developments of countermeasures for were started, contractual effort to fabricate a demonstrated, and the program will transition to advanced development in 1982. A program was started to refine techniques to detect, collect, and process and complete configuration of the in-house high-density, wideband recording and analysis system. Breadboard models of the best antenna and matching units for were developed and feasibility testing with emphasis on applications conducted.

Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED) Budget Activity: #1 - Technology Base

2. FY 1982-FY 1984 Planned Program: The Chaff program will complete the study and techniques for improvement. The program will begin in FY83, and designs will be evaluated in FY84. The assessment of will begin in FY84. Developments to improve missile detection will continue with a Tri-Service analysis and signature and atmospheric measurements. The simulation and prototype sensor evaluation will be done in FY84. developments will include construction of a target signature data base, testing of a warning receiver, and modeling of an warning receiver. The warning receiver will transition to advanced development in FY84. A subsystem will be evaluated in FY82 for use in Radar Warning Receivers. FY83 will complete development of warning receiver techniques, and FY84 will complete the brassboarding of new signal processing methods for radar warning receivers and begin the testing of these methods. efforts will include studies of advanced the effectiveness of different waveforms and modeling of techniques for advanced An advanced system breadboard will be developed in FY83, and a model to generate complex countermeasures waveforms will be developed in FY84. In FY82 the advanced analysis will be completed and incorporated in the engineering development program. Development of a countermeasures subsystem will begin in FY83, and development of a countermeasures system against will begin in FY84. Approaches to countering will be determined in FY84. The Radar Jamming program will continue with further tests of the The Navy-developed ALQ-99 jammer will be mounted in a UH-1 helicopter and demonstrated for Army use. Development of hardware and software to sort and track will begin in FY82, and in FY83 the jammer will be tested against these radar types. Development of countermeasures against will be completed in FY84. Development of optimized electronic countermeasures for use with radar jammers will begin in FY82 and transition to advanced development in FY84. Development of a miniature will begin in FY82 and transition to advanced development in FY84. The communications systems begun in 1981 will continue through the period with brassboard testing in FY84. The developments started in FY81 of a miniaturized/monolithic receiver/direction-finding (DF) subassembly and a assembly will continue through the period. Integration of both assemblies into a for range testing and capability demonstration is scheduled for FY84. The program to develop a signal collection/analyses processor designed to will continue through the period. The development started in FY81 will

continue with the goal of transitioning into developing systems beginning in FY84. Development will continue on distributed processors with the addition of high-level language capabilities using a new bipolar signal processor and complex signal detection and recognition algorithms. In FY84 a 32-bit microprocessor, bubble memory and flouting point signal-processing capability will be added. The signal processor development initiated in FY81 for the will continue with the goal of developing a small seeker. Support to the effort will continue and antenna developments designed to develop lightweight, high wave antennas with will continue. High frequency and very high frequency antennas will be evaluated in FY84. Developments to develop a jamming capability against will be initiated in FY82.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project #A042 Title: Tactical Electronic Warfare Techniques
Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronic and Physical Sciences Budget Activity: #1 - Technology Base

A. DETAILED BACKGROUND AND DESCRIPTION: Improve Army Tactical electronic warfare (EW) capability to: (1) Protect both air and ground forces against radar, electro-optical (EO) and infrared (IR) homing missile threats, and radar and optically guided weapons; (2) intercept, identify, locate, target and counter command, control, and communications (C3), Data Links, intelligence, surveillance, and target acquisition (ISTA), Radar, EO and IR, as well as missiles and other weapons by means of new, adaptive and expandable EW techniques; (3) Reduce vulnerability of friendly communications electronics (CE), and missile systems to hostile EW actions. For noncommunications EW the approach is to develop a new generation of threat-compatible equipment, both modular and expandable. This equipment will permit deployment in high-risk areas and provide realtime mission capabilities while circumventing some of the inherent constraints of ground operation and low performance, constrained airborne platforms. For the protection of combat systems, the general approach is to provide warning, jamming, or decoying of the weapon and/or operator. To accomplish effective jamming against the new radars and missiles which contain numerous ECCM features, will be developed. Improved decoys will be developed which will deploy rapidly and much better match the characteristics of the protected target to defeat schemes. For the vulnerability/ECCM area the approach includes development of ECCM technology for communications, development of ECCM technologies for combat surveillance systems, and development of EW threat technologies for use in EW missile vulnerability programs.

B. (U) RELATED ACTIVITIES: This work is in direct support of the Program Manager for Aircraft Survivability Equipment and of programs/projects 6.37.45.A/D905 (Tactical Electronic Support Measures (ESM)), 6.37.45.A/D925 (Tactical Electronic Warfare and Intelligence Command and Control Systems), 6.37.55.A/D251 (Protective Electronic Warfare EW Equipment), 6.37.55A/DK14 Expendable Jammers), 6.37.18.A/D626 (Nonmissile Vulnerability/Susceptibility), 6.37.18.A/D267 (Missile Susceptibility), 6.37.55.A/DK12 (Division Tactical Electronic Countermeasures (ECM) Systems), 6.37.55.A/DK13 (Non-Communications ECM), 6.47.45.A/D906 (Tactical ESM Systems, 6.47.45.A/D926 Tactical Electronic Warfare and Intelligence Command and Control Systems 6.47.50.A/DL12 (Division Tactical ECM Systems), 6/47/50.A/DL14 (Expendable Jammers), and 6.47.50. A /DL13 (Non-Communication ECM). Triservice technical efforts in electronic warfare receive extensive review as a result of a participating in Joint Service Technical Programs, Electronic Counter-Countermeasure Workshops and Joint Technical Coordinating Groups which eliminate duplication among the Services.

Project #A042 Title: Tactical Electronic Warfare Techniques
Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronic and Physical Sciences Budget Activity: #1 - Technology Base

C. (U) WORK PERFORMED BY: The Electronic Warfare Laboratory (EWL), US Army Electronics Research and Development Command (ERADCOM), Fort Monmouth, NJ, is the in-house developing organization responsible for this project. The top five contractors are RCA Corp., Burlington, MA; Sanders, Nashua, NH; Perkin Elmer, Wilton, CN; Hazeltine Corp, Greenlawn, NY; and Georgia Institute of Technology, Atlanta, GA. There are 11 other contractors with a contract value of $2517 thousand.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY81 and Prior Accomplishments: In the area of survivability and vulnerability Special Chaff has been fabricated and a Chaff
Measurements were conducted on the aerodynamic and electromagnetic properties of special
Radar warning developments including testing Radar Warning system was accomplished, and development of a radar warning receiver subsystem was initiated. The Laser Warning Receiver subsystem was integrated with the AN/APR-39 for tests. Flight tests against radars were conducted utilizing the with favorable results, demonstrating a definite potential for use against radars. Successful field testing has proved the validity of using expendable repeaters in Radar Targeting. Radar jamming sorter/tracker algorithms were developed, and analysis of active/passive decoys was initiated. Laser efforts have included completion of a Laser Beamrider countermeasures analysis, and Laser Air-to-Surface Missile (ASM) decoy countermeasures techniques were demonstrated. Development was started on designed to protect US Army aircraft from Air Defense EW System (ADEWS) threat analysis and effectiveness/survivability measurements were completed, and the ADEWS prototype was successful testing against Efforts were initiated to build and develop radio frequency (RF) circuits and processing of Wideband preamps for were fabricated and a high-power jammer amplifier was designed utilizing
Initial investigations in the ESM area demonstrated the feasibility of A continuous wave (CW) heterodyne receiver/transmitter has been developed and tested to define limitations of augmentation. Preliminary antenna design concepts were investigated for both broadband transmit and Ultra High Frequency (UHF) antennas.

2. FY 1982-FY 1984 Planned Program: The Chaff program will complete the study and

Project #A042 Title: Tactical Electronic Warfare Techniques
Program Element: #6.27.15.A Title: Tactical Electronic Warfare Technology
DOD Mission Area: #521 - Electronic and Physical Sciences Budget Activity: #1 - Technology Base

techniques for improvement. The program will begin in FY83, and designs will be evaluated in FY84. The assessment of will begin in FY84. Developments to improve missile detection will continue with a Tri-Service analysis and signature and atmospheric measurements. The simulation and prototype sensor evaluation will be done in FY84. developments will include construction of a target signature data base, testing of a warning receiver, and modeling of an warning receiver. The warning receiver will transition to advanced development in FY84. A subsystem will be evaluated in FY82 for use in Radar Warning Receivers. FY83 will complete development of warning receiver techniques, and FY84 will complete the brassboarding of new signal processing methods for radar warning receivers and begin the testing of these methods. efforts will include studies of advanced the effectiveness of different waveforms and modeling of techniques for advanced An advanced system breadboard will be developed in FY83, and a model to generate complex countermeasures waveforms will be developed in FY84. In FY82 the advanced analysis will be completed and incorporated in the engineering development program. Development of a countermeasures subsystem will begin in FY83, and development of a countermeasures system against will begin in FY84. Approaches to countering will be determined in FY84. The Radar Jamming program will continue with further tests of the The Navy-developed ALQ-99 jammer will be mounted in a UH-1 helicopter and demonstrated for Army use. Development of hardware and software to sort and track will begin in FY82, and in FY83 the jammer will be tested against these radar types. Development of countermeasures against will be completed in FY84. Development of optimized electronic countermeasures for use with radar jammers will begin in FY82 and transition to advanced development in FY84. Development of a miniature will begin in FY82 and transition to advanced development in FY84. The communications systems begun in 1981 will continue through the period with brassboard testing in FY84. The developments started in FY81 of a miniaturized/monolithic receiver/direction-finding (DF) subassembly and a assembly will continue through the period. Integration of both assemblies into a for range testing and capability demonstration is scheduled for FY84. The program to develop a signal collection/analyses processor designed to will continue through the period. The development started in FY81 will continue with the goal of transitioning into developing systems beginning in FY84. Development will continue on distributed processors with the

addition of high-level language capabilities using a new bipolar signal processor and complex signal detection and recognition algorithms.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

5. Resources ($ in thousands):

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5702	6505		Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5773	6524		Continuing	Not Applicable

Decrease in FY81 and FY82 due to adjustments to inflation indices. Decrease in FY83 due to reprogramming to higher priority Army programs.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.27.16.A
Title: Human Factors Engineering System Development
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	7005	8547	9173	11409	Continuing	Not Applicable
AH70	Human Factors Engineering in System Development	7005	8547	9173	11409	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The basic Army need for this activity centers about the requirement to ensure that Army materiel can be effectively operated and maintained by the soldier in the operational environment. Therefore, this effort is directed toward generating human factors data and providing these to the appropriate components of the Army Materiel Development and Readiness Command (DARCOM). In this regard, soldier interface issues have been studied to: improve US Army artillery system effectiveness in combat; increase the US Army's ability to fight in built-up areas; improve the individual soldier's personal equipment and its compatibility with all other items (weapons, gas mask, load-carrying equipment, and armored vest); reduce noise damage to hearing among military personnel; improve performance of individual and crew-served weapon systems during periods of reduced visibility and smoke on the battlefield; improve development of visual displays for future Army air defense systems; reduce aircrew workload imposed by the introduction of new electronic displays, controls, and data processing equipment into Army helicopters; improve ammunition resupply procedures; ensure effective soldier integration into command, control, and communication nets; reduce manpower requirements and enhance performance through the use of artificial intelligence/robotics. Examples of specific weapon systems benefiting from this program include: M1 Tank, Artillery Battery Computer System, XM198 Self-Propelled Howitzer equipment employment, infantry fighting vehicle, improved TOW vehicle, Hellfire, enhanced self-propelled artillery weapons systems, Army Helicopter Improvement Program, Advanced Attack Helicopter, Division Air Defense Gun, Field Artillery Ammunition Support Vehicle, Heavy Expanded Mobility Tactical Truck, Modular Record Traffic Terminal, Modular Tactical Communications Center, fire support C3, new handguns and rifles, new load-bearing equipment, NBC equipment, and logistic systems such as ammunition handling and packaging.

Program Element: # 6.27.16.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Human Factors Engineering in System Development
Budget Activity: #1 - Technology Base

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Continue to generate human factors data and ensure their application in support of current and future Army materiel. Human factors support will be provided to over 120 systems and subsystems in various stages of development. Additionally, studies will be conducted to gain important human factors data in support of all mission areas with special emphasis in fire support, C2/C3 and artificial intelligence/robotics.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	7005	8547	9173	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6297	8668	9296	Continuing	Not Applicable

The funding increase of $708 thousand in FY 1981 is a result of reprograming at higher levels to initiate a program on Automatic Data Collection Systems and to expand ongoing efforts concerned with Military Operations in Built-Up Areas. The funding decrease of $121 thousand in FY 1982 is a result of the amended budget request and the application of the revised inflation pricing index. The funding decrease of $123 thousand in FY 1983 is a result of reprograming actions to comply with OSD decisions.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.27.16.A Title: Human Factors Engineering in System Development
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is conducted by the US Army Human Engineering Laboratory (HEL), Aberdeen Proving Ground, MD, a unique, central laboratory of the US Army Materiel Development and Readiness Command (DARCOM), that provides research support to all of the DARCOM Commodity Command and Project Managers in the technology area, Human Factors Engineering. Under this program, the Laboratory conducts fundamental and applied research, weapon system concept feasibility evaluation, and system performance measurements and provides human factors engineering application support on Army materiel items during development. The Laboratory operates a DOD-wide scientific data bank which includes data collected anywhere in the world in this technology field. This program, through research and field experiments, supports the development of small arms, infantry weapons, aviation, artillery, missile systems, communication and electronics equipment, combat vehicles, wheeled vehicles, clothing, and personal equipment. The ultimate objective of this work is to assist in the development and production of the most effective and least expensive weapons and equipment for United States soldiers for combat anywhere in the world. Human factors engineering detachments or offices are located at major Army development activities, TRADOC and the Project Manager for Training Devices (PM TRADE), and the Cold Regions Test Center.

G. (U) RELATED ACTIVITIES: This Laboratory (HEL) is a Leader in tri-Service coordinating; e.g., under a tri-Service human factors technology coordination group. HEL chairs or participates in a helicopter human factors engineering subcommitte and human factors test and evaluation subcommittee, assembles all appropriate data, publishes all tri-Service human factors engineering design standards and human factors engineering design handbooks, chairs two NATO Research and Development committees, and performs an independent human factor engineering review for all major Army materiel systems. Biomedical input into Army materiel design is coordinated through this program.

H. (U) WORK PERFORMED BY: In-house work is performed by the Army Human Engineering Laboratory, Aberdeen Proving Ground, MD, supported by the US Army Tank-Automotive Research and Development Command, US Army Missile Command, US Army Communication Development Command. The top five contractors whose contracts exceed $25,000 per contract are: AAI Corporation, Baltimore, MD; Andrulis Research Corporation, Bethesda, MD; Litton Systems, Inc., Woodland Hills, CA; Armament Systems, Inc., Anaheim, CA; Southwest Research Institute, San Antonio, TX. In addition to the five major contractor a total of $565,000 was distributed to eight other commercial concerns.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Preliminary design for construction of robotic ammunition transport device

Program Element: # 6.27.16.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Human Factors Engineering in System Development
Budget Activity: #1 - Technology Base

has been completed. Orders have been placed for a Unimation Model 4000 robot and a Digital Equipment Corporation model PDP 11/03 computer for use in its design. A program designed to assess the effects of firing shock (recoil) on gunner performance has been initiated. Data on "g" loadings is a function of gun firing impulse, vehicle weight, and other significant parameters have been obtained during the initial phase. General Military Operations in Urban Terrain (MOUT) coordination was effected with all services through individual specific efforts and in support of the Joint Services MOUT steering Group and ADPA International Symposium. Tests were conducted with various smoke devices to determine time versus distance obscuration relations within buildings. Preliminary information is available in this area for the first time. Two lighting concepts have been developed and tested in the Laboratory. These lighting concepts may serve as solutions for helicopter fleet retrofit to ensure night vision goggle compatibility. Viper noise restriction has been removed; man rating test of M198/155M with M203 prop charges are in progress; a blast test trailer is under contract; a quiet vehicle program has reduced sprocket and idler noise by approximately 12 db; final reports are completed on modeling skin penetration from particular matter and secondary debris from small rocket firings and methodology for weapon development testing. Data in these reports will be used by developers in developmental testing. Artillery C3 - Human Engineering Laboratory Battalion Artillery Test (HELBAT) 8- integrated subsystems and conducted evaluations of these sybsystems. Terminals and command links for an integrated fire support C3 system have been developed and integrated to provide artillery's first look at capabilities of follow-on systems. Completed baseline data and generated model describing current artillery capability. This study will provide a baseline against which to compare improvements in hardware, training, or techniques. Initiated studies into the feasibility of using robotics in the ammunition supply point (ASP) to speed up operations, reduce manpower requirements, and reduce the real estate required by reducing the required stockpile on hand.

2. (U) FY 1982-FY 1984 Program: Concepts for automating the ASP will be examined to increase the effectiveness of the ASP. A program will be initiated to integrate the previous three years of testing and development with the newly emerging science of robotics. The entire system from the loading/assembly/packaging (LAP) plant to the firing weapon will be examined. Compatibility of aircrew personnal equipment, NBC equipment, and helicopter cockpits will be addressed. Data are anticipated to define operator performance limatations and assist in crewstation design. The effects of NBC-protective equipment on air defense operations will be examined. These data will serve to identify the potential degradation of operational effectiveness resulting from NBC conditions. Continue to support the TRADOC System Analysis Activity (TRASANA) in developing a war game for MOUT by coordinating pertinent MOUT weapon effects, communications, and other MOUT data. These efforts will result in more realistic and accurate modeling of MOUT, hence, better guidance in the weapons selection process, force structuring, etc. Collection of baseline data in support of the fire control research effort will be initiated.

Program Element: # 6.27.16.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Human Factors Engineering in System Development
Budget Activity: #1 - Technology Base

This will include comparison assessments of new concepts in fire control systems using both thermal sights and millimeter radar under simulated battlefield conditions. The demonstration project of a Unimation 4000 robot augmented by a PDP 11/03 computer and newly designed equipment to provide a robotic loading system for the M110 8" howitzer will continue. Field experiments to measure gunner performance with forward-looking infrared (FLIR)-equipped antitank/tank weapons will be conducted. These data are needed to model gunner performance and to develop training methods for thermal sights. Artillery C3 study--HELBAT 8--complete system field evaluations will assess system and subsystem strengths and weaknesses and plan follow-on evaluations of subsystems. Assessments will be made of the artillery's ability to deliver timely, effective fire in a mobile battlefield situation using improved C3 techniques and materiel in support of the Army Field Artillery Tactical Data System (AFATDS) program. Design and conduct a field evaluation (HELBAT) of two integrated fire support C3 systems superimposed on an operational field artillery unit. Study results will be utilized to define the follow-on phase of AFATDS remote terminal systems. A rudimentary Human Factors Engineering uniform model for three climate environments, temperate, cold, and extreme cold, will be established. One or two operational sequences and/or tasks will be selected. Combined uniform systems assessment under each of the climatic situations will be conducted to field-verify the model. In blast overpressure, a critical-level theory for impulse noise exposure will be verified through experiments with real ears (rifle spectrum). This integrated theory of acoustic trauma will establish an absolute upper limit to nontraumatic blast overpressure (BOP) exposures for rifle spectrum on real ears. This project is supported by approximately 142 civilians and 27 military personnel. Breakout of these personnel is as follows:

	CIVILIAN	MILITARY
Professional	88	7
Support	54	20
Total	142	20

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.17.A
DOD Mission Area: # 522 - Environmental and Life Sciences (ED)

Title: Human Performance Effectiveness and Simulation
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3196	3373	3581	4369	Continuing	Not Applicable
A790	Human Performance Effectiveness and Simulation	3196	3373	3581	4369	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The battlefield of the future will employ more lethal weapons. These weapons systems and supporting automated command, control, communication and intelligence (C3I) systems are becoming more sophisticated and demand the performance of more complex tasks by human operators and maintenance personnel. Research requirements fall into four areas. One is the need to measure the contribution of the human to system effectiveness so that appropriate decisions can be made as part of the Defense (Army) Systems Acquisition Review Committee (DSARC/ASARC) process. Second, research is needed for C3I systems to influence system design to facilitate human performance through improvements in the soldier-system interface. There also must be research to provide a basis for the design of simulators and training devices to support training for emerging systems that will minimize the use of costly operational equipment. Lastly, there is the need for the inclusion of human performance parameters in land combat models. This Program Element addresses fundamental research issues in each of the four areas. Results will provide an empirical basis for Advanced Development applications.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Funds for FY 1983 are required to continue the following research: human factors design considerations for battlefield automated systems, procedures to determine system manpower/personnel requirements at ASARC milestones, design parameters for cost-effective simulators and training devices, and the modeling of human performance in new weapon systems. Emphasis will be placed on research directed at the "soldier-system interface" to improve the allocation of tasks between man and machine (i.e., letting equipment handle tasks better performed by hardware, freeing the

Program Element: #6.27.17.A
DOD Mission Area: # 522 - Environmental and Life Sciences (ED)

Title: Human Performance Effectiveness and Simulation
Budget Activity: #1 - Technology Base

human for more demanding decisionmaking tasks). Outcomes of this research will influence future design and development of: procedures and facilities for determining operator performance requirements for emerging weapon systems; procedures for evaluating C3I system design options involving the human operator; procedures for assessing command group operations to improve allocation of tasks between man and machine; guidelines for the design of training-effective simulators/training devices for air defense, field artillery, armor, infantry and aviation; and recommendations for including human performance parameters in land combat models.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	3196	3373	3581	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	3196	3580	3802	Continuing	Not Applicable

The funding decrease of $107 thousand in FY 1982 is a result of the amended budget request and the application a of revised inflation pricing index. The funding decrease of $221 thousand in FY 1983 is a result of program realignment within the Army.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.17.A
DOD Mission Area: # 522 - Environmental and Life Sciences (ED)

Title: Human Performance Effectiveness and Simulation
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The general objective of this research is to increase the effectiveness of human performance in new, more lethal, more sophisticated weapon systems and supporting command and control systems. Research is directed at: establishing relationships between system design and performance demands on the human operator; developing guidelines for improved "soldier-system interface" design; estimating the parameters of human performance in tactical systems for use in land combat models that would improve their relevance and validity; and establishing parameters for the design of more cost-effective simulators and training devices. This research will provide procedures for transforming human performance requirements into system design characteristics, with the intent of simplifying the operator's task. It will also lead to guidelines for improving command and control staff performance in future automated C3I systems. Guidelines for the development of interactive soldier-computer displays will lead to the design of more efficient soldier-computer communication in automated systems. Inclusion of human performance parameters in land combat models will permit more realistic modeling of the future battlefield. Research under this program element will also provide an empirical basis for the design of cost-effective simulator and training devices employing the most advanced technologies available.

G. (U) RELATED ACTIVITIES: Results of human factors research transition to Advanced Development under Program Element/Project 6.37.39A793 (Human Factors in Training and Operational Effectiveness); results of simulator and training device research transition to Advanced Development under Program Element/Project 6.37.44A795 (Training Simulation). Duplication of effort within the Army is reduced through annual Technology Base Reviews chaired by the Director of Army Research, and within the Department of Defense by annual Apportionment Reviews chaired by a representative of OUSDRE. Coordination is furthered within the Department of Defense through DOD Topical Reviews, participation on the DOD Human Factors Engineering Technical Advisory Group, the Integrated Perceptual Information for Designers Working Group and DOD/NASA Simulation Technology Coordination Panel. This research is coordinated directly with other service R&D organizations, such as the Air Force Human Resources Laboratory (AFHRL), the Naval Personnel Research and Development Center (NPRDC), the Army Project Manager for Training Devices (PM TRADE), the Army Human Engineering Laboratory (HEL), and the Naval Training Equipment Center (NTEC).

H. (U) WORK PERFORMED BY: (Primary Contractors) Human Resources Research Organization, Alexandria, Virginia; Decisions and Designs, Inc., McLean, Virginia; Litton Systems, Inc., Sunnyvale, California; Pritsker and Associates, Inc., West Lafayette, Indiana; and Vector Research, Inc., Ann Arbor, Michigan. There are three additional contractors with contracts totaling $52,000. The in-house developing organization responsible for this program is the US Army Research Institute for the Behavioral and Social Sciences (ARI).

Program Element: #6.27.17.A
DOD Mission Area: # 522 - Environmental and Life Sciences (ED)

Title: Human Performance Effectiveness and Simulation
Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Research under this program element has had the following results (grouped into four research need areas for ease of exposition). Human Performance and System Design: Draft procedures for transforming task performance requirements data into system design characteristics. Identification of manpower, personnel, and training requirements for the PATRIOT air defense system, Division/Corps Self-Propelled Weapon Systems (DSWS/CSWS) and Multiple Launch Rocket System (MLRS). Design specifications for a facility for measurement of air defense job requirements. Human Factors in Automated Systems: A set of standardized tactical display symbols for interoperability across automated C2 systems. Measurement criteria and recording system for assessing impact of automation on battalion command group performance. Design guidelines for tactical information data bases in automated C2 systems. Human Performance Parameters in Land Combat Models: Model of AN-TSQ-73 (Missile Minder) air defense system operator performance. Model of artillery crew performance. Identification of human performance variables critical to land combat. Design Requirements for Simulation and Training Devices: Functional specifications for tactical performance simulation research facility. Analytic assessment of variables relevant to the physical fidelity of simulators and training devices. Design specifications for an aviation training research simulator.

2. (U) FY 1982-FY 1984 Planned Program: This program element is intended to result in the following research outcomes, grouped into four research need areas. Human Performance and System Design: Development of preliminary procedures for translating design concepts into soldier skill requirements. Continued development of preliminary procedures for matching hardware design to operator/maintenance skills and aptitudes. Human Factors in Automated Systems: Increased research emphasis on soldier-system interface in systems employing advanced information technology. Guidelines for the design of job aids for lower aptitude personnel. Continued research on human information processing in automated systems. Human Performance Parameters in Land Combat Models: Development of generalized operator model for advanced weapon systems. Development of human decisionmaking models for advanced C2 systems. Development of models of human performance in extended operations. Design Requirements for Simulators and Training Devices (S&TD): Continued research on guidelines for application of advanced information technology (e.g., microprocessors) for improved simulators and training devices. Development of guidelines for improved maintenance simulation training. A total of 55 professional and 11 support personnel are involved in this effort.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.19.A Title: Mobility & Weapons Effects Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	5251	6266	8410	9402	Continuing	Not Applicable
AT40	Mobility & Weapons Effects Technology	5251	6266	8410	9402	Continuing	Not Applicalbe

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The potential for fighting a numerically superior, modern, mechanized opponent in a European environment requires that the effectiveness of the combat engineer be significantly increased. Exploratory development in military engineering can increase the effective employment and survivability of the Army's sophisticated weapons systems through: (1) providing ground mobility/countermobility technology that exploits the best killing characteristics of our new weapons and insures that battlefield terrain is used effectively as a force multiplier; (2) providing techniques for rapid repair of battle-damaged facilities and construction in support of combat and logistical elements in the theater of operations; (3) increasing our knowledge of weapons effects and the response of protective structures to nuclear and conventional munitions; (4) and providing technology for decreasing an enemy's ability to acquire targets, thus increasing the survivability of fixed installations supporting combat operations.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The US Army Engineer Combat Development Center, in the Engineer Family of Systems Study, identified critical combat engineering deficiencies in mobility, countermobility, and survivability. This program element addresses the identified deficiencies. The funds requested are to be used to bring to fruition programs on protective systems for artillery emplacements and rapidly emplaced fighting positions, vulnerability predictions of industrial buildings to tactical nuclear weapons, use of precast concrete pier modules as container ports, and better methods for design and construction of drilled piers in cohesive soils. In addition, funds will be applied to programs started in previous years on protection of underground hardened facilities from weapons attack, obstacle construction and counter-surveillance techniques, ground mobility prediction techniques, innovative mine detection and neutralization techniques, repair of battle-damaged facilities, and railroad rehabilitation evaluation. New programs and initiatives that will be pursued include protection of personnel in structures from the effects of chemical weapons and remote procedures for

Program Element: #6.27.19.A Title: Mobility & Weapons Effects Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

locating water supplies. The accomplishments expected from these programs will enhance the effectiveness of the combat engineer in support of the combat forces on the modern battlefield and increase the survivability of our forces.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5251	6266	8410	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5251	6275	7685	Continuing	Not Applicable

The decrease of $9 thousand in FY 1982 results from recalculating the estimated cost of the proposed research. The increase of $725 thousand in FY 1983 results from the need to fund high-priority research responding to increased emphasis in water supply detection and chemical protection of hardened facilities for the Army.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not Applicable

Program Element: #6.27.19.A Title: Mobility & Weapons Effects Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Research is conducted in the areas of weapons effects, combat engineering, theater of operations construction, and base/facility development. Specific objectives are: to provide the Army a capability to predict the effects and response of military targets to nuclear and nonnuclear munitions; to develop design and operational criteria for field fortifications; to develop design criteria and construction techniques for underground hardened facilities; to develop, improve and apply engineering technology for military road and airfield systems, lines of communication and base facilities, and logistics over-the-shore operations; to develop ground mobility techniques that assure terrain is used to maximum advantage; to develop techniques for rapid prediction of hydrologic conditions affecting military operations; to develop methods for standoff detection of mines under all conditions of terrain and environment; and to develop techniques and criteria for determining the physical properties and response of earth materials important to combat engineering and military construction activities supporting combat operations.

G. (U) RELATED ACTIVITIES: Program Element 6.11.02.A, Defense Research Sciences, Project AT22, Research in Soil and Rock Mechanics. Formal coordination of related mission-oriented research by the Navy, Air Force, Defense Nuclear Agency, Department of the Interior, Department of Transportation, Department of Energy, and the Department of the Army Materiel Development and Readiness Command is conducted through annual technical reviews, the Joint Services Civil Engineering Research and Development Coordinating Group and joint interagency activities. Informal coordination is conducted through frequent individual contracts. Coordination precludes duplication of effort.

H. (U) WORK PERFORMED BY: Approximately 84 percent of the work is performed in-house. The US Army Engineer Waterways Experiment Station, Vicksburg, MS, serves as the managing laboratory and is the primary performing activity. A portion of the work in the weapons effects area is performed by the US Army Construction Engineering Research Laboratory, Champaign, IL. Contractors are selected in accordance with Defense Acquisition Regulation procedures.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A technique for explosive antiarmor ditching was demonstrated to the 18th Engineer Brigade in Europe and the Combined Forces Command in Korea. Criteria for breaching a variety of dam types by nuclear and conventional explosives were finalized. Guidelines and recommendations were developed for predicting fallout radiation from low-yield shallow-buried detonations. The magnitude of stresses transmitted by nuclear explosions to silo walls at weak soil seams was determined. Guidelines were developed for electromagnetic pulse/electromagnetic interference shielding of bolt-together enclosures housing tactical equipment. The effectiveness of boulder screens for defeating

penetration of shaped charge weapons was determined. A shortened version of the Army Mobility Model was developed for use in cross-country mobility mapping by the Engineer Topographic Laboratories and the Defense Mapping Agency. A simplified soil trafficability prediction method was developed for use on an electronic calculator. Soil-filled fabric revetment concepts were developed and demonstrated to be feasible for protecting the Army's mobile field computer system from the effects of conventional weapons. Design guidance for construction of a mock urban troop training village using a bullet-absorbing, nonricocheting concrete material was developed. Potential materials for thermal camouflage of selected installations were evaluated during a NATO field experiment at an airbase in Germany. Candidate and alternate repair systems for repairing bomb-damaged runways were tested. Criteria for recycling existing asphalt pavements were developed resulting in conservation of petroleum and less cost. Design criteria were developed for use of thinner surfacing materials for tracked vehicular traffic to reduce pavement cost at military installations. A design concept for prefabricated concrete pier modules and promising procedures for evaluating war-damaged port facilities were developed. The Army's hydrologic capability has been upgraded with procedures based on current technology.

2. (U) FY 1982-FY 1984 Program: In FY82 a prediction of the levels of degradation of Warsaw Pact POL distribution systems from given US weapon systems will be determined. Initial analytical models for predicting the interaction of projectiles with boulder screens will be developed for use in the development of designs for protective shields. The linear feature crossing module of the Army Mobility Model will be validated. The Swedish Army Column Movement Model will be combined with the Army Mobility Model. Field tests will be conducted to evaluate the use of explosives for reducing bank slopes and to evaluate candidate systems for rapid construction of access/egress routes in soft soils. A single event streamflow forecast model will be developed to improve the Army's hydrologic support capability. The use of weather radars for monitoring and forecasting hydrologic conditions in tactical areas will be evaluated. A conceptual minefield design and deployment model will be developed for both antitank and antipersonnel mines. The most promising concepts for protecting artillery positions will be evaluated by troop use tests and will by live fire artillery tests. Digital image processing techniques will be developed to characterize scenes as viewed by different target acquisition devices for evaluation of camouflage effectiveness. A system for water-jet cutting of concrete will be evaluated for use in rapid runway repair. A method for detecting tunneling activity in rock will be finalized for use in locating tunnels beneath the Korean Demilitarized Zone. Techniques to assess damage to port facilities resulting from enemy attack will be developed. A methodology will be developed for defining the load-distributing characteristics of granular and stabilized soils in a pavement system. The present practices for military railroad inspection, maintenance, and rehabilitation will be evaluated. In FY83 a method for predicting vulnerability of industrial buildings to tactical nuclear weapons will be developed. The effects of slip and shearing at the buried structures/soil backfill interfaces resulting from explosive shock will be

Program Element: #6.27.19.A Title: Mobility & Weapons Effects Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

determined. Field validation tests of final candidate explosive designs for rapid atomic demolition munition emplacement will be conducted. A method to predict time to recover immobilized vehicles will be developed. The shallow snow model will be verified, and a preliminary model for describing the performance of bridging equipment will be developed. Concepts for employing explosive line charges to neutralize minefields will be finalized. Design concepts will be formulated for protecting artillery emplacements and rapidly emplaced fighting positions from damage by conventional weapons. The effects of fuel-air explosive weapons on urban structures will be determined. The requirements for design and construction of shelters to provide protection from chemical weapons will be identified. Field tests will be conducted to evaluate the feasibility of producing wet-gap fords with explosives. The tactical applicability of the single event streamflow model will be evaluated in a joint field exercise at a US military base. Basic digital camouflage effectiveness procedures for contrast reduction of target/background scenes will be developed. Measurements will be made of microwave absorption and reflection properties of potential camouflage materials for fixed installations. A design and expedient erection method for use of precast concrete pier modules as container ports will be developed. Guidelines for expedient location and harvesting of water for human survival in desert regions will be formulated. An improved methodology for design and construction of drilled piers in cohesive solid will be finalized. New backfill and surfacing layer materials for rapid runway repair and various materials and expedient systems for rapid repair of damaged port facilities will be evaluated. In FY84 techniques for rapid atomic demolition munition emplacement will be formulated. Models for predicting the interaction of projectiles and rubble/boulder screens will be validated for use in the development of designs for protective shields. The effect of locked-in stresses of earth masses on the propagation of explosion-induced ground shock will be determined. Draft manuals will be prepared on continuous wave techniques for electromagnetic pulse hardened facilities and on the use of fiber optic links. Models for predicting vehicle movement along roads and trails and for predicting obstacles barrier/counterbarrier effectiveness in combat operations will be verified. The shallow snow model will be integrated with Army Mobility Model. Techniques for the use of explosives to reduce slopes, bridge dry gaps, and create temporary wet-gap fords will be finalized. Automated procedures for processing radar rainfall data for hydrologic monitoring and forecasting will be developed. A preliminary continuous streamflow simulation model will be developed to upgrade the Army's hydrologic support capability. The use of distributed explosives for clearing mined areas will be evaluated. Terrain background signature data bases for Europe and Southwest Asia will be developed for use in evaluating mine detection systems. An index system will be developed for troop use to rapidly determine the protection provided by a particualr field fortification. Techniques for selective demolition of urban structures to create barriers and clear fields of fire will be developed. Existing protective structures will be tested for protection from chemical weapons. Potential measures for thermal camouflage of fixed installations will be developed and evaluated. A field demonstration will be conducted for rapidly repairing damaged runways using a newly developed system. Design methods for the rapid rehabilitation of damaged port facilities will be developed.

Program Element: #6.27.19.A Title: Mobility & Weapons Effects Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

Guidelines will be developed for locating and evaluating groundwater using ground-based geophysical techniques. New materials and techniques for rehabilitation and maintenance of military railroads will be evaluated. The program will be executed at the Waterways Experiment Station, Vicksburg, MS.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.20.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Environmental Quality Technology
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6437	7483	8706	9527	Continuing	Not Applicable
D048	Environmental Quality Research & Development	1815	2943	2523	3132	Continuing	Not Applicable
A835	Military Medical Environmental Quality	2896	3152	3753	3819	Continuing	Not Applicable
A896	Environmental Quality of Military Facilities	1726	1838	2430	2576	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Federal, state, and local regulations on environmental quality require that the Army minimize the impact of its peacetime operations on the environment. This program element provides the exploratory development support to the Army's program for compliance with these regulations. The major program thrust is to provide the technology base necessary to enable the Army to meet national, state, and local pollution abatement requirements to avoid curtailment of essential operations and minimize the cost of compliance. The program element consists of three projects: Project A835, performed by The Surgeon General, is concerned with the development of toxicological data on Army-unique pollutants for use in establishing safe environmental effect levels to support development of pollution control and monitoring technology. Project D048 efforts are performed by the US Army Materiel Development & Readiness Command (DARCOM) and is aimed at developing pollution abatement, treatment, and recovery methods for Army ammunition plants, arsenals, and depots. Project A896, performed by the Chief of Engineers, develops pollution abatement, impact assessment, and resource management methods for Army installations. The program is responsive to the science and technology objectives for environmental quality contained in the Army Science & Technology Objectives Guide (STOG).

Program Element: #6.27.20.A Title: Environmental Quality Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The FY 1983 funds are required to permit continuation of mammalian toxicity studies pollutants resulting from production of Army munitions; initiation of environmental effects research on smokes and obscurants used in training; testing of realtime monitors of pollution from munitions production processes; continuation of studies on effective recovery/reuse of waste explosives; development of methods for mitigating environmental impacts of training operation on Army training ranges and continuation research to develop cost effective technology for pollution abatement and monitoring of wastes from Army installations.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	6437	7483	8706	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6886	8681	9300	Continuing	Not Applicable

In FY 1981 - The decrease of $249 thousand was due to reprograming to higher priority Army programs. In FY 1982 - The decrease of $1,198 thousand is due to a congressional reduction in the program element. In FY 1983 - The decrease of $594 thousand is due to reprograming to higher priority Army programs.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not Applicable.

Program Element: #6.27.20.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Environmental Quality Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The program was initiated in 1973 to consolidate and better coordinate fragmented environmental quality exploratory development activities within the Army. The program is aimed at providing cost effective technology in support of the Army's efforts to achieve compliance with pollution abatement and environmental enhancement requirements for its industrial plant and military installation operations. The technical thrust areas of the program are: Environmental and Health Effects Research aimed at developing a data base of mammalian, aquatic, and vegetative chronic and acute toxicity information on the unique chemical wastes resulting from Army munitions plants and other pollution sources; Environmental Monitoring, Management, Assessment and Planning Technology to provide effective methods, procedures and systems for measuring and identifying pollutants, assessing environmental impacts of planned actions and information data bases for effectively performing management and planning functions with appropriate consideration of environmental protection and enhancement; and Source Reduction, Control and Treatment Technology to provide methods, processes, and systems to enable the Army to deal effectively and economically with the pollution problems at its industrial facilities and military installations.

G. (U) RELATED ACTIVITIES: Projects AH68 (Processes in Pollution Abatement Technology) and BS04 (Identification and Health Effects of Military Pollutants) in Program Element 6.11.02.A, Defense Research Sciences, comprise the basic research portion of the Army Environmental Quality Technology Base Program. Project AH68 is concerned with gaining an understanding of the fundamental chemical/physical processes that occur during treatment/disposal of munitions waste; Project BS04 is concerned with investigating the feasibility of developing less costly and time-consuming methods for conducting toxicology studies. Other related Program Elements incude 6.27.04.A, Military Environmental Criteria Development, which provides support to Army Installation Restoration Program and 6.27.77.A, Systems Health Hazard Prevention Technology, Project A878, Health Hazards of Military Materiel. Project A878 addresses the occupational health research program of The Surgeon General. Program Element 6.27.20 provides technology transfer to the pollution abatement activities being accomplished in the Military Construction, Army (MCA) and the Operation and Maintenance, Army (O&MA) appropriations. There is no duplication of effort within the Army program or with the programs of the Air Force and Navy. The Air Force and the Navy have environmental quality research efforts directed toward satisfying their specific mission needs. In areas of common interest, joint efforts are monitored by the Department of Defense through annual budget/apportionment reviews and periodic Topical Reviews on program areas of tri-Service interest. Semiannual meetings of the Joint Services Civil Engineering Research & Development Coordination Group (JSCERDCG) enable coordination of technical programs among the Services. Service coordination is further enhanced through the DOD Area Coordination Paper Nr. 42 on Environmental Quality Research and Development. Inter-Service coordination occurs routinely at the technical level on joint programs and technical efforts of mutual interest. Other federal agencies pursue environmental quality research programs related to their roles in the

Program Element: #6.27.20.A Title: Environmental Quality Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

federal government. These are: The Environmental Protection Agency (EPA), Department of Health and Human Services (HHS), Department of the Interior (DOI), National Aeronautics and Space Administration (NASA), Department of Agriculture (DA), the Department of Energy (DOE), Department of Transportation (DOT), and the Department of Housing and Urban Development (HUD). Coordination with these agencies is undertaken at the technical level to avoid duplication. Joint programs are undertaken in areas of common interest. In May 1981, a Memorandum of Understanding between DA and EPA was signed formalizing coordination and cooperation on research activities.

H. (U) WORK PERFORMED BY: Approximately 40% of the research effort is performed in-house by the US Army Toxic and Hazardous Materials Agency, Aberdeen Proving Ground, MD; US Army Armament Research and Development Command, Dover, NJ; US Army Natick Research and Development Laboratories, Natick, MA; US Army Mobility Equipment Research and Development Command, Ft. Belvoir, MD; US Army Test and Evaluation Command, Dugway Proving Ground, UT; US Army Medical Bioengineering Research Laboratory, Ft. Detrick, MD; Construction Engineering Research Laboratory, Champaign, IL; Waterways Experiment Station, Vicksburg, MS; and Cold Regions Research and Engineering Laboratory, Hanover, NH. Contractors include: Hercules Inc., Radford, VA; Mason and Hanger, Middletown, IA; Thiokol Inc., Shreveport, LA; JRB Associates, McLean, VA; Virginia Polytechnic Institute, Blacksburg, VA; University of Arizona, Tucson, AR; New York Polytechnic Institute, Brooklyn, NY; University of Illinois, Champaign, IL; Ciccone Associates, Woodbridge, VA; EG&G Bionomics, Wareham, MA; Inveresk Research International LTD, Edinburgh, Scotland; SRI International, Menlo Park, CA; IIT Research Institute, Chicago, IL, and The National Academy of Science, Washington, DC.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Science and Technology objectives for the environmental uality technology program address requirements for environmental and health effects research; environmental monitoring, management, assessment and planning technology; and environmental pollution source reduction, control and treatment technology. Accomplishments in these technical areas have included: establishment of interim environmental and health effects guidelines for critical wastes resulting from munitions manufacture, development of a computer system for aiding preparation and review of environmental impact assessments and statements; development of an installation noise contour system; development of field survey techniques for pollution detection and analysis; development of munition plant pollution monitoring devices, and a process for removing explosive wastes from munition plant wastewater. Other accomplishments have included: development of leachate control from landfills; evaluation of aqueous foam for noise attenuation; development of design criteria for application of rotating biological contractor to Army sewage treatment plants; development of a method for regenerating carbon

Program Element: #6.27.20.A Title: Environmental Quality Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

for reuse in treating munition plant wastewater; development of a microwave melt-out process for removing explosives from munitions.

2. (U) FY 1982-FY 1984 Program: In FY 1982, efforts toward completion of mammalian and aquatic toxicity studies are being continued on the primary munitions production water pollutants; efforts have been initiated toward development of an environmental and health effects data base for air and water pollutants resulting in demilitarization of conventional munitions, chemical characterization and environmental fate studies of Army smokes and obscurants have been initiated. Efforts are being continued to complete development and selection of technology for abatement of pollution from Army munition plants and depots based on cost-effective evaluation of candidate processes. Development of a process for treatment of electroplating waste is being completed, and evaluation of ultra sound/ozonation and super-critical water treatment processes for application to Army industrial wastes is in progress. Methods for requalification for use of explosives from recovered obsolete ordnance are being investigated; methods are being developed for treatment/disposal of hazardous wastes resulting from Army depot operations. Research is also continuing in FY 1982 to provide computer aids for decisionmaking in selection of technological solutions to Army pollution abatement problems; development technology to support conversion of heating plants to solid fuel. Emphasis is also being placed on supporting installation readiness and training missions through developing guidance for controlling/mitigating environmental impact to Army training ranges and expanding the noise prediction capability by incorporating rocket and M1 Tank noise characteristics. In FY 1983 mammalian aquatic toxicity studies of munitions production pollutants will be continued, and characterization and environmental fate studies of munition production air emission will be initiated. Air and water pollution from demilitarization of conventional munitions will be characterized, and environmental fate studies initiated; research will continue toward development of an environmental and health effects data base for Army-unique smokes and obscurants. Design criteria will be recommended for new munition plant wastewater and air pollution treatment methods; techniques will be optimized for recovery and reuse of explosives/propellants from obsolete munitions; monitors for toxic/hazardous munition plant effluents will be developed and tested. Field testing of procedures for assessing the environmental impact on training ranges in which new weapon systems are introduced will be performed, and new technology for treatment of installation wastes investigated. Guidelines for installation management of toxic/hazardous materials will be completed. The personnel required include 74 professionals and 31 support. In FY 1984, aquatic toxicity studies of munitions plant water-borne waste will be completed; characterization and fate studies of munitions plant air emissions will be continued. Characterization and fate study portions of the environmental and health effects data base for air and water emission from conventional munitions demilitarization operations will be continued. Data base development for Army smokes/obscurants will move into aquatic toxicity and ecological effects study phases while characterization and fate studies of these compounds are continued. Design criteria for new technology

Program Element: #6.27.20.A
Title: Environmental Quality Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

to abate munitions plant pollutants will be recommended as the development/evaluation of new systems is completed; studies and tests of advanced solid waste recovery and reuse techniques for conventional explosives/propellants will be continued; studies will be performed to demonstrate alternate disposal of explosive materials not amenable to reuse. Testing of hazardous materials monitors will be continued. Noise characteristics of new weapon systems will be modeled and incorporated into the noise prediction capability; new technology for treatment of installation waste streams will be evaluated and application for Army use recommended; studies will be continued to provide methods and techniques for environmental management of training areas.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.22.A
Title: Manpower Personnel and Training
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6203	5872	7370	8510	Continuing	Not Applicablwe
A791	Manpower Personnel and Training	6203	5872	7370	8510	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The volunteer Army today is faced with a dual manning problem: a reduced supply of recruits and increasing demands for high-technology skills for weapon system operation and maintenance. Research is required to produce more effective methods of recruiting, selecting, and assigning personnel. Improved methods of personnel system management are required, especially for use in units. Also, methods are required for integrating ... mental and physical capabilities of personnel into the design of new weapons and materiel systems. Technology base research is also required to provide an empirical basis for the design and development of appropriate instructional technology and new training programs for individual soldier skill development. Methods which will promote soldier commitment to the Army and to enhance unit cohesion while sustaining high performance are also needed.

C. (U) BASIS FOR FY 1983 RDTE REQUEST:

1. (U) Increased funding in FY 1983 is in response to a recognition of the need to control increasing manpower requirements for Army modernization. This technology base research program will develop methods for making long-term projections of aggregate Army manpower requirements in order to identify trends in terms of the numbers, skill levels, and training required. Trend information will be used to determine Army manpower, personnel training, and weapon system design policy and to influence the programing of resources. Also, more effective recruiting, accession, and assignment systems are needed to maximize use of the pool of available manpower talent while improving methods of using fewer personnel resources in new systems. Training methods are needed that take into account individual abilities, with emphasis on continued skill enhancement and team/unit skill development in operating units. Development of methods to improve integration of the soldier into his unit to increase unit cohesion and to improve mission readiness is also needed.

Program Element: #6.27.22.A Title: Manpower Personnel and Training
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

2. (U) No projected research for FY 1982 was canceled or deferred in this program element.

3. (U) This effort represents a continuing requirement to provide a research base for the development of new techniques and models intended to maximize the utilization of the Army's personnel resources. New advances in understanding human performance are combined with technological advances such as microcomputers, video discs, and optimization models to improve the Army's practices in training and utilization of soldiers.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	6203	5872	7370	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5020	6137	7796	Continuing	Not Applicable

Increase of $1183 thousand in the FY 1981 funding level is a result of reprograming to increase technology base research on techniques for improved basic skills training that will permit educationally disadvantaged volunteers to successfully complete BCT/AIT. The funding decrease of $265 thousand in FY 1982 is a result of the amended budget request and the application of a revised inflation pricing index. The funding decrease of $426 thousand in FY 1983 is a result of Army program realignment.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.22.A Title: Manpower Personnel and Training
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The proposed program focuses on four Army issues: manning Army systems, acquisition of quality manpower, training for combat effectiveness, and cohesion and leadership. Manning Army Systems: A complex, persistent military problem is to design and man military weapons systems to achieve maximum operational capability. Major aspects of this problem are: (1) forecasting operator and maintenance performance requirements for new weapon/equipment systems (demand), and (2) forecasting the availability and capabilities of soldiers for assignment (supply). In the first case, the long-range objective is the specification of methods for assessment of human resource requirements for weapon systems at the conceptual stage; short-range objectives include trials of current methods of manpower requirements modeling for both experimental test hardware and conceptual weapon systems. The objective of research directed at the problem of manpower supply is to explore a range of approaches for estimating the demand and supply implications of system design, and to develop recommendations for methods for allocating available soldier resources. Acquisition of Quality Manpower: In the all-volunteer force environment, the Army also faces continuing and increasing pressure to meet recruiting quotas, to select and properly assign quality soldiers, and to retain effective performers. Specific objectives of research directed at the solution of recruiting problems are: to determine factors accounting for differences in productivity of active Army recruiters; to determine the effects and interactions of recruiter and recruiter gender; and to develop a quantitative model interrelating characteristics of the recruiters with those of their recruits and their eventual performance in the Army. The objectives of selection and assignment research are to develop new measures of psychomotor, physical and cognitive abilities and relate them to the requirements of Army jobs, (thereby increasing the precision with which personnel can be assigned to military occupational specialties (MOS)). Research on the solution of retention and reenlistment problems is concerned with establishing parameters and variables associated with enlisted retention, examining variables that affect soldier attrition prior to first-tour completion and the decision to reenlist and identifying policy and leadership influence on enlisted attrition. Research on personnel system management is directed at needed unit-level personnel support system, command methods for handling personnel problems, and a methodology to optimize the officer career management process. Training for Combat Effectiveness: Research is required to provide an empirical basis for the further development of improved training programs for training from basic skills training for lower aptitude soldiers to technology-based training for soldiers in units. Technology base training research includes research to improve the effectiveness of the Army's Basic Skills Education Program (BSEP) through technology-based training methods; to determine the most effective training techniques for the acquisition and retention of military skills for soldiers of varying ability; to design more effective techniques for maintenance training; and to develop procedures for improved assessment of personnel proficiency. Cohesion and Leadership: Current Army problems of leader development exist at three levels: the junior and mid-level NCO, the company grade officer, and the field grade commander. Research will identify the skills and abilities underlying successful performance in senior positions and develop training programs to develop and strengthen such skills and abilities.

Program Element: #6.27.22.A Title: Manpower Personnel and Training
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

G. (U) RELATED ACTIVITIES: Products developed within this program that require further research effort transition to advanced development in programs 6.37.31 (Manpower and Personnel) and 6.37.43 (Education and Training). This effort is coordinated with Air Force Personnel Utilization Technology, PE 6.26.03.F; Navy Personnel Support Technology, PE 6.27.63.N; Education and Training, PE 6.36.43.A; Training and Simulation Technology, PE 6.22.05.F. Interservice coordination is assured through Department of Defense-sponsored topical reviews, annual budget and apportionment reviews. Tri-Service participation in preparation of Technology Coordinating Papers and Technical Advisory Groups in such areas as selection and assignment techniques, leadership development, and technical training. This includes both coordination of efforts and avoidance of unnecessary duplication of effort. Coordinated research programs are conducted with the Air Force, Navy and Department of Labor.

H. (U) WORK PERFORMED BY: (Primary Contractors) McFann and Gray Associates, Monterey, California; Dynamics Research Corp., Wilmington, Massachusetts; Human Resources Research Organization, Alexandria, Virginia; WICAT, Inc., Orem, Utah; and Richardson, Bellows and Henry Co., Washington, DC. There are eight additional contractors; the total value of the additional contracts is $133,000. The in-house developing organization responsible for this program is the US Army Research Institute for the Behavioral and Social Sciences (ARI).

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Past research has resulted in the following research products: Improved methods of projecting manning and skill maintenance requirements during the weapons system acquisition process; improved selection and assignment methods through the determination of physical and aptitude requirements for new weapons systems; development of better methods for integrating soldiers into their first unit of assignment through assessing the organizational factors associated with assimilating replacements; development of automated personnel assignment procedures for unit-level personnel assignment; an information data base of enlisted performance and first-tour retention factors in the first five years of the volunteer force; methods to improve training evaluation; a taxonomy for training scenarios for advanced air defense weapons systems; recommendations for new on-the-job, effective self-paced training techniques for selected combat and combat support skills; methods and materials for selecting and assigning Initial Entry Rotary-Wing (IERW) pilots; procedures for countering the effects of personnel turnover in armor crews; new training methods to enhance skill maintenance and transfer, with particular emphasis on combat and equipment maintenance jobs.

Program Element: #6.27.22.A Title: Manpower Personnel and Training
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Planned Program: The planned program will produce: computer-based system for accessioning and recruitment; methods for determining factors in NCO attrition; methods to determine personnel requirements of new weapon systems; methods to improve unit effectiveness; techniques to improve garrison management performance in combat units; methods for using instructional technology in maintenance training; models to determine long-term personnel requirements; techniques to improve unit cohesiveness; techniques for training combat skills; methods for conducting skill maintenance training in operational units; effective company-level leadership techniques; management techniques for collective training; maintenance training strategies; computer-based systems for more effective recruiter productivity; methods for predicting the performance of soldiers employing new weapons systems; and analytical tools to perform manpower resources cost analysis early in system design. A total of 47 professional and 10 support personnel are involved in this effort.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.23.A
Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5371	5574	6970	7251	Continuing	Not Applicable
AH98	Clothing and Equipment Technology	4617	5030	6262	6377	Continuing	Not Applicable
A427	Tactical Rigid Wall Shelters	754	544	708	874	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A strong in-house and contractual Exploratory Development Program is conducted to improve combat clothing, individual equipment, field service support equipment, and shelters in order to significantly increase the soldier's effectiveness in combat and survivability on the modern-day battlefield. Improved combat clothing is needed to increase the soldier's combat effectiveness and provide protection in both normal and extreme climatic conditions, and to provide camouflage, ballistic, chemical, flame, and thermal protection. Modern camouflage must decrease the probability of detection by an enemy using many modes of sophisticated surveillance ranging from daylight visible to night surveillance and thermal imaging devices. Improved protection from the increasing lethality of fragmentation weaponry is required for both ground and aircrew soldiers. Improved flame protection for combat uniforms is required to improve the effectiveness of the combat soldier in performing required tasks. Increased emphasis must be placed on providing eye protection against laser rangefinders and other directed energy threats. The ever-increasing threat of chemical/biological warfare necessitates protection against chemical/biological attack to permit the soldier to perform combat-essential duties in a chemically toxic environment, while still providing protection against all the threats of the integrated battlefield. Exploratory Development in tactical rigid-wall shelters will improve the capability of the shelters to resist the threat of nuclear, chemical, and biological warfare as well as improve the resistance of the shelters against conventional warfare. It is also part of a Department of Defense (DOD) effort to meet the International Organization for Standardization (ISO) specifications for movement of shelters by container ships and simultaneously reduce the proliferation of various sizes and types of tactical shelters and special-purpose vans currently in the inventory, provide improved

Program Element: #6.27.23.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Clothing, Equipment, and Shelter Technology
Budget Activity: #1 - Technology Base

performance, and reduce maintenance time and costs. The current emphasis on housing command and control functions, hospitals, missile systems, and Fire Direction Centers in tactical shelters requires extensive effort in hardening of shelters from the effects of Nuclear, Biological, and Chemical (NBC) as well as conventional threats. This program will yield the technology to ultimately field multipurpose, NBC-hardened, standard shelters for all of the DOD. Development effort in tentage is required to attain the capability to: design field shelters which more fully meet field-operational requirements, reduce the logistical support and financial investment required for current field shelters, and explore materials and design concepts for improving chemical protection to permit the continuation of essential missions in a chemically toxic environment. The major thrust of the organizational field equipment efforts is to provide greater mobility (lighter weight) and improve efficiency by using less fuel and power, and reducing water consumption and waste products, visual signature, and noise levels. Field sanitation/personal hygiene systems essential to the health and welfare of the combat soldier must also be compatible with chemical decontamination needs of the future.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Conduct research pertaining to the development and improvement of fibers, fabrics, materials, and new design applications for combat clothing, personal equipment, and field service support equipment and shelters to increase the survivability of the soldier on the battlefield. Conduct research to insure that these new materials and combinations of materials exhibit superior performance in the face of operational threats (ballistic, chemical agent, flame, laser, and thermal/infrared detection), as well as environmental conditions (extreme cold, extreme heat, rain, physiological stress). Develop procedures for protection of Army materiel and systems under all types of field conditions, both in use and while in storage. Determine resistance of new materials, materiel, supplies and systems to microbial degradation and contamination. Expand program to develop means for providing individual and collective protection against chemical agents for the soldier and his equipment, and to improve field sanitation/personal hygiene systems to enable a more efficient and faster method to decontaminate personnel, clothing, and equipment. Investigate composite panels for tactical shelters of balanced design to resist the conventional, chemical, and nuclear threats without excessive cost and weight penalties.

Program Element: #6.27.23.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Clothing, Equipment, and Shelter Technology
Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5371	5574	6970	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6317	5586	6864	Continuing	Not Applicable

Reduction of $946 thousand in FY 1981 funding level is a result of reprograming to higher priority Army requirements. The funding decrease of $12 thousand in FY 1982 is a result of the admended budget request and application o. revised inflation indices. The increase of $106 thousand in the FY 1983 funding level is the net result of a reduction in he scope of the planned program to fund higher priority Army programs and the addition of an effort for the special operations community.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.23.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Clothing, Equipment, and Shelter Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is designed to: improve human performance and soldier survivability; reduce the weight of soldier's clothing and equipment; upgrade levels of protection against chemical agents, flame, and fragmentation threats; provide countermeasure systems against detection by electro-optical devices; and explore the use of new materials and designs to protect the eyes against nuclear flash, laser, and ballistic threats. Also included are efforts to improve field service equipment and life support facilities, increase protection for systems housed in tactical rigid-wall shelters, and the development of design criteria and enhanced capability against chemical agents.

G. (U) RELATED ACTIVITIES: In order to preclude a duplication of effort, related research is coordinated with each of the other military services who develop their own service-related clothing and individual equipment items. Coordination and liaison with industry is accomplished by the US Army Natick Research and Development Laboratories. The Exploratory Development efforts in clothing and equipment move to Advanced Development under Program Element (PE) 6.37.47.A, Soldier Support/Survivability, Project D669, Clothing and Equipment, and to Engineering Development under PE 6.47.13.A, Combat Feeding, Clothing and Equipment, Project DL40, Clothing and Equipment. Advanced Development in tactical rigid-wall shelters is performed in PE 6.37.26.A, Combat Support Equipment, Project D428, Tactical Rigid-Wall Shelters. Engineering Development is conducted in PE 6.47.17.A, General Combat Support, Project D429, Tactical Rigid-Wall Shelters.

H. (U) WORK PERFORMED BY: The major in-house effort is performed by the US Army Natick Research and Development Laboratories, Natick, MA. Other Government activities involved are US Army Institute of Environmental Medicine, Natick, MA; US Army Materials and Mechanics Research Laboratory, Watertown, MA; US Army Chemical Systems Laboratory, Aberdeen Proving Ground, MD; Dugway Proving Ground, UT; and US Army Armaments Command, Dover, NJ. Current contractors are Brunswick Corp, Marion, VA; Kaman Avidyne Division, Burlington, MA; Albany International, Dedham, MA; Celanese Corporation, Summit, NJ; Rohm and Haas, Springhouse, PA; and ILC Dover, Frederica, DE. In addition there are 20 other contracts for approximately $1,500,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Developed fabrics which have combined protection against chemical agents and flame. Implemented the use of these new fabrics for the protection of aircrewman and combat vehicle crewman. Completed and implemented the development of the new technology for the fabrics used in the new Battledress Uniform system. Developed a polyester/wool fabric for use in the year-round uniform for the Army. Completed work on materials design to provide

Program Element: #6.27.23.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Clothing, Equipment, and Shelter Technology
Budget Activity: #1 - Technology Base

protection of individual soldier clothing and equipment against thermal imagers and radar. Completed work to assure that women soldiers are properly equipped with uniforms and load-carrying equipment so that they may perform essential duties in their ever expanding roles in the Army. Continued work on developing new approaches to provide chemical protection. This work included: evaluating nonwoven fabrics using carbon fibers, evaluation of processes and methods to obtain carbon-laminated or impregnated materials with optimum chemical protection and evaluation of selective permeable membranes and permeable-sorptive fibrous materials for an improved chemical agent protective system. Evaluated several flame-retardant finishes for use with the standard chemical protective overgarments. Developed experimental test methods to affect textile yarns ballistically in order to measure the material reaction in quantitative units of stress, strain and time. Completed development of a statistical method to evaluate results of fabric color matching. Work to harden tentage against the Chemical Warfare (CW) threat was continued. A system analysis was initiated to develop concepts for a new generation of general-purpose tentage which can effectively meet the CW threat when it is encountered. Contract work seeks a near-term solution to hardening the Tent, Expandable, Modular, Personnel (TEMPER) against the CW threat. Material and structural options for such tentage are being explored. A final design configuration for a new space heater was completed. The systems analysis on concepts for a field bath/laundry/decontamination system was continued. Work continued on the determination of the response of tactical shelters to dynamic (nuclear overpressure) loading and forces. Models were developed to determine the adequacy of changes in the design of tactical rigid-wall shelters. Work continued on evaluating commercial, nondestructive test devices to detect loss of integrity in bonding of panels for tactical shelters and the influence of thermal loading on the skin to core delamination. Work was continued on: solving the Nuclear, Chemical, Biological (NBC) ballistic threat for tactical shelters based on a review of the nuclear environment in which these shelters must be operated, and development of computer codes for the structural analysis of these shelters in the NBC environment. An Electromagnetic Interference (EMI) Protection Kit for the nonexpandable shelter was fabricated and installed for testing. A nonexpandable shelter full-scale test model was subjected to 10psi overpressure in a simulated nuclear event while fully instrumented.

2. (U) FY 1982-FY 1984 Planned Program: Continue exploratory development on fibers and fabrics for chemical and biological protective clothing and evaluate the potential of wet-laid, nonwoven materials containing activated carbon. Continue the evaluation of advanced chemical protective materials towards extending protection levels, shelf life and reduction of heat stress associated with current protective clothing. Extend the wear life of the current chemical protective clothing through the investigation of charcoal binders, formulations and materials. Combine flame-retardant properties with chemical protection on molded or dipped rubber handwear. Investigate perspiration poisoning responses of materials and

Program Element: #6.27.23.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Clothing, Equipment, and Shelter Technology
Budget Activity: #1 - Technology Base

analyze structure and physical property relationship in elastomers. Continue development of decontaminating techniques for chemical/biological protective clothing. Continue investigation of woven and nonwoven fabrics for camouflage in snow-covered terrains and develop concepts to improve camouflage of shelters in conventional tactical employments. Analyze areas of conflict in interoperability of camouflage materials among North Atlantic Treaty Organization (NATO) countries and initiate means of overcoming them. Investigate systems interaction of personnel and field items in relation to detection signatures. Investigate means of increasing performance, durability and application of camouflage to clothing and equipment items. Conduct biomechanical analysis on males/females using modified load-carrying equipment to provide design criteria for an advanced load-carrying system. Initiate development of clothing and equipment for the special operations community for use in various climatic environments. Initiate effort to enhance flame, ultraviolet and abrasion resistance on spun-bonded/melt-blown materials. Establish in-house capability to assess noise attenuation properties of textile materials and composites. Screen new materials for noise attenuation capability. Initiate development of novel combat clothing system with multiple protective capability against flame, ballistic, chemical and nuclear threats. Candidate Chemical Protective (CP) materials based on sorptive carbon will be laminated to shell and liner fabrics, fabricated into prototype uniforms for testing. New high-tenacity fibers will be evaluated for ballistic protection. Initiate effort to develop protection against new enemy ballistic threats. Develop fabrics with permanent antistatic properties for use in explosive environments. Complete evaluation of prototype combat uniforms with infrared suppressive and radar absorptive properties to reduce signature. Complete fabrication of both radar absorptive and infrared suppressive materials and evaluate in end item configuration. Investigate means to include camouflage performance in materials for CP ensembles, flame hardened garments, tactical shelters, and items for snow-covered terrains. Utilize integrated sizing study data to draft initial single-size clothing system patterns. Continue evaluation of nonwoven fabrics for shelter and parachute applications. Evaluate materials newly released to the commercial market for flame-retardance properties for possible military application. Complete the hardening of the Tent, Expandable, Modular, Personnel (TEMPER) tent to meet the chemical warfare threat in the near term; complete concept development and initiate exploratory development on tentage designs to most effectively meet the chemical warfare threat in the long term; investigate new techniques and concepts for future bath/laundry/decontamination system capable of meeting personal field hygiene needs with reduced water requirements as well as providing a decontamination capability for personnel and clothing when required. To improve field tentage, continue work on chemically resistant fabrics, inflatable beams and other efficient structural concepts, effective design for a Chemical Warfare (CW) environment, and habitability problems. Continue efforts for improved field latrines and waste disposal systems. Investigate field laundry concepts requiring minimal power and water and capable of decontamination of fabrics used for clothing, tents, covers, etc. Continue dynamic analysis of frame-and-panel designs, as well as new structural concepts for tactical,

Program Element: #6.27.23.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Clothing, Equipment, and Shelter Technology
Budget Activity: #1 - Technology Base

rigid-wall shelters. Work will continue on developing a more general dynamic analysis to include blast overpressure and ballistic impact loads. Continue evaluation of Nondestructive Testing (NDT) devices and make a determination as to the suitability for Army use. Continue development of design methodology and trade-off considerations for tactical shelters exposed to the Nuclear, Biological, Chemical (NBC) ballistic threat. Fabricate and evaluate by shock tube testing nuclear overpressure panels to interface with Army family of standard shelters. Evaluate data on simulated nuclear test on nonexpendable shelter and refine computer model of shelter exposed to overpressure. Investigate means for moving shelters short distances for complexing functions in the field; evaluate new materials and systems being proposed for military use for susceptibility to microbial deteriorata . Personnel Involved: professional - 45, support - 20.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #AH98 Title: Clothing and Equipment Technology
Program Element: #6.27.23.A Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is designed to increase the soldier's effectiveness in combat and survivability on the battlefield by: improving human performance, environmental protection, and personal comfort; reducing the weight of soldier's clothing and equipment; upgrading levels of protection against chemical agents, flame, and fragmentation threats; investigating countermeasure systems that provide camouflage of the soldier against detection by electro-optical devices; and exploring the use of new materials and designs to protect the eyes against nuclear flash, laser, and ballistic threats. Also included are efforts to improve field service equipment, field life support facilities, development of design criteria for field shelters, development of procedures for protection of Army materiel and systems under all types of environmental conditions while the equipment is both in use and in storage; and determination of resistance of new materials, materiel, supplies, and systems to microbial degradation and contamination.

B. (U) RELATED ACTIVITIES: In order to avoid a duplication of effort, related research is conducted by coordination with each of the other Services which develop their own Service-related clothing and individual equipment items. Coordination and liaison with industry is accomplished by the US Army Natick Research and Development Laboratories. The Exploratory Development efforts in clothing and equipment move to Advanced Development (AD) under Program Element (PE) 6.37.47.A, Soldier Support/Survivability, project D669, Clothing and Equipment, and to Engineering Development under PE 6.47.13.A, Combat Feeding, Clothing and Equipment, project DL40, Clothing and Equipment.

C. (U) WORK PERFORMED BY: The major in-house effort is performed by the US Army Natick Research and Development Laboratories, Natick, MA. Other Government activities involved are US Army Institute of Environmental Medicine, Natick, MA; US Army Materials and Mechanics Research Laboratory, Watertown, MA; US Army Chemical Systems Laboratory, Aberdeen Proving Ground, MD; and Dugway Proving Ground, Provo, UT. Current contractors are Albany International Research, Inc., Dedham, MA; Celanese Corp., Summit, NJ; Southern Mills, Atlanta, GA; Rohm and Haas, Springhouse, PA; and ILC Dover, Frederica, DE. There are 20 other contracts worth approximately $1.5 million.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Developed experimental test methods to affect textile yarns ballistically

Project: #AH98 Title: Clothing and Equipment Technology
Program Element: #6.27.23.A Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

in order to measure the material reaction in quantitative units of stress, strain and time. Completed development of a statistical method to evaluate results of fabric color matching. A system analysis was initiated to develop concepts for a new generation of general-purpose tentage which can effectively meet the Chemical Warfare (CW) threat when it is encountered. Contract work seeks a near term solution to hardening the Tent, Expandable, Modular, Personnel (TEMPER) against the CW threat. Material and structural options for such tentage are being explored. A final design configuration for a new space heater was completed. The systems analysis on concepts for a field bath/laundry/decontamination system was continued. Developed fabrics which have combined protection against chemical agents and flame. Implemented the use of these new fabrics for the protection of aircrewman and combat vehicle crewman. Completed and implemented the development of the new technology for the fabrics used in the new Battledress Uniform system. Developed a polyester/wool fabric for use in the year-round uniform for the Army. Completed work on materials design to provide protection of individual soldier clothing and equipment against thermal imagers and radar. Completed work to assure that women soldiers are properly equipped with uniforms and load-carrying equipment so that they may perform essential duties in their ever-expanding roles in the Army. Continued work on novel concepts and materials for cold weather clothing which will result in the integration of several items of cold weather clothing into a new system. This new system will be 30% lighter in weight and will result in improved performance and capability for the soldier. Continued work on developing new approaches to provide chemical protection. This work included: evaluating nonwoven fabrics using carbon fibers, evaluation of processes and methods to obtain carbon-laminated or impregnated materials with optimum chemical protection and evaluation of selective permeable membranes and permeable-sorptive fibrous materials for an improved chemical agent protective system. Evaluated several flame-retardant finishes for use with the standard chemical protective overgarments.

2. (U) FY 1982-FY 1984 Planned Program: Continue exploratory development on fibers and fabrics for chemical and biological protective clothing and evaluate the potential of wet-laid, nonwoven materials containing activated carbon. Further the potential of lightweight, nonwoven materials (other than wet-laid) for protection against the chemical and biological threat. Continue the evaluation of advanced chemical protective materials towards extending protection levels, shelf life and reduction of heat stress associated with current protective clothing. Extend the wear life of the current chemical protective clothing through the investigation of charcoal binders, formulations, and materials. Combine flame-retardant properties with chemical protection on molded or dipped rubber handwear. Determine chemical protective properties of wrapped carbon yarns, crushed foam and spun-bonded/melt-blown webs. Continue evaluation of nonsorptive approaches to fabric development to protect against chemically toxic environments. Investigate perspiration poisoning responses of materials and

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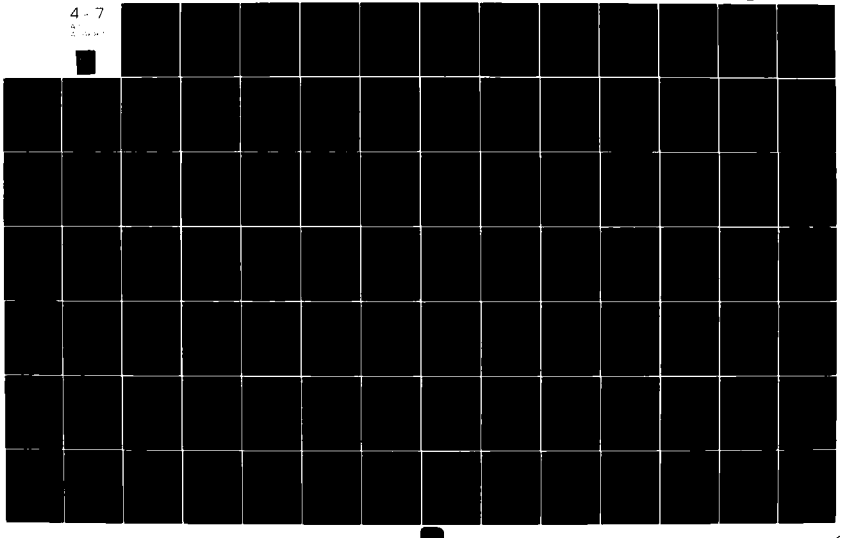

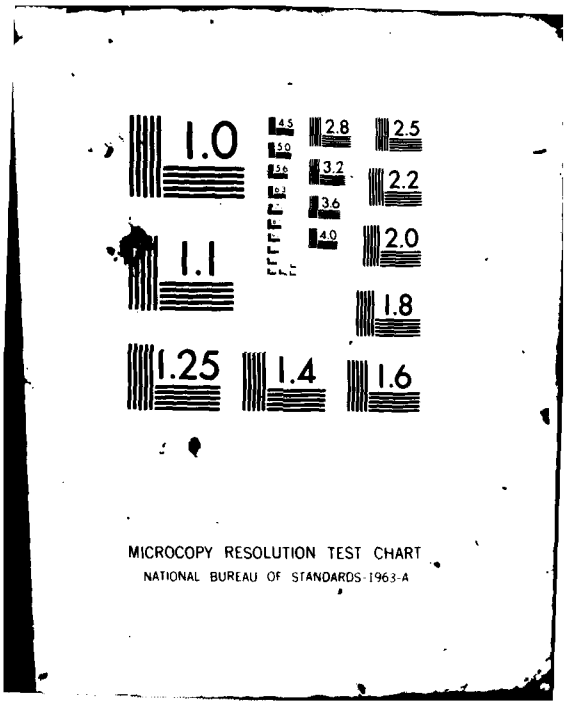
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Project: #AH98 Title: Clothing and Equipment Technology
Program Element: #6.27.23.A Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

analyze structure and physical property relationship in elastomers. Continue development of decontaminating techniques for chemical/biological protective clothing. Continue work on selective permeable membranes and permeable-sorptive fibrous materials for improved chemical agent protective systems. Continue investigation of woven and nonwoven fabrics for camouflage in snow-covered terrains and develop concepts to improve camouflage of shelters in conventional tactical employments. Analyze areas of conflict in interoperability of camouflage materials among North Atlantic Treaty Organization (NATO) countries and initiate means of overcoming them. Investigate systems interaction of personnel and field items in relation to detection signatures. Investigate means of increasing performance, durability and application of camouflage to clothing and equipment items. Conduct biomechanical analysis on males/females using modified load-carrying equipment to provide design criteria for an advanced load-carrying system. Initiate effort to enhance flame, ultraviolet and abrasion resistance on spun-bonded/melt-blown materials. Establish in-house capability to assess noise attenuation properties of textile materials and composites. Screen new materials for noise attenuation capability. Relationship between material properties and mechanism of acoustical energy attenuation will be determined. Initiate development of clothing and equipment for the special operations community for use in various climatic environments. Initiate development of novel combat clothing system with multiple protective capability against flame, ballistic, chemical and nuclear thrusts. Candidate Chemical Protective (CP) materials based on sorptive carbon will be laminated to shell and liner fabrics, fabricated into prototype uniforms for testing. New high-tenacity fibers will be evaluated for ballistic protection. Initiate effort to develop protection against new enemy ballistic threats. Develop fabrics with permanent antistatic properties for use in explosive environments. Investigate new methods of incorporating active charcoal in flexible cellular materials. Continue work on new concepts to incorporate Chemical Biological (CB), ballistic, camouflage, and flame protection into one combat uniform and reduce weight and bulk of current combat clothing while maintaining protective quality. Complete evaluation of prototype combat uniforms with infrared suppressive and radar-absorptive properties to reduce signature. Continue effort to quantify interaction of night vision sights with the eye to give a better understanding of effects of camouflage patterns at night. Complete fabrication of both radar-absorptive and infrared-suppressive materials and evaluate in end item configuration. Investigate means to include camouflage performance in materials for CP ensembles, flame-hardened garments, and items for snow-covered terrains. Complete quantification of eye/night vision sights interaction to evaluate effects of camouflage patterns at night. Utilize integrated sizing study data to draft initial single-size clothing system patterns. Continue testing of advanced candidate CP materials and uniform wear tests. Continue evaluation of nonwoven fabrics for shelter and parachute applications. Evaluate materials newly released to commercial market for flame-retardance properties for possible military application. Complete the hardening of the Tent, Expandable, Modular, Personnel (TEMPER) tent to meet the chemical

Project: #AH98 Title: Clothing and Equipment Technology
Program Element: #6.27.23.A Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

warfare threat in the near term; complete concept development and initiate exploratory development on tentage designs to most effectively meet the chemical warfare threat in the long term; continue structures and materials studies necessary to meet future tentage design requirements; transfer the heater study to engineering development; investigate new techniques and concepts for future bath/laundry/decontamination system capable of meeting personal field hygiene needs with reduced water requirements as well as providing a decontamination capability for personnel and clothing when required. To improve field tentage, continue work on chemically resistant fabrics, inflatable beams and other efficient structural concepts, effective design for a Chemical Warfare (CW) environment, and habitability problems. Continue efforts for improved field latrines and waste disposal systems. Investigate *field laundry* concepts requiring minimal power and water and capable of decontamination of fabrics used for clothing, tents, covers, etc. Evaluate new materials and systems being proposed for military use for susceptibility to microbial deterioration. Personnel involved: professional-40, support-17.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	4617	5030	6262	6377	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5512	5042	6149	Not Shown	Continuing	Not Applicable

Reduction of $895 thousand in the FY 1981 funding level is a result of reprograming to higher priority Army requirements.

Project: #AH98 Title: Clothing and Equipment Technology
Program Element: #6.27.23.A Title: Clothing, Equipment, and Shelter Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

The funding decrease of $12 thousand in FY 1982 is a result of the amended budget request and the application of revised inflation indices.

The increase of $113 thousand in the FY 1983 funding level is the net result of a reduction in the scope of the planned program to fund higher priority Army programs and the addition of an effort for the special operations community.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.24.A
Title: Joint Services Food System Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	6552	5556	5595	7012	Continuing	Not Applicable
AH99	Joint Services Food/Nutrition Technology	6552	5556	5595	7012	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army, as Executive Agent of the Department of Defense, conducts the DOD Food Research, Development, Testing, and Engineering Program in support of all the military services and the Defense Logistics Agency. Military food service operations are conducted under conditions which are, in many instances, quite different from commercial food service and require specialized foods, packaging, and equipment. This program is designed to meet unique military requirements for food systems to support ground combat, air and shipboard operations, and where needed, in garrison. It identifies items and technology available from industry which can be adapted or modified to fill military needs. Research and development programs are conducted when industry cannot provide required support due to lack of specialized expertise or knowledge of military systems and operations. Examples of such unique problems are: extending stability and safety of special combat rations designated for prepositioned war reserves; reducing weight and volume to minimize the logistical burden and accommodate extreme space limitations associated with military weapon systems such as nuclear submarines and ground armored vehicles; packaging to survive extreme mechanical and environmental stresses through long supply routes to remote locations and airdrop delivery systems; ensuring essential nutrition under extreme climatic and possible chemical, biological, and nuclear conditions to military forces worldwide and mass feeding of military personnel under combat conditions.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: This program is designed to respond to food service system requirements (deficiencies) that have been identified by the military departments and includes relevant technology base for the development, integration, and systematic application of food, equipment, packaging and other relevant technologies to the analysis and

Program Element: #6.27.24.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Joint Services Food System Technology
Budget Activity: #1 - Technology Base

design of new and/or improved food and food service concepts and systems. Systems targeted for modernization and improvement include Army and Marine Ground Combat Food Service Systems, Navy Shipboard Food Service System (primarily submarines), and Air Force Ground Launched Cruise Missile Food Service System. Particular emphasis, across all military food systems, will be applied to potential problems of food delivery under nuclear, biological, and chemical warfare conditions. Also included are investigations to improve efficiency of Navy in-port feeding systems and new concepts for improved food service management training for all services.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	6552	5556	5595	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5952	5736	6833	Continuing	Not Applicable

Increase of $600 thousand in the FY 1981 funding level is a result of reprograming to accelerate development of Army Combat Field Feeding System. The funding decrease of $180 thousand in FY 1982 is a net result of an increase in the amended budget request, the application of revised inflation indices, and a Congressionally directed decrease in the program of $167 thousand which had been requested for development of the MX Missile Ground Mode Food Service System. The FY 1983 decrease of $1,238 thousand is due to reduction in scope of program to fund other high-priority Army requirements.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.24.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Joint Services Food System Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The US commercial food industry over most of the world is based on a sophisticated, labor-intensive, high-energy system of distribution of mostly refrigerated, frozen food products, or shelf-stable products with short shelf lives. The food industry is oriented towards transfer of food from the farm to the local supermarket, while military rations may be transported anywhere in the world, by any available means and be stored under potentially adverse conditions often for long periods of time. An organized systematic approach is used to assess the capabilities and deficiencies of existing military food systems and to identify available technology and projected advancements in food, equipment, and related fields which can be applied to the Services' feeding problems. The objective is to upgrade the responsiveness of the military food service systems to existing and projected operational requirements. New concepts developed under this program utilize the most cost-effective solutions with the shortest feasible development cycle.

G. (U) RELATED ACTIVITIES: This work is being conducted as part of the DOD Food Research, Development, Test, and Engineering (RDT and Eng) Program which also includes programs in the following: Program Elements 6.11.02.A, Project AH52, Basic Research in Support Equipment for the Individual Soldier; 6.37.47.A, Project D610, Food Advanced Development; and 6.47.13.A, Project D548, Military Subsistence Systems. This is a coordinated Joint Military Service Program, and there are no other equivalent federal or any military expertise or in-house facilities available for the conduct of those required research and development activities.

H. (U) WORK PERFORMED BY: The majority of effort (about 70%) is conducted in-house by the US Army Natick Research and Development Laboratories, Natick, MA. Other Army and government laboratories that have provided assistance include the Letterman Army Institute of Research, the Presidio of San Francisco, CA; the Construction Engineering Research Laboratory, Champaign-Urbana, IL; and the Regional Laboratories of the Department of Agriculture. Various academic institutions have also performed work in this program, such as University of Nebraska, Lincoln, NE; Bowling Green University, Bowling Green, OH; Massachusetts Institute of Technology and Harvard University, Cambridge, MA; Baylor College of Medicine, Houston, TX; Worcester Polytechic University, Worcester, MA; New York University, New York City, NY; Texas A&M University, College Station, TX; and University of California, Los Angeles, CA. Contractors include National Academy of Science, Washington, DC; Arthur D. Little, Cambridge, MA; General Electric Co., Schenectady, NY; and Ralston Purina Corp, St Louis, MO.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Prototypes of improved Army and Air Force (USAF) Combat Food Service

Program Element: #6.27.24.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Joint Services Food System Technology
Budget Activity: #1 - Technology Base

Systems have been successfully tested. USAF plans to equip their Rapid Deployment Force with the new system. The Army version has a potential for reducing food service personnel in combat by 50 percent while continuing to produce highly acceptable hot meals. A prototype version of a Marine Corps (USMC) assault food packet was tested in NATO excerises and as a result has moved into final development steps leading to general adoption and use. New space-saving compressed foods were tested on a Navy nuclear submarine with results indicating that both submarines and surface ships could significantly increase endurance voyages using these new foods. The Navy continues to convert aircraft carriers and other ships to the fast food concept developed under this program. A new hospital food service system was designed and tested in an Army hospital with high patient acceptance and indications of food service labor savings of up to 30 percent.

2. (U) FY 1982-FY 1984 Planned Program: Concept development and technology base effort in support of: more efficient, highly mobile, less manpower-intensive combat food service systems for the Air Force, Army, and Marine Corps; food service capability in NBC-contaminated environments; specialized food service systems for the Air Force's GLCM missile system; unique requirements for remote and isolated locations where resupply is severely limited; advanced Navy Afloat Food Service systems which consider logistical limitations, operational efficiency, and labor reduction; new in-flight feeding system to support Air Force crews and troops on critical longer duration military airlift missions; automated managerial control systems, new managerial training techniques, and new garrison food service systems to increase the efficiency of and decrease the waste in military food service operations; improved food stability and quality measurement techniques, and the determination of microbiological safety and human acceptance parameters for new and modified subsistence items and rations in order to enhance the quality assurance, quality control, and quality assessment of military subsistence and rations; improved methods for processing, packaging, and storing food items to improve quality, reduce food losses, and enhance commercial producibility and affordability; basic heat transfer studies on food service equipment to improve yields, shorten food preparation times, and provide consequent savings in energy costs and improved field food service sanitation technology to eliminate potential health hazards and enhance operational and logistical efficiency. Initiate concept development and technology effort in support of development of integrated defense subsistence logistic system for worldwide wartime food service aimed towards enhanced readiness and maximum cost effectiveness; integrated, modularized feeding systems for wartime mobilization conditions that would address the particular requirements of dispersion of US Air Force units to collocated operating bases; and a combustion technology program for improved safety and fuel efficiency and diversity of field burners. Initiate development efforts aimed specifically at improvement of food service in extreme arctic conditions and an analysis of logistics alternatives for the maritime prepositioning of subsistence to support units of rapid deployment and strike forces. Continue efforts to determine effects of prolonged consumption of operational rations on combat effectiveness as a

Program Element: #6.27.24.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Joint Services Food System Technology
Budget Activity: #1 - Technology Base

basis for improved ration design. Continue technology base development in food processes preservation and stability; food service equipment design; food packaging/protection; food acceptance (human factors); and microbiological safety. This program involves 86 professional staff and 23 support personnel.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.25.A
Title: Computer and Information Sciences
DOD Mission Area: #521 - Electronic and Physical Sciences
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2058	1794	1966	2181	Continuing	Not Applicable
DY10	R&D in Multicommand Data Systems	2058	1794	1966	2181	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program's major thrust is to develop and use advances in computer software technology for near-term cost and quality improvements for multicommand nontactical ADP systems. Included are research and exploratory development efforts to: (1) Assist DOD/DA program managers in the planning and control of software development; (2) increase the reliability, usability, adaptability, and cost-effectiveness of multicommand ADP systems and defense computer applications; (3) reduce the time and costs attributed to software development and maintenance; and (4) focus on the support of current standard programing languages, including the development of programing and management tools for the effective implementation of a new standard high order language. Some work on advanced hardware peripherals and computer technology is included in support of the Standard Army Multicommand Management Information Systems (STAMMIS), combat service support systems (CS_3), and the acquisition of the Vertical Installation Automation Base Line (VIABLE).

C. (U) BASIS FOR FY 1983 RDTE REQUEST: This program will specifically address automated tools to increase the effectiveness of the requirements definition process, the test and evaluation of an advanced experimental Automated Project Management System (APMS) for software development managers; experimental tools and methodologies for the specification and measurement of software quality and complexity; the development of software rapid prototyping capability; the development and evaluation of a programing effort estimator based upon measures of specifications; and the application of a local computer network testbed to Army battlefield automation requirements. The program will evaluate the application of research results in data base machines towards reducing the time and cost of large data manipulation, access, and retrieval in an

Program Element: #6.27.25.A
Title: Computer and Information Sciences
DOD Mission Area: #521 - Electronic and Physical Sciences
Budget Activity: #1 - Technology Base

Army STAMMIS. The techniques will aim to reduce costs of computer software development, improve efficiencies in the STAMMIS user environment, and reduce duplication of effort. Efforts under this program element will include support for modernization of multicommand ADP hardware systems and upgrading large-scale software systems presently employed in military installations throughout the world by Program Managers and defense contractors. A primary FY83 thrust is to accelerate the use of new proven software advances for multicommand ADP hardware systems.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	2058	1794	1966	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1858	1797	2182	Continuing	Not Applicable

Funding in FY81 was increased through command reprograming to take advantage of research accomplishments in automating the requirement. Decrease in funds for FY82 and FY83 are due to reallocation to higher priority programs.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.27.25.A
DOD Mission Area: #521 - Electronic and Physical Sciences

Title: Computer and Information Sciences
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Department of the Army, DOD, and GAO studies have identified the effective and timely development of software to be a major problem area in the development of computer-based systems. The DOD Software Technology Initiative has recently enumerated several technical issues which require the support of the research community in addressing this problem. This Program has developed four primary research thrusts which directly support the DOD initiative: (1) The Requirements Analysis research will result in an Automated Requirements System (ARS) which significantly assists the user in communicating a precise statement of his needs; an analysis of these requirements; and a "rapid prototype" of the system to illustrate the implications of the users' requirements in terms of the target system. The ARS product should lead to a 30% reduction in software maintenance costs in resulting systems. (2) Metrics and Life Cycle Planning research has produced an experimental Automated Project Management System (APMS) to improve project management in software development projects. Additional research in cost estimation should result in the integration of an effective software cost estimation tool into APMS. Research in Decision Support Systems concepts and design methodologies will increase the effectiveness of automated systems support for Army decisionmaking. (3) Standard Language Support research has made significant strides in identifying and documenting tools and procedures for the measurement of software quality and complexity. Results of this program will reduce the overall cost of maintaining software-based systems and improve the quality of systems being fielded by the Defense Department. (4) Distributed Systems research has produced a local computer network testbed and is being used as a basis to research requirements for advanced battlefield automation. Analyses will reduce the uncertainties of advanced architectural concepts and shorten the gap between state-of-the-art and fielded technology. Data base machine technology research results are being aplied to very large Army data retrieval problems to reduce the response time and improve the effectiveness of data management in the Army. This entire Program is expected to result in substantial improvement in both Army internal software development and contractor-developed software products.

G. (U) RELATED ACTIVITIES: The Army's Military Computer Family program (MCF PE and Project No. 6.37.23.A/D101) Hardware, Software, and Instruction Set Architecture Product Planning is developing a compatible computer family and a high order language, Ada, which has application in advanced information systems. The Army's Integrated Software Research and Development (ISRAD) program received support from Project 6.58.98.A/MM 61 (Integrated Software). The Army's Nontactical ADP Technology Program Element, 6.37.65.A/DY13, resulted from research successes in APMS and ARS in this program. Participating development agencies include the Office of the Chief of Engineers, Military Personnel Center, Soldiers Support Center, Training and Doctrine Command, and the US Army Computer Systems Command. Research projects supported by this PE are coordinated by the DOD Management Steering Committee for Embedded Computer Resources and other DOD panels/committees. Continued liaison at the laboratory and action officer level with Navy and Air Force counterparts minimizes duplication of work. Several cooperative research projects are funded by the Rome Air Development Command (RADC) and the Army Research Office.

Program Element: #6.27.25.A
DOD Mission Area: #521 - Electronic and Physical Sciences

Title: Computer and Information Sciences
Budget Activity: #1 - Technology Base

H. (U) WORK PERFORMED BY: University of California, Berkeley, CA; General Research Company, Huntsville, AL; Georgia Institute of Technology, Atlanta, GA; RAVEN Systems and Research, Inc., Washington, DC; Kansas State University, Manhattan, KS; Purdue University, Lafayette, IN. In-house developing agencies include: US Army Institute for Research in Management Information and Computer Sciences (AIRMICS), Atlanta, GA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: AIRMICS-USACSC's R&D Multicommand data Systems Project (DY10): Technological Accomplishments during FY 1977 through FY 1981 included the following key efforts: A 15-volume set of guidebooks was published for the software community describing how to do structured programing; two handbooks issued describing for government managers how to formulate and manage software development in defense programs. Demonstrated a specialized lightweight, miniature, low-power, handheld data entry/display terminal suitable for a military field environment. AIRMICS developed a cost estimation and sizing model. Although it was originally aimed at decision support applications (command and control and management information systems), initial experiments indicate it has wider applications. An Information Processing System Simulator (IPSS) was used as a sketching tool for the Standard Installation Division/Personnel System (SIDPERS) in back-end, interactive configuration. Jointly, with the Navy, conducted an evaluation of the suitability of IPSS for use by DOD in computer performance prediction, sizing, and design optimization. Developed complementary requirements technology called "System Sketching" to provide feedback about system characteristics to prospective users. Evaluated a group of software management tools for integration into the smart terminal system; two terminals were placed in operational development environment for early user feedback. Demonstrated the concept of a Back-End Data Base Management System (DBMS) on a minicomputer for possible application to future information systems architecture. Developed and demonstrated a hardware network of three microcomputers interconnected to a minicomputer. To preserve large previous investments, investigation efforts were made into portability of COBOL languages to multiple vendor hardware which concluded with an identification of a proper COBOL subset and mapping algorithm. In FY 1980, effectively demonstrated the capability of Input/Output Requirement Language (IORL) to translate and analyze requirements for the Army's Standard Army Multicommand Management Information Systems (STAMMIS); i.e., Standard Army Maintenance System (SAMS). Developed concept and prototype extension to Problem Statement Language (PSL/PSA) to facilitate development of software requirements specifications and to support automated system sketch. Enabled Technology transfer of requirements engineering technology to major STAMMIS redesign effort (i.e., STAMMIS Standard Army Financial Systems). Investigated the feasibility of applying microcomputer technology to STAMMIS by establishing an experimental model of interactive logistics system utilizing

Program Element: #6.27.25.A
DOD Mission Area: #521 - Electronic and Physical Sciences

Title: Computer and Information Sciences
Budget Activity: #1 - Technology Base

low-speed communication network; distributed data base control and COBOL application programs were implemented on microcomputer-based hardware. An advanced information systems research effort was undertaken to identify experimental development projects which would serve as "real world" vehicles for the transfer of advanced concepts and technologies to future Army systems. In FY 1981, development was begun on an Automated Requirements System to include system definition and design of the user interface. Local Computer Network research produced a simulation model for predicting network performance, a nonintrusive network monitor, and a traffic generation capability to provide for experimental evaluation of distributed architectures. MILPERCEN data transfer research was completed with results being forwarded to the personnel community. Experimental data base machine was completed and relative evaluation of software implementation of Data Base Management System (DBMS) Integrated Relation Systems (INGRES) was initiated. Exploratory development of advanced personnel requirements in local computer networks on the battlefield was initiated with the Soldier Support Center. Validation and automation of microestimating technique for systems change packages is scheduled for completion in December 1981.

2. (U) FY 1982-FY 1984 Planned Program: Continue research and exploratory development efforts in the areas of requirements analysis, metrics, and life-cycle planning technology, distributed systems and standard language support. Begin coding of Automated Requirements System (ARS) and complete design of advanced system sketch to produce rapid prototypes of realistic-size systems. A verification and validation methodology, complete with tools and procedures, will insure that the produced software code correctly implements functional and performance requirements. Complete demonstration of experimental ARS and development of system sketch for integration into ARS. Initiate research into automated translation of very high level language (e.g., Problem Statement Language and Problem Statement Analysis (PSL/PSA) to COBOL program.) Transition experimental Automated Requirements System (ARS) results to advanced development project (FY13) in program element 6.37.65, Non-Tactical ADP Technology. Begin development of techniques for estimating development effort based on analysis of high level software specifications. Complete evaluation of production profiles and error histories to identify characteristics of error-prone programs. Begin design and development of experimental software quality management support system. Begin exploratory design and development of software maintenance tools and procedures. Incorporate dual topology capability into local computer network testbed. Complete evaluation of Battlefield Administration Automation Architecture (BAAA) technical feasibility. Complete evaluation of data base machine (DIRECT) performance against distributed Data Base Management System (DMBS) (INGRES). Complete research in data base administration functions. Develop, test, and evaluate Decision Support System (DSS) design and development methodologies for the Army systems. Transition experimental automated Project Management System (APMS) research results to this advanced development, Program Element 6.37.65.A. Initiate exploratory research in software reliability models for Army software development. Begin exploratory development of advanced data base concepts to support software resource estimating requirements and methods.

Program Element: #6.27.25.A
DOD Mission Area: #521 - Electronic and Physical Sciences

Title: Computer and Information Sciences
Budget Activity: #1 - Technology Base

3. (U) Program to Completion: This is a continuing program. The anticipated results of the future program are: Demonstrated color-graphics applications and quantitative tools to aid managers and decisionmakers; an experimental system that integrates unstructured and structured problems through the use of behavioral sciences, computer sciences, and operations research or systems analysis; provisions for better scheduling and control of projects and time reduction in project decisionmaking; a developmental system which can be engineered into a configuration compatible with Ada Programing Support Environment (APSE) and the Army's plan for Post-Deployment Software Support (PDSS).

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	2691	2657	2900	4709	Continuing	Not Applicable
A230	NSTD Technology	2691	2657	2900	4709	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Exploratory Development program provides the technology base to support future Non-System Training Device developments. Non-System Training Devices are developed to provide general military training and training on more than one item/system. A System Device provides training on a specific item/system. Modern weapons systems are being integrated into the force at unprecedented rates. Arrival of this sophisticated, high-technology equipment will coincide with increased constraints on people, dollars, and time in a training environment where the cost of ammunition and equipment operation continue to rise. Training devices and training simulation provide force multipliers that improve combat effectiveness at a lower overall training cost. The combat effectiveness of Army personnel is key to both compensating for the numerical superiority of opposing forces and for maintaining a ready force. This combat effectiveness can best be achieved by innovative, efficient, and results-oriented training. The major thrust in the development of new training devices is to develop equipment that allows a high transfer of knowledge and experience from the training situation to a combat situation. The Army has a continuing need to expand the technology base for training devices and simulation to support the development of training environments and training systems that provide the training required to win in any conflict.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Requested funds will continue ongoing developmental effort and initiate exploratory development on new, promising concepts and technology products that will ultimately transition into Advanced or Full-Scale Development. Specific thrusts will (1) continue development of techniques for improving the effectiveness of battlefield engagement simulation exercises; (2) develop and evaluate Computer Generated Imagery (CGI) techniques to provide realistic out-the-window scenes including return fire and multiple moving targets; (3) continue to improve the effectiveness of maintenance training and explore more effective use of realtime feedback in maintenance trainers; (4) develop and evaluate High Detail Daylight Display for Nap-of-the-Earth flight training; (5) initiate efforts on a comprehensive Area Weapons Effects Simulation program to complement the Multiple Integrated Laser Engagement System (MILES); (6) and expand the Squad

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

Weapon Analytical Trainer concept in include antitank/armor crew training in fire command and control, target engagement and fire distribution.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	2691	2657	2900	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	2776	3165	4295	Continuing	Not Applicable

Reduction of $85 thousand in FY 1981 funding is a result of reprograming of funds to higher priority Army requirements. Decrease in FY 1982 of $508 thousand is a result of the amended budget request and the application of revised inflation indices. Decrease in FY 1983 funding requirement of $1,395 thousand is a result of reducing the scope of the planned effort to fund other higher priority Army requirements.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This continuing program provides for the Exploratory Development of training devices which are developed to support general military training and training on more than one item/system. The effort under this program is directed towards providing a technology base in support of Army training device development. The cost of training with operational equipment, the lack of available training areas, and the need for high levels of proficiency to achieve full combat effectiveness require continuing examination of approaches to simulation and training devices. This program provides the necessary "front-end" analytical effort required to smoothly transition developments into Advanced Development and Engineering Development. The program is structured into five technology areas as follows:

(1) (U) Engagement Simulation: To develop technologies to support training associated with the conduct of large-scale, two-sided combined arms field exercises in typical modern battlefield environments.

(2) (U) Maintenance Simulation: To develop technologies for reducing dependency on the use of operational equipment for maintenance training.

(3) (U) Visual Simulation: To develop technologies associated with visual presentation of information, nonprogramed real-world scenes and simulated imagery.

(4) (U) Simulated Environment Applications: To develop and evaluate alternative approaches to simulating the operator, crew, and team training. To develop means of quantitatively measuring the effectiveness of training systems.

(5) (U) Electronic Simulation: To develop technologies for applications of electronic techniques associated with computer, communications, automatic control, and sensors to support and to pioneer training approaches.

G. (U) RELATED ACTIVITIES: To avoid duplication of effort, close coordination is maintained with other services through Training and Personnel Technology Conferences, Topical Reviews, Joint Service Technical Coordinating Group - Simulators and Training Devices, Department of Defense Simulator Technical Advisory Group, worldwide staffing of Training Device Requirements, and the collocation of the Office of the Army Project Manager for Training Devices (PM TRADE) and the Naval Training Equipment Center (NTEC). The technology/devices developed within this Program normally progress to Non-Systems Training Devices (NSTD) Advanced Development (PE 6.37.38.A) and/or NSTD Engineering Development (PE 6.47.15.A).

H. (U) WORK PERFORMED BY: In-house development is performed by the Project Manager for Training Devices, Orlando, FL; Naval Training Equipment Center, Orlando, FL; United State Army Armament Command, Dover, NJ; and Letterman Army Institute of Research, Presidio, San Francisco, CA. Prime contractors include Grumman Aircraft, Long Island, NY; Seville Inc., Pensacola, FL; Sanders Associates, Nashua, NH; and Burtech, Tulsa, OK.

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The preliminary Systems Engineering designs for four (4) Army Maintenance Training and Evaluation Simulation System (AMTESS) approaches were completed and two conceptual approaches were selected to enter the breadboard prototype phase. Two contracts were awarded for delivery of breadboard models in 2nd Quarter FY 1982 for evaluation of training effectiveness by the air defense and ordnance schools. Feasibility of the Automatic Weapons Effects Simulator (AWESS) was established, and the AWESS program transitioned to Full-Scale Development in 3rd Quarter FY 1981. Collaborative efforts with the Air Force Human Resources Laboratory in the development and evaluation of a High Detail Daylight Display for Nap-of-the-Earth flight training were initiated. The Area of Interest (AOI) investigation continued with the effort directed toward the development of technical approaches for multiple viewpoint Computer Generated Imagery (CGI) displays. The Squad Weapons Analytical Trainer (SWAT) concept was extended to antiarmor weapons systems. Significant progress was demonstrated in the development of thermal targets for use on tank gunnery ranges.

2. (U) FY 1982-FY 1984 Planned Program: The preliminary systems engineering design effort of the Army Maintenance Training and Evaluation Simulation System (AMTESS) concept will conclude with the delivery of breadboard models for test and evaluation by the proponent schools. Training effectiveness analysis of the AMTESS breadboards will be conducted in the 1st and 2nd Quarters of FY 1982. The results of this effort will provide the technical and operational base for more efficient and effective acquisition of Army maintenance training equipment. The Computer Generated Imagery (CGI) effort will continue with the development of models that portray visual scenes with sufficient realism for effective utilization in visual simulators. Current Computer Generated Imagery training systems cannot meet target identification requirements at far ranges and are limited because they cannot process enough information to generate high-detail targets or background scenes. The High Detail Daylight Display effort will be directed toward resolving these limitations for selected portions of the viewing field. Its cooperative effort with the Air Force Human Resources Laboratory will continue with emphasis on the utilization of novel techniques to provide areas of high detail. A simulation of area weapons effects will be continued with those technically feasible weapons signature concepts for mine, mortar, nuclear, biological, and chemical (NBC), and cannon artillery systems entering the breadboard fabrication phase. The resulting simulators will be interoperable with the Multiple Integrated Laser Engagement System (MILES). Programs are planned for the development and evaluation of feasible concepts for the simulation of the dirty battlefield effects for use in Engagement Simulation Exercises. The sensor simulation program will continue with emphasis on developing techniques for portraying the characteristics of such sensors as Far Looking Infrared (FLIR), Target Acquisition Data System (TADS), and Pilot Night Visual System (PNVS). This effort will provide the technology base for development of simulators for training surveillance and target acquisition tasks. An effort to portray the thermal images and infrared signature of threat armor weapons will be initiated. A Rich Scene Visual Presentation (RSVP) effort to experimentally determine the level of complexity required to train for Nap-of-the-Earth flying will be initiated.

Program Element: #6.27.27.A Title: Non-Systems Training Devices (NSTD) Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

Preliminary engineering designs will be initiated to exploit advances in microprocessor interactive intelligent terminals and computer speech technology in development of a family of low-cost personal tutorial devices for use at or near weapons system sites. Ten (10) professional and two (2) support personnel from the Army Office of the Project Manager for Training Devices (PM TRADE) are involved in this program.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.30.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Cold Regions Engineering Technology
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4262	5443	6660	6966	Continuing	Not Applicable
AT42-A	Combat Operations Support	1091	1382	1580	1725	Continuing	Not Applicable
AT42-B	Combat Development Support	1852	2461	3230	3328	Continuing	Not Applicable
AT42-C	Maintenance/Operation of Facilities in Cold Regions	482	600	705	765	Continuing	Not Applicable
AT42-D	Cold Regions Design and Construction	837	1000	1145	1148	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program addresses the mission need to insure that the Army combat capability is maintained in both winter temperate zones and in extreme cold environments. Specific objectives are to: (1) develop methods for determining how terrain, climate, and adverse environmental conditions affect the performance of Army materiel; (2) develop cost effective techniques for operating and maintaining Army facilities in areas where cold weather presents a problem; and (3) develop engineering construction criteria valid for cold climates.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The FY 1983 request is based on meeting combat requirements established by the US Army Engineer Center, US Army Training and Doctrine Command (TRADOC), troop units, the US Army Materiel Development and Readiness Command (DARCOM), and by the US Army Corps of Engineers (USACE) in meeting the military construction, operation, and maintenance mission in cold climates. Task A requirement is to insure a US winter combat capability at least equal to that of Eastern European countries. Task B is to assist designers of weapons and equipment used in winter warfare and under other adverse conditions. Two items are particularly important in Task B: (1) removing or reducing ice buildup from combat helicopters and other military equipment, and (2) insuring that battlefield targeting systems remain effective in blowing snow, dust, winter fog, and smoke. Task C is to provide a marked reduction in the costs of operating and maintaining military facilities in cold climates. Research in Task D seeks to reduce the estimated $50 million required every year to replace roofs and pavements which have failed prematurely due to stresses imposed by the cold.

Program Element: #6.27.30.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Cold Regions Engineering Technology
Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	4262	5443	6660	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4262	5651	6797	Continuing	Not Applicable

The major significant changes in funding are the decrease of $208 thousand in FY 1982 and the decrease of $127 thousand in FY 1983. The decrease in FY 1982 and FY 1983 is attributable to the application of Congressionally directed changes and reductions for increased efficiency.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.27.30.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Cold Regions Engineering Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND DESCRIPTION: The US Army Cold Regions Research and Engineering Laboratory (USACRREL) provides centralized management for this project. Some of the work is conducted by the US Army Engineer Waterways Experiment Station (WES) and the US Army Engineer Topographic Laboratories (ETL). Research is conducted in four areas to: (1) provide US forces with a winter combat capability so that winter conditions become an advantage rather than a disadvantage; (2) overcome environmental constraints on materiel and provide the field commander with equipment that works as intended in a cold battlefield environment; (3) maintain and operate Army facilities in northern areas where winter conditions require different methods and techniques; and (4) develop new designs for rehabilitation of existing northern Army facilities to reduce the current energy and maintenance cost penalty attributable to winter conditions.

G. (U) RELATED ACTIVITIES: Related to this research are: the Corps of Engineers Civil Works Research and General Investigation programs in Cold Regions Hydrology, Ice Engineering, and Land Treatment; Program Element 6.11.02.A, Defense Research Sciences, Project AT24, Snow, Ice and Frozen Ground; Program Element 6.27.31.A, Military Facilities Engineering Technology, Project AT41, Military Facilities Engineering Technology; Project A896, Environmental Quality for Military Facilities; and Program Element 6.21.11, Atmospheric Investigations. There is no duplication of effort within the Army programs; coordination is maintained by means of reports and regular interlaboratory meetings.

H. (U) WORK PERFORMED BY: The US Army Cold Regions Research and Engineering Laboratory, Hanover, NH, is the primary performing activity. Approximately 74% of work is performed in-house. The remaining portions of the work are performed at the US Army Engineer Topographic Laboratories at Fort Belvoir, VA; the US Army Engineer Waterways Experiment Station, Vicksburg, MS; the US Army Facility Engineer Support Agency, Fort Belvoir, VA; and US Army Engineer District, Alaska, North Pacific Division, North Central Division, Missouri River Division, and North Atlantic Division. The performing agencies also contract for research support; contractors include the University of Alaska and Colorado State University.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: In FY 1980, USACRREL developed the technical plan for winter battlefield obscuration research. The plan incorporates laboratory research with a series of major field exercises and addresses the performance of electro-optical weapon systems in an environment with obscured visibility: falling snow, dust, fog, and smoke. A prototype system was developed to eliminate ice fog produced by field generators operating in freezing conditions. A simulator was developed which permitted laboratory studies of the effect of snow-cover on the performance of antipersonnel

Program Element: #6.27.30.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Cold Regions Engineering Technology
Budget Activity: #1 - Technology Base

mines. A calibrated vapor barrier test facility was completed for large-scale wall testing. In FY 1981, SNOW-ONE, the first in the series of battlefield obscuration field experiments, was conducted during the winter in northern Vermont. Fourteen major Department of Defense agencies participated in the exercise to test the performance of some of the most sophisticated electro-optical equipment now under development. This will result in a winter battlefield environmental data base with which future materiel and equipment may be designed and tested. A study comparing military and civilian tires showed that on snow and thawing soil military vehicles perform better with civilian tires than with military tires. A simple mathematical model of frost heave action was validated through field tests and can now be used to predict pavement performance on a variety of pavement designs. The Laboratory published and distributed worldwide a guidebook on the repair and prevention of pavement potholes. New techniques for construction of snow fortifications were developed and distributed to the field. A troop test was conducted with the 172d Brigade in Alaska to demonstrate the effectiveness of snow fortifications against Soviet weapons. The new types of snow fortifications provide better protection faster than either standard US methods or current Soviet techniques. Performance data were assembled to evaluate and improve the design of intrusion sensors in cold regions. Environmental data were tabulated so that designers of major weapons can assess the risk of failures in adverse environments against the cost of designing to specific performance levels in any environment. Laboratory tests and field trials were conducted on foundations, quick curing of low-temperature concrete, utility distribution systems, and pavements. This research was translated into construction criteria with the issuance of several Technical Manuals. Underground surveys were made in Alaska to demonstrate the use of electrical resistance technology to locate permafrost, locate underground water sources, and identify soil type and bedrock, with particular emphasis on grounding and cathodic protection potential. Infrared equipment to detect moisture-contaminated insulation was developed.

2. (U) FY 1982-FY 1984 Program: The Frost Effects Research Facility will be constructed at the Cold Regions Laboratory during FY82. This building will provide USACRREL and the Army the most extensive capability for modeling the effects of frost action on pavement systems, utilities, and foundations. The emphasis on solving winter battlefield problems will remain very strong with continuation of bridging, mobility, mine/countermine performance and emplacement of weapon systems. The second field exercise in the SNOW-ONE series will be conducted during FY82 in northern Vermont. The performance in snow-covered terrain of scatterable mines delivered by artillery will be evaluated in FY82. Two manuals will be published: "Pavement Design for Frost Conditions" and "Foundations in Areas of Deep Seasonal Frost and Permafrost." In FY83 the SNOW test series will focus on the effect of the reflectance characteristics of snow on the winter battlefield. Work to improve thermal performance and moisture resistance design criteria for military facilities in cold regions will continue. Combat engineer work will concentrate on the development of techniques for bridging frozen rivers, stabilizing

Program Element: #6.27.30.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Cold Regions Engineering Technology
Budget Activity: #1 - Technology Base

riverbanks, repairing airfields quickly during periods of low temperature, improving the performance of mines and countermine measures in snow, ice, and frozen soil, as well as the performance of ground vehicle operations in thawing soils. A major effort will be made to complete the documentation of the most effective methods of utilizing mines, mine detection systems, and countermine systems in winter. Equipment designed to eliminate ice fog generated by mobile and fixed equipment in freezing temperatures will be tested. Research will also address the potential of ice fog as offensive tactical camouflage and as a defensive countermobility measure. The emergence of the Far North as an area of economic and strategic importance causes DOD periodically to review its cold climate combat requirements. USACRREL research programs will shift as required to meet these needs. The primary thrust of the program in FY84 will continue to be on combat engineering and battlefield obscuration. The SNOW-TWO experiment will continue with manmade obscurants: smokes and battle debris. Continuing work on the performance and detection of mines in winter environments will ensure the successful winter deployment by the late 1980's of the new family of mines now under development. Research and facilities engineering will continue and will emphasize technology to meet construction and maintenance demands of rapid deployment scenarios during winters.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.31.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Military Facilities Engineering Technology
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3735	3397	4250	4422	Continuing	Not Applicable
AT41	Military Facilities Engineering Technology	3735	3397	4250	4422	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program first addresses the task of providing cost-affordable facilities for the Base Development and the Installation Support Activities of the Army. The Army of the 1980's and 1990's will require a physical plant inherent with much more sophisticated technical systems to support its Readiness and Training missions. Existing facilities will have to be upgraded accordingly and the new construction made to suit. The cost of providing new facilities already has an important impact on affordability and readiness. The program is essential to support the planning, design, construction, operation, and maintenance of Army facilities worldwide. The thrust is to provide technology to increase productivity and responsiveness in the planning, design, construction, and maintenance functions performed by Army engineers in providing facilities in temperate and tropical climates, and to make the construction and maintenance of the facilities affordable on a life-cycle basis. The program also addresses the development of technology to reduce skill levels and logistics for troop construction and operation of base development and the installation support activities in theaters of operations in temperate and tropical climates.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Funds are required to continue the development of products and systems to increase the productivity in all phases of the military construction process. Systems under development include methods for cost effective master planning, design procedures for rapidly evaluating alternative designs and building systems, nondestructive testing techniques for construction quality control, management information systems for facilities engineers, new roofing systems and materials, and methods to reduce or eliminate corrosion on military installations. Systems development costs have been analyzed with respect to the priority of the requirement for each system, the availability of personnel resources to accomplish the research within a prescribed timeframe, and the expected cost savings when the systems are in use.

Program Element: #6.27.31.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Military Facilities Engineering Technology
Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	Additional To Completion	Total Estimated Costs
RDTE					
Funds (current requirements)	3735	3397	4250	Continuing	Not Applicable
Funds (as shown in FY 1982 submissions)	3735	3502	4200	Continuing	Not Applicable

FY 1982 and FY 1983 funding was changed from FY 1982 submission to initiate development of facilities technology to support new weapons systems.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.31.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Military Facilities Engineering Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objectives of this program are to: (1) increase the productivity of Army resources required to master plan, design, construct, operate and maintain permanent installations; (2) minimize the life-cycle costs of the Army facilities; and (3) develop facility designs requiring less time and lower skill levels for troop construction of base facilities in a theater of operations. The research is directed to four major thrust areas: (1) systems to improve productivity and quality of military construction at minimum cost; (2) systems to maximize the effectiveness of resource allocation to operate, maintain, and repair existing facilities; (3) alternatives to high-cost construction materials, complex construction systems, current ineffective construction quality control methods, and repair and maintenance techniques used in facility operations; and (4) materials and construction techniques for rapid base camp construction in a theater of operations.

G. (U) RELATED ACTIVITIES: This project is coordinated Service-wide through the Joint Service Civil Engineering Research and Development Coordinating Group. Coordination with intergovernmental agencies is accomplished through the Joint Services Building Materials Program with the National Bureau of Standards, Modular Integrated Utility Systems with the Department of Housing and Urban Development, and participation in the National Academy of Sciences Building Research Advisory Board. Related Programs include: Program Element 6.11.02.A, Defense Research Sciences, Project AT23, Basic Research in Military Construction, US Army Construction Engineering Research Laboratory, Champaign, IL; Program Element 6.27.19.A, Engineering Technology (ED), Project AT40, Mobility and Weapons Effects, US Army Engineer Waterways Experiment Station, Vicksburg, MS; Program Element 6.27.20.A, Environmental and Life Sciences (ED), Project A896, Environmental Quality Technology, US Army Engineer Construction Engineering Research Laboratory, Champaign, IL; and Program Element 6.27.81.A, Engineering Technology (ED), Project AT45, Military Energy Technology, US Army Construction Engineering Research Laboratory, Champaign, IL, Technology, US Army Construction Engineering Research Laboratory, Champaign, IL. Duplication is avoided through monitoring of projects by the Directorate of Research and Development, USACE, annual coordination meetings with the other USACE laboratories and coordination meetings with other agencies as described above.

H. (U) WORK PERFORMED BY: Approximately 65 percent of project funds are used for in-house effort at the US Army Engineer Construction Engineering Research Laboratory. Primary contractors are the University of Illinois, Urbana, IL; and the University of Michigan, Ann Arbor, MI.

Program Element: #6.27.31.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Military Facilities Engineering Technology
Budget Activity: #1 - Technology Base

1. (U) PROGRAM ACCOMPLISHMENT AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Improvements to the military facilities planning, design, and construction process provided by this research include: (1) a Computer-Aided Engineering and Architectural Design System for preconcept design to provide greater productivity in facility design, (2) a Technical Manual on Systems Building to enable military construction to take advantage of the cost savings possible in the use of systems buildings, (3) planning guidance for training ranges for the M1 tank, the infantry fighting vehicle/calvary fighting vehicle, and the AH-64 helicopter, (4) field-tested microprocessors for project pay estimates and construction scheduling, (5) weld quality monitor to determine the quality of a weld during automatic welding, and (6) a guide on nondestructive testing techniques to improve quality of construction. Accomplishments to assist facilities engineers include: (1) a master plan for developing a Computer-Aided Facilities Engineer Management System, (2) preliminary conceptual design of an automated Housing Operation and Management System, (3) a mathematical model for forecasting the costs of pavement deterioration and repair versus new replacement pavement, and (4) a maintenance guide for reducing corrosion on military installations. Accomplishments in materials and techniques for use in a theater of operations include: (1) commercially available programable calculators were adapted, programed for theater of operations use, and field tested at eight sites in Korea, Europe, and CONUS, (2) a foam ballistic blanket material system was devised to resist shrapnel for near-miss artillery detonations.

2. (U) FY 1982-FY 1984 Program: Planned accomplishments to improve military construction process include: (1) conduct a test of the Computer-Aided Engineering and Architectural Design System in concept designs of facilities planned for FY84 MCA Program, (2) complete development of methodology for automating Project Development Brochure (PDB) generation fou use in the Computer-Aided Engineering and Architectural Design System, (3) evaluate the Industrialized Building Feasibility System to identify family housing projects with a potential for use of systems building techniques to reduce costs and provide housing units in less time, (4) provide guidance on use of standardized building modules to reduce construction costs while maintaining the flexibility needed for the buildings to satisfy functional requirements, (5) complete design of life-cycle costs data base for buildings, (6) investigate technology to make facilities more resistant to chemical and biological agents, and (7) develop guide specifications for single-ply roof systems. Planned accomplishments to provide technology for application in facilities, operations, and maintenance include: (1) complete a pavement performance prediction model to aid decisionmaking on pavement repair needs and expenditures, (2) develop guide specifications for coating systems to comply with health and hazard regulations with no degradation in the quality of the coating, (3) complete methodology for consolidation of facility engineer work efforts in geographic areas, (4) field-test corrosion monitor for determining extent of corrosion in pipes, and (5) develop automated housing assignment methodology for Army Housing Operation Management.

Program Element: #6.27.31.A Title: Military Facilities Engineering Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

Scheduled accomplishments to provide technology to support theater of operations construction include: (1) preliminary design criteria for utilization of field-formable plastic foam ballistic blanket material systems in theater of operations applications, (2) develop concept for expanding use of automation by the combat engineer in the 1980's and 1990's, (3) develop procedures to improve the joining of aluminum alloys in the field, (4) develop and integrate an engineer model into the theater combat simulation model to provide simulation of engineer organization operation concepts in theater battlefield environment, (5) complete evaluation of polymeric materials for infrared camouflage applications in theater of operation facilities. Anticipated personnel assignments to this project each fiscal year are: professional 45, support 20.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.32.A
Title: Remotely Piloted Vehicles (RPV) Supporting Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1456	0	1588	3447	Continuing	Not Applicable
AF34	Remotely Piloted Vehicle Supporting Technology	1456	0	1588	3447	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to develop technological capabilities in those areas which currently limit the operational potential of small RPV's for Army missions of Target Acquisition, Designation and Aerial Reconnaissance (TADAR), and for future missions. RPV's are required to extend the eyes of the Brigade and Division commanders to the range of their artillery, increase the effectiveness of their direct support firepower, and provide laser designation for laser-guided weapons. Growth capabilities, cited in the requirements document for the TADAR mission, needing further development include extended range and multiple control operations. This project will define and develop those capabilities. Other activities include development of night and all-weather sensors, automatic cuers and intelligent handwidth compression devices, survivability/vulnerability analysis, and study of future missions; e.g., relay, electronic support measures, and radiac survey. These exploratory development efforts will enhance the mission effectiveness of small RPV's, improve system reliability, and reduce life-cycle costs, wherever possible. RPV technology offers opportunities for saving lives and money on high risk mission for pilots and aircraft.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Funds requested provide for development of Multiple Aguila Control System (MACS) permitting multimission operations for mini-RPV's, continued development of bandwidth reduction/intelligent target tracker equipment, mission effectiveness/survivability enhancement simulation and analysis and continued investigation of millimeter wave components and techniques for a mini-RPV radar sensor.

Program Element: #6.27.32.A Title: Remotely Piloted Vehicles (RPV) Supporting Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1456	0	1588	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1727	2836	3000	Continuing	Not Applicable

FY 1981-FY 1983 reductions were due to general budget reductions and reprogramming of funds to higher priority Army requirements. Funds will be reprogrammed to continue this program in FY82.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.32.A Title: Remotely Piloted Vehicles (RPV) Supporting Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of the Army RPV program is to field mini-RPV systems which have high reliability and which are cost-effective for selected missions. The first priority Army mission is Target Acquisition, Designation, and Aerial Reconnaissance (TADAR). The first-generation system will provide day mission capabilities via a fixed-wing mini-RPV under command from a Ground Control Station (GCS). The engineering development (ED) contract for TADAR was awarded in August 1979 and the ED contract for the GFE data link (Modular Integrated Communications and Navigation System--MICNS) was awarded in May 1979. This program provides a technical development base for improvements to the RPV. Programs are structured to accommodate growth, most notably a night mission capability Foward Looking Infrared (FLIR), multiple control and other modular payloads. Alternate missions are being considered, including electronic warfare (both communication and noncommunication jamming), relay, decoy, and radiac survey. This exploratory development program addresses the growth capabilities for the RPV system, as well as the future mission configurations. Analysis, simulation, and limited testing are conducted so that subsystems/payloads essential to the complete RPV system can be selected and optimized. Five areas of investigation are being pursued: Air mobility (survivability, propulsion, and launch/recovery), radar (millimeter), missions, command and control (multiple control, extended range, and out of line-of-sight), and electro-optics (low-cost FLIR's, lasers, and autotrackers).

G. (U) RELATED ACTIVITIES: Within the Army, Advanced Development is conducted under Program Element (PE) 6.37.25.A, Remotely Piloted Vehicles (RPV)/Drones, and Engineering Development of the first generation RPV is being conducted under PE 6.47.30.A, Remotely Piloted Vehicles. The Air Force RPV programs consisting of PE 6.37.39.F, Advanced RPV's, and PE 6.47.46.F, Expendable Drones, are being monitored. The Army and Air Force RPV program managers meet periodically to assure cooperation between the services. A Memorandum of Understanding (MOU) with the United Kingdom was initiated in FY 1979, and opportunities are being examined for interoperability between the two nations.

H. (U) WORK PERFORMED BY: The Research and Technology Laboratories, Headquarters, Moffett Field, CA; and the Applied Technology Laboratory, Fort Eustis, VA; US Army Electronics Research and Development Command, Fort Monmouth, NJ; Night Vision and Electro-Optics Laboratory, Fort Belvoir, VA; US Army Avionics Research and Development Activity, Fort Monmouth, NJ; and the US Army Human Engineering Laboratory, Aberdeen Proving Ground, MD. Contractors participating are: Norden, Norwalk, CT; Systems Planning Corporation, Washington, DC; Developmental Sciences, Inc, City of Industry, CA; RCA, Burlington, MA; and Harris Corporation, Melbourne, FL.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

Program Element: #6.27.32.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Remotely Piloted Vehicles (RPV) Supporting Technology
Budget Activity: #1 - Technology Base

1. (U) FY 1981 and Prior Accomplishments: This was a new program in FY 1977 and the bulk of funding was directed toward the development, fabrication, and ground testing of an antijam data link, the Integrated Communication and Navigation System (ICNS) built by the Harris Electronics Corporation. This system was subsequently integrated into two Aquila RPV's and flight tested in FY 1978 at Fort Huachuca, AZ, under PE 6.37.25.A, Remotely Piloted Vehicle Drones. The Army Required Operational Capabilities (ROC) for the Target Acquisition, Designation, and Reconnaissance System (TADARS) stated that multicontrol was a growth consideration for the data link and that the night vision capability was a growth requirement for mission payloads. As such, in-house studies of multiple-control option within the Ground Control Station (GCS) and antenna configuration options were initiated in FY 1978. Two contracts was awarded in FY 1978 (Ford Aerospace and Honeywell) for the modification of a Honeywell POISE gimbal to include 8-12 micron FLIR's and ground testing. The sensor was subsequently modified to enhance recognition ranges. Modifications were completed on a 95 Gigahertz millimeter surveillance radar to enable ground testing in FY 1979. Ground-based testing of the millimeter radar was performed at a contractor site and testing at a Government site and continued into FY 1980. In FY79, in addition to the foregoing, automatic recovery investigations were conducted and a flight demonstration of one concept was demonstrated, an alternate pneumatic launcher was ground-tested, propellers optimized for performance were fabricated, and acoustic signature characteristics of propellers were statically and dynamically tested in an effort to reduce acoustic observables and thereby increase survivability. Also study was initiated with Calspan in FY 1979 to determine if mini-RPV's need to carry Air Traffic Control/Identification Friend or Foe (ATC/IFF) equipment to avoid midair collisions as well as to enhance coordination with friendly air defenses. The study was completed in 1980. In FY 1980 solicitations were initiated for the design of alternative antenna configurations (planar and horn) essential to the accomplishment of the multicontrol growth capabilities cited in the Required Operational Capability (ROC) and RPV/MICNS contracts. Draft final reports for preliminary design of the multiple Aquila Control System were completed. An Electromagnetic Compatibility and Analysis Center (ECAC) study was completed in FY 1980 to determine the validity and better define the extended range growth requirements cited in the ROC for RPV application. In-house evaluation of open and ducted propeller designs as well as in-house survey of engines suitable for growth version of an RPV were conducted by Applied Technology Laboratory. Mission Effectiveness and Survivability Enhancement (MESE) Analyses/Simulations are being conducted to quantify advantages of alternate mission payload and multicontrol/multimission operations.

2. (U) FY 1982-FY 1984 Program: Multiple Aquila Control System (MACS) development permitting multimission operations for mini-RPV's at extended ranges will begin. Changes to the ground control station (GCS) as needed for multicontrol operations will be determined through simulation. Simultaneous control of up to 8 RPV's through a single RPV section will then

Program Element: #6.27.32.A Title: Remotely Piloted Vehicles (RPV) Supporting Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED) Budget Activity: #1 - Technology Base

be feasible. The Mission Effectiveness and Survivability Enhancement (MESE) program will continue to quantify advantages of alternate and ancillary payloads in single as well as multiple control operation simulations. Miniaturization of key components essential to the adaptation of a millimeter radar to a mini-RPV will continue. An assessment of radar technology to establish the promising applications for a mini-RPV will be completed. Development of bandwidth reduction intelligent target tracker techniques/devices suitable for use with small RPV's will begin. The resulting cuers will decompose imagery into descriptors and coordinates for bandwidth compression ratios that can be adjusted adaptively up to 10,000 to 1. Intelligent tracker concepts for predicting and anticipating target signatures under changing conditions will be assessed. Ancillary investigation of propulsion, launch, recovery, and survivability equipment will be conducted as warranted by the emerging future uses of these mini-RPV's.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.33.A
Title: Mobility Equipment Technology
DOD Mission Area: #523 - Engineering Technology (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	10007	10164	11278	12717	Continuing	Not Applicable
AH20	Mobility Equipment Technology	10007	10164	11278	12717	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The work under this program is Exploratory Development in the areas of fuel (fossil and synthetic), lubricants, power transmission fluids and corrosion-preventive coatings; mine detection and neutralization; advanced tactical barriers and related concepts; camouflage; power generation; bridging; water and wastewater management; environmental control for vans and shelters; marine equipment; counterization, construction equipment; expedient surfacing and soil stabilization; and physical security. These efforts are required because of the unavailability of: field fortifications and obstacles that effectively provide the ability to economize forces, exhaust an attacking enemy, and provide adequate gain in time to prepare for offensive action; antivehicular barriers that require reduced logistical and support burdens; controllable barrier systems that effectively impede enemy units but permit safe passage of friendly forces; tunnel detection methods to recognize acoustic activity associated with underground activities; physical security data acquisition and analysis system to prevent stealing, sabotage, and espionage; tactical sensors to provide remote target-locating capability; highly competent means of standoff detection of surface-laid mines; a family of mine neutralizers for use by air and ground vehicles and in a manpack mode; sufficiently strong, advanced, lightweight mobile bridging structures for Class 60 and Class 70 bridges; highly efficient camouflage techniques for thermal decoys that provide low emissivity in the dark; rapid means for soil stabilization and emplacement of expedient surfacing; means for provision of rapid soil stabilization and emplacement of expedient surfacing; means for provision of rapid logistics-over-the-shore operations; high-efficiency fuel cell catalysts and electrodes for silent power generation; economical and effective air conditioning capabilities for combat vehicles and shelters; means for providing low vulnerability fuels to help generate significant improvement in combat survivability; detailed understanding of effects of alternate/synthetic fuels on combat vehicle operations and performance; adequate guidelines for reliable use of extended-internal

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

oils and lubricants and re-refined oils; and highly reliable hydraulic fluids with improved fire resistance, low-temperature operational properties, and potential for economic use.

C. (U) BASIS FOR FY 1983 RDTE REQUESTS: Because of the large number of new program starts in FY 1982 and prior years, work this fiscal year will be concentrated primarily on continuation and completion of major ongoing tasks. The following programs will be continued: Investigation of improved air conditioning systems that provide chemical, biological, and radiological protection for armored combat vehicles; continued work on low-cost fuel cell, improved tactical electric power distribution, and new air conditioning concepts. Continue programs to improve close-in buried mine-field detection and stand-off surface minefield detection, close-in neutralization of minefields, stand-off neutralization of minefields by means of high energy explosives and remotely controlled vehicles and advanced barrier systems. Investigate military effectiveness and perform systems analysis of field fortifications. The new major thrust will be continued on high-strength, lightweight composites for mobile bridging. Continue development of improved methods for supply distribution, excavation, camouflage, explosive and minefield detection neutralization. Develop and evaluate reverse osmosis technology for water purification with ability to remove trace turbidity and improved water detection methods for desert environments. Complete evaluation of coatings and adhesives for seamless water supply tanks. Continue tasks to develop and evaluate improved multipurpose antifreeze, high-performance engine oils, high-energy fuels, alternate/synthetic fuels including the validation of gasohol performance in Army equipment, and nonflammable hydraulic fluid for unique Army engines. Continue program to modify ground combat fuels to satisfy the urgent needs for improved fire survivability.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	10007	10164	11278	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	11242	11389	15899	Continuing	Not Applicable

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

Reduction of $1235 thousand in the FY 1981 funding level is a result of reprograming to higher priority Army requirements. The funding decrease of $1225 thousand in FY 1982 is a result of the amended budget request and the application of revised inflation and civilian pay pricing indices. Reduction of $4621 thousand in the FY 1983 funding level is a result of program realignment to fund programs with higher Army priority.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program covers those efforts directed toward overcoming obstacles to mobility vehicle and ground troops, irrespective of whether the obstacles are enemy created, naturally created, or are a result of our own logistics shortcomings. Concurrently, the program explores systems for the physical security of our forces and support activities for the use of new and advanced camouflage techniques and new barriers and intrusion detection devices. It covers Exploratory Development work to detect and neutralize minefields, and new and improved marine and bridging capabilities to bypass minefields and/or to cross water- and land-gap obstacles. New and improved mobile electric power sources and distribution means are explored. It covers work to determine whether Army diesel engines can operate satisfactorily on nonspecification fuels; e.g., those with a high sulfur content which are common in many parts of the world. At the same time, new formulations are tested to significantly decrease the fire hazard of fuels, lubricants, and hydraulic fluids used in our combat and tactical vehicles. It covers the Exploratory Development of high-energy fuels to increase vehicle range and engine efficiency, and the effort toward increasing availability of conventional, alternate, and synthetic fuels including the evaluation of gasohol performance in Army equipment. Finally, it covers water purification systems, containerized, bulk-cargo and fuel-handling equipment, logistics watercraft, environmental control equipment, and rapidly emplaced construction materials to provide the support needed to sustain Army mobility and logistics in a hostile environment.

G. (U) RELATED ACTIVITIES: In the fuels and lubricants technical area, active liaison and coordination is maintained with other Military Departments, the Environmental Protection Agency, Federal Aviation Administration, and Department of Energy. The Countermine and Barrier technical area provides direct support for Advanced and Engineering Development Program Elements: 6.36.06A, Landmine Warfare; 6.36.19A, Countermine and Barriers; 6.46.19A, Landmine Warfare; and 6.46.12A, Countermine and Barriers. The fuels and lubricants technical area provides direct support for the Advanced Development Program Element: 6.31.04A, Fuels and Equipment. The engineer/logistics support technical area provides support for related Advanced and Engineering Program Elements: 6.37.02A, Electric Power Sources; 6.37.26A, Combat Support Equipment; 6.47.14A, Tactical Electrical Power Sources; and 6.47.17A, General Combat Support. There is no unnecessary duplication of effort within the Army or the Department of Defense related to this program area.

H. (U) WORK PERFORMED BY: In-house work is performed by US Army Mobility Equipment Research and Development Command, Ft. Belvoir, VA; US Army Engineer Waterways Experiment Station, Vicksburg, MS; US Army Tank-Automotive Command, Warren, MI; US Army Materiel Systems Analysis Agency, Aberdeen Proving Ground, MD; Natick Research and Development Command, Natick, MA. Contractual support is provided by ERIM Corp., Ann Arbor, MI; Brunswick Corp., Deland, FL; CALSPAN, Buffalo, NY; ENSCO Inc., Springfield, VA; Colorado School of Mines, Golden, CO; Hughes Aircraft, Fullerton, CA; MTIO Corp, La Thamgto, NY; Creative Tech, Scottsdale, AZ; University of Pennsylvania, Philadelphia, PA; BDM, McLean, VA.

Program Element: #6.27.33.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Mobility Equipment Technology
Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: In combat support technology vortex propeller tests were completed and final report prepared, cost and technical assessments were developed for 60-ton Amphibian Vehicle. A modular laboratory model antiventing system for air-cushion vehicles was designed and fabricated and feasibility shown. Feasibility analysis of air-cushion barge system for logistics-over-the-shore mission was initiated. Investigation to improve life and wear characteristics of air-cushion vehicle skirt components was initiated. A system analysis of US Army logistics-over-the-shore operation and system development was completed. Formulation of rubber-coated material to improve life characteristics of air-cushion vehicle fingers was completed and fingers were fabricated and tested. Test report was prepared and formulation specification prepared for procurement. Technical and cost assessments were prepared for Formal Requirement Document for heavy-lift amphibians. For materials handling equipment, a system description of a load stability safety device was formulated. An airfoil device was tested on turbine generators to defeat thermal detection of hot exhaust gases. Initiated major project to measure and suppress infrared signatures of power sources. Studies of physical security resulted in a report which indicates the capabilities of the present system and points up the areas in which analysis improvement is necessary. Completed analysis of selected seismic direction techniques for tunnel detection. Completed selection/ initial instrumentation of test site for field evaluation of tunnel detection systems. The bridging finite element computer model was modified and updated. Composite materials work included design of an aluminum/graphite epoxy, aluminum sandwich mobile bridge bottom chord. Designed and tested all-composite mobile bridge traversing beam progressing. Capabilities of various commercially available hydraulic tree transplanting equipment to excavate for field fortifications were evaluated. Performed investigations of a sandbag filler and sealer prototype. Concepts for battlefield covers and digging equipment were demonstrated. A Soviet scattermine threat assessment was completed that identified probable Warsaw Pact tactics and strategy. Identified Materials Handling Equipment conceptual alternatives for forward combat resupply and determined boundary conditions for Materials Handling Equipment used for transition to war. Initiated design and fabrication of waste heat-powered absorption air conditioner. Modified fuel cell electrodes evaluated to examine tolerance to repeated startups and shutdowns. New catalyst systems were tested for adiabatic reforming of logistic fuels for fuel cells. Fabricated prototype of 30KW modular power conditioner. Tested pulse power components for stored energy systems and made high-power test stand operational. Mechanized pipe-laying machine design concept was completed. Completed system analysis of Air-Cushion Vehicle bulk fuel transport. Developed test methods for fire resistant fuel components. Completed development of a candidate corrosion-inhibited turbine engine oil and completed rig test. In the infrared/radar attenuation area, installation and testing of a 100GHZ radar imaging system was completed.

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Planned Program: In materials handling equipment, will continue investigation of: supply distribution system deficiencies; materials handling in the theater of operations; and operation of a containerized distribution system in a logistics-over-the-shore and rapid deployment force environment. Continue development of integrated waste-heat exchanger and refrigerant generator. Investigate water recycling to the adibiatic reformer for conditioning of logistic fuels. Fabrication of breadboard models for mechanized pipelaying machine will be initiated. Design parameters for transporting bulk fuel across the beach in support of amphibious operations will be determined. Will investigate low temperature physical properties of fire resistant fuels. Analyze and define synthetic liquid fuels from coal. Investigate effects of fuel additives on fire resistent fuels stability. Complete high temperature engine oil tests. Continue evaluation of ground water detection methodologies. Camouflage electromagnetic properties of ferrites used in radar absorbing paints will be measured. Radar attenuation characteristics of paint samples will be measured and evaluated. An operational concept paper for camouflage, countersurveillance, and deception measures will be prepared. Develop a technical and management plan for suppressing thermal and acoustic signatures from engine generator sets. Measurements will be made of various radar attenuating concepts with emphasis on a special design of nonwoven metallized cloth. Data acquisition and analysis system for physial security will be evaluated. Initiate tactical sensor design of robotics locating system for indexing and joining two independent objects for automated handling. Evaluate breadboard models of approaches and continue data base collection for tunnel detection. Continue geophysical consultation and theoretical studies. Initiate testing of bridging composite traversing beam. Continue support of international group efforts. Continue development of the high-speed earth excavator for excavations from 2-18 feet wide and up to 6 feet deep. Conduct concept feasibility demonstrations of integrated materials handling systems and report on results. Complete development of waste-heat powered absorption air conditioner, and initiate tests to determine cooling capabilities and overall efficiency. Initiate evaluation of hybrid electric power sources (fuel cell/battery). Demonstrate pulse-power generation hardware for directed energy weapon application. Start assessments of antimist diesel and turbine fuels and field fuel production technology. Continue investigations on synthetic fuels, fire-resistant fuel and fuel-deterioration mechanisms. Initiate development of a new nontoxic and lead-free, solid film lubricant and preservative for small arms, large caliber weapons, and missiles. Complete test of nonflammable hydraulic fluid. Select fluid for multipurpose turbine engine/transmission oil and initiate limited field testing with M-1 tanks. Prototype ground water detection equipment will be developed. The feasibility of an alternate oxidant to replace chlorine and enhance remote outpost water-production units operations will be initiated. Camouflage concepts for specific critical systems will be refined and developed. Experimental prototypes of kits to suppress acoustic and thermal signature of the 30KW generator set will be built and tested. Camouflage paint developed to defeat the primary wavelength for the 1.06-micron laser will be tested. Design specifications for tactical sensor-robotics locating system will be completed. Initiate design studies of select metal-matrix bridge elements. Initiate studies of field repair of aluminum and

Program Element: #6.27.33.A Title: Mobility Equipment Technology
DOD Mission Area: #523 - Engineering Technology (ED) Budget Activity: #1 - Technology Base

composite-material bridge structures. Continue high-stability truss tube program. In field fortifications and excavation efforts, develop concept for operator/machine interface that offers the most potential benefits for the excavation system. Determine feasibility of roller for use as a threat simulation to defeat magnetic-influence fuzed mines. A program will be initiated to identify systems for the defeat of sense and destroy type mines. An analysis will be initiated to identify concepts for countering chemical and biological mines. Initiate studies of supply distribution system requirements for the 1990's. Complete engineering development of thermally integrated methanol/air fuel cells, fire-resistant fuels, ground-water detection system and water quality analysis kits. Initiate engineering development of general purpose conditioner using modularization- and microprocessor-based control and diagnostic technology. Continue work on closed circuit refueling components, all season engine oils and lubricants, and optimize elastomeric properties against attack by alternate fuels. Conclude evaluation of radar absorbing paint. Complete thermal/acoustic kit designs for diesel generators. Procure small-scale robotics locating system for test and evaluation. Best features from the thermal and acoustic kits for the 30-kilowatt generator will be combined and tested. Measurements of the electro-magnetic properties of special ferrites will be completed. Appropriate paint mixtures will be formed into radar-absorbing paint, their transmission and reflection properties will be measured and optimum paints will be evaluated. Investigate other earth-moving concepts, vibration, and controlled explosion. Experimental Airborn Mine Detection system breadboard evaluation will be completed. Demonstrate feasibility for a neutralization system capable of a three- to five-kilometer standoff effective against hardened mines with complex fuses. Analysis leading to the definition of systems to defeat wide-area top-attack mines will be completed. This program involves 27 professional personnel and 55 support personnel.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.34.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Defense Against Chemical Agents
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	14402	25785	26865	37123	Continuing	Not Applicable
AH26	Medical Defense Against Chemical Agents	5260	0	0	0	-	26454
A875	Medical Defense Against Chemical Agents	9142	25785	26865	37123	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This research program emphasizes prevention of chemical warfare casualties through pharmacologic intervention in the poisoning/incapacitating process of the threat chemical warfare agents (nerve, blister, cyanide). The majority of resources in this program support the development of prophylactic, pretreatment, and antidote drugs that will neutralize lethal/incapacitating effects of chemical warfare agents and ionizing radiation. This program is also concerned with the development of medical materiel, therapeutic drugs, and decontamination compounds to insure adequate patient care, field resuscitation, life support during evacuation, field decontamination of patients, and patient management in field medical units when chemical warfare agents are used by hostile forces against US Armed Forces.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The requested funds will be used to support development of the Integrated Medical System for Individual Protection. Major areas of effort will be: the definition, development, validation, and maintenance of standardized animal, behavioral, cellular, and biochemical models and procedures to elucidate the biological sequence of effects of chemical warfare agents, antidotes, and decontaminating compounds, and to conduct safety, tolerance, and efficacy studies of antidotes and decontaminating materials; the development of antidote, prophylactic, therapeutic, and decontamination compounds for the safe and efficacious prevention and treatment of the effects of chemical warfare agents and ionizing radiation; the development of a medical and scientific rationale for the management, prognosis, triaging, and treatment of chemical warfare and radiation casualties; the development of a decontamination data base; and the development of medical materiel for the decontamination, evacuation, and treatment of mass chemical warfare casualties.

Program Element: #6.27.34.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Defense Against Chemical Agents
Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	14402	25785	26865	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	14814	25852	19557	Continuing	Not Applicable

Reduction of $412 thousand in FY 1981 is the result of an adjustment of $183 thousand for travel, consultants, inflation indices, and OSD deferrals, and reprograming of $229 thousand to Program Element 6.11.02.A, Defense Research Sciences, Project BS10, Research on *Military Disease*, Injury, and Health Hazards, Scientific Area E, Medical Chemical Defense Science Base/Mechanisms of Action of CW Agents and Antidotes. The decrement in funding shown in FY 1982 is the result of repricing the budget based upon decreased inflation factors. Increase of $7.3 million is due to the FY 1983 projected expansion of chemical warfare/chemical and biological defense (CW/CBD) program.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.34.A
DOT Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Defense Against Chemical Agents
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The Warsaw Pact countries have a considerable array of lethal chemical warfare agents available for deployment against US Armed Forces, and are philosophically prepared to use them. Because of a decade of deemphasis on the chemical threat posed by our adversaries, a critical gap exists today in the ability to protect US Forces on the chemical battlefield. This Program Element represents the entire US Army exploratory development effort in medical chemical defense, supporting not only Army requirements, but joint service requirements of the Air Force and Navy as well. The objective of the program is the development of an Integrated Medical System for Individual Protection which will provide the medical material needed to minimize deaths, disabilities, and patient loads, and improve survivability, patient care, combat effectiveness, and mission accomplishment on the integrated battlefield. The major objectives of this relatively new exploratory development effort continue to be: development of prophylaxes, pretreatment compounds, antidotes, and therapeutic drugs for the safe and efficacious prevention and treatment of the effects of chemical warfare agents while minimizing drug-induced side effects that would degrade operational capability; development of criteria for triaging casualties on the integrated battlefield that identify the probability of survival with exposure to differen chemical warfare threat agents and for deciding whether to evacuate a chemical agent casualty to a clean environment for treatment or to treat the casualty in a contaminated environment; development of a patient decontamination technology data base by establishing decontamination criteria, exploring new technologies, converting biomedical data to engineering criteria, and establishing the performance/physiological burden imposed by decontamination/materiel so that an effective and practical patient decontamination system can be developed; and assessment of physiological burden imposed by chemical warfare protective materiel such as masks, clothing, and drugs. The exploratory development supported by this Program Element/Project is absolutely essential to the development of medical materiel required to prevent mass chemical warfare casualties and the US losing the tactical advantage on the integrated battlefield.

G. (U) RELATED ACTIVITIES: This Program Element/Project is supported by basic research done in Program Element 6.11.02.A, Defense Research Sciences, Project BS10, Military Disease, Injury, and Health Hazards, and supports advanced development efforts in Program Element 6.37.51.A, Medical Defense Against Chemical Warfare and Program Element 6.37.62.A, Medical Chemical Life Support Materiel. Duplication of effort within the Army is avoided by central management of the program on the Medical Aspects of Chemical Defense by the US Army Medical Research and Development Command. Duplication of effort across the services is avoided by coordination and collaboration with the Air Force and Navy, as required of the Army as the Executive Agency for the DOD chemical defense effort. Formal coordination is achieved through a Memorandum of Agreement with the Air Force and the Joint Technology Coordinating Group, which represents the Army, Navy, and Air Force. All work is coordinated with quadripartite and NATO nations through meetings and Data Exchange Annexes.

Program Element: #6.27.34.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Defense Against Chemical Agents
Budget Activity: #1 - Technology Base

H. (U) WORK PERFORMED BY: The five largest contractors supported by this effort are: Ayerst Laboratories, New York, NY; University of Maryland School of Medicine, Baltimore, MD; SRI International, Menlo Park, CA; Washington State University, Pullman, WA; and University of Arizona, Tucson, AZ. There are 32 additional contractors supported at a total dollar value of $3,372,953. In-house research is supported at the US Army Medical Research Institute of Chemical Defense (formerly the US Army Biomedical Laboratory), Aberdeen Proving Ground, MD; the US Army Research Institute of Environmental Medicine, Natick, MA; the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, MD; the US Army Institute of Dental Research, Washington, DC; the US Army Aeromedical Research Laboratory, Fort Rucker, AL; the Letterman Army Institute of Research, Presidio of San Francisco, CA; and the Walter Reed Army Institute of Research, Washington, DC.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A Nerve Agent Antidote Replacement Task Force, formed at the recommendation of the Advisory Committee on Chemical Agent Antidotes, negotiated a contract within the pharmaceutical industry for the expeditious reformulation of a nerve agent antidote to replace that which is currently fielded. The final clinical trials required for FDA approval to use the drug in humans were initiated. This effort was delayed by the issue of contractor indemnification. A potential new antidote for cyanide poisoning was evaluated and compared to the antidote currently in use. A worldwide assessment of autoinjector technology for the self-administration of protective/antidote compounds for chemical warfare agents was conducted. The heat stress induced by the chemical warfare protective ensemble on the crew of the M1 tank operating in a hot environment was assessed. A contractor identified two promising candidate antidotes for blister agent poisoning. Development was initiated on resuscitators for chemical warfare casualties, and a prototype decontaminable patient litter was developed in-house. This two-year-old program has made significant gains, but a great deal needs to be done, and will require further expansion in order to meet the existing, recognized threat. A very positive accomplishment of the program during FY 1981 was the increased involvement of excellent scientists in the civilian sector as evidenced by a threefold increase in the contract program during this period. However, the program continued to be hampered by a less than adequate or appropriate physical plant for the conduct of biomedical research using chemical warfare agents. A shortage of in-house scientists in a number of specific disciplines (e.g., pharmacology, toxicology, neurosciences) required to exploit and advance existing technology has slowed the advancement of the program.

2. (U) FY 1982-FY 1984 Planned Program: Required research on the replacement nerve agent antidote will be completed, and initial fielding will begin in FY 1982. Evaluation of compounds having potential for providing improved

Program Element: #6.27.34.A
Title: Medical Defense Against Chemical Agents
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

antidotes/therapies for nerve agent, blister agent, and cyanide poisoning will continue. A major new emphasis will be placed on evaluating several compounds for their potential to be used as pretreatment drugs in order to provide a degree of protection against nerve agent poisoning. The program will strive to produce compounds inducing maximum protection and minimum objectionable side effects. Efforts will continue on the development, both conceptually and with hardware, of an effective system of chemical casualty management. This effort will focus on: a resuscitatorfor far-forward use with chemical casualties; a multipatient resuscitator for use with mass chemical warfare casualties at the second and third echelons of medical treatment; a patient wrap to protect patients from chemical contamination during the evacuation process; chemical agent dosimeters for medical personnel; vital signs monitors for both far-forward use during evacuation and at second and third echelons of medical treatment; and chemical agent detector technology. Efforts will continue on development of a decontamination data base in order to establish appropriate criteria for patient decontamination and systems to accomplish the patient decontamination. The physiological burden on soldiers who have heat stress induced by protective clothing and antidote effects will be evaluated. The effectiveness of drugs against ionizing radiation, to include neutron radiation, will be evaluated. Personnel to be utilized: 134 professional and 203 support.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.46.A
Title: Tactical ADP Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	7024	8029	7076	6003	Continuing	Not Applicable
A094Q0	Military Computer Family	737	2385	1905	2600	Continuing	Not Applicable
A094R0	Software Techniques	3030	1834	1785	1068	Continuing	Not Applicable
A094S0	Teleprocessing Design Center	849	1602	1253	358	Continuing	Not Applicable
A094T0	Intelligent Terminal Family	158	-	-	-	Encompassed in A094Q0 Military Computer Family	
A094U0	System Management Engineering	298	360	374	474	Continuing	Not Applicable
A094V0	Test Technology	362	240	255	0	Continuing	Not Applicable
A094W0	System Architecture Science	720	644	535	575	Continuing	Not Applicable
A094X0	Communicative Technology	870	964	969	928		

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the technology base for new concepts and advances in technology to meet the presently unsolved problem of survivable, interoperable, cost-effective, maintainable tactical command, control, and information-handling systems for the modern battlefield. Exploratory development is performed in software technology (common programing language, Ada, and software development and maintenance environment), hardware (including specific portions of the Military Computer Family (MCF) consisting of computers and peripherals), software and computer system engineering technology (protocols, data bases, operating systems), and new technology for data storage and transmission. This program addresses the methodology and technology which need to be developed to insure the capability of performing timely and accurate malfunction identification, isolation, diagnosis, and failure prediction of information handling components of Army Systems to be fielded in the 1980-1990 timeframe. The goals of this program are to provide the necessary technology to enhance effectiveness, survivability, and interoperability of automated systems, provide for technology insertion into fielded systems and reduce costs for development, maintenance, and logistic support for automated systems.

Program Element: #6.27.46.A
Title: Tactical ADP Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)
Budget Activity: #1 - Technology Base

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The funds are required to continue exploratory development for the Military Computer Family (MCF) in order to provide up-to-date equipment for new systems and technology insertion into all battlefield automation systems. Product Planning of MCF Life Cycle Cost Model and Analyses and work in the areas of advanced hardware/software system architecture and realtime distributed processing configuration of MCF computers will be continued. A study to increase the screen size of electroluminescent displays and to investigate the use of the MCF single-board computer to develop an intelligent display terminal will be completed. A program to provide software tools and documentation to project managers for use of the Software Development Support System (SDSS) will be continued. An automated tool to assist the combat developer in defining his requirements and communicating them to the system developer will be improved and adapted for the Ada language system. Work will continue on the automated Computer Resource Management (CRM) data base. Further work will be performed in improving policies, procedures, and standards for the management of computer resources. The Systems Validation Facility will illustrate a computer system architecture which addresses battlefield survivability and computer security requirements. The common high order computer programing language, Ada, and adequate software support tools will be exploited to reduce costs in software development and maintenance. Secure interfaces to the Advanced Research Project Agency Network (ARPANET/Autodin II) are essential to provide a means of connecting distant development centers and reduce costs and increase efficiency of handling systems which have classified software modules. These interfaces to the microprogramable multiprocessor (MMP) and SDSS will be tested. Army testing requirements for digital, hybrid, and microwave/millimeter systems will be developed. Work will be continued to increase the measurement capabilities of Test Measurement and Diagnostic Equipment (TMDE) while reducing the physical size of the TMDE. TMDE encompassing digital microprocessor technology is used for diagnosis, adjustment, and repair of communications-electronic equipment to include selected tactical automation items. Research will be performed in distributed processing, encompassing advanced concepts in architecture, software, hardware, and communications interfaces. This work is vital to insure a high degree of integrated, survivable, mobile command, control, and communications automation for the future battlefield.

Program Element: #6.27.46.A
Title: Tactical ADP Technology
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)
Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	7024	8029	7076	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	7295	8053	8618	Continuing	Not Applicable

Decreases in FY 1981 and FY 1983 are attributable to subsequent reprioritization of project efforts within the Army's technology base program. FY 1982 differences are due to inflation adjustments.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.27.46.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Tactical ADP Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Automation and communication are critical to the combat effectiveness of most battlefield systems. These technologies have been improving and expanding at an explosive rate. This rapid development rate has created standardization, performance, and testing problems that must be corrected now if the US Army is to field cost-effective systems that are survivable, interoperable, and mobile as well as usable and supportable by the soldier in the field. The goal and objectives of this program are to accelerate the fielding and improve the survivability, mobility, and interoperability of these systems, to reduce the cost of development and support of tactical automation and communication systems, to insure the availability of Test Measurement and Diagnostic Equipment to diagnose and predict malfunctions in a cost-effective, timely manner. Problems that must be corrected are in the areas of: software cost and performance, testing, proliferation of incompatible products (computers, terminals, peripheral devices, languages, software tools), reliability and cost of input/output devices, and support of automated systems (hardware, software, people) after deployment and the ability to train personnel in the new technology effectively. The approach to correcting these problems is to provide: technologies for a common compatible family of computers and peripherals (terminals, displays, auxiliary memories, etc.), transportable software products and tools (including the common high-order language, Ada), improved testing equipment and techniques; and to provide policy, procedures, standards, and regulations prioritizing the utilization and implementation of these assets. Software products and tools will be developed in a time-phased manner with the initial emphasis on the Ada language and requirements tools. Subsequently these standardized and configuration-managed tools will be used for the specification and implementation of multiprocessor and microprocessor system configurations. The final phase will provide techniques, procedures, and tools for the detection, control, and correction of field software failures with a reduction of required skill levels in the field. The System Architecture and Science Program encompasses investigations in automated systems methodologies for the development and maintenance of large software-intensive systems, the development of software generators that automatically produce test procedures for large scale integrated/very large scale integrated (LSI/VLSI) circuits, development of experimental distributed processing command, control, communications, and intelligence (C3I) systems, and exploratory research in a new initiative for application of artificial intelligence and robotics to C3 systems design.

G. (U) RELATED ACTIVITIES: This program is related to all Army battlefield automation systems as it will provide technology for a standard family of computers, software, and peripheral devices for such systems. It provides the exploratory development needed for direct support to Program Element 6.37.23.A and PE 6.47.27, Command and Control. Research and studies performed by the Air Force and Navy are also related. Coordination is accomplished by reviews conducted by the Department of Defense, through the exchange of technical reports, attendance at scientific meetings and conferences, and

Program Element: #6.27.46.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Tactical ADP Technology
Budget Activity: #1 - Technology Base

through the Joint Service Research and Development (R&D) Technology Panel to the Office of the Secretary of Defense (OSD) Management Steering Committee for Embedded Computer Resources.

H. (U) WORK PERFORMED BY: EG&G, Rockville, MD; General Research Corp., McLean, VA; Computer Sciences Corporation, Moorestown, NJ; Control Data Corporation, Minneapolis, MN; Softech, Inc., Waltham, MA; Teledyne Brown Engineering, Huntsville, AL; Higher Order Software, Inc., Cambridge, MA; Giordano Assoc., Sparta, NJ. Among the contracts to be awarded for FY82 will be those for training on the Software Development Support System and for improved CRM documents. In total, $4,902,000.00 in contracts will be awarded in FY82. In-house development is performed by the United States Army Communications Research and Development Command at Fort Monmouth, NJ, and the Army Communicative Technology Office at Fort Eustis, VA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: (For FY 1980 and prior, these programs were under Program Element 6.27.01.A, Department of the Army Project 1L162701AH92B).

1. (U) FY 1981 and Prior Accomplishments: The Military Computer Family (MCF) is an approach to effect standardization of the major hardware (computers and peripherals) and software (language, operating systems, tools, and products) components of battlefield automated systems. A contract was awarded for hardware system architecture design and support for the Military Computer Family (MCF). A new MCF system concept was developed, requirements were delineated, and a new high-speed computer-to-computer interface was developed. A life cycle cost model and logistics model have been completed for use by the MCF contractors during development. Army policy states that a common high order computer language, Ada, will be used for software development in all new battlefield automated systems beginning after January 1983. Currently internal as well as contractual efforts have been initiated to develop Ada and its related products and tools. Studies were initiated to prepare for transition of the Ada language to systems under development. Ada program design contracts were initiated to produce materials for the design of training courses for the Ada programing language and to verify the ease of programing using Ada. Two characteristically different battlefield automated systems are being modeled with the Ada language to exploit the major generic functions of the language and its role in Battlefield Automated System design. Participated with other services and NATO for computer resource management. A set of guidebooks defining the life cycle acquisition and maintenance of computer resources was developed along with policy documents regarding utilization and implementation of standard computer resources. A Computer Resource Management (CRM) training contract was awarded which will make use of the guidebooks. The Microprogramable Multiprocessor (MMP) is being enhanced to support activities relative to MCF system

Program Element: #6.27.46.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Tactical ADP Technology
Budget Activity: #1 - Technology Base

producibility, integration, and validation as well as to verify intrasystem communication efficiency. A secure interface capability between the Post-Deployment Software Support (PDSS) computer and remote sites using the Defense Advanced Research Projects Agency Network (ARPANET) communications was planned. An ARPANET Interface Processor was acquired to connect remote tactical equipment to the TDC. A contract was awarded to prepare a detailed Army Test Program Set (TPS) Software Development and Support Facility Plan which will address the problem of reducing the total developmental costs of TPS's. Awarded a contract to provide a pin electronics design for automatic switching of the test equipment interface to the unit under test to result in affordable, reliable, and compact testers. An investigation was initiated to determine the extent to which functional testing procedures for LSI and VLSI digital components can be automatically generated. Research was conducted with video discs to evaluate alternative technologies for potential military applications.

2. (U) FY 1982 Program: Documentation for the MCF life-cycle cost model and the logistics model will be completed. Exploratory developments in hardware system architecture for the MCF will continue along with fine-tuning of the Nebula instruction set architecture and use of MCF computers in distributed processing configurations. A project in realtime distributed processing in support of multiprocessor efficient and survivable configurations of MCF computers will be initiated. A contract will be awarded for investigations of the enhancements to Nebula for a future generation of MCF computers. A joint effort with the Electronics Research and Development Command (ERADCOM) will be initiated to increase the electroluminescent displays and investigate the feasibility of using the MCF single-board computer for an intelligent display/terminal. These results will be applied to the MCF peripherals program. The multiyear Ada language systems efforts will be continued to add to the integrated set of products and tools needed to support Ada and satisfy the needs of the automated tactical systems developers. An effort will be initiated to develop a prototype structured design diagrammer which will enhance ability to maintain operational software developed under other efforts. In the Teleprocessing Design Center (TDC), an interface between the MMP and tactical systems at other locations and between the PDSS computer and remote sites using AUTODIN II communications will be developed. In the TDC alternative computer, system architectures will be investigated which address battlefield survivability and computer security requirements. A contract to develop improved CRM documents and synthesis of requirements analysis techniques will be continued. The automated CRM data base will become operational. Test program set software tools for the Software Development and Support Facility will be developed. Hardware will be assembled to demonstrate Pin Electronics capability. The impact of distributed processing on instruction set architecture and hardware implementation will be investigated. Contracts will be awarded in the testing, software development and maintenance areas, and in investigations of distributed processing design methods for survivable, mobile battlefield automated systems. A commercial microprocessor-based distributed system will be acquired as a laboratory facility to

Program Element: #6.27.46.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Tactical ADP Technology
Budget Activity: #1 - Technology Base

develop a distributed operating system and conduct experiments using Ada. A situation reporting system will be the initial distributed system designed. Communicative technology efforts will include enhanced disk mastering and replication, voice technology integrated with video disk systems and analyses to develop preferred video disk storage architecture for a very high-speed, multiple-access archive.

3. (U) FY 1983 Planned Program: The multiyear Ada language systems efforts will be continued to add to the inventory of products and tools needed to support Ada and satisfy the needs of the battlefield automated system developers. Development of the MCF life-cycle cost model will be completed. Exploratory developments in hardware system architecture for the MCF will continue. A project in realtime distributed processing in support of multiprocessor efficient and survivable configurations of MCF computers will be initiated. The study of life-cycle support of battlefield automated systems will continue. Effort to identify the training needs for use of automated requirements development and analysis methodology will continue. Studies of the interaction between host and target systems will continue. Tactical computer peripherals will be advanced by using distributed techniques, improving human interfaces, and achieving compatibility of interfaces. Development of the Ada language system with its software support tools will include specific tools for maintenance purposes. To this end, the effort to develop a prototype-structured design diagrammer will continue. Development of test program set software tools for the Software Development and Support Facility will be continued. A contract for the development of new automatic microwave testing techniques will be continued. Demonstration of pin electronics capabilities will continue. In the area of communicative technology, work will be performed to understand appropriate ways in which information to be maintained in a locally accessed electronic archive should be recorded both for internal retention and network distribution.

4. (U) FY 1984 Planned Program: Continue product planning and control contractual efforts for the MCF life cycle cost model and analyses, advanced hardware system architecture, and realtime distributed processing configuration of MCF computers. A study to identify standard software tools and products to be exported to software support centers will be initiated. The host/target interaction studies will be expanded to include multiprocessor and microprocessor target systems. Packet switching concepts will be implemented, and intrasystem communication efficiency will be verified. In addition, contractual support efforts will be actively pursued in the areas of distributed terminal/peripheral system methodologies, microprocessor/microcomputer hardware/software/firmware trade-off techniques for terminals/peripherals, as well as advanced techniques relative to extended man/machine interactive methodologies for enhancements of advanced terminal technology. Emphasis will be placed on realistically evaluating the major benefits of distributed microprocessor systems versus centralized processing, and the trade-offs involved. It is planned to initiate a contractual effort to study and evaluate

Program Element: #6.27.46.A
DOD Mission Area: #521 - Electronic and Physical Sciences (ED)

Title: Tactical ADP Technology
Budget Activity: #1 - Technology Base

methodologies for achieving optimal design criteria relative to microprocessor-driven intelligent terminals and peripherals. A contract to develop improved CRM documents and synthesis of requirements analysis techniques will be continued. CRM requirements will continue to be analyzed, and the automated CRM data base will become operational. In the TDC, computer system architectures will be illustrated which address battlefield survivability and computer security requirements.

5. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.70.A
Title: Military Disease Hazards Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	16194	17115	24979	29805	Continuing	Not Applicable
A870	Risk Assessment of Military Disease Hazards	3067	3223	4849	5853	Continuing	Not Applicable
A871	Prevention of Military Disease Hazards	13127	13892	20130	23952	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Military disease hazards technology is the core Army program for exploration of strategies which will lead to control of parasitic, bacterial, rickettsial, and viral diseases of military importance and development of an effective medical defense against biological weapons. The program fulfills a need for development of a system of vaccines and drugs for protection against biological warfare (BW) agents and diseases affecting worldwide deployment of troops.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: FY 1983 will see an expanded research effort in development of vaccines, drugs and antitoxins against diseases and toxins of potential BW importance. A major emphasis will be on developing a system of tests for rapid field identification and diagnosis of BW agents and/or diseases. In addition, previously described multiyear efforts will be continued.

Program Element: #6.27.70.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Military Disease Hazards Technology
Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	16194*	17115**	24979***	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	16140	17156	19227	Continuing	Not Applicable

* Increase of $54,000 in the FY 1981 funding level is a result of reprograming to enhance exploratory development of drugs.

** The funding decrease of $51,000 in FY 1982 is a result of repricing the budget based upon decreased inflation factors.

*** The increase in funding for FY 1983 is due to the expansion of the Chemical Warfare/Chemical and Biological Defense (CW/CBD) Research Expansion Program and to the consolidation of the Army and Navy infectious disease research programs as directed by Congress in the FY 1982 Approriations Bill.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.27.70.A
Title: Military Disease Hazards Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program element is designed to exploit promising technology developed from the science base of the Army medical research and development effort; it permits thorough and more detailed experimentation and investigation to proceed on projects that lead toward fielding of vaccines, drugs, repellents, adjuvants, and diagnostic procedures. For example, in vaccine development, activities conducted in this program element include development of experimental animal models for specific diseases, preparation of immunizing materials, and tests for antigenicity and immunogenicity in small animals. In drug development, experiments are designed to identify compounds with specific therapeutic activity and then to conduct a primary screen of these compounds for activity. Major emphasis is placed on those diseases which history has shown to have serious impact on troops operating in the field, e.g., malaria, leishmaniasis, scrub typhus, diarrhea, and dengue. In addition, high hazard diseases which have potential BW importance are investigated, e.g., botulism, Ebola, Marburg, Lassa, anthrax, Q fever, and various hemorrhagic fevers.

G. (U) RELATED ACTIVITIES: This program element is an integral part of the Army medical research and development effort. It bridges the science base in Program Element 6.11.02.A, Project BS10 (Research on Military Disease, Injury, and Health Hazards) and the production of items in Program Element 6.37.50.A, Project D808 (Drug and Vaccine Development). Overall review and control of DOD's medical research was brought under centralized management in FY 1981 by the formation of the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee. Joint Technology Coordinating Groups (JTCG) were established in various disciplines to insure effective management at the investigative level. Two JTCG review research within the Army's Military Disease Hazards Research Program. They are the JTCG for Infectious Diseases of Military Relevance (JTCG/IDMR) and the JTCG for Medical Biological Warfare Defense (JTCG/MBWD). Each JTCG has representatives from each of the three services. The mission of each JTCG has been established; it is to: (1) assess and prioritize disease threats, recommend research efforts to counter identified threats, and analyze the resources available to meet these research requirements; (2) recommend interservice distribution of responsibility for program execution, changes in program direction or emphasis, new initiatives, and other matters dealing with program requirements and relevance; and (3) review and coordinate disease research and development programs. Duplication of effort is avoided. The World Health Organization (WHO) serves as the de facto international clearinghouse for medical information; Army scientists serve as consultants to WHO and have ready access to its studies, reports, and publications. In addition, other coordination is accomplished through routine means, such as exchange of reports among staff and laboratory organizations, site visits by project officers, scheduling of technical symposia on selected topics, etc.

Program Element: #6.27.70.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Military Disease Hazards Technology
Budget Activity: #1 - Technology Base

H. (U) WORK PERFORMED BY: Approximately 72% of the research is performed by in-house laboratories at the Walter Reed Army Institute of Research, Washington, DC, and field units in Thailand, Malaysia, Brazil, and Kenya; the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, Frederick, MD; the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Frederick, MD; and the Letterman Army Institute of Research, Presidio of San Francisco, CA. The remaining research is conducted under contracts with nonprofit organizations, universities, and industries. The five major contracts are those with the Institute for Medical Research, Kuala Lumpur, Malaysia; University of Miami, Miami, FL; Hazleton Laboratories America, Inc., Vienna, VA; the Smithsonian Institution, Washington, DC; and the National Research Council, Washington, DC. The Naval Medical Research Institute, Bethesda, MD, and Naval units in Egypt, Indonesia, and the Philippines conduct infectious disease research under Army program management. Forty other contractors are funded in the amount of $2,721,902.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Accomplishments in research against potential BW agents include the following: development of an antitoxin against botulism type E was enhanced by a new system to produce high titers of botulism type E; a cellular component derived from a virulent Philadelphia strain of Legionella (the causative organism of Legionnaire's disease) was demonstrated to be an effective immunogen for mice; living experimental vaccines prepared from naturally attenuated strains of Lassa fever virus immunized and protected both guinea pigs and monkeys to virulent viral challenge; the standard Rift Valley fever vaccine failed to protect rats against an aerosol dose of virus (this is significant due to the likelihood that any BW agents that might be employed against our troops will be an aerosol); a totally synthetic medium was developed for a strain of Bacillus anthracis, the causative organism of anthrax. Among the classical communicable diseases, those which historically have caused mortality and morbidity in combat troops, the following advances are noted: monoclonal antibodies were used to screen and identify protective merozoite antigens, an important step in developing new antimalarial drugs; the principal vector of malaria in Southeast Asia was recognized as a species complex, a finding which may impact on control programs and epidemiological investigations; a new culture system was developed to support drug development efforts against leishmaniasis (kala azar or Oriental sore).

2. (U) FY 1982-FY 1984 Program: In BW defense research, the screening of new antiviral drugs will continue with testing directed against high hazard viruses. Each of the seven botulinum toxins will be made into vaccines and tested in animal systems. Tests for rapid identification and diagnosis for a wide range of BW agents and/or diseases will be developed;

Program Element: #6.27.70.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Military Disease Hazards Technology
Budget Activity: #1 - Technology Base

it is expected that this effort will be largely contractual. In infectious disease research, a candidate drug effective against drug resistant strains of malaria will be identified and the preclinical testing initiated. Other antimalarial drugs showing promise in screening will be tested in nonhuman primates. Exploratory development of candidate malaria vaccines will continue. Vaccines for two serotypes of dengue will be administered to primates for efficacy and safety determinations. The formulation of candidate vaccines against African trypanosomiasis (sleeping sickness) will be developed in model systems. Scrub typhus vaccines will be evaluated for safety, immunogenicity, and protection in nonhuman primates.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A871
Program Element: #6.27.70.A
DOD Mission Area: #522 - Environmental & Life Sciences (ED)

Title: Prevention of Military Disease Hazards
Title: Military Disease Hazards Technology
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This project is designed to develop technology for prevention and treatment of infectious diseases of military importance. Emphasis is placed on serious diseases which have occurred repeatedly as epidemics during mobilization and deployment of military forces. Studies are conducted on a range of parasitic, bacterial, rickettsial, and viral diseases. Research on disease vectors and their control is an integral part of this effort. In addition, this project includes tasks which are designed to develop an effective medical defense against known and potential biological weapons. Priority is placed on designing methods and procedures to identify the occurrence of a biological attack and determine the etiologic agent in the shortest period of time.

B. (U) RELATED ACTIVITIES: Project A871 is the chief project in Program Element 6.27.70.A. It is closely allied to Project A870, Disease Risk Assessment to Troop Operations and Mobilization, also in Program Element 6.27.70.A. Together these projects link the science base in Program Element 6.11.02.A, Project BS10 (Research on Military Disease, Injury and Health Hazards) and the production of items in Program Element 6.37.50.A, Project D808 (Drug and Vaccine Development). Overall review and control of DOD's medical research was brought under centralized management in FY 1981 by the formation of the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee.

C. (U) WORK PERFORMED BY: Approximately 73 percent of the research is performed by in-house laboratories at Walter Reed Army Institute of Research, Washington, DC, and field units in Thailand, Malaysia, Brazil, and Kenya; the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, Frederick, MD; the US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Frederick, MD; and the Letterman Army Institute of Research, Presidio of San Francisco, CA. Approximately 27 percent of the research is conducted under contract with nonprofit organizations, universities, and industries. The five major contracts are those with the Institute for Medical Research, Kuala Lumpur, Malaysia; University of Miami, Miami, FL; Hazleton Laboratories America, Inc., Vienna, VA; Gorgas Memorial Institute, Balboa Heights, Panama; and the National Research Council, Washington, DC. This last organization administers the US Army Medical Research and Development Command's Associate Program which allows qualified young scientists to work in Army medical research laboratories as full-time investigators. Thirty-one other contractors are funded in the amount of $2,212,382. Elements of Naval Medical Research and Development Command participate under Army lead.

Project: #A871 Title: Prevention of Military Disease Hazards
Program Element: #6.27.70.A Title: Military Disease Hazards Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The standard Rift Valley fever vaccine (developed at the US Army Medical Research Institute of Infectious Diseases) failed to protect rats against an aerosol dose of virus; the vaccine consistently has been effective for intraperitoneal challenges; this funding is significant due to the likelihood that any biological warfare (BW) agent that might be employed against our troops will be an aerosol. The cynomolgus monkey was demonstrated to be a useful model for the study of botulism. Development of an antitoxin agent against botulism type E was enhanced by a new system to produce high titers of botulism type E. Experimental live vaccines prepared from naturally attenuated strains of Lassa fever virus immunized and protected both guinea pigs and monkeys against virulent viral challenge. A totally synthetic medium was developed for the V770 strain of bacillus anthracis, the causative organism of anthrax. Monoclonal antibodies were used to screen and identify protective antigens for malaria. A new culture system was developed to support drug development efforts against Leishmaniasis (kala azar or oriental sore).

2. (U) FY 1982 to FY 1984 Program: In BW defense research, the screening of new antiviral drugs will continue with testing directed against high hazard viruses. Each of the seven botulinum toxins will be made into vaccines and tested in animal systems. Tests for rapid identification and diagnosis of a wide range of BW agents and/or diseases will be developed; it is expected that this effort will be largely contractual. In infectious disease research, a candidate drug effective against drug-resistant strains of malaria will be identified and the preclinical testing initiated. Other antimalarial drugs showing promise in screening will be tested in nonhuman primates. Exploratory development of candidate malaria vaccines will continue. Vaccines for two serotypes of dengue will be administered to primates for efficacy and safety determinations. The formulation of candidate vaccines against African trypanosomiasis (sleeping sickness) will be developed in model systems. Scrub typhus vaccines will be evaluated for safety, immunogenicity, and protection in nonhuman primates. Navy investigators will continue studies of rapid diagnosis and treatment of diarrheal disease.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

Project: #A871 Title: Prevention of Military Disease Hazards
Program Element: #6.27.70.A Title: Military Disease Hazards Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

5. (U) Resources ($ in Thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	13127*	13892**	20130***	23952	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	12725	13925	15605	-	Continuing	Not Applicable

* The increase in funding for FY 1981 is a result of reprograming to higher priority Army requirements.

** The decrease in funding for FY 1982 is a result of repricing the budget based upon decreased inflation factors.
*** The increase in funding for FY 1983 is due to the expansion of Chemical Warfare/Chemical and Biological Defense (CW/CBD) research and to the consolidation of the Army and Navy infectious disease research programs as directed by Congress in the 1982 Appropriations Bill.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical Area: #01 Title: Prevention of Diseases Affecting Troop Operations and Mobilization

Project: #A871 Title: Prevention of Military Disease Hazards

Program Element: #6.27.70.A Title: Military Disease Hazards Technology

DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This technical area provides the basis for formulation, advanced development, production, and testing of drugs, vaccines, and other biological means to protect against infectious diseases. Research is aimed at preventing diseases in order to minimize impacts on training and mobilization for military operations throughout the world. Recent emphasis has been placed on assisting the Rapid Deployment Force (RDF); the best possible preventive medicine is included in operational plans for the RDF so that its mission will not be compromised by sickness.

B. (U) RELATED ACTIVITIES: Related Army studies are conducted under the other two technical areas in this project: 02, Prevention of Biological Warfare Diseases; and 03, Vector Control. All work is related to research performed under Program Element 6.11.02.A, Project BS10 (Research on Military Disease, Injury, and Health Hazards); and Program Element 6.37.50.A, Project D808 (Drug and Vaccine Development). Overall review and control of the Department of Defense's (DOD) medical research was brought under centralized management in FY 1981 by the formation of the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee. Liaison is also maintained with the Uniformed Services University of the Health Sciences and other government agencies.

C. (U) WORK PERFORMED BY: Approximately 46 percent of the work is conducted at Walter Reed Army Institute of Research, Washington, DC, and field units in Brazil, Kenya, Malaysia, and Thailand. Approximately 54 percent of the research is conducted under contracts with nonprofit organizations, universities, and industries. The five major contracts are those with the Institute for Medical Research, Kuala Lumpur, Malaysia; the University of Miami, Miami, FL; Hazleton Laboratories America, Inc., Vienna, VA; Gorgas Memorial Institute, Balboa Heights, Panama; and the University of Georgia, Athens, GA. Twenty four other contractors are funded in the amount of $1,723,995.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Monoclonal antibodies were used to screen and identify protective antigens for malaria. A new culture system was developed to support drug development efforts against leishmaniasis (kala azar or oriental sore). Treatment of leishmaniasis was shown to be enhanced markedly in animal models by the use of encapsulated

Technical Area: #01 Title: Prevention of Diseases Affecting Troop Operations and Mobilization

Project: #A871 Title: Prevention of Military Disease Hazards

Program Element: #6.27.70.A Title: Military Disease Hazards Technology

DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

drugs. A compound was identified that will protect mice against induced trypanosomiasis (sleeping sickness) following the administration of a single dose of this drug.

2. (U) FY 1982 to FY 1984 Program: A candidate drug effective against drug resistant strains of malaria will be identified and preclinical testing initiated. Other antimalarial drugs showing promise in screening will be tested in non-human primates. Exploratory development of candidate malaria vaccines will continue. Vaccines for two serotypes of dengue will be administered to primates for efficacy and safety determinations. The formulation of candidate vaccines against trypanosomiasis will be developed in model systems. Scrub typhus vaccines will be evaluated for safety, immunogenicity, and protection in nonhuman primates. Encapsulated drug delivery systems will be applied to parasitic diseases other than leishmaniasis. Personnel to be utilized: 24 professional and 44 support.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	5120	5526	9220	10595	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4963	5431	6086	-	Continuing	Not Applicable

The increase of $157 thousand in the FY 1981 funding level is a result of reprograming to provide for development of new drugs. The funding increase of 95 thousand in FY 1982 is a result of the amended budget request and the application of revised inflation and civilian pay pricing indices. The increase in FY 1983 funds is due to the consolidation of the Army and Navy infectious disease research programs as directed by Congress in the FY 1982 Appropriations Bill.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Technical Area: 02
Project: A871
Program Element: 6.27.70.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Prevention of Biological Warfare Diseases
Title: Prevention of Military Disease Hazards
Title: Military Disease Hazards Technology
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This technical area provides the basis for formulation, advanced development, production, and testing of drugs, vaccines, and other biological means of protection against potential biological agents. Data are utilized to formulate a comprehensive medical approach for prevention and treatment of biological warfare (BW) casualties.

B. (U) RELATED ACTIVITIES: Related Army studies are conducted under the other two technical areas in this project: 01, Prevention of Diseases Affecting Troop Operations and Mobilization, and 03, Vector Control. All of this work is related to research performed under Program Element 6.11.02.A, Project BS10 (Research on Military Disease, Injury, and Health Hazards) and Program Element 6.37.70.A, Project D808 (Drug and Vaccine Development). Overall review and control of the Department of Defense (DOD) medical research was brought under centralized management in FY 1981 by the formation of the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee. Coordination is also maintained with the Uniformed Services University of the Health Sciences and other government agencies.

C. (U) WORK PERFORMED BY: Approximately 88 percent of the research is performed by the US Army Medical Research Institute of Infectious Diseases, Fort Detrick, Frederick, MD. The remaining 12 percent of the work is conducted under contract with nonprofit organizations and universities. The top five contracts are with the National Research Council, Washington, DC; Brigham Young University, Provo, UT; Korea University, Seoul, Korea; University of California, Irvine, CA; and the Michigan Department of Public Health, Lansing, MI. Two other contractors are funded in the amount of $18,887.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Type E botulism was cultured in a fermenter system for the first time. The cynomolgus monkey was demonstrated to be a useful model for the study of botulism. Experimental live vaccines prepared from naturally attenuated strains of Lassa fever virus immunized and protected both guinea pigs and monkeys from virulent viral challenge. A totally synthetic medium was developed for a strain of the bacterium that causes anthrax. The attenuated strain of Junin virus (the virulent strains of which cause Argentinean hemorrhagic fever) was found to protect monkeys and rodents against both the Argentinean and Bolivian forms of hemorrhagic fever.

Technical Area: 02
Project: A871
Program Element: 6.27.70.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Prevention of Biological Warfare Diseases
Title: Prevention of Military Disease Hazards
Title: Military Disease Hazards Technology
Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Program: In BW defense research, the screening of new antiviral drugs will continue with testing directed against high hazard viruses. Preparation of an experimental vaccine for Korean hemorrhagic fever will be undertaken. Each of the seven botulinum toxins will be made into vaccines and tested in animal systems. Animal models for Ebola virus will be developed as a prerequisite to safety and efficacy testing of a potential vaccine. Tests for rapid identification and diagnosis for a wide range of BW agents and/or diseases will be developed; it is expected that this effort will be largely contractual.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	7482*	8076**	10261***	11800	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	7253	7937	8895	-	Continuing	Not Applicable

* Increase of $229,000 in the FY 1981 funding level is a result of reprograming to enhance medical means of protection against potential biological agents.

** The funding increase of $139,000 in FY 1982 is a result of the amended budget request and the application of revised inflation and civilian pay pricing indices.

*** The increase in funding for FY 1983 is due to the expansion of the Chemical Warfare/Chemical and Bological Defense (CW/CBD) Research Expansion Program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.72.A
Title: Combat Casualty Treatment Technology
DOD Mission Area: #522 - Environmental and Life Sciences (RD)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6353	6749	6682	8486	Continuing	Not Applicable
A874	Care of the Combat Casualty	6353	6749	6682	8486	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is the core Army exploratory development to improve methods of treatment and management of battlefield casualties from conventional and nonconventional weapons. This technology must be revised to keep pace with the increased capability of newly developed weapons to inflict wounds of greater numbers and severity. Casualties returned to duty represent a major source of individual replacements in combat; research in this program addresses casualty treatment methods to improve the rate of return to duty, decrease resource utilization, and decrease mortality and morbidity.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: These funds will be directed toward research for improved treatment of battlefield casualties. Thrusts will be undertaken to improve fluids administered for replacement of blood volume and prevention and treatment of infection associated with injury. The improvement of understanding and ability to influence wound healing, the improvement of techniques and agents for anesthesia in combat casualties and improved medical materiel are other thrusts. Previously described multiyear efforts will be continued.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

Program Element: #6.27.72.A
Title: Combat Casualty Treatment Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED)
Budget Activity: #1 - Technology Base

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	6353	6749	6682	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6351	6764	7585	Continuing	Not Applicable

The increase of two thousand dollars in FY 1981 is a result of revised inflation and civilian pay pricing indices. The decrease in FY82 is a result of budget repricing. The decrease in funding of $903K in FY 1983 is a result of technology base reprioritization by the Deputy Chief of Staff for Research, Development and Acquisition.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.27.72.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Combat Casualty Treatment Technology
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program element is directed toward development of methods which reduce medical manpower, supply, and equipment needs in order to more rapidly return casualties to duty and reduce mortality and disability. These goals will be met by development of new casualty localization, far forward resuscitation, stabilization, evacuation, and definitive treatment techniques, and by development of simplified and refined field-storable medical supplies and equipment. No such research requirement or counterpart situation exists outside the military. Specific efforts include methods to improve casualty survival by development of new blood substitutes to carry oxygen to the body, new drugs to combat shock and infection, development of techniques for assessment and management of high-velocity, laser, and blast overpressure injuries and development of innovative modern field medical materiel.

G. (U) RELATED ACTIVITIES: This program contains, in part, items and systems that will progress to advanced and engineering development in related Program Element 6.37.32.A, Combat Medical Materiel, and Program Element 6.47.17.A, General Combat Support, respectively; related science bases in physiology, biochemistry, physics, pharmacology, microbiology, chemistry, toxicology, pathology, and neurological sciences are provided under Program Element 6.11.02A/Project BS10, Research on Military Diseases, Injury and Health Hazards. Coordination effected with the Navy, Air Force, Uniformed Service UHS, NIH and with other federal agencies, and the Armed Services Biomedical Research Evaluation and Management (ASBREM) committees insures relevance and prevents duplication of effort in all aspects of field casualty care.

H. (U) WORK PERFORMED BY: Approximately 60% of the work is performed in-house at the Letterman Army Institute of Research (LAIR), Presidio of San Francisco, CA; the US Army Medical Bioengineering Research and Development Laboratory (USAMBRDL), Fort Detrick, Frederick, MD; Institute of Surgical Research (ISR), Ft Sam Houston, TX; and Walter Reed Army Institute of Research (WRAIR), Washington, DC. Major extramural contracts are with University of California, San Diego, CA; Yale University, New Haven, CT; and Queens Hospital Center, Honolulu, HI. A total of 24 other contracts are supported at a dollar value of $1,706,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Clinical trials of an improved blood preservation system Citrate Phosphate Dextrose Adenine 2 (CPDA 2) to extend military field storage blood time to 42 days were completed. Advanced studies on modified stroma-free hemoglobin, a blood substitute, were performed. The only large animal whole-body metabolic chamber in the USA to enable metabolic studies of burn wounds was constructed and employed. Initial evaluation of several antishock drugs and methods was completed. A high-velocity missile laboratory was completed and studies initiated. Development was initiated for equipment to monitor the high-noise, high-vibration environment of tactical ambulances and for a wheeled field

Program Element: #6.27.72.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Combat Casualty Treatment Technology
Budget Activity: #1 - Technology Base

gurney. Continuing projects are the tactical ambulance adaptation study, selection of a replacement field medical refrigerator, development of a method in teleradiography imaging techniques, developments of a system for onsite medical gas generation, and development of containers for protection of delicate commercial equipment procured for field use.

2. (U) FY 1982 to FY 1984 Program: Present CPDA 2 data to Bureau of Biologicals for approval for commercial use. Blood substitute and additive research to ultimately replace need for whole blood in far forward treatment visits will be continued. Further studies of burn injury, high-velocity missile wounds, nonocular laser injuries, and blast overpressure injuries with emphasis on infection, skin substitutes, augmented wound healing, neuroendocrine responses, and burn inhalation injuries will be undertaken. Shock/antishock investigations pointed specifically to field use will proceed. It is anticipated that this program element will incorporate and fund studies for improved treatment of psychiatric battle casualties from Program Element #6.27.77.A, System Health Hazard Prevention Technology Soldier Effectiveness, DA Project #A879, Medical Factors Limiting Soldier Effectiveness, in FY 1983. Developmental testing of a prototype teleradiography imaging X-ray system will begin. The tactical ambulance adaptation study will continue. The collection and computerization of lists of medical items requiring protective containers continue for the development of packaging requirements for field medical materiel. Drawings of a small family of these containers will be furnished to Review Meetings for type classification and entry into the system. Field anesthesia equipment upgrading will commence. Developmental criteria and exploratory development of onsite oxygen-generating systems and onsite sterile water-generating systems will be converted to prototype models. Field medical materiel will continue to be developed and refined as new technology becomes available.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.75.A
Title: Combat Maxillofacial Injury
DOD Mission Area: #522 - Environmental & Life Sciences (ED)
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	615	1473	2619	3044	Continuing	Not Applicable
A825	Combat Maxillofacial Injury	615	1473	2619	3044	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element is the core Department of Defense technology base to develop methods and materials for prevention, treatment, and management of combat maxillofacial injuries. Included is the development of materials and equipment required to provide essential dental treatment in the combat environment.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Major new thrusts are: evaluation of the feasibility of incorporating therapeutic agents for control of infection and pain, improvement of bone repair into absorbable materials being developed to treat maxillofacial wounds, and field dental equipment development. To be continued are previously described Army multiyear efforts and Navy efforts pertaining to maxillofacial injury and combat dentistry.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	615	1473	2619	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	610	1476	1653	Continuing	Not Applicable

Program Element: #6.27.75.A Title: Combat Maxillofacial Injury
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

The funding increase of $5 thousand in FY 1981 is a result of the application of revised inflation and civilian pay pricing indices. The funding decrease of $3 thousand in FY82 is a result of budget repricing. The funding net increase of $974 thousand in FY 1983 is the result of: decrease of $224 thousand as a result of reprograming to higher priority Army requirements and increase of $1.2 million to maintain Navy programs as a result of Congressionally directed change in FY 1982 designating Army as the lead agency.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.27.75.A Title: Combat Maxillofacial Injury
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The rate of head and neck wounds increased steadily from World War II to reach 51 percent in Vietnam. In addition, those killed in action by wounds related to this area increased from 25 to 47 percent. Combat wounds to the face and neck are among the most catastrophic and difficult to treat, presenting unique and complex therapeutic problems requiring highly specialized management. In combat, most of these injuries are treated by dentists. Despite intensive predeployment treatment during Vietnam, 8 to 14 percent of troops in the field at any given time required dental treatment to return them to combat duty. This program will improve management of maxillofacial injuries and provide more effective dental treatment in combat. Major concerns are: (1) protection of the maxillofacial area; (2) development of new/improved materials and methods for rapid, simplified treatment of maxillofacial wounds; and (3) development of methods, materials, and equipment to provide dental treatment in the field.

G. (U) RELATED ACTIVITIES: Related basic research efforts are conducted under Program Element 6.11.02.A/BS10, Research on Military Disease, Injury, and Health Hazards. The Army is the lead agency for research on combat maxillofacial injury and combat dentistry and coordinates Army and Navy efforts in these subjects. No other agency with the Department of Defense conducts research on these subjects. Coordination is achieved with the National Institute of Dental Research and National Advisory Dental Research Council by the Army Research Area Manager.

H. (U) WORK PERFORMED BY: In-house developing organizations are the US Army Institute of Dental Research, Washington, DC; and the Navy Medical Research and Development Command, Bethesda, MD. The principal contractors are: Battelle Memorial Institute, Columbus, OH; Biotek, Inc., Wilmington, MA; Southern Research Institute, Birmingham, AL; and the University of Connecticut, Farmington, CT.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A simple, lightweight, plastic shield provided significant protection from facial wounds caused by small fragments. Computer modeling was used to predict the extent of maxillofacial damage from high-velocity missiles. Two antibiotics, Ampicillin and Gentimacin, were successfully prepared in extended release formulations to provide long-term, single-dose treatment to decrease infection in maxillofacial wounds. High-pressure oxygen therapy demonstrated a reduction in maxillofacial infections. The efficacy of freeze-dried bone grafts for treatment of maxillofacial bone-loss wounds was demonstrated. A partially absorbabic implant device was effective in stabilizing lower jaw fractures. A material was developed for facial soft-tissue surgery. An analgesic incorporated into a wound dressing material was evaluated in animals. Drugs for control of inflammation, pain and infection were experimentally incorporated into a temporary dental filling material for use in the field.

Program Element: #6.27.75.A
DOD Mission Area: #522 - Environmental & Life
Title: Combat Maxillofacial Injury
Budget Activity: #1 - Technology Base

2. (U) FY 1982-FY 1984 Program: A maxillofacial casualty long-term reconstruction study and evaluation of high pressure oxygen therapy for control of maxillofacial wound infections will be completed. Approaches to increase protection of the face and neck in combat will continue. Absorbable materials developed for combat maxillofacial wound and hollow-organ repair will continue to be evaluated. New designs of absorbable ceramic to replace lost maxillofacial bone will be investigated in animals. Evaluation of freeze-dried and vascular/cortial bone grafts and microsurgical techniques for repair of maxillofacial wounds will continue. New moldable, absorbable materials will be studied for stabilizing maxillofacial wound defects. Permanent implants to repair fractures and lost teeth will continue in human tests. Methods of modifying the bone-healing process in maxillofacial wounds will be evaluated. Topical enzyme preparations with concurrent electric stimulation to enhance maxillofacial wound-healing will be evaluated. Tissue glue will be investigated for its potential in treating maxillofacial wounds. Development of new dental filling materials for rapid, simple field use will continue. Experimental prototypes of highly mobile, miniaturized field equipment will be developed. Studies will begin on incorporating bone-forming, antibiotic, and analgesic agents into absorbable materials being developed to treat maxillofacial wounds. Development of penetrating analgesics which can be applied directly to tooth or bone surfaces will be initiated. Personnel to be utilized: 25 professional and 52 support. Navy studies of methods to enhance maxillofacial wound healing will continue under Army program management.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	12545	13963	18066	21385	Continuing	Not Applicable
A878	Health Hazards of Military Materiel	6399	7327	11456	13516	Continuing	Not Applicable
A879	Factors Limiting Soldier Effectiveness	6146	6636	6610	7869	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is the core Army Technology Base to define the impact of high-technology weapon systems and other materiel and extreme climates or environments upon the health and performance of soldiers during rapid deployment and sustained operations and to protect the health of civilian workers engaged in the production of militarily unique chemical compounds. The principal efforts of this research are to furnish useful data and information required by Army planners and developers to produce combat-effective soldier/machine combinations, and provide medical information necessary to determine exposure and design standards to protect the health of employees at Army production facilities.

C. (U) BASIS FOR THE FY 1983 RDTE REQUEST: Funding of the 1983 program is requested to provide essential information for protecting soldiers and DA civilian employees from the health hazards incurred during production and use of military materiel. Emphasis is placed on quantifying and preventing the health hazards due to blast overpressure, noise, vibration, electromagnetic radiation, toxic chemicals, and climatic extenes associated with military operations; quantifying and preventing neuropsychiatric problems associated with rapid deployment, sustained operations, and all other facets of military life and operations affecting the readiness and capability of Army personnel; and providing occupational safe exposure criteria for the protection of civilian employees in Army munitions plants and contributing to the cost effective design of such plants.

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	12545	13963	18066	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	12209	15529	20812	Continuing	Not Applicable

Increase of $336 thousand in the FY 1981 funding level is a result of reprograming to initiate an additional program on physical fitness. Decrease in funding in FY 1982 is the result of a Congressional budget change. Reductions in funding in FY 1983 are the result of reprograming to higher priority Army requirements.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Current and developing doctrine and materiel generate conditions, apart from the dangers of combat, which are hazardous to the health of Army military and civilian personnel, in addition to making additional physical and mental performance demands upon soldiers. High-technology weapons systems generate blast overpressures great enough to destroy hearing or cause lung collapse of crewmembers. Accepted scenarios of future conflicts assume a high probability of deployment of laser devices and systems in both antimateriel and antipersonnel modes, and the increasing use of laser technologies in combat training increase the probability of ocular injuries. The development of armored vehicles of greater size, speed, and firepower results in concomitant increases in noise, vibration impact damage, and toxic gas exposure to crewmembers. Research in this program element provides the data necessary to enable military planners and materiel developers to assess the magnitude of hazards and develop safe design criteria protecting the health of soldiers and civilian employees. Specific research areas include: auditory and nonauditory effects of blast overpressure; noise and vibration hazards of Army combat vehicles; the effects produced by clothing ensembles and crew compartments upon performance and the ability to sustain it; requirements for life support systems within crew compartments; impact biodynamics of crashworthiness and personnel armor; the effects of lasers of various wavelengths on the skin and eyes; the bioeffects of millimeter and microwave exposures; the effects of toxic chemical and gas exposures on Army munition plant workers, soldiers utilizing smokes and obscurants, occupants of armor vehicle crew compartments, soldiers drinking field water supplies contaminated with normally occurring pathogens and trace minerals, with chemicals discharged during normal industrial operations or as a result of destruction during combat, and with chemical and biological warfare agents; the neuropsychiatric effects of rapid deployment, sustained operations, and general stresses of military life on soldier performance; the effects of climatic extremes such as heat, cold, and high terrestrial altitude on the soldiers ability to deploy and perform under sustained operations; the physical requirements associated with selection of personnel to perform Army military occupational specialty-related tasks; and the effects of various types of sensory enhancement devices on military operations.

G. (U) RELATED ACTIVITIES: Toxic chemical hazard assessment is complemented by Program Element 6.11.02/BS04, Identification and Health Effects of Military Pollutants, and 6.27.20.A/835, Military Medical Environmental Quality. Basic science research is performed under Program Element 6.11.02.A/BS10, Research on Military Disease, Injury and Health Hazards. Technology transfer, research coordination and collaboration, and duplication of effort is avoided through intra-Army and tri-Service agreements, regulations, and informal meetings.

H. (U) WORK PERFORMED BY: Approximately two-thirds of the research within this program is performed in-house, and the remaining one-third is conducted under contract. In-house research is performed by the US Army Aeromedical Research Laboratory, Fort Rucker, AL; Letterman Army Institute of Research, Presidio of San Francisco, CA; Walter Reed Army Institute of Research, Washington, DC; US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Frederick,

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

MD; US Army Research Institute of Environmental Medicine, Natick, MA. The top five contractors include: Oak Ridge National Laboratory, Oak Ridge, TN; USEPA Health Effects Research Laboratory, Research Triangle Park, NC; Georgia Technical Research Institute, Atlanta, GA; GTE Products Corporation, Needham, MA; and University of Massachusetts, Amherst, MA. In FY 1981, $1,486,148 was provided to 37 additional contractors to conduct research in this program.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: An assessment of the systemic effects of experimental animals exposed to blast overpressure from the M198 howitzer was completed, as were human risk assessments for exposure to the M198 and the VIPER antitank weapon. The effects of Army combat vehicle vibration on muscle physiology, neck muscle stress, static and dynamic visual acuity, and cardiopulmonary mechanics were investigated. Collaborative studies were conducted on auxiliary cooling systems to minimize heat stress in hot vehicular environments and to evaluate their effect on crew performance. Insulation and permeability values of various types of cold weather and water immersion clothing, sleeping systems, and footwear were determined. Health hazard problem definition studies were conducted on major smokes and obscurants and health hazard assessments determined for inventory smoke munitions. Research needs were identified for the high concentrations of various toxic gases that accumulate in weapon system crew compartments. A comprehensive problem definition study was completed on field water supply and sanitation to determine doctrinal needs and health protection criteria for field soldiers exposed to toxic contaminants, biological pathogens, radiological substances, and associated chemical agent hazards. Field studies were conducted to determine the relationship of health status to deployment and combat readiness. Followup studies on various factors affecting the health and performance of women in the Army were initiated. The effect of fatigue, crew work/rest schedules, and extended flight operations upon aviator performance was assessed to recommend optimal aviator-to-aircraft staffing ratios. Equipment and procedures were developed and validated for Army physical fitness training and testing programs, medical screening for personnel over the age of 40, and physical profiling of enlistees at Armed Forces Entrance and Examination Stations. Methods were developed to reduce the symptoms of acute mountain sickness and to define the mechanisms of high terrestrial altitude acclimatization. Various types of invasive and noninvasive procedures were developed to prevent or reduce heat injury and death.

2. (U) FY 1982-FY 1984 Program: Research efforts will continue to investigate the systemic and auditory effects of blast overpressure from artillery weapon systems. Physiological responses of an individual under solar heat loads will be evaluated in relation to ambient temperature, wind, clothing ensembles, age, and sex. The interactive effects of cold exposure, physical activity, and high terrestrial altitude will be assessed. Studies to determine the performance degradations and neuropsychiatric casualties that occur as a function of rapid deployment, translocation, and sustained combat training exercises will continue. Studies will be continued to determine optimal auxilary cooling systems to reduce heat stress for

Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

crewmen in combat vehicle compartments. The biophysics and bioeffects attributable to nonionizing radiation (millimeter and microwaves) under laboratory conditions which simulate operational exposures will be analyzed. Heat stress and performance data will be assessed on soldiers wearing chemical warfare-protective suits while conducting military training exercises. Methods to assess hearing protection in the field will be developed and hearing protection requirements established for each developmental combat vehicle system in the inventory. Studies to determine the health hazards of new generation lasers will be initiated. The development of methodology to define the mechanisms involved in cold injury and heat illness will continue. The effects of Army combat vehicle vibration on operator fatigue and performance will be identified. A toxicologic data base will be developed for chemicals associated with binary munition phase I facilities. An epidemiological study of munitions plant workers exposed to explosives that may be potential carcinogens will be conducted. Methods will be developed to improve hearing protection without compromising voice communication in the Army field environment. Development of training programs to enhance the physical fitness and performance of soldiers engaged in military operations will continue. Medical screening procedures will be developed to detect individuals at risk of cardiovascular disease prior to participating in physical training programs. To enhance the ability of soldiers to perform in extreme environmental conditions, therapeutic agents and methods will be developed to reduce or prevent cold injury and heat illness.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: A878 Title: Health Hazards of Military Materiel
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The purpose of this Army exploratory development program is to determine and define human health threats that are: (a) built into weapon systems, (b) caused by or accompany military operations, (c) generated during combat training, (d) inherent to the microenvironment of combat vehicles and clothing, and (e) produced by Army industrial operations. Specific research areas include: determining the effects of noise and vibration in combat vehicles on the health and performance of crewmembers; evaluating thermal stress, military effectiveness, and tolerance limitations on soldiers operating in microenvironments created by military clothing ensembles and vehicle crew compartments; determining human auditory and nonauditory tolerance *limitations to blast overpressures generated* by Army artillery; assessing aircraft onboard oxygen generating systems, other crew life support equipment, impact protection equipment for Army vehicles and ballistic crash impact protection provided by personal body armor; defining the effects of battlefield smokes, obscurants, crew compartments, field water supplies, Army munition plants, propellant combustion products, and synthetic fuels used in training and combat upon the health and performance of soldiers; and assessing the biological effects of exposure to laser, microwave and millimeter wave radiation to develop and recommend criteria and countermeasures for protection of health and performance.

B. (U) RELATED ACTIVITIES: Research is performed in support of Army Program Elements 6.11.02.A, Defense Research Sciences, Project BS10, Research on Military Disease, Injury and Health Hazards; and 6.27.77.A, Systems Health Hazard Prevention Technology, Project 879, Medical Factors Limiting Soldier Effectiveness. Portions of the program concerned with evaluating toxic chemical hazards are closely coordinated and complemented by Program Element 6.11.02.A, Defense Research Sciences, Project BS04 Identification and Health Effects of Military Pollutants; and 6.27.20.A, Environmental Quality Technology, Project 835, Military Medical Environmental Quality. Technology transfer and research coordination occur through intra Army and tri-service agreements, regulations, and informal meetings to complement joint efforts and avoid duplication. Medical research is purposely keyed to DARCOM weapon systems Project Manager milestones. Representatives from Army Medical Research and Development Command laboratories attend the Tri-Service Aeromedical Research Program (TARP), Air Standardization Coordinating Committee, Helicopter Research Coordination Panel (HRCP) and NATO's Advisory Group for Aerospace Research and Development to ensure collaborative efforts and minimize duplication. Memorandums of understanding exist between the USAMRDC and the Defense Canadian Research Institute of Environmental Medicine to enhance cooperative research on toxic gases in combat vehicles and between USAMRDC and the Army Human Engineering Laboratory to ensure adequate medical/human factors input into the Army Systems Acquisition Review Council (DSARC). The Army, Navy, and Air Force have established a tri-service Electromagnetic Radiation Plan under the guidance of the Under Secretary of Defense for Research

Project: A878 Title: Health Hazards of Military Materiel
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

and Engineering. Periodic updates of this plan ensure proper allocation of limited resources to the highest priority tasks identified. Emphasis is placed on mutual sharing of laboratory facilities between services whenever possible. A formal facility use agreement is maintained between the Army and the Bureau of Radiological Health, Environmental Protection Agency, and the Armed Forces Radiology Research Institute. The Army also maintains a program with Department of Defense Electromagnetic Compatibility Analysis Center regarding special utilization and operational system configurations.

C. (U) WORK PERFORMED BY: Research efforts are evenly divided between in-house laboratory research and contractual work. In-house Laboratory investigations are conducted by the US Army Aeromedical Research Laboratory, Fort Rucker, AL; Letterman Army Institute of Research, Presidio of San Francisco, CA; Walter Reed Army Institute of Research, Washington, DC; US Army Medical Bioengineering Research and Development Laboratory, Fort Detrick, Frederick, MD; US Army Institute of Environmental Medicine, Natick, MA. The top five contractors include Oak Ridge National Laboratories, Oak Ridge, TN; USEPA Health Effects Research Laboratory, Research Triangle Park, NC; Georgia Technical Research Institute, Atlanta, GA; GTE Products Corporation, Needham, MA; and Applied Physics Laboratory, Johns Hopkins University, Baltimore, MD. During FY 1981 there were 27 additional contractors at a cost of $1,025,276.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Development of a field unit to measure the noise hazard of large weapons was completed. A preliminary test of the VIPER shoulder fired antitank weapon was conducted. A research plan to determine the adequacy of hearing protective devices for use with the M198 artillery system was prepared and staffed. Human risk assessments were conducted following exposure to the M198 and the VIPER antitank weapons. Small animal studies were performed to determine parameters of blast overpressure injury and the blast overpressure near field mapping model was validated. A cross sectional epidemiologic survey of pulmonry function in artillerymen was completed. New hearing threshold limits were established for aviators. Techniques were refined to quantify the effects of vibration on muscle physiology, neck muscle stress, and cardiopulmonary mechanics. The effect of whole body vibration on static and dynamic visual acuity was determined. A comparative summary was prepared of vibration levels in Army helicopters, and guidelines established for vibration testing. Collaborative studies were continued on auxilliary cooling systems to minimize heat stress in hot vehicular environments. An evaluation of the BOTSBALL as a simplified measure of environmental heat stress resulted in tri-service type classification of the item to identify operational and training heat stress levels. Biophysical properties of desert water bags were evaluated and the effect of auxilliary cooling was incorporated into a model to predict heat stress. Permeability and insulation values were defined for cold weather and water immersion clothing, sleeping systems,

Project: A878 Title: Health Hazards of Military Materiel
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental & Life Sciences (ED) Budget Activity: #1 - Technology Base

and footwear. Toxic gas buildup in crew compartments of the OH 58C and AH 1S Helicopters was determined, and a portable gas analyzer for airborne use was evaluated. A comparative evaluation of the MBU/12 P and the P/Q aviator oxygen masks was performed and a field assessment of the United Kingdom's Nuclear Biological and Chemical protective clothing ensemble was conducted during helicopter operations. Aviation crew injury studies were initiated in collaboration with the US Army Safety Center and a report was prepared of head injuries encountered in aviation accidents. Routine helmet impact evaluation tests were conducted on prototype helmets. Exploratory procedures to assess safety of the Army CO2 laser designator were completed and large spot flash studies (optical countermeasures) in human volunteers were completed. The feasibility for noninvasive dosimetry of microwave exposures using scattering parameters, time delay spectrometry and polarization transformation was demonstrated. Methods were determined for the improved resolution of microwave images of isolated organs. Health hazard problem definition studies were completed on major smokes/obscurants munition chemicals (including zinc chloride, fog oils, diesel fuel, phosphorus smokes, urea formaldehyde resins, cetyl alcohol, and hexachloroethane). Health hazard assessments of the production and use of white phosphorus felt and red phosphorus butyl rubber inventory smoke munitions were completed as was the design and development of an aerosol generator for mammalian inhalation toxicology of diesel fuel and fog oil smokes/obscurants.

2. (U) FY 1982-FY 1984 Program: Revised blast overpressure field maps for the M198 and M109 artillery systems will be completed to provide safety recommendations. The requirement for double hearing protection will be validated for the M198, M109, and antitank weapons. Single and repeated blast exposures will be used to evaluate large animal pulmonary function. Methods will be developed to assess hearing protection in the field and determine hearing protection requirements for each developmental combat vehicle system in the inventory. The effects of vehicle vibration on operator fatigue and performance will be identified. The relationship between the effects of vibration and noise on hearing change will be studied and eye muscle compensation techniques characterized for visual tasks that require pursuit tracking under conditions of whole body vibration. Heat stress data will be assessed in occupants of armored fighting vehicles, aircraft compartments, and ground crews while wearing chemical warfare protective suits in hot environments. The biomedical heat transfer characteristics of combat vehicle helmets and infantry battle uniforms will be assessed prior to standardization. Auxiliary heating and cooling approaches to reduce tolerance limitations from environmental extremes will be evaluated. The capability and accuracy of the heat casualty prediction model will be expanded with data obtained from copper manikins. Principles of clothing design will be established to minimize thermal stress and optimize the dynamic changes in clothing insulation and permeability associated with wearer activity for Army uniforms. Biomedical guidelines for head impact forces and helmet design and a dynamic test program to determine shell toughness of flight helmets will be developed. Study of eye laser hazards will be expanded to include new neodymium and dye lasers and to determine corneal bioeffects of repeated exposures to infrared

Project: A878
Program Element: #6.27.77.A
DOD Mission Area: #522 - Environmental & Life Sciences (ED)

Title: Health Hazards of Military Materiel
Title: Systems Health Hazard Prevention Technology
Budget Activity: #1 - Technology Base

lasers. Mammalian inhalation toxicology and health hazard assessment studies will be completed on inventory smokes/obscurants including diesel fuel, white phosphorus felt, and red phosphorus butyl rubber. Studies will continue to determine the effects of chronic, cumulative, and multiwave length laser exposures on skin. The technology for providing simultaneous ballistic and laser eye protection on the battlefield will be investigated. Studies of the effects of visual performance produced as a function of reduced light transmission through protective filters will be initiated. An aviator heat stress model will be developed to determine the physiological status of flight crews during chemical defense flight operations. A new sectional heated and sweating copper manikin capable of simulating human motion will be designed and procured. The cooling capabilities of various liquid and air cooled undergarments will be determined using electrically heated sweating copper manikins. The effects of vibration on the neuromuscular system, skeletal system, articulting surfaces, visual acuity, and sensory perception will be determined. Methods of improved hearing protection without compromising voice communication will be developed for the Army environment. Combusion products from propellants used in armored vehicles will be characterized, and health hazard assessment studies will be conducted on the most prominent crew compartment toxic hazards. The performance and physiological effects of carbon monoxide exposures in Army field weapon system crewspaces will be determined. A toxicologic data base will be developed for chemicals associated with binary munition phase I facilities. New methodologies will be developed for multiwavelength ocular protection that does not compromise visual function under various environmental illumination conditions. Efforts to establish damage risk criteria for unprotected ears exposed to artillery blast overpressure will continue.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

5. (U) Resources: ($ in Thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	6399	7327	11456	13516	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6025	8879	13407	-	Continuing	Not Applicable

Project: A878
Program Element: #6.27.77.A
DOD Mission Area: #522 - Environmental & Life Sciences (ED)

Title: Health Hazards of Military Materiel
Title: Systems Health Hazard Prevention Technology
Budget Activity: #1 - Technology Base

Increase of $374 thousand in the FY 1981 funding level is a result of reprograming within the Program Element due to realignment of program objectives and the application of revised inflation and civilian pay pricing indices. The decrease in FY 1982 is the result of the amended budget request and the application of revised inflation and civilian pay pricing indices. The reduction in funding in FY 1983 is the result of reprogramming to higher priority Army requirements.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #A879
Program Element: #6.27.77.A
DOD Mission Area: #522 - Environmental and Life Sciences (ED)

Title: Medical Factors Limiting Soldier Effectiveness
Title: Systems Health Hazard Prevention Technology
Budget Activity: #1 - Technology Base

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objectives of this Army technological base project are oriented toward the behavioral, physiologic, and performance requirements imposed by military operations. Research is directed toward preventing casualties by focusing on: (a) predisposing factors which make the individual soldier more vulnerable or susceptible because of inadequate physical conditioning, training, indoctrination, or coping skills, and (b) increased stress imposed by harsh environmental extremes, complex and exhausting performance demands, and life-threatening risks which may exceed human tolerance. Behavioral and physiological investigations are pursued to identify environmental and operational stresses and to develop relationships between such stresses and soldier tolerance and survivability. Militarily relevant efforts include development of medical indices for crew workload and fatigue, physical fitness and personnel selection criteria, environmental stresses of heat, cold, and altitude, and aspects of sustained operations.

B. (U) RELATED ACTIVITIES: Related Army research is performed under Program Element/Projects 6.11.02.A/BS10, Research on Military Disease, Injury and Health Hazards, and 6.27.77.A/A878, Health Hazards of Military Materiel. Coordination is maintained on the neuropsychiatry program between the Walter Reed Army Institute of Research and the Army Research Institute for the Behavioral and Social Sciences (ARI). The US Army Medical Research and Development Command conducts research on the medical and biological aspects of mutual interest areas such as unit cohesion, combat stress, and human performance in continuous operations. The Commander, US Army Medical Research and Development Command (USAMRDC), is a member of the Board of Directors of the Army Research Institute for the Behavioral and Social Sciences. In addition, the Commander, USAMRDC, is a member of the Department of Defense Drug and Alcohol Abuse Advisory Committee for the purpose of coordinating triservice activities and avoid duplication of effort. Personnel in the Division of Neuropsychiatry, Walter Reed Army Institute of Research, maintain interrelationships and liaison with various military panels to include Human Dimensions Task Force, Soldier Support Center at the US Army Training and Doctrine Command (TRADOC); North American Treaty Organization (NATO) Ad Hoc Working Group on Biomedical Aspects of Continuous Land Combat, AD 2000; US Army War College, Liaison on Unit Cohesion, Continuous Operations, and Military Stress with Army Research Institute; and Skills Requirement Action Planning Group, US Army Training and Doctrine Command. Representation from USAMRDC is provided to the Department of Defense Drug and Alcohol Abuse Research and Development Liaison Group, with the National Institutes of Health's Alcohol Drug Abuse and Mental Health Administration (ADAMHA) to oversee activities of the National Institute on Drug Abuse (NIDA) and National Institute on Alcohol Abuse and Alcoholism (NIAAA). An extensive network of formal and informal relationships with other government agencies and Army medical laboratories is maintained. The US Army Aeromedical Research Laboratory provides representation to the Triservice Aeromedical Research Panel (TARP), the Air Standardization Coordinating Committee, and the Helicopter

Project: #A879 Title: Medical Factors Limiting Soldier Effectiveness
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

Research Coordination Panel (HRCP) for the purpose of exchanging research results, ensuring collaborative efforts and avoiding duplication of effort. Scientists from USAMRDC participate in international study groups such as NATO's Advisory Group for Aerospace Research and Development and the Technical Coordination Program (TCP). Extensive coordination is maintained between personnel at the US Army Institute of Environmental Medicine with Navy, Air Force, Marine Corps, NASA and various National Research Council Committees to conduct collaborative research projects and minimize duplication of effort.

C. (U) WORK PERFORMED BY: In-house research is performed by the US Army Aeromedical Research Laboratory, Fort Rucker, AL; US Army Research Institute of Environmental Medicine, Natick, MA; and the Walter Reed Army Institute of Research, Washington, DC. Approximately 92% of the research in this technology base is performed in-house. The top five contractors are: University of Massachusetts, Amherst, MA; University of California, San Diego, La Jolla, CA; St. Louis University, St. Louis, MO; University of Florida, Gainesville, FL; and University of Colorado, Denver, CO.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Field studies to determine the relationship between health status and deployment and combat readiness were conducted. A study of the psychological factors affecting women in the Army determined that women in nontraditional jobs are at a greater risk for health problems and at greater stress than women in traditional jobs. Studies were continued to define the relationship between unit cohesion and social support and endurance and maintenance of effective performance in combat. After completion of two field studies on overseas deployment, controlled studies were initiated on the physiological disruption caused by rapid translocation across time zones. An initial analysis of measures of soldier effectiveness during Army continuous operations was completed. A Field Manual on Stress in the Military Environment was completed, and the draft of a field manual on Stress in Continuous Military Operations was prepared. The effectiveness of prehydration volume replacement and prior heat acclimatization was demonstrated to prevent and forestall heat injury and death in animals. Mild dehydration was demonstrated to result in a significant large increase in hand cooling rates of soldiers exposed to cold, whereas increased physical fitness produced a significant delay in decreased finger temperature upon cold exposure. Performance decrements were measured at high terrestrial elevation and methods were developed to reduce significantly the severity of acute mountain sickness. Studies were conducted to evaluate the energy expenditure of soldiers using various clothing items. A physical fitness profile test battery was refined for use at the Armed Forces Entrance Examination Station. A study was conducted to determine the strength and stamina requirements for implementing gender-free Military Occupational Specialty standards. Medical screening systems were developed for physical training and testing of Army Personnel over the age of 40. The medical and physiological responses to an aerobic training

Project: #A879 Title: Medical Factors Limiting Soldier Effectiveness
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

program in personnel 40-55 years of age were evaluated, and additional research determined that a properly designed training program can improve both muscular and cardiovascular fitness. Mathematical and computer models were developed to predict light reflections on helicopter windscreen canopies and determine how these reflections can be reduced. Studies were performed on the visual adaptation changes produced by red versus blue-white instrument panel lighting for helicopters. Instrumentation was refined for the human factor analyses of Army helicopter visual display systems, and a method was developed to rapidly measure visual contrast sensitivity. An evaluation was completed of Army aviator physiological and psychomotor performance using night vision goggles during sustained periods of helicopter flight. An assessment of man/helicopter performance as a function of extended flight requirements and aviator fatigue was completed.

2. (U) FY 1982 to 1984 Program: Factors will be identified within military organizational structures and environments that lead to decrements in personnel performance; dysfunctional behaviors, and psychiatric casualties. The effects of severe stress as mediated by a series of relationships between factors within the individual, the team or group, and the organizational environment will be examined. Intervention and prevention strategies to be used by command leadership and mental health personnel will be developed to enhance unit structure and cohesion and to prevent unit disruption. Information and recommendations on the effects of heat and drinking water requirements will be provided for the Rapid Deployment Force and military units engaged in desert operations. The acute coagulatory and biochemical effects of frostbite injury will be determined, and the use of intravenous fluid management to reduce injury in frostbite victims will be assessed. Techniques, procedures, and neuromechanisms will be investigated to exploit the ability of cold-induced vasodilatation modifying peripheral temperature regulation. The feasibility of employing biological and biochemical markers to measure man's performance in the cold will be evaluated, and infrared thermography will be used to develop predictive indices for improved diagnosis and treatment of cold injury. The effect of protective agents on heat-damaged livers will be studied, and the effects of reticuloendothelial stimulation on heat stress susceptibility determined. Prophylactic/therapeutic agents and techniques will be investigated to enhance military effectiveness for operations at high terrestrial altitudes. Individual susceptibility to high-altitude sickness will be assessed to determine preselection criteria for high-altitude operations/training and tasks will be developed to predict ventilatory responses at high altitude. Laboratory investigations will be conducted to predict the effects of dehydration at various exercise intensities and levels of climatic heat stress. Studies of the effects of solar heat loads at various heat levels, wind velocities, and clothing ensembles upon performance will be conducted. The potential for heat stress will be determined in armored fighting vehicles and aircrew compartments. The effects of physical condition, as a function of sex and age, on physiologic responses in extreme climatic conditions will be evaluated. Criteria to modify or prevent the environmental stress and fatigue in military medical, garrison and field settings will be developed. The role of footwear and training techniques in

Project: #A879 Title: Medical Factors Limiting Soldier Effectiveness
Program Element: #6.27.77.A Title: Systems Health Hazard Prevention Technology
DOD Mission Area: #522 - Environmental and Life Sciences (ED) Budget Activity: #1 - Technology Base

training-induced orthopedic injuries will be evaluated. Physical fitness requirements for training and combat will be determined and more cost effective physical training programs developed. Alternative techniques and equipment for measuring visual dark adaptation capability of soldiers/aviators will be examined. Optical analyses of visors, protective eyewear, and aircraft transparencies (e.g., windscreens and crew compartment blast shields) will continue. Biomedical criteria for crew selection and retention standards will be developed with emphasis on visual, auditory, pulmonary, and dynamic strength standards. Research will be conducted on helicopter pilot/crew work/rest schedules to implement during sustained flight operations.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in Thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	6146	6636	6610	7869	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6184	6650	7405	-	Continuing	Not Applicable

The decrease in FY 1982 is the result of budget repricing. Reductions in funding in FY 1981 and FY 1983 are the result of reprograming to higher priority Army requirements.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.27.81.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Energy Technology Applied to Military Facilities
Budget Activity: #1 - Technology Base

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1435	1977	1891	2102	Continuing	Not Applicable
AT45	Energy Technology Applied to Military Facilities	1435	1977	1891	2102	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Eighty-four percent of the annual energy consumed in the Army is in the operation of its installations. This results in an annual facility energy cost in excess of $1 billion. This program provides technology for Army installations to reduce energy consumption, to minimize the effect of energy shortages and high costs, and to provide facilities to meet Force Modernization and the Army of the 90's requirements with affordable energy systems. The program develops guidance and criteria for unique Army needs selecting the most effective energy conservation technology from the choices developed in the Department of Energy and civil sector, alternate energy sources to replace fossil fuels, and use of indigenous energy resources on Army installations. Since DOE and industry are not directing their efforts specifically toward Army energy needs in Army missions but are undertaking significant efforts in technology with apparent import to the Army, this program is aimed at assessing emerging technologies in terms of economic and reliability impacts on Army energy requirements, altering technologies as required to make them beneficial to the Army and to developing protocol for controlling energy consumption in the Army without affecting missions in Training and Readiness. A cooperative research and development effort with the other DOD agencies is being pursued to preclude duplication.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The funds requested are to support the research and development to improve Army capabilities in three areas. The first is in the adaptation or development of technologies for facility design with emphasis on affordable buildings which are energy efficient. The second area includes the technologies for retrofitting existing buildings to conserve energy, and monotoring and control systems to effectively manage energy resources on an installation. The third area includes the adaptation of technologies for the direct combustion of solid fuels in Army central heating plants and the development of detailed guidance for cost effective and reliable solar energy systems as an alternate energy source for heating and cooling of military facilities.

Program Element: #6.27.81.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Energy Technology Applied to Military Facilities
Budget Activity: #1 - Technology Base

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1435	1977	1891	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1435	1579	1890	Continuing	Not Applicable

AT45 - FY 1982 funding increased from the FY 1982 submission because of adding small bearing unit research to meet general budget reductions in the Army's requirements at isolated locations. The FY 1983 funding increased because of recalculation of project funding requirements.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not Applicable.

Program Element: #6.27.81.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Energy Technology Applied to Military Facilities
Budget Activity: #1 - Technology Base

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The Army facility energy costs, which make up 84% of Army energy consumption, have tripled from 1973 to 1980 even though energy consumption was reduced by 30%. The facility energy costs, which will exceed $1 billion in FY81, take a 50% greater share of the defense budget than they did in 1973. To reduce this rising utility cost, the Army must achieve further reductions in energy consumption without impairing mission effectiveness and find effective and reliable alternate energy sources. This exploratory research program will evaluate the technologies being developed by the Department of Energy, other DOD agencies, and private industry for cost effective application to Army installations, and for those technologies which have the potential for positively affecting the Army's energy posture, make any modification necessary to meet Army requirements, and develop the tools, criteria, guidance, and procedures for implementing these technologies at Army installations. Technologies for (1) improving the energy efficiency of new construction through new design techniques and design concepts, (2) upgrading the energy *effectiveness of existing* Army facilities, (3) improving the operation of Army buildings to reduce energy consumption, (4) improving the management of energy resources for installations and (5) utilizing alternate and indigenous energy sources will be included in this program.

G. (U) RELATED ACTIVITIES: This program is coordinated on an inter-Service basis with both the Navy and the Air Force through the activities of the Tri-Service Energy R&D Group, Joint Services Civil Engineering Research and Development Coordinating Group, and the DOD-DOE Workshops. Joint programs with the Air Force include the Energy Audit Program and technology transfer of the Building Loads Analysis and Systems Thermodynamics (BLAST) Program. Related Projects are: Program Element 6.11.02.A, Defense Research Sciences, Project T23, Basic Research in Military Construction, US Army Construction Engineering Research Laboratory, Champaign, IL, Program Element 6.27.31.A, Military Facilities Engineering Technology, Project T41, Military Facilities Engineering Technology, US Army Construction Engineering Research Laboratory, Champaign, IL; Program Element 6.27.20.A, Environmental Quality Technology, Project 896, Environmental Quality Technology US Army Engineer Construction Engineering Research Laboratory, Champaign, IL; and Program Element 6.37.34.D, Military Engineering Technology, Project T09, Energy Systems Tests, US Army Construction Engineering Research Laboratory, Champaign, IL. In cooperation with the Department of Energy, the US Army has been assigned lead responsibility for coordinating the DOD energy activities in solar heating and cooling, computer programs to determine energy characteristics of buildings, wood-fired boilers, energy storage and distribution, energy conservation, and advanced heating and air conditioning systems.

H. (U) WORK PERFORMED BY: Approximately 65 percent of project funds will be used for in-house effort at the US Army Engineer Construction Engineering Research Laboratory with participation by the US Army Facility Engineer Support Agency, Ft. Belvoir, VA.

Program Element: #6.27.81.A
DOD Mission Area: #523 - Engineering Technology (ED)

Title: Energy Technology Applied to Military Facilities
Budget Activity: #1 - Technology Base

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: In the area of energy conservation, the Building Loads Analysis and Systems Thermodynamics (BLAST) energy analysis program was completed and was also interfaced with the Army Corps of Engineers Computer Aided Engineering and Architectural Design System (CAEADS) for use in concept designs of buildings. An analysis of the Army military construction process to define energy decisions needed at each stage of the process was completed and areas were defined where improved methods and information are needed. Energy analysis algorithms usable by small computers were evaluated in a joint venture with the National Bureau of Standards to provide energy analysis tools for use in facilities planning and early design phases. Retrofit energy conservation concepts to reduce energy consumption in existing buildings built to standard designs were developed. Methods to reduce electrical energy consumption were developed and provided to installations. In the area of alternate fuels, meters for measuring the output from solar energy systems were developed and tested. An easy-to-use method for evaluating the economics of solar heating and cooling systems in early stages of design was developed. Acceptance test procedures for modular heat recovery incinerators and design criteria changes for materials handling systems for storing and moving waste-derived fuels and wood pellets were developed.

2. (U) FY 1982-FY 1984 Program: The planned research in the area of the energy conservation includes: (1) development and testing of computerized tools to enable Army engineers to more effectively layout and design facilities for minimum energy use during the early stages of the military construction process, (2) methodology for improving the effectiveness of underground thermal distribution systems, (3) a handbook of Army facility energy use patterns, (4) an evaluation of advanced concepts for small heating units, (5) advanced methods for energy conservative operation of existing buildings and facilities, (6) procedures and algorithms to improving the effectiveness of energy monitoring and control systems, (7) methods for upgrading existing energy system heating and cooling controls. The planned research in the area of Alternate Fuels includes: (1) development of methodology and criteria to select the most favorable mix of alternate fuels for facilities operation at Army installations through the year 2000, (2) development of improved criteria and operational guidance for implementing cost effective solar thermal energy systems in the Army, and (3) development of concepts for advanced energy storage and distribution systems. Anticipated personnel assignments to this project each fiscal year are: professional 16 and support 7.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.31.02.A
Title: Materials Scale-Up
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4056	3986	7478	16061	Continuing	Not Applicable
D071	Materials Scale-Up/ Structures Demonstration	4056	3986	7478	16061	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Work in this program element involves three Army mission needs: advanced, survivable, heavy armor for combat vehicles which combines effective defense against advanced Soviet threats and reduced weight by 30 to 70 percent to maximize ground mobility and to allow for rapid deployment; metal-matrix composite mobile assault bridging structures to extend the current 18-meter span limitation to 30 meters and increase stiffness and ground mobility of assault bridges; and metal-matrix composite transmission housings for the CH-47D-type helicopter to significantly reduce noise and vibration and extend maintenance requirements from 2000 hours to 4000 hours. This work involves scaling up structures to production dimensions. The work fully characterizes materials and structures to permit confident, reliable, and cost effective use by the Army. The work conducted in this program will provide hard design data for new structures to shorten the time to the field, to avoid cost overruns, and to minimize failures and maintenance problems once fielded.

C. BASIS FOR FY 1983 RDTE REQUEST: Work will be conducted to scale up and demonstrate | and advanced metal-matrix composites for aircraft and bridging. New for heavy combat vehicle survivability against advanced threats will be prototyped and tested. A contract will be awarded to produce tooling for fabrication of full-scale CH-47D-type metal-matrix composite transmission housings. The composite transmission housings will increase strength in stiffened areas by 35 percent, reduce deflection at critical bearing supports by a factor of 2.5,

reduce the noise level by 7-12 decibels and reduce installed weight by up to 35 pounds due to lowered requirements for acoustic barriers. Work will be carried out to scale up and fabricate full-scale metal-matrix components for Army mobile bridging. Besides providing increased assault bridge span length (31 vs 18 meters) to cross the majority of gaps anticipated in the European theater, metal-matrix composites will result in a weight reduction of 95 pounds per foot of bridge or 5 tons over the 31-meter span. In addition to the lighter bridge, the requirements for transporter capacity will be reduced. Overall, the lighter weight bridge will provide the bridge-transporter/erection system the capability to effectively move with the current faster armored ground combat force.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	4056	3986	7498	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	2793	5426	9966	Continuing	Not Applicable

Increase of $1263 thousand in FY 1981 funding level is a result of reprograming to execute Congressional interest scale-up program on metal matrix composites. The funding reduction of $1440 thousand in FY 1982 is due to the application of revised inflation indices, program realignment, and restructuring to fund Army requirements with higher priority. Reduction of $2488 thousand in FY 1983 is a result of program realignment and restructuring in order to fund higher priority Army requirements.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.31.02.A Title: Materials Scale-Up
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. DETAILED BACKGROUND AND DESCRIPTION: Structures will be scaled up and tested for for heavy combat vehicle survivability, metal-matrix composites for the CH-47D-type transmission housings, and metal-matrix composites for Army mobile tactical bridges. The work will demonstrate the superiority of advanced composites to fabricate scaled-up prototypes, demonstrate cost effectiveness of advanced materials hardware, and thereby minimize production surprises. will provide significantly greater protection over conventional steel armor for the same weight of material. Implementation of an aluminum oxide fiber-reinforced magnesium transmission housing on CH-47D-type helicopters will result in reduced noise and vibration, and increased transmission life. It will reduce greatly undesirable component movement that causes excess wear. Overall helicopter maintenance will be reduced, especially high-cost unscheduled maintenance frequently prevelant in drive systems. Introduction of metal-matrix composites into tactical bridges will result in potential weight savings of 40 to 80 percent over current bridges. In accomplishing these goals, a complete and detailed engineering property data base for these materials will be made available to the bridge designer for fabrication of new systems. The work will help satisfy Army requirements to meet increasing demands for faster, stronger, lighter, and at the same time, more economical weapon systems. The work will demonstrate the reliability, maintainability, and cost effectiveness necessary for confident use.

G. (U) RELATED ACTIVITIES: The Air Force, Navy, other Government agencies, and allied nations have analogous programs. Although similar in approach, these programs differ greatly in emphasis placed on materials advanced development for specific hardware applications. Coordination within the Department of Defense is achieved through the Office of the Deputy Under Secretary of Defense for Research and Engineering's Apportionment Reviews and Ad Hoc Services Materials Laboratories Council meetings. Coordination with the nonmilitary federal agencies is effected through participation in activities of the National Materials Advisory Board of the National Academy of Science--National Academy of Engineering, and the Federal Council on Science and Technology - Committee on Materials. International coordination is effected through participation in the Technical Cooperation Program with Australia, Canada, New Zealand, and the United Kingdom, and the Structures and Materials Panel of the Advisory Group for Aerospace Research and Development of the North Atlantic Treaty Organization. Related efforts are Program Element #6.11.01.A, In-House Laboratory Independent Research; Project #A91A, same title; Program Element #6.11.02.A, Defense Research Science, Project AH42, Materials and Mechanics; and Program Element #6.21.05.A, Materials, Project #AH84, same title. These Program Elements and Projects reflect the Research and Exploratory Development from which emerge the materials and materials data on which this Program Element is based. There is no unnecessary duplication of effort within the Army or Department of Defense in this program area.

Program Element: #6.31.02.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Materials Scale-Up
Budget Activity: #2 - Advanced Technology Development

H. (U) WORK PERFORMED BY: In FY 1983 it is planned that approximately 55 percent of the effort will be accomplished in-house at the US Army Materials and Mechanics Research Center, Watertown, MA; US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA; US Army Armament Research and Development Command, Dover, NJ; US Army Aviation Research and Development Command, Fort Belvoir, VA, and Fort Eustis, VA; and US Army Missile Command, Redstone Arsenal, AL. The top five contractors are: Boeing Vertol, Philadelphia, PA; Los Alamos Scientific Laboratory, Los Alamos, NM; M.C.I., Columbus, OH; United Technologies, Hartford, CT; and Bolt, Beranek and Newman, Cambridge, MA. There are 11 additional contracts totaling $1,608 thousand.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1981 and Prior Accomplishments: Prior work conducted on achieved much greater protection against kinetic energy threats for the same weight of material, and indications are that it may be equally effective against chemical energy penetration. Application of these armors to combat vehicles will result in a significant reduction in the weight of armor with an equal amount of protection. A CH-47 helicopter transmission housing with two graphite-aluminum metal-matrix reinforcement plates was flight tested while instrumented for noise and vibration. Test data were compared to baseline flight test data. Results showed that at the normal 245 revolutions per minute rotor speed, the metal-matrix composite reinforcement provided an average above 8 decibels reduction in noise. Five aluminum oxide-reinforced magnesium subscale transmission housings were fabricated and tested. This work demonstrated producibility for the composite system and scaling data for fabrication of the full-scale case. Analyses were conducted that showed that incorporation of the composite case into CH-47D-type helicopters can increase the mean time between transmission removal from 1200-2000 hours to 4000 hours and reduce transmission maintenance by at least one-half. Components for selectively reinforcing the bottom chord and tension bar links underwent scale-up for incorporation into the 30-meter assault bridge. Analyses have also shown that incorporation of a silicon carbide-reinforced aluminum mobile bridge bottom chord will save over a ton in comparison with the present all-aluminum alloy member. Analyses and subscale tests have indicated that substitution of the composite member will increase the bridge section strength by 60 percent and its stiffness by over 30 percent so that the Abrams tank can be carried over a 52-meter span without the need for auxilary cable reinforcement. Tests have shown that eliminating the need for deploying the reinforcing cables makes it unnecessary for the launcher crew to expose themselves to enemy fire. Major barriers to the production of uniform, reproducible, high-quality staballoy and tungsten core munition materials have been identified and corrected. The relationship between fracture toughness, temperature, strength level and elongation of depleted uranium and high-density tungsten alloys was determined. A ballistic test facility for evaluation of scale model penetrators has been established. A technical data package has been generated for

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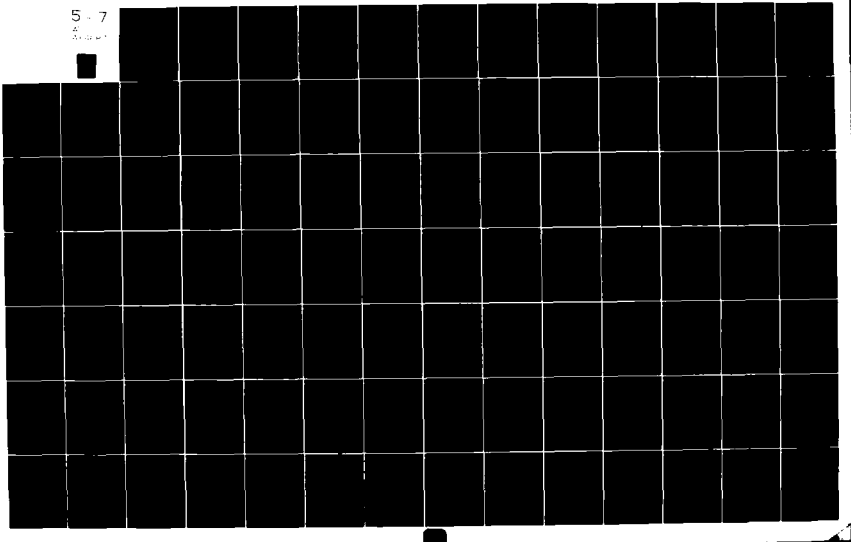

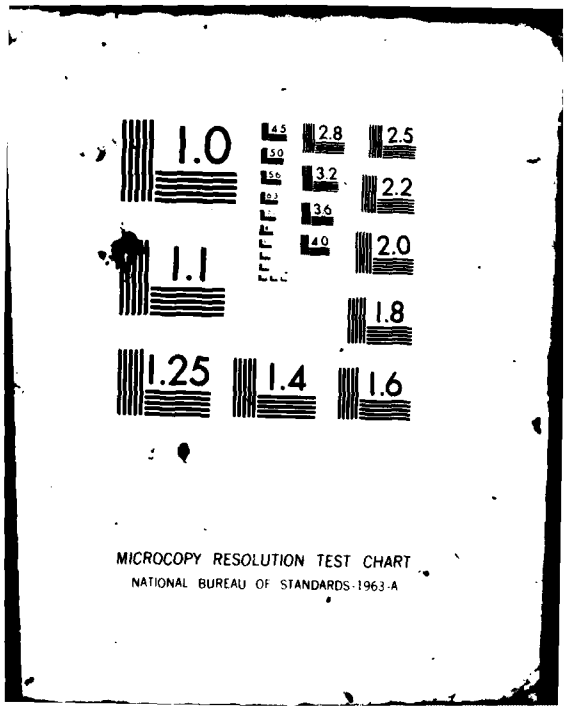
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ballistics-protection liners for the M113-class armored personnel carriers. Tests with kinetic energy fragments and antipersonnel projectiles have confirmed the effectiveness of kevlar liners in reducing casualties by 48% by decreasing the number, dispersion, and velocity of behind-the-armor fragments. In addition, tests have shown the beneficial effects of kevlar liners for radiological protection and reduction in chemical energy round penetration.

2. FY 1982-FY 1984 Program: will be scaled up and tested for heavy combat vehicle systems. Superior armor systems will be validated by subscale through full-scale testing. An advanced armor system will be produced for application to the M1 and M60A1E, M2, and M3 classes of armored vehicles. These armors will provide much greater protection than is available from the same weight of rolled homogeneous armor or provide a significant weight reduction for vehicle armor at the same protection. Effectiveness will be validated against high-density, kinetic energy penetrators and shaped charge munitions. Metal-matrix composites will be used to construct the transmission housings for the CH-47D-type and other helicopters. Results from the previous subscale work will provide scaling and producibility data for fabrication of the full-scale CH-47D-type main transmission housing. Installation of the composite transmission housings in the CH-47 will double the mean time between replacement (4000 vs 2000 hours) and reduce drive train and acoustic barrier weight by 20 percent. Demonstration tests will be conducted to determine the extent that unscheduled drive train maintenance will be reduced. Unscheduled drive train maintenance currently accounts for one-fifth of all maintenance. The reduced maintenance requirements will increase readiness rates and reduce life-cycle costs. Prototype through full-scale components and structures will be fabricated and demonstrated for metal-matrix composite mobile bridges. Composite botton chord and tension bar links will be produced first, followed by more complex structural components. The increased strength and stiffness of metal-matrix composites will result in increasing the span length from the current limitation of 18 meters to 30 meters and load capacity from 60 to 70 tons. Full incorporation of composites into mobile assault bridges will result in a 50-percent weight reduction (95 vs 200 pounds per foot of bridge) with increased system ground mobility and reduced transporter requirements. Work will begin to develop infantry fighting vehicle hull wall structures incorporating resin-matrix composites, kevlar-reinforced plastics, steel and/or aluminum to defeat armor-piercing projectiles and large caliber fragmenting munitions. Advanced composite gun barrel prototypes will be fabricated from fiber-reinforced plastic and ceramic materials which will provide increased performance with a 20-40-percent anticipated weight reduction over currently fielded systems.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.31.04.A Title: Fuels and Lubricants Advanced Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	695	1304	1871	3878	Continuing	Not Applicable
D150	Fuels and Equipment	695	1304	1871	3878	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army's research, development, test, and evaluation program has been lacking in an adequate capability to conduct advanced development of component subsystem necessary for use of new fuels and lubricants and capability to execute field/user evaluation and testing prior to issuing new products. The purpose of this program is to conduct the necessary advanced development for new fuels, fluids, and subsystems, and to conduct field user evaluation to verify the acceptability of these fuels and lubricants for use in military vehicles and other items of materiel.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: No major new starts will be initiated in this fiscal year. Work will be concentrated on continuation and completion of major ongoing tasks initiated in FY 1982 or prior years. The following programs will be continued: advanced development and field evaluation of low-vulnerability fuels that will significantly increase survivability of ground combat vehicles encountering fuel system fires; advanced development and field evaluation of improved high-performance engine oils, high-energy fuels, alternate/synthetic fuels in Army equipment and nonflammable hydraulic fluids for unique Army engines.

Program Element: #6.31.04.A Title: Fuels and Lubricants Advanced Development
DOD Mission Area: #553 - Engineering Technolgy (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (Current requirements)	695	1304	1871	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	940	2308	2912	Continuing	Not Applicable

The reduction of $245 thousand in the FY 1981 funding level is a result of reprograming to higher priority Army requirements. The funding decrease of $1004 thousand in FY 1982 is a result of the amended budget request and the application of revised inflation and civilian pay pricing indices. The reduction of $1041 thousand in FY 1983 is a result of program realignment due to changes in scope and scheduling of work, primarily in the synthetic fuels validation tasks.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.31.04.A Title: Fuels and Lubricants Advanced Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program covers those efforts directed towards overcoming obstacles to mobility and increased survivability of ground combat vehicles caused by present low probability of survivability of crews and costly damage to vehicles beyond the point of salvage due to fuel system fires of ground combat vehicles. Multiple lethal effects of intense heat, exploding ammunition, and disabling atmospheric environment are the threats that must be overcome. One of the objectives of this project is to develop a low-vulnerability fire-safe fuel that will significantly increase the survivability of combat vehicles. The approach taken is to optimize an emulsion of diesel fuel, water, emulsifiers, and antimist additives to achieve the required properties. Laboratory and fleet tests will be performed to ensure compatibility with the appropriate Army ground combat vehicles. A field mixing unit and modified pumping/filtration equipment are being developed to prepare and handle the fuel. The program includes the planning and execution of the advanced fleet testing and qualification of synthetic mobility fuels for Army vehicles and equipment, including shale oil fuel and fuel processed from coal. The introduction of a ground gas turbine engine in the Abrams Tank imposes additional performance criteria onthe engine oil. Work must be conducted to evaluate the performance of corrosion-inhibited turbine engine oil under field conditions. Work must also be carried out on the development of field test kits for defining the quality of diesel fuel in storage, field and depot environments to ensure satisfactory operability of vehicles and equipment.

G. (U) RELATED ACTIVITIES: In the fuels and lubricants technical area, active liaison and coordination is maintained with the other Military Departments, the Environmental Protection Agency, Federal Aviation Administration, and the Department of Energy. Unnecessary program duplication is avoided through the holding of regular joint meetings and reviews. Related exploratory development work is performed by the Army under Program Element 6.27.33.A, Mobility Equipment Technology.

H. (U) WORK PERFORMED: In-house work is performed by the US Army Mobility Equipment Research and Development Command, Ft. Belvoir, VA, and the US Army Fuels and Lubricants Research Laboratory, Southwest Research Institute, San Antonio, TX.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Completed advanced development of gasohol fuel and completed three gasohol fleet tests. Completed tests of diesel/alcohol fuel blends. A gasohol specification has been prepared, and a quarterly gasohol newsletter is being published to provide gasohol-use information to the Defense community. A corrosion-inhibited turbine engine oil has been developed and successfully tested at the engine manufacturer's laboratory and at Corpus Christi Army Depot. A 100-gallon-per-hour mixing unit for fire-resistant fuel components has been constructed. Laboratory tests have shown that stable emulsives of fire-resistant fuel can be made with impure water containing small quantities of dissolved solids, thus demonstrating that field water can be used for mixing fire-safe fuels.

Program Element: #6.31.04.A
DOD Mission Area: #553 - Engineering Technolgy (ATD)
Title: Fuels and Lubricants Advanced Development
Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Program: Work will be conducted to: complete evaluation of gasohol fleet tests; begin acceptance evaluations on multipurpose engine oils and long-life military greases; coordinate testing of corrosion-inhibited turbine engine oil; and fabricate prototype fuel monitors and begin testing and prepare reference synfuels for key military engines and components. Expand program for field testing of shale-derived fuels. Conduct advanced development and plan field tests of coal-derived fuels. Conduct fuel tests of all-season engine oils and improved greases for military vehicles. Accelerate field tests of fuel monitors. Complete engine and component tests on reference synfuels. Continue development of field fuel-quality monitor and accelerated fuel qualification procedures. Start advanced development of corrosion-inhibited turbine engine oil and long life collant systems. Perform user acceptance tests on fuel stabilizer, shale fuels, and nonflammable hydraulic oil. Continue field and fleet testing of shale-derived and coal-derived fuels.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.01.A
Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3868	2963	8660	33504	Continuing	Not Applicable
DB72	Propulsion Components	0	817	1305	2105	Continuing	Not Applicable
D447	Demonstration Engines	3868	2146	7355	31399	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The program objective is to evaluate and demonstrate the integration and performance potential of advanced propulsion components and drive train technology through confirmatory tests of engines and transmissions. This component technology development is absolutely essential if the Army is to field light and heavy helicopters in the 1990s that can support both Rapid Deployment Forces (RDF) and conventional heavier forces. This advanced engine and transmission technology will be developed for use in existing as well as advanced airmobility systems and provides for significant improvements in fuel efficiency while substantially increasing reliability, maintainability and availability for improved operational and mission effectiveness. These specific projects will provide Army Aviation a required propulsion system for future light helicopters (800 HP - Advanced Technology Demonstrator Engine - ATDE) as well as medium- to heavy-lift helicopters (5000 HP - Modern Technology Engine - MTE) in addition to transmissions/drive systems for both classes of helicopters.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Demonstrator Engines (D447): Contracts were awarded in February 1977 for design, fabrication, and testing of two 800 shaft horsepower (shp) Advanced Technology Demonstrator Engine (ATDE) designs. Initial performance testing, begun in FY 1980 and completed in FY 1981, successfully demonstrated achievement of design goals of 20-percent reduction in specific fuel consumption (SFC), 30-percent increase in specific power (SHP per pound of airflow), and 50-percent reduction in vulnerable area. Testing in FY 1982 will evaluate engine capabilities while operating on synthetic fuels (shale-based) and JP-8 and include endurance and abrasive (sand ingestion) testing intended to more thoroughly explore the aircraft usage potential of the two designs. Certain long-leadtime material (e.g., forgings, castings, blades) will be ordered to provide a capability for an expanded test program in FY 1984 and FY 1985. A joint Army-Navy program for

Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

the design and component requirements of an engine in the 5000 SHP class with a potential for 28-percent reduction in fuel consumption and a significant (43 percent) increase in range and/or helicopter payload will be initiated. Propulsion Components (DB72): This project includes funds in FY 1983 to initiate design efforts to integrate the many advanced helicopter transmission components that have been developed in preceding years into complete transmissions for test. The improved components will include advanced gear designs, high hot-hardness materials, high-speed clutches, lightweight steel and composite housings. These designs will be evaluated against objectives of increased life and reliability, and decreased noise, weight, and life cycle costs. Selected designs will be fabricated and tested in subsequent years.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	3868	2963	8660	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4309	2969	26761	Continuing	Not Applicable

The decrease in FY 1981 funding level is a result of reprogramming to higher priority Army requirements. The decrease in FY 1982 funds reflects the application of revised inflation and civilian pay pricing indices. The reduction in FY 1983 funds is due to major program realignment caused by reprogramming to higher priority Army requirements.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to evaluate and demonstrate the integration and potential of advanced propulsion components and drive train technology through integration of advanced components and full-scale tests of engines and transmissions. The program provides for design, fabrication, and testing of advanced propulsion and transmission systems. In recent years the need for improvements in technology has become more pronounced, not only in the areas of increased performance, but also in areas of cost, reliability, maintainability, safety, and survivability in hostile environments. Advanced component technology from Army aeronautical exploratory development and other Government and industry-sponsored programs is applied to advanced gas generators, engines, and drive trains in demonstration and validation tests. Primary emphasis is placed on preplanned product improvements of existing aircraft and on those areas that will benefit near-term aircraft development programs. D447: Complete engine subsystems are integrated and tested under the Advanced Technology Demonstrator Engine (ATDE) program. Initiate design and fabrication of the modern technology engine (MTE) in FY 1983. DB72: The Helicopter Advanced Drive Train (HADT) program provides the systems approach for a multidisciplinary effort and places drive train technology on a par with the many advances made in aircraft turbine engines.

G. (U) RELATED ACTIVITIES: Mutual exchanges of information occur with the United States Air Force, the United States Navy, and National Aeronautics and Space Administration. Agencies are advised of program progress by semiannual meetings, an informal Tri-Service Coordination Group, and visits to industry. Related Program Elements are 6.11.02.A, Air Mobility; 6.22.09.A, Aeronautical Technology; and 6.42.06.A, Blackhawk; 6.22.03.F, Aerospace Propulsion; 6.32.16.F, Advanced Turbine Engine Gas Generator; 6.32.02.F, Advanced Propulsion Subsystems Integration; 6.32.10.N, Advanced Aircraft Propulsion.

H. (U) WORK PERFORMED BY: Detroit Diesel Allison Division, General Motors Corporation, Indianapolis, IN; and AVCO Lycoming Division, Stratford, CT. The program is the responsibility of the Applied Technology Laboratory of the US Army Research and Technology Laboratories, US Army Aviation Research and Development Command, Fort Eustis, VA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Two successful efforts that have been completed were the 1500 shaft horsepower Demonstrator Engine program and the Small Turbine Advanced Gas Generator (STAGG) program. The 1500 Demonstrator Engine program identified the capabilities and limitations of an engine in that size class and has since transitioned through full engineering development as the T700 engine for the Army's UH-60A BLACK HAWK helicopter. The Navy selected a derivative of the T700 engine for use in the Light Airborne Multipurpose System (LAMPS) MK III (SH-60B) Seahawk helicopter, and another derivative will be used in the Army Advanced Attack Helicopter (AH-64 APACHE). The successful STAGG program

Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

validated significant engine performance improvements in the critical gas generator section. Technology validated under STAGG has been integrated into Air Force secondary power systems, commercial helicopters, and ongoing Army helicopter development programs. After the success of the T700 engine program, it was determined that the greatest improvement for future aircraft systems can best be realized through technology verification in an engine of approximately 800 shaft horsepower. The technology demonstrated in this successful program provides the basis and opportunity to move into an engineering development program for future applications in next-generation helicopters as well as product improvements to current inventory aircraft. Also under this program element, several new and/or unique approaches to helicopter transmission design have been or are being validated through experimental hardware testing. Some of the designs and approaches which are now incorporated in production and/or developmental helicopters are: (1) use of ZE41 magnesium as a transmission housing material in civil applications and in the Army's UH-60A Blackhawk helicopter, AH-64 Advanced Attack Helicopter (AAH), CH47D helicopter, and the Navy's SH-60B Seahawk helicopter; (2) high-speed spiral bevel gears in the UH-60A and SH-60B helicopters; and (3) cylindrical roller bearing in the UH-60A and SH-60B helicopters. During FY 1978, the Advanced Transmission Component program resulted in: (1) manufacturing of high-contact ratio test gears; (2) advanced design thrust-carrying cylindrical roller bearing fabricated and tested for over 200 hours; (3) design of a modified tapered roller bearing; (4) completed fabrication of magnetic seals; and (5) defined heat treatment required for new X-53 gear material contained in the 800 shaft horsepower Advanced Technology Demonstrator Engine (ATDE) program with the two related contractors, AVCO Lycoming and Detroit Diesel Allison. The design, fabrication, component testing, and gas generator testing have all been successfully completed, and full-scale engine demonstration testing is underway. Horsepower and fuel consumption goals (reduction of specific fuel consumption by 20 percent and increase in specific horsepower of 25-35 percent) have been successfully demonstrated. Under a cofunded program with the Navy, an all-ceramic bearing was installed in a J402-CA-700 engine and successfully run for 50 minutes without lubrication, with bearing temperatures stabilizing at 575 degrees F. D447: During FY 1981, final demonstration testing of the two 800 shaft horsepower Advanced Technology Demonstrator Engines (ATDE) was completed and final drawings and reports submitted. Also, contracts were awarded for follow-on efforts to the 800 ATDE for performance testing using alternate/synthetic fuels and the evaluation of components not validated in basic program. During 4th quarter FY 1981, a finalized memorandum of understanding (MOU) with the Navy for a jointly developed 5000 horsepower modern technology (fuel efficient) engine program was officially signed. DB72: Initiated program on transmission input module design for the AH-64 APACHE and UH-60 BLACKHAWK aircraft for an advanced lightweight drive system.

2. (U) FY 1982-FY 1984 Planned Program: D447: Continue work on 800 shaft horsepower Advanced Technology Demonstrator Engine (ATDE) follow-on program. Determine the capability of the engine to perform using alternate/synthetic fuel. Continue validation testing of critical components. Initiate procurement for long-leadtime hardware for use in the

Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

Prototype Preliminary Flight Rating (PPFRT) program. Complete definition of requirements for the 5000 shaft horsepower Modern Technology Engine (MTE) program. Finalize with the Navy a detailed Memorandum of Agreement (MOA) for a Joint MTE program. DB72: Initiate large transmission technology program jointly with Defense Advanced Research Projects Agency (DARPA) to evaluate large transmission components utilizing assets in existence from heavy-lift helicopter (HLH) Program. Complete design of high-speed transmission input module for the APACHE and BLACKHAWK and select final configuration. Concepts to be considered are advanced gear designs, high-speed clutches, lightweight/high-strength housing, and high hot-hardware materials and bearings calculated to reduce system weight and cost. For FY 1983: D447 Award contracts for the prototype Preliminary Flight Rating (PPFRT) program for the Advanced Technology Demonstrator Engine (ATDE). Initiate contracts on thermally controlled shrouds and cooled radial turbine. The flight rating program for the 800 ATDE will procure sufficient hardware to permit completion of all component and engine testing required for experimental flight release and will conduct all required analyses and demonstrations for components and engines. All hardware designs will incorporate improved features designed during the basic ATDE program and the follow-on effort as well as those improvements defined as a result of the detailed analysis required for flight rating. Also planned are award of contracts for the 5000 shaft horsepower Modern Technology Engine (MTE) program and initiate component design and hardware fabrication. The thermally controlled shroud effort will include completion of design, analysis, and initiation of hardware fabrication. The cooled radial turbine effort will consist of contract award and initiation of component design for subsequent inclusion in gas generator/engine test environments. In the 5000 MTE program, component design and fabrication will be completed and component testing will be initiated. DB72: The designs completed in FY 1982 will be evaluated, and the best design for the hardware fabrication and test phase will be selected. Long-leadtime materials and other hardware for light drive system will be ordered. Initiate manufacturing drawings and begin fabrication of hardware.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D447 Title: Demonstration Engines
Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to evaluate and demonstrate the technology integration and widespread potential of advanced technology propulsion components through integration of advanced components and full-scale developmental tests of propulsion systems. Primary emphasis is placed on Preplanned Product Improvements (P3I) of existing aircraft and on those areas that will benefit near-term aircraft development programs. Currently, complete engine subsystems are integrated and are being tested under the Advanced Technology Demonstrator Engine (ATDE) program. Design and initial fabrication of the fuel-efficient Modern Technology Engine (MTE) will begin in FY 1983. The MTE is a 5000 shaft horsepower engine that can replace the current engines on the CH-47D Chinook Helicopter in the 1990 timeframe, providing a potential for 28-percent reduction in fuel consumption and 43-percent increase in range or payload. The Demonstrator Engines program provides for design, fabrication, and testing of advanced propulsion systems. In recent years the need for improvements in technology has become more pronounced, not only in the areas of increased engine performance and reduced weight, but also in areas of reduced fuel consumption and cost, and increased reliability, maintainability, safety, and survivability in hostile environments. Advanced component technology from Army aeronautical exploratory development and other Government and industry-sponsored programs is applied to advanced gas generators and engines in demonstration and validation tests.

B. (U) RELATED ACTIVITIES: Exchange of information occurs with the United States Air Force, the United States Navy, and National Aeronautics and Space Administration. Agencies are advised of program progress by semiannual meetings, an informal Tri-Service Coordination Group, and various visits to industry. Related Program Elements are 6.11.02.A, Air Mobility; 6.22.09.A, Aeronautical Technology; 6.42.16.A, Propulsion systems; 6.42.06.A, BLACK HAWK; 6.22.03.F, Aerospace Propulsion; 6.32.16.F, Advanced Turbine Engine Gas Generator; 6.32.02.F, Advanced Propulsion Subsystems Integration; and 6.32.10.N, Advanced Aircraft Propulsion.

C. (U) WORK PERFORMED BY: The current contractual efforts under this program element are performed by Detroit Diesel Allison Division, General Motors Corporation, Indianapolis, IN; and AVCO Lycoming Division, Stratford, CT. The overall program is the responsibility of the Applied Technology Laboratory of the US Army Research and Technology Laboratories, US Army Aviation Research and Development Command, Ft. Eustis, VA.

Project: #D447 Title: Demonstration Engines
Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Two successful efforts of this project were the 1500 shaft horsepower Demonstrator Engine program and the Small Turbine Advanced Gas Generator (STAGG) program. The 1500 Demonstrator Engine program identified the capabilities and limitations of an engine in that size class and has since transitioned through full engineering development as the T700 engine for the Army's UH-60A BLACK HAWK Helicopter. During 1977, the Navy selected a derivative of the T700 engine for use in the Light Airborne Multipurpose System (LAMPS) MK III (SH-60B) Seahawk Helicopter. Another derivative, the T701, will be used in the Advanced Attack Helicopter (AH-64 APACHE). The earlier STAGG program was successful in validating significant engine performance improvements for the T700's critical gas generator section. Technology validated under STAGG has also been integrated into Air Force secondary power systems, numerous commercial helicopters, and ongoing Army helicopter development programs. After the success of the T700 Engine Program, it became evident that the greatest improvement for future aircraft systems would be realized through technology verification in an engine of approximately 800 shaft horsepower. The technology demonstrated under this successful program provides the basis and opportunity to move into an engineering development program for future applications in next-generation helicopters as well as product improvements to current inventory aircraft. By FY 1981, the design, fabrication, component testing, and gas generator testing had all been successfully completed, and full-scale engine demonstration testing is underway. Horsepower and fuel consumption goals (reduction of specific fuel consumption by 20 percent and increase in specific horsepower of 25-35 percent) have all been demonstrated. Under a cofunded program with the Navy, an all-ceramic bearing was installed in one of the prototype engines and successfully run for 50 minutes without lubrication, with bearing temperatures stabilizing at 575 degrees F. Final demonstration testing of the two 800 shaft horsepower Advanced Technology Demonstrator Engines (ATDE) was completed in FY 1981. Two contracts were awarded in FY 1981 for follow-on efforts to the ATDE for performance testing using alternate/synthetic fuels. A further evaluation of components not validated in the basic program will also be performed. During 4Q FY 1981 a Memorandum of Understanding (MOU) with the Navy for the jointly developed 5000-horsepower modern-technology (fuel-efficient) engine (MTE) program was agreed to and signed by both the Army and Navy. One of the greatest improvements in aircraft performance, payload, endurance, cabability, availability, and empty weight can be achieved by fuel-efficient/lightweight engines. The objective for the MTE is to demonstrate 20-40-percent reduction in specific fuel consumption which translates into a 20-35-percent reduction in mission fuel or a 40-50-percent increase in aircraft range for the same mission fuel. The reduction in size and weight also means a reduction in critical materials.

Project: #D447 Title: Demonstration Engines
Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Program: Work will continue on the 800 shaft horsepower Advanced Technology Demonstrator Engine (ATDE) follow-on program with final drawings and reports submitted by contractors. A determination will be made as to the capability of the engine to perform using alternate/synthetic fuel with continued validation testing of critical components. Procurement will be initiated for long-leadtime hardware for use in the ATDE Prototype Preliminary Flight Rating (PPFRI) program. The integration of advanced high-efficiency components in an engine one-half the power and size of the T700 provides a strong technology base for small significantly reduced fuel consumption simple cycle engines with integrated digital controls and particle separators. The next generation of Army helicopters will require this technology for improved speed, range and payload to better perform its required missions. Further, definition of requirements for the 5000 Modern Technology Engine (MTE) program will continue. For FY 1983 specific contracts will be awarded for the Prototype Preliminary Flight Rating (PPFRT) program for the Advanced Technology Demonstrator Engine (ATDE). The flight rating program for the 800 ATDE will procure sufficient hardware to permit all components and engine testing required for experimental flight release and will conduct full analyses demonstrations of components and engines. All hardware designs will incorporate improved features defined during the basic ATDE program and the follow-on effort as well as the improvements defined as a result of the detailed analysis required for flight rating. Also planned are award of contracts for the 5000 Modern Technology (fuel-efficient) Engine (MTE) program with initiation of component design and hardware fabrication. For FY 1984 the 800 shaft horsepower ATDE flight rating program will continue with concurrent 5000-horsepower MTE component, gas generator and full engine testing.

3. (U) Program to Completion: This is a continuing program.

Project: #D447 Title: Demonstration Engines
Program Element: #6.32.01.A Title: Aircraft Power Plants and Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

4. (U) Major Milestones:

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1982 Submission
Start Modern Technology (Full-Efficient) Engine (MTE).	1Q FY 1983	N/A
Demonstration Completed	2Q FY 1986	N/A
Engr Development Start	1Q FY 1987	N/A
Preliminary Flight Rating Test	4Q FY 1988	N/A
Military Qualification Test	4Q FY 1990	N/A
First Production Engine	4Q FY 1991	N/A

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3868	2146	7355	31399	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4018	2151	25099	N/A	Continuing	Not Applicable

The FY 1981 decreased funding reflects internal Army reprograming to higher priority Army programs. The FY 1982 decrease reflects changes in inflation indices and adjustments for civilian pay increases. The FY 1983 decrease reflects a significant reduction in effort again due to restructuring of the Modern Technology Engine program to comply with reprograming for higher priority Army programs.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.32.06.A
Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	1941	497	5581	16253	Continuing	Not Applicable
D043	Aircraft Weapons Fire Control	1941	0	5157	13553	Continuing	Not Applicable
D044	Aircraft Gun-Type Weapons	0	497	200	1090	Continuing	Not Applicable
D318	Air Self-Defense Systems	0	0	224	1610	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the advanced development and testing of new aircraft weapon subsystems to improve the capability of aircraft weapon systems under conditions of day/night and adverse weather. New concepts in target acquisition and fire control will be developed to satisfy the need for improved system accuracy, reduced aircraft exposure during target acquisition and engagement, terminal effects, airframe compatibility, and overall system reliability. Program objectives will be accomplished through the design, fabrication, and testing of advanced development fire control devices for aircraft weapon systems on attack and scout-type helicopters. The approach is to consider the several factors that make first-round hits difficult; i.e., a wide variety of weapons with their corresponding variations in ballistics, operation at long range and low altitude, and adverse visibility environments such as night/bad weather/vegetation/background clutter.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Continue into the third fiscal year, the competitive design and fabrication of an advanced development model adverse environment target acquisition and fire control system. Integration design of the pod-mounted radar with other current on-board electro-optic sensors will be flight tested on an experimental helicopter. Initiate the development of a Helicopter Automatic Targeting System (HATS) that will automatically acquire targets and hand-off to a missile seeker when used in conjunction with electro-optical remote view systems. Initiate a program to incorporate an active recoil mechanism for current helicopter turreted cannons in order to achieve substantial reductions in cannon recoil forces and vibrations induced into the airframe.

Program Element: # 6.32.06.A Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirement)	1941	497	5581	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	2516	10312	24790	Continuing	Not Applicable

The FY 1981 decrease is due to Congressional action directing the Army to consider future Mast-Mounted Sight Development under the Army Helicopter Improvement Program (AHIP). The FY 1982 decrease is a result of direct Congressional action deleting funds in Project D043. The FY 1983 decrease reflects reprograming to higher priority Army requirements.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: # 6.32.06.A
Title: Aircraft Weapons
DOD Mission Area: #555 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to continue advanced development of airborne weapon subsystems for future use in helicopters. Proven concepts from exploratory development of new or improved aircraft weapon subsystems are evaluated and directed towards general aircraft use and towards specific aircraft application. The primary efforts for this program are to design, fabricate, test, and evaluate breadboard and brassboard models and prototype hardware of airborne weapons and associated equipment for use in the helicopters. The approach is to consider the several factors that make first-round hits difficult; i.e., increased performance, a wide variety of weapons with their corresponding variations in ballistics, operation at long range and low altitude, and adverse visibility environments such as night/bad weather/vegetation/background clutter. The components and system efforts of this project consider operations under these conditions. The types of fire control hardware being developed will include, but not be limited to, computers; passive and active automatic trackers; mast-mounted sight systems; acoustic sensors; fiber optic guided missiles; night, adverse environment, all-weather acquisition and targeting systems; radar, forward-looking infrared (FLIR) and stabilization systems. Foreign state-of-the-art trends and potential threats to present and future materiel or systems are being considered.

G. (U) RELATED ACTIVITIES: Project personnel maintain close liaison with other military services and with industry to avoid duplication of effort. The Army participates in the Department of Defense Tri-Service Joint Technical Coordinating Group for Munitions Development. Army personnel working within this program participate in the North Atlantic Treaty Organization Air Armament Working Party and the Air Standardization Coordinating Committee, Working Party 20. These groups and working parties provide a medium for exchange of technical information and determination for joint use and standardization of airborne weaponization items. An Army representative serves on the Air Munitions Requirements and Development committee (AMRAD), an organization within the Office of the Secretary of Defense. One function of this committee is the establishment of joint-service requirements and development of air munitions. Related exploratory development is conducted under Program Element 6.22.01.A, Aircraft Weapons Technology, and engineering development under Program Element 6.42.02.A, Aircraft Weapons.

H. (U) WORK PERFORMED BY: Contractors are Westinghouse Corp, Baltimore, MD, Martin Marietta, Orlando, FL, Hughes Helicopters, Culver, CA, Bell Helicopter Company, Fort Worth, TX, Rockwell International, Columbus, OH. In-house: US Army Aviation Research and Development Command, St. Louis, MO, US Army Armament Research and Development Command, Dover, NJ, US Army Missile Command, Huntsville, AL, US Army Test and Evaluation Command, Aberdeen Proving Ground, MD, US Army Electronics Research and Development Command, Fort Monmouth, NJ.

Program Element: # 6.32.06.A
DOD Mission Area: #553 - Engineering Technology (ATD)
Title: Aircraft Weapons
Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Work performed with the goal of improved target acquisition has covered technological areas including electro-optics, infrared, millimeter wave radar, and improved stabilization. Specific efforts include the development and flight testing of airborne laser rangefinders (both galium arsenide and neogynium yag) as well as moving target indicator radars. Infrared technology has been evaluated for weapon sighting systems at low-light levels and under adverse weather conditions. Automatic target tracking from an airborne platform was demonstrated using a special-purpose electronic processing unit operating from television and Forward Looking Infrared (FLIR)-type video formats obtained from remote sighting systems. The feasibility of heliborne antiradiation missiles and use of semiactive lasers for guidance of point target weapons was demonstrated. Shallow Cone-Shaped Charge (SCSC) technology for high-energy, dual-purpose rounds was developed and is being incorporated into ammunition development programs. With respect to weapon system integration problems, specifications for external stores suspension equipment for Army aircraft were evaluated and are currently being used for the AH-1S and Advanced Attack Helicopter (AAH) systems. Fire control computers were evaluated on the Multiweapon Fire Control Testbed and specification input prepared for the AH-1S and the AAH fire control systems. To assist the AH-1S program, the feasibility of an integrated laser rangefinder with input to the rocket fire control subsystem was demonstrated on the M-65 sight, and this hardware is now being incorporated into the AH-1S. In the area of recoil attenuation, a modified 20mm turret with a flight-qualified hydraulic constant recoil mechanism was integrated and flight tested. A breadboard model of a mount for the development of a high-impulse recoil attenuation device was completed and tested. Based on the data obtained from medium-impulse recoil tests, a detailed mathematical model of the recoil mechanism was programmed to simulate burst firings. Data from this simulation were used to design a recoil mechanism that will be applicable to current attack helicopters and to compare present recoil mechanism forces with mechanism forces of a new hydraulic constant recoil concept. To assist in the area of reducing detectability of a helicopter, and hence increasing survivability, fabrication and flight testing of a mast-mounted sight feasibility demonstrator were initiated. A contract was awarded to Bell Helicopter for the design and fabrication of a nonrotating platform for a feasibility demonstration of the Mast-Mounted Sight on the OH-58C helicopter. Selection of contractors (Martin Marietta and Westinghouse) for the development of an adverse environment target acquisition and fire control system was accomplished. This system will be capable of performing the following functions: furnish fire control data for missiles, guns, and rockets; detect vehicles and air defense systems, moving and stationary; determine position of targets; classify and prioritize targets; ground mapping; and provide information for navigation update. An in-house effort was initiated to develop requirements and a request for quotations (RFQ) to industry to develop a helicopter automatic targeting system which will function with electro-optic devices to automatically detect, classify, and prioritize targets in the area of search.

Program Element: # 6.32.06.A Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Planned Program: Design of helicopter adverse weather fire control radar prototypes will be continued; tower test of each system will be conducted, and aircraft integration of these systems will be initiated. These prototypes will be capable of performing the following functions: furnish fire control data for missiles, guns, and rockets; detect vehicles and air defense systems, moving and stationary; determine position of targets; classify and prioritize targets; ground mapping; and to provide information for navigation update. Critical radar components will be fabricated and tested, design of the system will be finalized, and long-lead hardware procured by competing contractors. Efforts in automatic target cueing, thrust of which is to decrease aircraft exposure and crew workload by providing automatic target cueing and automatic on-board target handoff, will continue by applying this capability to systems with infrared and television sensors. Competitive contracts will be awarded for development of a helicopter automatic targeting system (HATS) for eventual flight tests in the YAH-64 helicopter. Development of an acoustic sensor system that has potential for detecting, tracking, and classifying threat vehicles based on sound characteristics without requiring line-of-sight contact with the target will be initiated. A program will be initiated to incorporate an active recoil mechanism into the AH-1S cannon turret in order to achieve substantial reductions in cannon recoil forces and vibrations induced into the airframe. This will permit use of higher impulse ammunition and/or an increase in the rate of fire for the cannon in order to enhance the aircraft's air self-defense capability. The system will improve cannon accuracy, acquisition system performance through reduced vibration, and aircraft stability through reduced forces during firing sequence.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D043 Title: Aircraft Weapons Fire Control
Program Element: #6.32.06.A Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is needed for the advanced development and testing of new aircraft fire control subsystems to improve the capability of aircraft under conditions of day/night adverse weather and limited visibility. Currently planned and available systems other than the AH-64 TADS/PNVS do not have adverse visibility capability and are limited in range. New concepts in target acquisition and fire control will be developed to improve system accuracy, terminal effects, airframe compatibility, and overall system reliability. Program objective will be accomplished through the design, fabrication, and testing of advanced development experimental hardware of fire control devices for aircraft weapon systems on attack and scout-type helicopters. The approach is to consider the several factors that make first-round hits difficult (i.e., operation at long range and low altitude and adverse visibility environments such as night/bad weather/vegetation/background clutter) and to develop experimental systems to overcome these factors. The types of fire control hardware being developed will include, but not be limited to: computers; passive and active automatic trackers; mast-mounted sight systems, acoustic sensors; fiber optic guided missiles; all-weather acquisition and targeting systems; radar, and stabilization systems. Foreign state-of-the-art trends and potential threats to present and future materiel or systems are being considered.

B. (U) RELATED ACTIVITIES: Project personnel maintain close liaison with other services and with industry to avoid duplication of effort. The Army participates in the Department of Defense Tri-Service Joint Technical Coordinating Group for Munitions Development. Army personnel working within this program participate in the North Atlantic Treaty Organization Air Armament Working Party and the Air Standardization Coordinating Committee, Working Party 20. These groups and working parties provide a medium for exchange of technical information and determination for joint use and standardization of airborne weaponization items. An Army representative serves on the Air Munitions Requirements and Development committee (AMARD), an organization within the Office of the Secretary of Defense. One function of this committee is the establishment of joint service requirements and development of air munitions. Related exploratory development is conducted under Program Element #6.22.02.A, Aircraft Weapons Technology, and engineering development under Program Element #6.42.02.A, Aircraft Weapons.

C. (U) WORK PERFORMED BY: Contractors are: Westinghouse Corporation, Baltimore, MD; Martin Marietta, Orlando, FL; Bell Helicopter Company, Ft. Worth, TX; Hughes Helicopter Company, Culver City, CA: Rockwell International, Columbus, OH. In-house: US Army Aviation Research and Development Command, St. Louis, MO; US Army Armament Research and Development Command, Dover, NJ; US Army Missile Command, Huntsville, AL; US Army Test and Evaluation Command, Aberdeen Proving Ground, MD; US Army Electronics Research and Development Command, Ft. Monmouth, NJ.

Project: #D043 Title: Aircraft Weapons Fire Control
Program Element: #6.32.06.A Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Work performed with the goal of improved target acquisition has covered technology areas including electro-optics, infrared, millimeter wave radar, and improved stabilization. Specific efforts include the development and flight testing of airborne laser rangefinders (both galium arsenide and neodynium yag) as well as moving target indicator radars. Infrared technology has been evaluated for weapon sighting systems at low-light levels and under adverse weather conditions. Automatic target tracking from an airborne platform was demonstrated using a special-purpose electronic processing unit operating with television and Forward Looking Infrared (FLIR)-type video formats obtained from remote sighting systems. The feasibility of heliborne antiradiation missiles and use of semiactive lasers for guidance of point target weapons was demonstrated. Current programs are underway to further develop and field this technology. Airborne computers were evaluated on the Multiweapon Fire Control testbed and specification input prepared for the AH-1S and the Advanced Attack Helicopter fire control systems. To assist the AH-1S helicopter program, the feasibility of an integrated laser rangefinder with input to the rocket fire control subsystem was demonstrated on the M-65 sight, and this hardware is now being incorporated in the AH-1S. Hardware has been developed and flight tested to evaluate close loop fire control systems concepts. Results have indicated that refinements are required to make significant improvements in system performance. To assist in reducing detectability of helicopter, and hence increase survivability, fabrication and flight testing of a mast-mounted sight feasibility demonstrator were conducted. Under Army contract, Bell Helicopter designed and fabricated a nonrotating platform for feasibility demonstration of a mast-mounted sight on the OH-58C helicopter. Selection of contractors for the development of a Helicopter Adverse Weather Fire Control/Acquisition Radar System (HAWFCARS) was completed and contract awarded. An in-house effort was initiated to develop requirements and a request for quotations (RFQ) to industry to develop a helicopter automatic targeting system which will function with electro-optic devices to automatically detect, classify, and prioritize targets in the area of search. The helicopter targeting system is essential to reduce detection while engaging remote targets on a lethal battlefield.

2. (U) FY 1982-FY 1984 Program: Design of the HAWFCARS will be initiated, incorporating the following functions: furnish fire control data for missiles, guns, and rockets; detect vehicles and air defense systems, moving and stationary; determine position of targets; classify and prioritize targets; ground mapping; and provide information for navigation update. Development of the adverse environment target acquisition and fire control system will be continued. During FY 1982, critical radar components will be fabricated and tested, design of the system will be finalized, and long-lead hardware procured. Helicopter (AH-64) interface hardware will be designed and fabrication initiated. A contract will be

Project: #D043 Title: Aircraft Weapons Fire Control
Program Element: #6.32.06.A Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

awarded early this year to initiate the development of a Helicopter Automatic Targeting System (HATS). This effort will involve the further advancement of the automatic target-cueing technology developed under Program Element #6.22.01.A, Aircraft Weapons Technology. It has been determined that the technique can be applied to systems utilizing infrared and television sensor acquisition principles. The ability to track and identify up to thirty targets will be investigated. Intelligent tracking, automatic onboard target handoff, and passive ranging functions will be investigated. Design integration will be initiated to incorporate HATS into the AH-64 Target Acquisition Designation System for flight test evaluation. A program will be initiated to apply a fiber optic guided missile to a helicopter for evaluation. This concept has the potential for firing missiles in an indirect fire mode, automatic target tracking, and lock-on after launch for rapid, multiple target engagements. Initiation of a second-generation mast-mounted sight will begin to provide an increase in range performance and reduction of the sight weight distributed above the helicopter rotor head. A program will be initiated to combine the millimeter wave radar with a US Army Missile Command-developed missile RF seeker on the AH-64 for system definition and evaluation. Fabrication of the airborne adverse weather target acquisition system utilizing millimeter wave technology will continue. A pod-mounted radar will undergo tower performance test, AH-64 simulator test, and integration of the radar system into the AH-64 test aircraft for initial total system evaluation. The detail design of the Helicopter Automatic Targeting System will be completed; algorithms for both the TV and Forward Looking Infrared (FLIR) will be developed. Airborne application of acoustics technology will be initiated to develop a passive, non-line-of-sight, omnidirectional acoustic sensor on Army helicopters to provide the crew with early cueing, direction of potential targets and classifications of targets up to 10 km in any weather condition. Development of HAWFCARS, HATS, Mast-Mounted Sight, and Fiber Optic Guided Missile will continue.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

Project: #D043 Title: Aircraft Weapons Fire Control
Program Element: #6.32.06.A Title: Aircraft Weapons
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirement)	1941	0	5157	13553	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	2516	10312	24790	—	Continuing	Not Applicable

Reduction in the FY 1981 funding level is a result of reprograming to Program Element #6.36.07.A, Project D640, Army Small Arms Program, due to realignment of program objectives. Reductions in FY 1982 are due to Congressional deletion. FY 1983 reductions are a result of the amended budget request and the application of revised inflation and civilian pay pricing indices.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.07.A
Title: Aircraft Avionics Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2101	2312	4494	6868	Continuing	Not Applicable
DB97	Avionics Equipment	2101	2312	4494	6868	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: In order to survive the hostile environment created by the Warsaw Pact's massive air defenses, Army aircraft must have the improved capability to operate at nap-of-the-earth (NOE) altitudes while supporting ground combat forces around the clock at night and during adverse weather. This program element supports this requirement by providing technology demonstration and advanced development leading to engineering development of cockpit instruments, communication equipment and navigational items necessary for NOE combat. Emphasis is on hardware which will provide a capability for day/night, adverse weather aviation operations in a mid- to high-intensity war environment.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The FY 1983 program will concentrate on Advanced Development in the areas of: Advanced Communications, Controls and Displays, Air Traffic Management, Nap-of-the-Earth Navigation, and Environment Sensors. Specific programs will be flight tested in a testbed research aircraft.

Program Element: #6.32.07.A Title: Aircraft Avionics Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirement	2101	2312	4494	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	2301	5120	7300	Continuing	Not Applicable

FY 1981, FY 1982 and FY 1983 decreases were reprogramings to higher priority items. The FY 1982 and FY 1983 cuts will have significant impact on integration efforts in the UH-60 Systems Test for Avionics Research (STAR) aircraft.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.32.07.A Title: Aircraft Avionics Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Army aviation needs are addressed under this effort in the areas of reduced pilot workload and improved helicopter performance through jam-resistant communications, improved aircraft survivability through the air traffic management program, and improved surveillance and target acquisition through improved Nap-of-the Earth navigation systems. These systems will be flight tested in the Systems Testbed for Avionics Research (STAR) aircraft belonging to the Avionics Research & Development Activity (AVRADA). Development also includes improving the man-machine interface between pilot and helicopter to reduce the effort spent on repetitive flying requirements so that aircrews can concentrate on their tactical mission and the combat environment. Key considerations in all designs are improvements in cost, reliability, survivability and compatibility with the expected battlefield environment.

G. (U) RELATED ACTIVITIES: In order to avoid unnecessary duplication of effort, related programs of the Air Force, Navy, and other organizations are monitored through committees and working groups. A close watch of public sector technology is also maintained.

H. (U) WORK PERFORMED BY: Avionics Research and Development Activity, Fort Monmouth, NJ. Contractors include Sperry, Phoenix, AZ, General Electric, Binghamton, NY.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Analyzed acoustical and electrical noise data and developed specifications for audio unit (utilizing autocorrelation noise-canceling techniques) to reduce pilot's headset noise. Investigated use of liquid crystal displays for helicopter instrumentation. Evaluated conventional flight director systems to allow helicopter instrument landings. Accomplished computer modeling of aircraft vulnerability, survivability, performance, and avionics reliability. Completed development of voice gating circuitry. Evaluated cockpit lighting techniques. Completed investigation of state-of-the-art low-airspeed sensing system. Demonstrated single-frequency transmission system. Developed and installed integrated target location and navigation system for OPTIC IV OH-6A helicopter which provides evaluation of automatic target location, offset navigation update, and night hover capabilities. Completed concept formulation package for nap-of-the-earth communication system. Initialed and completed the in-house conversion of a production UH-60 BLACK HAWK helicopter to a Standard Testbed for Avionics Research vehicle.

2. (U) FY 1982-FY 1984 Planned Program: Complete the installation and flight tests of the Night Navigation Pilotage System in the Systems Testbed for Avionics Research (STAR) aircraft. Initiate development of the Standard Programable

Program Element: #6.32.07.A Title: Aircraft Avionics Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

Control Display Modules. Begin Air Traffic Control testbed design which will be utilized to performed feasibility demonstrations of emerging Integrated Communications Navigation Identification (ICNI) developments. Initiate review of aircraft lighting specifications and standards for future aircraft. Install the Army Digital Avionics system and Pod I CO2 Nap-of-the-Earth sensor into the STAR and demonstrate weapons guidance potential in ground tests. Design concept and preliminary subsystem design of a hybrid CO2 and millimeter (mm) sensor taking advantage of the qualities of both. Fabricate Standard Programmable Control Display Modules (SPCDM) either as a stand-alone control or for common control of multiple systems using a data bus architecture. Initiate development of a programable keyboard for use in SPCDM. Complete Air Traffic Control testbed design, integrate existing secondary surveillance radar and air traffic control hardware, and test and evaluate concepts. Start measurements and testing of lighting systems to reduce aircraft electro-optical signatures. Initiate advanced development of a Digital Multiplexed Audio System (DMAS) providing noise suppression and TEMPEST compatibility. Perform Army Digital Avionics System flight tests in the STAR. Initiate subsystem/component fabrication of CO2/MM hybrid system capable of detection and identification of enemy aircraft, target descrimination, aircraft hover, and collision avoidance. Demonstrate Standard Programmable Control Display Module functional capability and programmable keyboard concepts. Integrate interface equipment and conduct preliminary tests of Air Traffic Control/Command and Control (C2) system. Complete digital multiplexed audio system effort and initiate integration of complete audio subaystem into STAR. Definitize data for lighting standards for future Army aircraft. Transfer exploratory development efforts in voice recognition and response equipment and distributed airborne communication systems into advanced development. (These system together with DMAS form the communications system for future advanced aircraft.)

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.09.A
Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	247	1809	3784	7464	Continuing	Not Applicable
DB31	Manufacturing Technology	0	295	0	868	Continuing	Not Applicable
DB32	Ground Support Equipment	0	0	135	860	Continuing	Not Applicable
DB33	Cargo Handling Equipment	0	529	569	1400	Continuing	Not Applicable
DB45	*Aviation Life Support Equipment*	247	985	3080	4336	Continuing	Not Applicab[illegible]

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The US Army not only must develop aviation systems for increased firepower and mobility, but also must develop the support equipment necessary to gain maximum effectiveness from these systems and their crews. This program develops new Aviation Life Support Equipment (ALSE) to improve efficiency and survivability of aircrews in Nuclear, Biological, Chemical (NBC), and adverse climatic environments, and provides for cargo handling and ground support equipment to increase aircraft effectiveness and operational readiness. This program element, (1) provides for the advanced development of ALSE for aircraft and individual crewmembers to enhance their efficiency, safety, and survivability while operating in a hostile tactical or climatic environment, (2) provides for the advanced development of new cargo-handling equipment to increase the speed and reduce manpower required for the loading and movement of cargo by helicopter, (3) provide for the advanced development of ground support equipment designed to gain maximum benefit from current and future aircraft by enhancing the maintenance, servicing, and damaged/downed aircraft recovery capability for the Army aircraft fleet. These projects support a reduction in the proliferation of support equipment by the development of standardized items applicable to more than one aircraft system. The program element also includes the advanced development and optimization of manufacturing processes and techniques to insure that economic manufacturing technologies are available for further development under a procurement funded Manufacturing, Methods, and Technology (MM&T) program. The zero funding of DB31 in FY83 is a result of higher priority Army requirements.

Program Element: #6.32.09.A Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Aviation Life Support Equipment (ALSE): The FY 1983 request will fund the initiation of development for the Aircrew Life Support System Integrated Battlefield (ALSSIB), a hot air self-decontamination system for helicopters, and the continuation of work on the Integrated Aircrew Helmet System (IAHS). The ALSSIB is a major effort to develop and integrate into one system the various aircraft and personnel devices necessary to provide a total aircrew life support package to improve the ability of Army aviation elements to operate in a hostile tactical or climatic environment. This effort addresses the nuclear, biological, chemical, and laser weapons threat. The IAHS effort addresses deficiencies associated with subsystem compatibility and added weight when night vision devices, protective/oxygen masks, and nuclear flash/laser protective visors are combined on the current helmet. The IAHS will produce a new lightweight structure with improved crash protection, noise attenuation and communications capabilities that is designed to fit both female and male aircrew members. The IAHS will also include modular protective systems to offset nuclear flash, chemical, biological, and laser threats. Cargo-Handling Systems: Based on the need for increased capabilities in the transport of cargo by helicopter, FY 1983 funding will permit advanced development to proceed for increasing the productivity of both external and internal delivery of cargo. Specific work efforts include a semiautomatic Container Lift Adapter Helicopter (CLAH), an 8x8x20-foot cargo gondola, improvements/refinements to the 25,000-pound-capacity cargo slings, and an efficient means to acquire external loads under low-visibility conditions. The Container Lift Adapter Helicopter together with the developmental cargo gondola will provide an efficient and rapid means for the CH-47 to externally attach, carry, and discharge aggregated bulk loads. Ground Support Equipment: An advanced development effort will be initiated with the fabrication of prototype hardware for developmental testing of repair concepts for battle-damaged helicopters.

Program Element: #6.32.09.A Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	247	1809	3784	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1853	1810	3201	Continuing	Not Applicable

The reduction of $1606 thousand in the FY 1981 funding level is a result of reprograming to higher priority Army requirements. The funding decrease of $1 thousand in FY 1982 is a result of the amended budget request and the application of revised inflation and civilian pay pricing indices. The funding increase of $583 thousand in FY 1983 is a result of an increased thrust in the advanced development of Aviation Life Support Equipment combined with reduced scope for the cargo-handling and manufacturing technology areas.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.32.09.A Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program element is to continue advanced development of those concepts in Aviation Life Support, cargo-handling, ground support, and manufacturing technology that have demonstrated the most promise in meeting the Army's prioritized needs in these areas. The aviation life support project was established to consolidate, manage and execute the advanced development of all equipment designed to sustain aircrews and passengers in their flight environment. This project includes special aircraft subsystems, components common to multiple aircraft, and equipment worn by aircrews. Specific efforts include a joint development with the US Navy of an Inflatable Body and Head Restraint System (IBAHRS) for the AH-1 and AH-64 attack helicopters and an Integrated Aircrew Helmet System (IAHS) for improved crash and hearing protection and for improved weight distribution, and mounting of laser/nuclear flash protection, night vision devices, and protective/oxygen masks. The initiation of the Aviation Life Support System Integrated Battlefield (ALSSIB) represents a major effort to bring together many of the life support components into a single, compatible system which will enhance aircrew efficiency as well as provide protection on the modern battlefield against nuclear flash, biological, chemical, laser, and fragmentation threats. The objective of the cargo-handling project is the timely development and validation of techniques for efficient loading and movement of cargo by helicopters. Specific work units include the Container Lift Adapter Helicopter (CLAH), a Helicopter External Gondola System (HEGS), a Low Visibility External Load Acquisition System (LOVLAS), improvement of the 25,000-pound-capacity cargo slings, a Tandem Two-Hook Beam (TTHB) for the UH-60 helicopter, and the Helicopter External Cargo Snubbing System (HEXCSS). The CLAH and the 8x8x20-foot gondola (HEGS) will be integrated into a system that will provide an efficient means for the CH-47 helicopter to acquire, carry, and discharge aggregated bulk loads. The CLAH will also be adaptable to other International Standards Organization (ISO) containers. The TTHB represents an advanced load suspension system for the UH-60 which will provide greater load stabilization and helicopter performance than is now possible with single point hookups. The Advanced Materials External Sling System (AMSS) development will produce a lightweight, longer life, 25,000-pound sling system for Army and US Marine Corps helicopters. Development of the HEXCSS will fulfill a need for an improved, portable means of acquiring, raising, and snubbing an external load against the underside of the aircraft to eliminate load motion and to reduce the overall height of the aircraft and its load. The LOVLAS will provide an increase in overall lift efficiency and safety of helicopter external load operation through the improvement in the capability to acquire loads under low-visibility conditions. The ground support project is aimed at improving combat readiness by enhancing aircraft maintenance, servicing, and damaged/downed aircraft recovery capability. The Helicopter Battle Damage Repair (HBDR) concepts will improve helicopter operational availability through greater repairability/defersability of combat damage. The advanced development of a Standard Maintenance Information and Display Syste. (SMIDS) is oriented to the development of a portable, ground-based information system which will provide a more effective and faster means of checkout and fault isolation of complex systems. The Damaged Aircraft Recovery Kit will replace the current obsolete aircraft recovery kit with a new, multiservice, lightweight recovery kit which will be

internally transportable in the UH-60 or UH-1 helicopter. The manufacturing technology project considers specific efforts such as the fabrication of bulk material and rapidly solidified structures by continuous fusing and the replacement of critical/strategic materials with new alternatives to insure that economic manufacturing technologies are available for further development if needed.

G. (U) RELATED ACTIVITIES: Aeronautical Technology, Program Element 6.22.09.A, and Air Mobility Support Equipment, Program Element 6.42.04.A. Aviation Life Support Equipment (ALSE) is coordinated through the Tri-Service ALSE Working groups and the ALSE Management Steering Council. Cargo-handling equipment developments are closely coordinated with the development of airdrop equipment and techniques through the Joint Technical Airdrop Group (formerly Joint Technical Coordinating Group for Airdrop) and the annual OSD Apportionment Review of Aeronautical Technology. Project personnel maintain close liason with other military services and industry as well as participate in Joint Working Groups, to avoid unnecessary duplication.

H. (U) WORK PERFORMED BY: Naval Air Development Center, Warminister, PA; Natick Research and Development Command, Natick, MA; US Army Aviation Research and Development Command, St. Louis, MO; Thiokol Chemical Company, Inc., Brigham City, UT; Technar, Arcadia, CA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Aviation Life Support Equipment (ALSE): The joint Army/Navy development of an Inflatable Body and Head Restraint System (IBAHRS) for helicopter crash protection was continued with contractor fabrication of prototypes and design verification tests. Head impact protection testing of the Integrated Aircrew Helmet System (IAHS) was provided by Wayne State University. Support for the nuclear flash protection effort was furnished by the Department of Energy and the US Air Force. Laser protection support was provided by Letterman Army Institute of Research, and support in the communication area was furnished by the Army Aviation Research and Development Activity. Planning was initiated for the Aviation Chemical Protection Program and for the Aircraft Lift Support System Integrated Battlefield (ALSSIB). Helicopter Anti/Deicing: Project started in 1977 with analysis of ice protection requirements for Army helicopters. Design, fabrication, and installation of ice-protected components for UH-1H test demonstration helicopters were initiated. Initial flight tests in both natural and simulated icing conditions have been completed. Cargo-Handling Equipment: No funds were appropriated for this project in FY 1979 and FY 1980. FY 1981 funds were reprogramed to meet higher Army priorities. Work in FY 1981 was limited to planning for resolution of problems experienced with the semiautomatic Container Lift Adapter Helicopter (CLAH) in earlier RDT&E work. Ground Support Equipment: Project unfunded in FY 1980 and FY 1981.

Program Element: #6.32.09.A Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

Exploratory work under 6.2 project was conducted on the Helicopter Battle Damage Repair (HBDR) concepts and the Standard Maintenance Information and Display System (SMIDS). Manufacturing Technology: Project unfunded in FY 1980; FY 1981 funds were reprogramed to meet higher priority Army requirements. Planning was conducted in FY 1981 for a bulk material fusing process.

2. (U) FY 1982-FY 1984 Planned Program: Aviation Life Support Equipment (ALSE): The Inflatable Body and Head Restraint System (IBAHRS) validation will be completed with installation in the AH-1 helicopter and DT/OT I testing conducted. IBAHRS transition to engineering development is planned for FY 1983. An advanced development contract for the Integrated Aircrew Helmet System (IAHS) will be competitively awarded in FY 1982, prototype fabrication and DT/OT I testing planned for FY 1983, and transition to engineering development planned for FY 1984. Advanced development of the Helicopter Self-Decontamination System, using hot-engine exhaust/bleed air will be initiated in FY 1982, prototype fabrication planned for FY 1983 and technical feasibility tests conducted by the Chemical Systems Laboratory to demonstrate that the heat and dwell times will not damage helicopters. Advanced development will be completed in FY 1984. Advanced development for the future aviator's Chemical/Biological (CB) prototype mask will be initiated in FY 1982, continued in FY 1983 with prototype fabrication and design verification testing and completed in FY 1984 following DT/OT I testing. Advanced development of aircrew laser protective devices will be initiated in FY 1983 through alternative approaches of a helmet-mounted subsystem and protective coatings for helicopter canopies. This project will continue through FY 1984 with prototype fabrication and design verification tests. The Aviation Life Support System Integrated Battlefield will enter advanced development in FY 1983 and continue through FY 1984. The Airborne Remote Chemical Detection System is planned to transition from exploratory to advanced development in FY 1984. This effort addresses the problem of providing advanced warning to aircrews in order to take evasive maneuvers/defensive measures and to warn others of impending threat. Cargo-Handling Equipment: Resolve aerodynamic problems of the Container Lift Adaptor Helicopter (CLAH) for external cargo delivery operations; and if successful transition to full-scale development. Conduct flight and ground tests of the 8x8x20-foot Helicopter External Gondola System (HEGS) and transition to full-scale engineering development. Initiate development and then conduct concept evaluation tests of the Low-Visibility Advanced External Load Acquisition System (LOVLAS) for cargo and utility helicopters. Define necessary changes and then initiate user testing of improved, lightweight components for the 25,000-pound-capacity cargo slings for helicopters (AMSS). Initiate flight tests of a Tandum Two-Hook Beam for the UH-60 when carrying external cargo. Design and then contract for test hardware to be used in the development of a method of acquiring, raising, and snubbing external cargo to the underside of helicopters (HEXCSS). Ground Support Equipment: Conduct advanced development through DT/OT I testing of Helicopter Battle Damage Repair (HBDR) concepts and a Standard Maintenance Information and Display System (SMIDS). Initiate development of the Damaged Aircraft Recovery Kit which will replace the current obsolete aircraft

Program Element: #6.32.09.A Title: Air Mobility Support
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

recovery kit with a new multiservice kit capable of transport on the UH-1 or UH-60. Manufacturing Technology: Initiate advanced development for a method of fabricating bulk material and rapidly solidified structures by continuous fusing of one layer of material onto another. Initiate advanced development of material systems and processes to substitute for critical/strategic materials.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.11.A
Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	12306	28438	33809	45459	Continuing	Not Applicable
DB41	Advanced Structures	8213	16234	21397	22501	Continuing	Not Applicable
D313	Research Aircraft Systems	961	775	1747	3236	Continuing	Not Applicable
D314	Advanced Rotor Systems	389	2155	1295	9094	Continuing	Not Applicable
D315	Advanced Flight Controls	2743	9274	9370	10628	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army needs these Advanced Technology Development Programs in order to field future aviation systems that are less expensive, and simultaneously more reliable, maintainable and survivable. In the Central Europe, the Middle East, or any known scenario, the modern helicopter will face an awesome array of air defense threat systems to include optically and radar-guided 23mm, 30mm and 57mm weapons; SA-6, 7 and 9, infrared and radar guided missiles; and potential nuclear/biological/chemical and laser threats. As a result, the helicopter must possess improved mobility firepower, and inherent features providing durability and sustainability for extended periods of combat. Army helicopters must be durable, damage resistant, easy to repair and maintain, and possess the highest level of availability possible. The application of composite materials to primary helicopter structures, fiber-optic technology to flight controls, and advanced rotor technology to existing and proposed rotor systems is the key to providing survivable Army aviation assets essential to the future integrated battlefield. These programs represent investments in Technology Development in order to maximize Army aviation's future availability and capability to perform its combat mission. This Program Element provides for the Advanced Development and Demonstration of Full-Scale Aircraft Components and Subsystems. As such, the work supported by this program element directly addresses these critical needs essential to future operational effectiveness through full-scale flight testing and demonstration of advanced state-of-the-art components and subsystems. Recently, major emphasis has been placed on advanced composite rotary-wing structures for lower weight, lower costs, longer life, and improved survivability; on advanced rotors for improved performance and ballistically tolerant materials at lower cost and with reduced maintenance requirements; and on advanced flight controls for reduced weight and cost, improved survivability, and reduced pilot workload and initial training requirements. Support costs for maintaining the experimental

Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

research and test aircraft used in the above programs are carried under a separate project line (D313) as shown above. The efforts to be accomplished under this program element will be a significant part of the technology base for the next-generation helicopters of the early- to mid-1990's. Selected near-term advances will be applied to aircraft such as the UH-60 BLACKHAWK and AH-64 APACHE as block modifications. This program funds technology thrusts that are absolutely essential if Army aviation is to as effectively contribute to the air/land battle of the 1990's to 2000 as it does to the current Army combined Arms Team.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Project DB41: Continues the Army's Advanced Composite Airframe Program (ACAP) to demonstrate that composite structural materials in helicopter primary structural components reduce cost weight, parts count and are consistent with the combat environment expected for Army aviation. Project D313: Continues su port for research aircraft used in exploratory and advanced development. This is necessary to reduce development times and permit flight demonstrations of emerging new concepts. Research aircraft include the Rotor Systems Research Aircraft (RSRA), the UH-1H in-flight simulator, XV-15 Tilt Rotor Research Aircraft, and other aircraft participating in joint Army/NASA projects. Project D314: Continues the Army's advanced rotor system demonstration program for significantly improved rotor efficiencies. Project D315: Continues the Army's advanced digital-optical (fiber-optic) flight control system (ADOCS) demonstration program for rotary-wing applications.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in Thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	12306	28438	33809	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	12792	28520	41084	Continuing	Not Applicable

The FY 1981 decrease is the result of reprograming action to higher priority Army programs and the application of general Congressional reductions for improved efficiencies. The FY 1982 decrease reflects the application of revised inflation and civilian pay pricing indices. The FY 1983 decrease again reflects reprograming action within the Army to higher priority programs.

Program Element: #6.32.11.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Rotary Wing Controls, Rotors, and Structures
Budget Activity: #2 - Advanced Technology Development

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.32.11.A
Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This advanced development program provides for the development, verification, and demonstration of vital technology in areas currently restricting Army airmobile systems. This continuing program is formulated on the basis that advances in state-of-the-art technology will be made only if technology is validated and technical confidence is gained through component or system demonstration in actual or simulated flight conditions. These demonstrations further influence early consideration of new technology integration with existing and state of the art systems and enhance opportunities to apply the technology to existing systems in block modifications or service life extension programs. The program includes efforts in advanced rotors and flight control systems and in the application of advanced materials and structures. Foreign state-of-the-art trends and potential threats to the present and future materiel systems and subsystems have been and are continually considered.

G. (U) RELATED ACTIVITIES: The technology being developed and demonstrated in this program is closely coordinated and related to work being conducted by the Navy, Air Force, and National Aeronautics and Space Administration (NASA). Duplication of effort is avoided through coordination with these agencies on a continuing basis and through joint program reviews, exchange of information and reports, the Technical Cooperation Program, NASA Research and Technology Committees, North Atlantic Treaty Organization (NATO) Standardization Agreements (STANAG's), and the NATO Advisory Group on Aerospace Research and Development (AGARD). This program is included in the Tri-Service Aeronautical Vehicle and Structures Technology Coordinating Papers. Efforts under this program are related to activities under Program Element 6.22.09.A, Aeronautical Technology, as well as to other major Army aircraft systems currently under development (AH-64 - Advanced Attack Helicopter-Apache). The Tilt Rotor Research Aircraft program is jointly funded by the Army, Navy, and the National Aeronautics and Space Administration (NASA), and the rotor research program utilizing the Rotor Systems Research Aircraft is jointly funded by NASA and the Army only. Numerous tasks in this program had their origin within efforts performed in Program Element 6.22.09.A, Aeronautical Technology.

H. (U) WORK PERFORMED BY: This work is performed by the Research and Technology Laboratories of the US Army Aviation Research and Development Command located at Moffett Field, CA; Fort Eustis, VA; and Hampton, VA. Work in related activities is also performed by the National Aeronautics and Space Administration (NASA) Ames and Langley Research Centers, located at Moffett Field, CA, and Hampton, VA. The top five contractors are: Hughes Helicopters, Culver City, CA; Sikorsky Aircraft, Stratford, CT; Boeing Vertol Company, Philadelphia, PA; Kaman Aerospace Corporation, Bloomfield, CT; and Bell Helicopter Textron, Fort Worth, TX. Much of the contract work is competitive, and the contractors are to be determined. The total anticipated contract dollar value for FY 1983 is approximately $25,000,000.

Program Element: #6.32.11.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Rotary Wing Controls, Rotors, and Structures
Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Project DB41: The Advanced Composite Airframe Program (ACAP) was initiated in FY 1979. A preliminary design was conducted which included trade-off investigations and concept selections. This effort was concluded in FY 1980. In FY 1980 a Request for Proposal (RFP) was released and proposals received for Phase I (detailed design and support testing) and Phase II (full-scale fabrication and ground/flight tests). In FY 1981, two contractors, Sikorsky Aricraft and Bell Helicopter Textron, were competitively selected for the Phase I effort with an option to initiate the Phase II effort. Project D313: This project was initiated to allow support cost for research aircraft to be identified separately from the cost of research conducted on or with the aircraft. Separation of research and support cost greatly facilitates tracking total development expenses. In FY 1980 these funds supported the UH-1H V/STOLAND aircraft involved in the controls program; the YO-3A aircraft, which was used for AH-1S (Ogee Tip) in-flight acoustic measurements; the Rotor Systems Research aircraft (RSRA) being readied for testing an S-61 rotor system; and the Tilt Rotor Research Aircraft currently completing concept validation. In FY 1981, noise measurements were conducted on a Hughes 500D with tandard and four-bladed tail rotor systems using the YO-3 aircraft. Flight tests were also initiated with an an AH-1G instrumented helicopter. Project D314: Advanced rotor work was previously accomplished under project D157. The most recent effort completed was the feasibility demonstration of the Bearingless Main Rotor (BMR) concept. In FY 1980 the Integrated Technology Rotor (ITR) Program was initiated to demonstrate the application of state-of-the-art rotor technology efficiencies. Funds from the project were also used in support of the S-61 rotor flight research efforts to establish a data base for the ITR. In FY 1981, a request for proposal (RFP) was released for the concept definition phase of the ITR program. This phase will examine various concepts, geometric constraints, approximate stress analysis, component sizing, and control system layouts to identify an optimum structural configuration on which to base a preliminary design. Project D315: All work in this area was conducted under the Advanced Digital/Optical Control System (ADOCS) program. Primary emphasis has been on the contractual development of various digital/optical (fiber-optic) components to include control media mechanization, fiber optic transducers, optical servovalves, nonconventional electric power supplies, and advanced rotor actuation concepts. In FY 1981, component development programs initiated in FY 1980 were completed and fabrication initiated. A contract was awarded for development of an advanced controller and related flight control system. The advanced digital/optical control system (ADOCS) flight demonstrator request for proposal (RFP) was issued with a planned award in 1Q FY 1982.

2. (U) FY 1982-FY 1984 Program: Project DB41: The Advanced Composite Airframe Program (ACAP) detail design will be completed along with the critical design review. Testing of specimens and test fixtures will be undertaken and

Program Element: #6.32.11.A
DOD Mission Area: #553 - Engineering Technology (ATD)
Title: Rotary Wing Controls, Rotors, and Structures
Budget Activity: #2 - Advanced Technology Development

manufacturing techniques will be assessed. Project D313: The Rotor Systems Research Aircraft (RSRA), configured in the helicopter mode, will continue S-61 helicopter rotor testing. Concept validation on the XV-15 Tilt Rotor Research Aircraft will be completed. Support for research activities involving the YO-3A, UH-1H, AH-1G, and CH-47 aircraft will continue. Project D314: Results of the concept definition phase will be evaluated and multiple contracts awarded 3Q FY 1982 for the Integrated Technology Rotor (ITR) preliminary design, which will extend the concept definition to the entire rotor system including blade design, controls/interface with flight vehicle, aerodynamic stability, loads, and handling qualities. Project D315: Emerging results from the advanced controller/flight control effort will be briefed and incorporated in the Advanced Digital/Optical Control System (ADOCS) flight demonstrator preliminary design. Advanced rotor actuation concepts will be completed with submission of a final report. Recommendations from this report will also be included in the preliminary design anticipated to be completed by the end of 1Q FY 1982. Detailed design of the ADOCS demonstrator will also be completed. For FY 1983: Project DB41: During the first half of FY 1983, Advance Composite Airframe Program (ACAP) design support tests will be completed and proposed manufacturing methods assessed. An in-process review will be held to evaluate contract efforts to date and provide final approval of complete aircraft detail design. On or about 3rd Quarter FY 1983, contractual efforts will be initiated for detailed tooling designs, development of manufacturing plans, and fabrication of full-scale airframe tooling. Project D313: S-61 rotor research will be completed. The Tilt Rotor Research aircraft will complete documentation testing, making the aircraft available for more extensive Army operational suitability tests and demonstrations to isolate known missions where the tilt rotor concept provides significant advantages over other aircraft configurations. Project D314: Preliminary design of the Integrated Technology Rotor (ITR) will be completed during 4th Quarter FY 1983. At this time, one or two contractors will be selected to conduct detailed design fabrication and flight test hardware. Project D315: Fabrication of flight test hardware including controller, sensors, and optical interconnects will be started and testing begun prior to aircraft installation. For FY 1984: Project DB41: The Phase II contract will continue. The fabrication of the flight vehicle will be initiated. Project D313: The Rotor Systems Research Aircraft (RSRA), YO-3A, UH-1H, AH-1G, will continue to be used in a variety of flight test programs. Project D314: The detailed design studies for the Integrated Technology Rotor (ITR) will be initiated early in FY 1984, followed closely by component fabrication and design substantiation testing. Planning will begin and a development plan prepared for the High Technology Rotor (HTR). Project D315: A full-up flight demonstration and verification of the Advanced Digital/Optical Control System (ADOCS) will be started in 4th Quarter FY 1984.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #DB41 Title: Advanced Structures
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: As units of the combined arms team, Army aviation members must be prepared to fight in a high threat environment at low altitude, day and night, and under all weather conditions. In the Central Europe, Middle East, or any known scenario, the helicopter will face an awesome array of air defense threat systems to include optically and radar guided 23mm, 30mm, and 57mm weapons; SA-6, 7, and 9 infrared and radar-guided missiles; and potential nuclear/biological/chemical and laser threats. As a result, the helicopter must possess improved mobility, firepower, and inherent features providing durability and sustainability for extended periods of combat. This necessitates that Army helicopters must be durable, damage resistant, easy to repair and maintain and possess the highest level of availability possible. The application of composite materials to primary helicopter structures is the key to providing the Army aviation essential for the future integrated battlefield. The objective of this project is to demonstrate and establish advanced structures technology for helicopters. The advanced structural technology resulting from this program will be applicable to current aircraft (UH-60 Black Hawk, AH-64 Apache) as product improvements as well as future Army aircraft systems and ultimately will benefit other DOD services, agencies, and the US helicopter industry as well. This program is designed to demonstrate that composite materials technology can be applied to primary rotorcraft structures to gain significant system improvements including: reduced weight and cost, increased ballistic damage tolerance, reduced radar cross-section, improved crashworthiness, reduced maintenance, improved survivability, and easier repair of battle damage while operating in a combat environment. State-of-the-art composite materials require less energy for fabrication than metals, will reduce demand for expensive metals in critically short supply, and promise reduced life cycle costs. The near-term goals for this program are a demonstration of a 22-percent reduction in cost and 24-percent reduction in system weight when compared with a baseline metal airframe.

B. (U) RELATED ACTIVITIES: The technology being developed and demonstrated in this program is related to Navy (62241N - Aircraft Technology) and the National Aeronautics and Space Administration (NASA) Research and Technology Objectives Plan (505-42-13). Duplication of effort is avoided by coordination with these agencies on a continuing basis through: joint program reviews, exchange of technical data and reports, The Technical Cooperation Program (TTCP), NASA research and technology committees, North Atlantic Treaty Organization (NATO) Standardization Agreements (STANAGS), and the NATO Advisory Group on Aerospace Research and Development. Efforts under this program are related to Exploratory Development tasks being accomplished under Program Element #6.22.09.A, Aeronautical Technology (Tech Area - AH76B). As part of a joint Army-NASA agreement initiated in 1979, the NASA Langley Research Center and the collocated Army Structures Laboratory (Army Aviation

Project: #DB41 Title: Advanced Structures
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

Research and Development Command) have structured a comprehensive Advanced Rotorcraft Technology Program to follow and complement the Army's Advanced Composite Airframe Program (ACAP). NASA, in turn, will investigate second-generation concepts for possible civil applications. These two programs are being closely coordinated to avoid duplication and derive maximum advancements in composite technology. Although there are similar civil and military composite structures requirements, combat suitability dictates that the Advanced Composite Airframe Program (ACAP) demonstrate the benefits of composites when considering military requirements such as vulnerability reduction, reduction of detection, crashworthiness, laser hardening, and chemical/biological agent protection/decontamination.

C. (U) WORK PERFORMED BY: This work is performed by the Applied Technology Laboratory at Fort Eustis, Virginia, a part of the US Army Aviation Research and Development Command. In FY 1981, two contractors, Sikorsky Aircraft and Bell Helicopter Textron, were competitively selected for a Phase I effort (detailed design and design support testing). This effort will continue for 17 months. Upon completion, Phase II (design fabrication and test) will commence upon formal recommendation of the review board. The total anticipated contract dollar value for FY 1983 is $19,000,000.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The preliminary design of the Army's Advanced Composite Airframe Program (ACAP) was initiated in FY 1979 as the principal effort for project number DB41. Preliminary concept design was solicited from all of the prime helicopter companies. This effort included trade-off investigations and concept selections with emphasis on the best concepts for composite structural joining, fabrication, assembly, and tooling. All primary and secondary airframe structure designs considered maximum benefits from weight, cost, producibility, maintainability, vulnerability, and survivability. The preliminary design investigation was completed in FY 1980, and the weight and cost savings were confirmed to be achievable. The next step was to demonstrate these improvements and to establish confidence in composite materials for primary airframe structures. Phase I (detail design and support testing) and Phase II (full-scale fabrication, ground/flight test) planning was therefore initiated, and proposals for this effort were received for evaluation. Technical personnel were drawn from the Army research community including the Ballistics Research Laboratory (BRL) and the Army Materiel and Mechanics Research Center (AMMRC), and personnel from NASA, the Navy, and the Air Force provided additional expertise for the Phase I selection. Two contractors, Sikorsky aircraft and Bell Helicopter Textron, were competitively selected for the Phase I effort with an option to initiate the Phase II effort based upon a review board decision. Current funding levels permit two contractors for Phase II. The primary focus of Phase I is on the detail design of the composite

Project: #DB4. Title: Advanced Structures
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

airframe structure with consideration of structural integrity, manufacturing methods, crashworthiness, laser, and radar effects, and interface with other vehicle systems and subsystems.

2. (U) FY 1982-FY 1984 Program: During FY 1982 design of test specimens (i.e., airframes sections, subcomponents, joints, attachments) and test fixtures will be initiated. Test specimen and fixtures will be fabricated, and laboratory design support tests also initiated. The design support tests will be conducted to verify and quantify structures and materials, radar reflectivity, drag/stability, airframe/landing gear drop test capability, and laser and lightning characteristics. Manufacturing methods for full-scale airframe fabrication, along with detailed design and design support test efforts, will also be further assessed and a final selection made. The Phase I effort will be completed by the end of FY 1982 and a Government In-Process Review will be conducted to review the status and results. Upon completion of the review, the Government will determine which Phase II effort(s) will be authorized. This procedure is the result of current funding limitations and realistic assessment of composite structures technology. At the start of FY 1983, the Phase II efforts will be initiated upon the recommendation of the In-Process Review. This effort will include airframe fabrication, structural test, flight vehicle assembly, and ground and flight test demonstration, and will continue for 30 months before completion of the program. Also during FY 1983, the Phase II effort will include detailed tooling designs and development of manufacturing plans along with fabrication of full-scale airframe assembly and tooling. The full-scale airframe components and airframe assemblies will be subjected to laboratory structural static and dynamic tests. Phase II contractual effort will continue into FY 1984. During this year laboratory structural tests will be completed. In addition to the structural tests, ballistic tests and airframe drop tests will also be conducted. The fabrication and assembly of flight vehicles will be initiated. These efforts will consist of fabricating three complete airframe assemblies. The manufacturing techniques selected will be assessed with regard to compatibility with the advanced structural configuration, and cost tracking of composite components will be performed to substantiate projected production cost trends. Upon successful assembly of the flight vehicles, ground tests of the vehicles will commence.

3. (U) Program to Completion: The ground test will be completed in early FY 1985. The first flight of the complete vehicle is scheduled for the first quarter of FY 1985 with 50 hours of flight test. The Advanced Composite Airframe Program (ACAP) will be completed in the third quarter of FY 1985. Based on the experience gained in the ACAP, the advanced composite structures technology will be utilized to initiate the Advanced Composite Rotor Hub program in FY 1984. This 3-year program is to develop and demonstrate composite rotor hub technology for implementation into the Army's inventory and new aircraft systems. The goals for this program are 22-percent weight savings, 24-percent acquisition cost savings,

Project: #DB41 Title: Advanced Structures
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

simplicity in design, reduced drag, and reduction and elimination of critical precious metals in the rotor hub. Advanced materials and automated manufacturing concepts for large structural components will be used to allow quantity production at lowest possible cost. At about the same time, this technology and experience will also be used to develop a small (3000-pound design gross weight), low-cost composite airframe with inherent concepts for crashworthiness and damage tolerance to protect helicopter crews and high-cost subsystems. This program will develop a small, lightweight, and highly durable composite airframe applicable to larger quantity production of the next-generation light helicopters (LHX) for the 1990's.

4. (U) Major Milestones:

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1982 Submission
Preliminary Design Completion	3Q FY 1980	3Q FY 1980
Phase I Award	2Q FY 1981	2Q FY 1981
Phase I Completion	4Q FY 1982	2Q FY 1983
Phase II Initiation	1Q FY 1983	3Q FY 1983
Phase II Completion		
ACAP Program Completion	3Q FY 1985	3Q FY 1985

The 6-month advance in Phase I completion is the result of contract negotiation for a revised funding profile which allows an 18-month period of Phase I performance instead of an extended 24-month phase. This shorter Phase I period permits a more cost effective overall program and timeliness of technology benefits and transfer. The advance in Phase I completion naturally will result in a six-month advance in Phase II initiation.

Project: #DB41 Title: Advanced Structures
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	8213	16234	21397	22501	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6571	16282	19529	N/A	Continuing	Not Applicable

The funding increase in FY 1981 reflects a minor Congressional supplemental increase. In FY 1982, the funding decrease reflects changes in inflation indices and adjustments for civilian pay increases. In FY 1983, the funding increase reflects an FY 1982 amended program adjustment necessitated by refinement of the Army's advanced structures program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D315 Title: Advanced Flight Controls
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to advance flight contro technology for Army aircraft through development, verification, and validation of improved flight control concepts. This program is necessary to provide improved capability, survivability, reliability, maintainability, and a better crew-aircraft (man-machine) interface for rotorcraft systems. The program includes the integration of flight control system logic, mechanization, displays, and sensors into the aircraft system. The basic approach uses a digital avionics and fiber optics data connector. The principal goal of the program is to permit pilots to perform demanding nap-of-the-earth, adverse weather, and night operational missions without mission degradation due to excessive pilot workloads and allow the pilots to concentrate on tactical mission needs. Emphasis will be on systems that can be retrofitted to existing aircraft as product improvements and on supporting near-term development programs. Critical test missions include tactical flight profiles for nap-of-the-earth/low-level terrain flying during adverse weather and hostile battlefield conditions for both day and night operations.

B. (U) RELATED ACTIVITIES: The technology being developed and demonstrated in this program closely follows related Navy (Program Element #6.22.41.N, Aircraft Technology), Air Force (Program Element #6.22.01.F, Flight Dynamics), and National Aeronautics and Space Administration (NASA) programs (Research and Technology Operations Plan: 505-42-31). Coordination with these agencies and others is accomplished on a continuing basis to include: joint program reviews; exchanges of technical information and reports; execution of joint projects; and program interfaces required as part of the Department of Defense Tri-Service Aeronautical Vehicle Technical Coordinating Paper (TCP). Program duplication of effort is also avoided through technical panel and action group coordination as a part of The Technical Cooperation Program (TTCP), NASA's Research and Technology Committees, North Atlantic Treaty Organization (NATO) Standarization Agreements (STANAG's) and the NATO Advisory Group on Aerospace Research and Development (AGARD). This program is supported, in part, by exploratory development activities under Program Element #6.22.09.A, Aeronautical Technology, as well as other major Army aircraft weapon systems currently under development (AH-64 Advance Attack Helicopter-Apache).

C. (U) WORK PERFORMED BY: This work is performed by the Research and Technology Laboratories, a part of the US Army Aviation Research and Development Command. Laboratories located at Moffett Field, CA, and Fort Eustis, VA, will execute the program. Work in related activities is also performed by the National Aeronautics and Space Administration Ames Research Center, located at Moffett Field, CA. The contracts for FY 1982 will be competitively determined. The total anticipated contract dollar value for FY 1982 is approximately $7,602,000.

Project: #D315 Title: Advanced Flight Controls
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The Advanced Digital/Optical Control System (ADOCS) Determination and Finding (D&F) was approved third quarter FY 1979. Since that time, the program has focused on the development of components and technology in anticipation of the FY 1984 flight demonstration program. The two control media mechanization programs investigating fly-by-wire and fly-by-fiber optics trade-offs were initiated in FY 1980 and completed in FY 1981. This effort provided data on optimum control media paths along with information on additional testing necessary to assure successful utilization in a control system. The six digital optical transducer programs initiated in FY 1980 completed preliminary and detail design phases and began fabrication. Design data obtained under these contracts will be available for the Advanced Digital/Optical Control System (ADOCS) flight demonstration contractor for preliminary system design. The optical servovalve contract awarded in last quarter FY 1980 completed preliminary and detail design phases and began fabrication. The Advanced Controller/Advanced Flight Control System (AFCS) contract was awarded first quarter FY 1981 with a 24-month period of performance. During this period, initial literature review, analyses, and simulations will be completed. An advanced rotor actuation concept contract was awarded in first quarter FY 1981 with a period of performance of 15 months. All technical work under this contract was completed in FY 1981 and includes preliminary designs of small- and medium-size helicopter rotor actuation concepts. The Advanced Digital/Optical Control System (ADOCS) flight demonstration Request for Proposal (RFP) was issued second quarter FY 1981 with planned award in first quarter FY 1982. A 52-month period of performance is planned. The entire preliminary design phase for the digital optical and backup control systems is planned to be completed in FY 1982.

2. (U) FY 1982-FY 1984 Program: The six digital optical transducer contracts and the two optical servovalve contracts will be completed in FY 1982. The resulting design and test data will be used to assist in selection of the technology concepts to be used in the flight demonstration control system. The advanced controllers Advanced Flight Control System Task I post-simulation briefing will provide data to the Advanced Digital/Optical Control System (ADOCS) flight demonstration contractor in first quarter FY 1982. The Task II completion and post-simulation briefing is planned for last quarter FY 1982. This will supply control/display system information to the flight demonstration contractor. Also during this period, the advanced rotor actuation concepts will be completed with submission of the final report. The recommendations from this preliminary contract will be analyzed for potential follow-on laboratory hardware for feasibility demonstrations. The flight demonstration preliminary design will be completed and the detail design started fourth quarter FY 1982. A one-year effort will be started in the second quarter FY 1982 to investigate the feasibility of an optical to fluidic servovalve and of an

Project: #D315 Title: Advanced Flight Controls
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

optical switch mechanism. Both concepts represent significant advances over current optical and fluidic technology. Detail design of the flight demonstrator will be completed during the first quarter of FY 1983. Upon completion, fabrication of hardware will begin immediately, with projected completion during first quarter FY 1984. Integration and testing of all flight hardware will be completed prior to aircraft installation. All flight hardware will be installed in the test aircraft and subjected to extensive ground and tiedown testing prior to actual flight testing. Flight safety approval will be obtained following completion of the ground test program. First flight will occur fourth quarter FY 1984. Additional work on advanced optical component concepts will be continued to include the completion of the optical/fluidic servovalve and optical switch effort initiated in FY 1982. A full-up flight demonstration and verification of the Advanced Digital/Optical Control System (ADOCS) will be initiated fourth quarter FY 1984.

3. (U) Program to Completion: A full-up flight demonstration and verification of the advanced digital/optical control system will be completed at the end of FY 1984 or start of FY 1985. This program is a continuing effort which will develop other advanced flight control hardware and associated technology.

4. (U) Major Milestones:

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1982 Submission
Contract Program Initiation	3Q FY 1980	3Q FY 1980
Program Initiation, Flight Demonstration	1Q FY 1982	4Q FY 1981
First Flight	4Q FY 1984	4Q FY 1983
Final Report (ADOCS)	1Q FY 1986	4Q FY 1984

The delay in the initiation of the flight demonstrator program from 4Q FY 1981 to 1Q FY 1982 was due largely to a redistribution of funds within the program element during the fiscal year. Delay of first flight from 4Q FY 1983 to 4Q FY 1984 resulted from the above delay and from a more realistic schedule based on additional planning. Completion of the program (Final Report) has been changed from 4Q FY 1984 to 1Q FY 1986 to reflect the above changes as well as a change in the test plan. (The number of flight test hours was increased from 25 hours to 100 hours, thus accommodating a planned follow-on program in the basic demonstration effort.)

Project: #D315 Title: Advanced Flight Controls
Program Element: #6.32.11.A Title: Rotary Wing Controls, Rotors, and Structures
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

5. (U) Resources ($ in Thousands): A full-up flight demonstration and verification of the advanced digital/optical control system will be demonstrated at the end of FY 1983 or start of FY 1984. The program is a continuing effort.

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	2743	9274	9370	10628	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4892	9302	10562	N/A	Continuing	Not Applicable

The adjustment in FY 1981 reflects a redistribution of funds within the program element to higher priority Army projects. The FY 1982 and FY 1983 decreases reflect changes in inflation indices, adjustments for civilian pay increases, and restructuring of the Advance Digital/Optical Control System (ADOCS) project profile.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environmental & Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3926	5980	3522	8278	Continuing	Not Applicable
DB34	Rotorcraft Systems Integration Simulator (RSIS)	3436	2616	3311	4286	Continuing	Not Applicable
DB39	Flight Simulator Components	490	3364	211	3992	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army, the other Services, and other Federal Agencies need an engineering simulator to reduce development cost of rotorcraft systems by providing the means to examine new technology developments, rotorcraft systems integration problems, and man-machine interface problems early in the development cycle. Use of a high fidelity engineering simulator in rotorcraft development will reduce time as well as cost. Also, the Army and the other Services have a continuing need for development of advanced flight simulator components to offset increased training cost and to provide the simulated environments required for training full combat mission training for the AH64 APACHE and other sophisticated weapon systems using sensors and flying at Nap-of-the-Earth (NOE). This program provides for the development of a versatile, high-fidelity, ground-based helicopter simulator to support Army aviation system development and for the development of flight simulator components to provide simulated environments required for pilot/gunner combat training. Use of the simulator for system development include support of conceptual design trade-offs, prototype development, flight tests, product improvement evaluations, and analysis of aircraft accidents and investigations for accident prevention (DB34), flight simulator component development includes development of advanced components such as scene generator, threat array, and systems integration into flight training systems for the AH64 APACHE and other Army simulators (DB39).

Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environmental & Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Continue the contract development of the Advanced Cab and Visual System (ACAVS), and accept delivery of the rotor system motion generator - perform integration into development station at AMES research center. Complete motion generator system development. Continue planning related to simulator operational uses (DB34). Continue accelerated development of feasibility demonstration brassboard of advance simulation capabilities and scene management techniques needed to meet AH64 combat mission simulator requirements (DB39).

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST ($ in thousands):

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	3926	5980	3522	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	6366	7773	5764	Continuing	Not Applicable

FY81 decrease reflects the application of general Congressional reduction. The FY82 decrease: Adjusted inflation indices and Congressional reduction in RDTE funding. FY83 decrease: Due to funding requirements of higher priority, the Army deferred the aviation training center simulator (DB35) and reduced funds for advance development in simulator visionics (DB39).

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.32.16.A
Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environmental & Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to provide the Army the advance research necessary for providing realistic, cost effective, and life saving state-of-the-art synthetic flight simulators. Rotorcraft Systems Integration Simulator (RSIS): Numerous studies, including those by the Army Scientific Advisory Panel (ASAP) Ad Hoc Working Group on Research Facility Requirements for Nap-of-the-Earth (NOE) Day/Night Visual Flight Studies, recommended that the Army, as the lead Service for helicopter R&D, place increased emphasis on research and development in helicopter flying qualities using ground-based simulation. Use of the ground based simulation technique in helicopter development will permit more detailed evaluation of engineering concepts before a commitment to flight hardware, will compress development time and reduce cost. The Rotorcraft Systems Integration Simulator (RSIS) expands the capabilities of the National Aeronautics and Space Administration (NASA) Vertical Motion Simulator, under a joint Army-NASA agreement. This agreement will minimize costs of a high fidelity simulator obtain increase technical expertise in the development of this aeronautical engineering research facility. The Flight Simulator Component (FSC) program provides for the development and demonstration of advanced flight simulation techniques and components for incorporation into the design of future simulators or and for improving training capabilities of current simulators. Full consideration is being given to the accomplishment of the program through cooperative development with Navy and Air Force laboratories. This effort includes the development of visual simulation components designed to provide full mission training capability for NOE flight, navigation, gunnery, and survivability in a combat environment. Current program includes preliminary design studies and brassboard demonstration for the development of wide-angle, high-resolution, high pictorial detail visual simulation techniques that provide large frontal and downward angle viewing for NOE flight and integrate multiple-viewpoint sensor displays for tactical mission training. Multiple viewpoint displays that simultaneously provide a scene by the pilot's eye and as sensed by infrared or optical sensors located in other parts of the aircraft - are critical for weapons system and crew integration training. Efforts related to training in gunnery skills include the development of innovative techniques for multiple viewpoint image generation and display for effectively simulating extended range target and sensor images. Technologies include computer image generation (CIG) edge management techniques for full mission simulation. The Army Scientific Advisory Panel (ASAP) also recommended a modest increase in utilization flexibility of an existing training simulator for training-related research. An Aviator Training Research Simulator (ATRS) Letter of Agreement (LOA) is being staffed between TRADOC and DARCOM to define requirements for a research simulator configured specifically for the study of aviation training problems, and the means to improve aviation training while declining costs.

Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environmental & Life Sciences Budget Activity: #2 - Advanced Technology Development (ATD)

G. (U) RELATED ACTIVITIES: Program Element 6.42.17.A, Synthetic Flight Training Systems, and 6.22.09.A, Aeronautical Technology. This research and development effort is unique to Army requirements of simulating Nap-of-the-Earth (NOE) helicopter flight visual simulation displays. Coordinated use of Air Force and National Aeronautics and Space Administration (NASA) facilities is being accomplished to minimize program costs. The Research and Engineering Division, Project Manager for Training Devices, Naval Training Equipment Center is tasked with the responsibility to monitor all related research and development to preclude duplication of effort.

H. (U) WORK PERFORMED BY: The Project Manager, Training Devices, Orlando, FL; Naval Equipment Training Center, Orlando, FL; US Army Research and Technology Laboratories, Ames Research Center, Moffett Field, CA; American Airlines Simulator Engineering, American Airlines Plaza, Fort Worth, TX. Total program control is exercised by the Army Materiel Development and Readiness Command.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Rotorcraft Systems Integration Simulator: Completed preliminary design studies for modifying National Aeronautics and Space Administration (NASA) Vertical Motion System. Installation of a CDC 7600 general-purpose digital computer which will satisfy the computational requirements of the Rotorcraft Systems Integration Simulator (RSIS). Contracts awarded for modifying the NASA Vertical Motion Simulator (VMS) motion system and conceptual design studies for the interchangeable cab, cab development station, and the advanced visual system. Flight Simulator Components: Feasibility of a single channel Laser Scan Image Generator (LSIG) was demonstrated and achieved improved visual display scene quality at substantially reduced operating costs. The LSIG design was included in the Cobra simulator production contract. Cooperative effort drew to completion with demonstration in 1QFY82 of the cability for generating a high-detail region in a low-detail background scene. This technique is being developed to simulate targets and weapon effects out to maximum ranges of aerial weapon systems for training target recognition and acquisition.

2. (U) FY 1982-FY 1984 Planned Program: Rotorcraft Systems Integration Simulator (RSIS): Receive competitive proposals, evaluate and award the contract for advance cab and visual system. Flight Simulator Component: Award multiple contracts for integration of R&D exploratory programs that demonstrate advance visual simulation capabilities such as providing multiple viewpoints and multispectral/visual simulations required for AH64 combat mission simulator and other emerging advanced weapon systems. Continue cooperative efforts for design and development of a wide-angle, high-detail, light-value

Program Element: #6.32.16.A Title: Synthetic Flight Simulators
DOD Mission Area: #552 - Environmental & Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

projector. In FY83, the Rotorcraft Systems Integration Simulator (RSIS) program will complete the motion generator system development. Continue the contract development of the advanced cab and visual system. Furthermore, the flight Simulator Components will select the most viable concepts for meeting AH64 Combat Mission Simulator requirements and initiate accelerated development of feasibility demonstration brassboards and scene management techniques required for advanced visual simulation capabilities to support AH64 CMS. Delivery and evaluation of light-value projector for use in wide-angle, high-resolution displays. In FY84, the Rotorcraft Systems Integration Simulator: Initiate integration of the Advanced Cab and Visual System to the motion base. Begin initial RSIS system checkout and verification. Flight Simulator Components: Initial demonstration and evaluation of advance visual simulation capabilities including integration of improved prototype light-value projector. Begin development of next-generation image generation technology to support requirements for high-rate information processing and image delivery systems.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.16.A
Title: Airdrop Equipment and Techniques
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1775	2695	1688	2084	Continuing	Not Applicable
D266	Airdrop Equipment & Techniques	1775	2695	1688	2084	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports advanced development of airdrop equipment and techniques to reduce airdrop aircraft vulnerability to enemy air defenses, to improve operational capability to conduct airborne assaults including Rapid Deployment operations, and to provide an improved airdrop resupply capability for both airborne and conventional forces of all services. Development of personnel and cargo parachutes, airdrop containers, and other aerial delivery equipment is included. addressed are of airdrop forces and materiel, and

Efforts are focused on new airdrop equipment and techniques which are transitioned from Program Element 6.22.10.A, Airdrop Technology, for demonstration of technical, operational, and economic feasibility prior to final development and fielding as airdrop equipment. Thus, this program element provides a vital link between research and engineering of airdrop equipment and techniques.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Continue development and validation of: a capability to airdrop supplies from high altitudes (Ultra-High Level Container Airdrop System); a means to facilitate rapid assembly of airborne forces on drop zone during low-visibility conditions (Drop-Zone Assembly Aids, Non-Visual); and a system that increases the capabilities to airdrop supplies from C141 aircraft (Bundle Airdrop System (C141)). Complete the advanced development and transition to

Program Element: #6.32.18.A Title: Airdrop Equipment and Techniques
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

engineering development the following: Drop Zone Assembly Aids, Visual, for clear/good-visibility conditions and a system to permit tandem airdrop of platform loads using the Airdrop Controlled Exit System.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1775	2695	1688	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1258	2702	4709	Continuing	Not Applicable

The increase of $517 thousand in FY 1981 resulted from reprograming funds from Project Element 6.42.18.A, Airdrop Equipment Development. The FY 1982 decrease of $7 thousand resulted from the application of revised inflation pricing indices. The $3021 thousand decrease in FY 1983 reflects reprograming of funds to higher Army RDTE priorities.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) Not applicable.

Program Element: #6.32.18.A Title: Airdrop Equipment and Techniques
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: There are nine major tasks scheduled under this program element in the period FY 1982-1984. Not all of these tasks, however, will be ongoing concurrently. The tasks are the advanced development of: (1) Drop Zone Assembly Aids Systems (Visual and Non-Visual) to permit rapid location and identification of airdropped materiel and rapid assembly of airborne units; (2) Airdrop Controlled Exit System to solve the problem of excessive drop-zone dispersion for heavy drop platform loads; (3) Ultra High Level Container Airdrop System to provide the capability to airdrop supplies from an altitude of 7600 meters with an accuracy of 200 meters; (4) Bundle Airdrop System (C-141) to permit the airdrop of supplies and personnel from an aircraft during a single pass over the drop zone; (5) Special Operations Advanced Parachute System (ram air parachute) to provide a capability to airdrop personnel accurately from high altitudes and large offsets from the target area; (6) Heavy Drop Rigging System to enhance rigging and derigging of platform loads; (7) High-Level Platform System to allow airdrop of platform loads from an altitude of 7600 meters; and (8) Two-Staged Personnel Parachute System to provide a capability to airdrop personnel and accompanying bundles at low altitudes and high speeds.

G. (U) RELATED ACTIVITIES: Program Element 6.22.10.A, Airdrop Technology; Program Element 6.42.18.A, Airdrop Equipment Development; Joint Air Movements Board; Joint Technical Airdrop Group; Mutual Weapons Data Exchange Agreements with France, Germany, and Korea; North Atlantic Treaty Organization Air Transport Working Party; United States/German Non-Major Items Meetings; and Air Standardization Coordinating Committee, Working Party 44, Standardization Agreements. International and interservice agreements and boards are used to exchange information on gains in airdrop technology, to avoid duplication of effort through joint and combined efforts, and to promote and attain the objectives of US Rationalization, Standardization, and Interoperability (RSI) policies and programs.

H. (U) WORK PERFORMED BY: Arthur D. Little, Inc., Cambridge, MA; Army Electronic Warfare Laboratory, Ft. Monmouth, NJ; Naval Ordnance Station, Indian Head, MD; AAI Corporation, Baltimore, MD; US Army Yuma Proving Ground, Yuma, AZ; and US Army Natick Research and Development Laboratories, Natick, MA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The design of the parachute recovery system for the Ultra-High Level Container Airdrop System (provides a capability to airdrop supplies from an altitude of 7600 meters) was completed; two preliminary airdrop tests were successfully conducted; and the developmental/operational test plans were prepared and approved. Plans were completed to test the Airdrop Controlled Exit System, and prototype systems were fabricated for engineering

Program Element: #6.32.18.A Title: Airdrop Equipment and Techniques
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

design tests and Development Test 1. The design of the pyrotechnic cutter for controlling the Two-Staged Personnel Parachute System for airdrop of personnel and accompanying bundles at low altitudes and high speeds was finalized and verified through developmental testing. Based on the results of an exploratory contract effort, prototype items were procured for the Drop-Zone Assembly Aids System, Visual--a developmental system to permit rapid assembly of airdropped men and materiel on the drop zone. An advanced development study and feasibility testing was initiated at the Electronic Warfare Laboratory, Ft. Monmouth, NJ, for a covert electromagnetic means to permit rapid assembly of airdropped forces under low-visibility conditions (Drop-Zone Assembly Aids, Non-Visual).

2. (U) FY 1982 Program: Conduct the In-Process Review and then transition to full-scale development the Two-Staged Personnel Parachute System with accompanying Bundles. Continue the advanced development/validation of the following work units: Drop-Zone Assembly Aids, Visual and Non-Visual; Airdrop Controlled Exit System; and Ultra-High Level Container Airdrop System. Initiate the following developmental efforts: Bundle Airdrop System (C141) to permit a greater capability to airdrop personnel and their equipment from C141 aircraft, Special Operations Advanced Personnel Parachute System, which will permit greater capabilities for special operations personnel to parachute from higher altitudes and offset distances to 50 kilometers from the landing zone, and a simpler/more efficient Heavy Drop Rigging System for platform loads.

3. (U) FY 1983 Planned Program: Complete the advanced development and prepare for transition to full-scale development in FY 1984 the Airdrop Controlled Exit System and Drop Zone Assembly Aids, Visual. Complete the design of components and initiate the Development/Operational Test I for the Bundle Airdrop System for C141 aircraft. Conduct Developmental/Operational Test I of the Ultra-High Level Container Airdrop System. Conduct design testing of the Electronic Wariare Laboratory concept(s) for Drop-Zone Assembly Aids, Non-Visual, and initiate design of a heading/distance prototype.

4. (U) FY 1984 Planned Program: Complete the advanced development and prepare for transition to engineering development in FY 1985 the Ultra-High Level Container Airdrop System and Bundle Airdrop System for C141 aircraft. Continue development and validation of the Drop-Zone Assembly Aids, Non-Visual, and the Special Operations Advanced Parachute System.

5. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.32.20.A Title: Light Helicopter Advanced Technology Demonstration (LHATD)

DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development (ATD)

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	0	944	14060	26100	41104
D325	LHATD	0	0	944	14060	26100	41104

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The work performed under this program element supports concept formulation and unique advanced development which is essential to permit Army aviation to sustain its mission capability in the Air/Land Battle of the 1990-2000's. The objective of this program is to conduct the development associated with a low-cost, lightweight, highly agile family of next-generation helicopters integrating the emerging technologies in composite structures, advanced avionics/electronics, flight controls, rotors, weapons, and propulsion systems. The resulting technology will provide significant improvements in helicopter weight, life cycle costs, battlefield sustainability, deployability, and adverse weather operation. The approach is based on a family of aircraft using a common dynamic baseline system to provide a simple, affordable, high-capability fleet of scout/attack and utility/observation helicopters to complement the current AH-64 (APACHE) and UH-60 (BLACK HAWK) fleets and tailored to the rapid deployment of future US forces and the air-land battle 2000. Projected improvements in Warsaw Pact air defense systems, lasers, electromagnetic pulse, chemical/biological, and electromagnetic warfare dictate that a new low mix capability in attack, observation, scout, and utility be developed as an option to the aging low mix of OH-58, AH-1, and UH-1H helicopters to counter the numerically superior Warsaw Pact. This series of light helicopters (LHX) represents a new plateau of airmobile capability by intentionally and precisely integrating all current and emerging technology. The result will be a helicopter that outperforms the Hind helicopter and its replacement, is more than 20-percent lighter than current technology aircraft, uses 30 percent less fuel, and substantially reduces crew workload.

Program Element: # 6.32.20.A Title: Light Helicopter Advanced Technology Demonstration (LHATD)

DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development (ATD)

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The current fleet of OH-58, AH-1, and UH-1s will begin to reach their programed service lives by the late 1980s or early 1990s. Service life extension programs will prolong the useful life of these aircraft, but will not adequately increase their capability to meet the forecasted threat. Significant technology improvements from ongoing development efforts will be available from composites, digital avionics, advance technology rotors, propulsion systems, lightweight drive components, and advanced weaponry; however, certain light helicopter-peculiar system demonstrations are required to resolve critical interface questions, evaluate optimum survivability and mission equipment packages, and establish the basis for Required Operational Capability (ROC) and System Specification inputs prior to prototyping and full-scale engineering development. The Light Helicopter Advance Technology Demonstrator (LHATD) program will accomplish these demonstrations and assure availability of low-risk integrated system technology for helicopter industry prototyping. The generic technical base programs have been reviewed for application to the Light Helicopter (LHX) family, and the funding level for LHATD is considered the minimum essential to meet program objectives.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands): Advance development initiated in FY 1983.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.32.20.A Title: Light Helicopter Advanced Technology Demonstration (LHATD)

DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development (ATD)

F. (U) DETAILED BACKGROUND AND DESCRIPTION: In November 1979, the Advanced Scout Helicopter (ASH) Special Army Systems Acquisition Review Council (ASARC) gave specific direction to proceed with the Army Helicopter Improvement Program (AHIP) in response to the near-term scout requirement, and also gave guidance to continue concept formulation for a new airframe development. Based on this latter tasking, concept studies for a family of light helicopters (LHX) were initiated, and the technology base was reviewed for application. During January-April 1981, the requirement for an LHX was investigated, and results showed both a quantitative and qualitative deficiency in the Army's helicopter fleet when projected into the 1990s timeframe. As a result, the Light Helicopter Advanced Technology Demonstration (LHATD) program was entered in the FY 83-87 POM to provide the essential technology bridge between the generic technology base programs and full-scale engineering development. Based on emerging results of the Aviation Mission Area Analysis (AMAA) and previous requirements studies, the Aviation Center, Ft. Rucker, AL, has drafted a Mission Element Need Statement (MENS) and is coordinating this document for approval in 4QFY 1982.

G. (U) RELATED ACTIVITIES: Concept and program formulation efforts have been conducted by the Directorate for Advanced Systems, Headquarters, US Army Aviation Research and Development Command (AVRADCOM), under Program Element 6.22.09.1, Aeronautical Technology, Project AH76. Project personnel maintain close liaison with other military services, industry officials, and user representatives as well as participate in Joint Working Groups. The Research and Technology Laboratories, AVRADCOM, are preparing a comprehensive Technology Development Plan (TDP) to insure full application of the generic technology base program and preclude duplicative efforts.

H. (U) WORK PERFORMED BY: The work will be performed by the Research and Technology Laboratories and Avionics Research and Development Activity of AVRADCOM. The principal laboratories involved are located at Moffett Field, CA; Ft. Eustis, VA; and Ft. Monmouth, NJ. Overall program direction and coordination will be provided by the Directorate for Advanced Systems, HQ AVRADCOM, prior to transition to a Project Manager's Office.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Not Applicable.

2. (U) FY 1982-FY 1984 Planned Program: In FY 1983 initiate advanced technology demonstrations of integrated cockpit

Program Element: # 6.32.20.A Title: Light Helicopter Advanced Technology Demonstration (LHATD)

DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development (ATD)

and mission equipment; lightweight, compact armament systems; and various integrated survivability features such as Nuclear, Biological, Chemical (NBC), laser countermeasures, and reduced observability. The integrated cockpit effort exploits the results of the Advance Digital/Optical Control System program as well as the Adverse Weather Fire Control Acquisition Radar System; integrates other advanced avionics, displays, flight controls, and weapon systems; performs comprehensive piloted simulation; and validates simulation through flight testing. The armament system task develops a preferred approach for multiple target servicing and establishes the desired level of weapons systems automation while optimizing weapons systems capabilities. The survivability task develops an optimum mix of survivability enhancement features and establishes a basis for the Required Operational Capability (ROC) and System Specification inputs. For FY 1984, advanced technology demonstrations will continue and augment generic technology base Advanced Development (6.3a) programs in areas identified by the Technology Development Plan and continuing concept studies. Tasks currently identified include: (a) expanding the advanced drive system component program into a subsystem demonstration, (b) flight testing of the adaptive fuel control, and (c) optimization of the integrated technology rotor for higher speeds.

3. (U) Program to Completion: The Advanced Technology Demonstration Program will be completed in FY 1986 and will resolve critical technology issues, develop best component mixes, and establish requirements and system specification inputs. Data obtained will provide low-risk technology engineering development approaches for contractor prototyping at the most advanced levels available.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.32.21.A Title: Nap-of-the-Earth Avionics and Navigation Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2-Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1594	2336	1899	8932	Continuing	Not Applicable
DB96	Aircraft Navigation & Control Equipment	140	0	0	1276	Continuing	Not Applicable
D312	Nap-of-the-Earth Essential Equipment	1454	2336	1899	7656	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the advanced development (AD) of air traffic management systems and new equipment to provide helicopter operation Nap-of-the Earth (NOE), in a sophisticated threat environment. DB96 supports the Combat Support Air Traffic Management System (CATMANS). The Combat Support Air Traffic Management System (CATMANS) will integrate existing sensor inputs from several sources in order to respond rapidly to airspace management requirements in a timely manner. Additionally, CATMANS will provide capability for enroute monitoring and terminal approach and landing of air traffic. The overall objective is to provide a coordinated Air Traffic/Airspace Management capability to apply Army Aviation assets more efficiently to the support of the ground battle. D312 supports development of new equipment to allow effective helicopter operations at those nap-of-the-earth altitudes required to avoid sophisticated enemy surveillance and air defense systems. Emphasis is on airborne target handoff which allows digital burst transmission so that target information from a scout helicopter can be instantly converted into firing information by an attack helicopter; a Multiple Antenna Unit to maintain line-of-sight communications; extended range navigational capability over land or water to support the Rapid Deployment Force concept; environment sensor capable of performing many functions simultaneously; the incorporation of Ring Laser Gyro (RLG) into an Attitude Heading and Reference System (AHRS) which will improve navigation accuracy; fabricate a testbed for applied systems integration which will be used to validate and standardize avionics systems architecture prior to production.

Program Element: #6.32.21.A Title: Nap-of-the-Earth Avionics and Navigation Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2-Advanced Technolog Development

C. (U) BASIS FOR FY 1983 REQUEST: The FY 1983 request supports: advance development in the Combat Support Air Traffic Management System; completion of the Multiple Antenna Unit and the extended range navigation advanced development; initiation of the Ring Laser Gyro-Attitude Heading and Reference System integration; and support of the testbed for system integration.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1594	2336	1899	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1594	6292	11570	Continuing	Not Applicable

FY 1982 decrease resulted from reprograming to meet higher Army priorities and Congressional action. FY 1983 decrease results from the elimination of planned programs such as a new sensor to allow aircraft to fly NOE by avoiding wire-like objects and the advanced state-of-the-art aircraft communications package. FY 1983 funding for JTMLS was placed on higher priority items pending review of alternatives to meet the Army landing requirement in the context of the overall, developing Position/Navigation architecture. A decision is expected in March and may require Congressional support to reestablish FY 1982 and/or FY 1983 funding.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.32.21.A Title: Nap-of-the-Earth Avionics and Navigation Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2-Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Project DB96: The Federal Aviation Administration (FAA) manages and funds the National Microwave Landing System (NMLS) development. However, in accordance with mutual agreements between the FAA and Department of Defense (DOD), funds ($6.5 million) and management responsibilities were transferred to DOD for the development of the first military system, the Joint Tactical Microwave Landing System (JTMLS). Program management responsibilities for the military systems are now assigned to DOD, who designated the Army as lead service for the JTMLS development. Although civil MLS equipment has been developed for test and evaluation, equipment to satisfy military requirements has not been developed. For the military, there are several key technical issues affecting the acceptance and ultimate design which have not been totally resolved. They are: adequacy of the proposed precision L-Band Distance Measuring Equipment (DME) to achieve accuracies to meet tactical needs; feasibility of operation in a tactical environment; performance of reduced-size ground antennas; and adequacy of collocated azimuth/elevation ground unit operation. The Advanced Development phase has concentrated on these critical issues. Project D312: This project was initiated to fund subsystems needed for nap-of-the-earth helicopter operations. Efforts center on a digital automatic target handoff system to allow a scout helicopter to pass target information rapidly to waiting attack helicopters without giving itself away to enemy detectors. Additional efforts include work in the areas of NOE navigation, environment sensing, and systems integration. The Multiple Antenna Unit will allow the transmission or reception of line-of-sight communication and navigation signals regardless of attitude/direction/location. An extended range navigation system will be developed which will support deployment of Army aircraft over extended distances across land or water. This is a capability which currently does not exist but is required for aircraft self-deployment in support of the Rapid Deployment Force (RDF). Present navigation systems employ conventional gyro technology which is limited in its operation. The Ring Laser Gyro-Attitude Heading Reference System development program will improve current navigation systems by replacing conventional gyros with a strapdown Ring Laser Gyro. The environment sensing efforts will take promising technologies from Exploratory Development and further refine them towards the ultimate goal of providing a sensor which will be capable of simultaneously performing target discrimination, accurate doppler navigation, precision hover and wire detection. In the systems integration area, a testbed will be fabricated which will be used to prototype avionic systems prior to production. This type of avionics prototyping is not presently being performed prior to production causing unexpected increases in production costs.

G. (U) RELATED ACTIVITIES: In order to avoid unnecessary duplication of effort, related programs of the Air Force, Navy, Federal Aviation Agency, and other organizations are monitored by the Army through committees and working groups. Cost reduction is pursued through joint developments and hardware standardization. This program element is related to Program Elements #6.22.02.A, Aircraft Avionics Technology, and #6.42.01.A, Aircraft Avionics. The Joint Tactical Microwave Landing System (JTMLS) program will capitalize upon the collective background and technology base already established through

Program Element: #6.32.21.A Title: Nap-of-the-Earth Avionics and Navigation Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2-Advanced Technology Development

ongoing development of the Federal Aviation Administration's (FAA) civil Microwave Landing System. The FAA program has proceeded through the technique analysis/contract definition and feasibility demonstration phases with prototype development and evaluation.

H. (U) WORK PERFORMED BY: Avionics Research and Development Activity, Fort Monmouth, N.J. Contractors include (Project D312) Rockwell Collins, Cedar Rapids, IA, (Project DB96) Bendix (Communication Division), Baltimore, MD.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Participated in the National Microwave Landing System (NMLS) program in the areas of program planning, preparation for the International Civil Aeronautics Organization (ICAO) Divisional meeting in April 1978, proposal evaluations, triservice testing of civil avionics, and preparing specifications for military Advanced Development equipment. Established Lead Service Program Office with supporting rationale and documentation. Conducted a cost/performance trade-off study for tactical and military landing systems. Procurement data package for the Joint Tactical Microwave Landing System (JTMLS) Advanced Development Program was completed which resulted in a request for proposals. A triservice team was established to evaluate bidders' proposals. Evaluation of proposals was completed in April 1980, with contract awarded 30 May 1980. Conducted nap-of-the- earth (NOE) communication test/evaluation program for a system that operates effectively during NOE flight in an electronic counter-countermeasure (ECCM) environment. Evaluated conventional flight director systems. Accomplished computer modeling of aircraft vulnerability, survivability, performance, and avionics reliability. Completed the contract for a Design Approach to a Laser Wire Detection System for a candidate Wire and Wire-Like Object Detection System. Awarded contract for development of the Airborne Target Handoff System (ATHS). Continued JTMLS and Airborne Target Handoff Advanced Development effort.

2. (U) FY 1982 Program: Complete Development Test I (DT I) and initiate Operational Test I (OT I) on the Airborne Target Handoff System. Initiate the Combat Support Air Traffic Management System (CATMANS) Advanced Development effort. Award an Advanced Development contract for a Multiple Antenna Unit. Prepare a specification and award a contract for fabrication of Extended Range Navigation Modules. Prepare a form, fit, and function specification for the Attitude Heading Reference System (AHRS).

3. (U) FY 1983 Planned Program: Complete OT I and prepare the required documentation for the Airborne Target Handoff System to enter into production. Complete the fabrication of the Extended Range Navigation Modules. Complete

Program Element: #6.32.21.A Title: Nap-of-the-Earth Avionics and Navigation Equipment
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2-Advanced Technology Development

Advanced Development of the Multiple Antenna Unit and prepare for Engineering Development contract award. Continue prior year effort on CATMANS.

4. (U) FY 1984 Planned Program: Continue Advanced Development (AD) effort on CATMANS. Complete documentation on Airborne Target Handoff System and transfer to production. Begin the development of a testbed for applied systems integration and generate Modernized UH-1 Data Package and initiate BLACK HAWK Block II systems efforts. Initiate AD contract for a Multifunction CO2 NOE Sensor System. This system (currently in exploratory development) uses a carbon dioxide (CO2) laser as a sensor and will provide target ranging (and limited identification), navigation, terrain-following, wire detection and precision hover capabilities.

5. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.33.06.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Terminally Guided Projectiles
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in Thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completio	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	10774	1997	6814	23610	Continuing	Not Applicable
D236	Terminal Guidance System	5575	1997	0	0	0	Not Applicable
D174	8" Guided Projectile	5199	0	0	0	0	Not Applicable
D232	155mm Fire Forget Munitions	0	0	6814	23610	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Fire Support Mission Area Analysis (FSMAA) conducted by the United States Army Field Artillery School (USAFAS) has indicated that the single most important deficiency within the Field Artillery (FA) is "insufficient munitions lethality." This study further indicated that this deficiency can be totally rectified by employing highly accurate projectiles that can sense a hard target and destroy the target. These projectiles are termed Fire & Forget (FAF). The use of FAF munitions increases artillery effectiveness while decreasing vulnerability. In addition, further benefits accrue due to reductions in logistical resupply. The effort to be undertaken under this line item is intended to develop such projectiles by means of a competitive demonstration of available technologies. A Mission Element Need Statement (MENS) has been prepared and a Letter of Agreement (LOA) will be prepared simultaneously with system selection.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The Department of the Army requirements clearly state an urgent need for these munitions. In addition, other programs have demonstrated the feasibility required to effect FAF capability. Consequently, FY83 funding is required in order to select the necessary contractors to enter a competitive demonstration. During FY83 the operational gun-hardened designs will be accomplished; flight test evaluation against various background clutter and target will be accomplished.

Program Element: # 6.33.06.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Terminally Guided Projectiles
Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional to Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	10774	1997	6814	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	10774	0	19635	Continuing	Not Applicable

The funds in FY82 reflect the termination of projects D236 and D174 for the antiradiation projectile by the Army and restoration by the Congress of $1997 in the Terminal Guidance System project (D236). FY83 funding represents a restructuring of this program element to develop 155mm fire-and-forget munitions.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: # 6.33.06.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Terminally Guided Projectiles
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The 155mm Fire-and-Forget munitions project represents an effort by the Army to competitively evaluate fire-and-forget munitions which are required to enhance the survivability and lethality of the Division Support Weapons System, formerly Enhanced Self-Propelled Artillery Weapons System (ESPAWS). These munitions are considered by both the developer and the user to be a critical portion of the system which will replace the current M109 Howitzer and become the primary Field Artillery direct support weapon. This project will examine competing seeker/lethal mechanism combinations competitively to reduce proliferation and control development costs. The alternatives involved employ varying technologies in seeker, guidance and control, and kill mechanisms. Seeker technologies include both millimeter wave and infrared. These technologies have been demonstrated previously in other applications, most notably the 8" Sense and Destroy Armor (SADARM) program. Guidance and control technologies are in various stages of maturity ranging from the Copperhead (demonstrated) through Canard homing projectiles (partially demonstrated) to spin-stabilized guided projectiles (undemonstrated). Kill mechanisms are all state-of-the-art and have been demonstrated in other projectiles. The US Army Armaments Research and Development Command, ARRADCOM, is presently conducting a comprehensive review of all applical technologies in order to provide data for a cost and operational effectiveness analysis which will recommend the most promising technologies for further development. Selection of technologies for hardware development will be made by a special Army Systems Acquisition Review Council (ASARC) currently scheduled for October 1982.

G. (U) RELATED ACTIVITIES: This development relies on extensive technology programs pursued under other programs; among them are: The Advanced Indirect Fire System (AIFS), an exploratory development program jointly funded by DARPA and DA under PE #ARPA-3806 and 1L162603AH18 (Large Caliber and Nuclear Technology) respectively. (The AIFS program was coordinated with the USA Missile Command and the AF Armaments Laboratory, Eglin AFB), the Sense and Destroy Armor (SADARM) projectile being developed under PE 6.36.28 D276 (SADARM), and the Spin-Stabilized Guided Projectile and Canard Homing Artillery Modular Projectile (CHAMP) being developed under PE 6.26.03 AH18 (Large Caliber and Nuclear Technology) and PE 6.36.28 D007 (Field Artillery Ammunition and Fuze Development). These programs complement but do not duplicate work in this program element.

H. (U) WORK PERFORMED BY: Contractors for the FY 1983 demonstration will be selected by a special Army Systems Acquisition Review Council (ASARC) in October 1982. Work performed in programs listed in para G above includes:

Program Element: # 6.33.06.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Terminally Guided Projectiles
Budget Activity: #2 - Advanced Technology Development

Sanders Associates Nashua, NH
Honeywell Corp., Minneapolis, MN
Aerojet Corp. Azuza, CA
Martin Marietta Corp. Orlando, FL
Raytheon Corp, Bedford, MA
US Army Armaments Research & Development Command, Dover, NJ - In-House Agency

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: Work previously accomplished under this program element concentrated on development of the Antiradiation Projectile (ARP). Funding for that project terminates at the end of FY81. There is no FY82 funding. In the FY83-84 timeframe, the seeker developments will be finalized, and tactical configuration seekers built for integration and testing in projectiles and/or submunitions. The technologies being developed under the Exploratory Development Programs will be evaluated for possible inclusion into Guided Projectiles and/or submunitions. Candidate technologies include solid-state strapdown guidance and improved self-forging-fragment warheads. In addition, prototype 8" SADARM sensors have been fabricated and installed on a helicopter for testing and evaluation. The preliminary results indicate acceptable performance in both the millimeter wave and infrared spectrum. As a result of these achievements, an Army study, to be conducted in FY82, will be utilized to provide data allowing an ASARC to select the projectile systems to enter advanced development.

1. (U) FY 1981 and Prior Year Accomplishments: Not applicable.

2. (U) FY 1982-FY 1984 Planned Program: In FY 1982 funds will be used for antiradiation seeker research. In FY 1983 and 1984, candidate seekers and kill mechanisms will be developed and competitively evaluated. Seekers will be extensively tested in helicopter captive flight tests to ensure the veracity of topological environments including the United States, Europe and the Middle East. In addition, weather effect data will be gathered. Seekers will be tactically configured to fit a 155mm projectile, and gun-hardened designs will be fabricated and tested. Microwave integrated circuitry will be developed. The program will lead to integration of seekers into competitive projective airframes, and testing of complete systems will be accomplished. Potential projectile applications include SADARM (155mm) Copperhead, and standard projectile variants.

Program Element: # 6.33.06.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Terminally Guided Projectiles
Budget Activity: #2 - Advanced Technology Development

3. (U) Program to Completion: In 1984 projectile/seeker candidates which have successfully demonstrated operational capability and cost effectiveness will be transitioned to advanced development. Further development should lead to procurement of 155mm Fire-and-Forget projectiles in the FY 1988 timeframe.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.33.13.A
Title: Missile/Rocket Components
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTINGS): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4229	311	9181	14024	Continuing	Not Applicable
D087	Missile/Rkt Components	0	0	50	0	Continuing	Not Applicable
D121	Guidance Control System	4229	0	0	0	Not Applicable	Not Applicable
D259	Micro Electronics for Air Defense Demonstrator	0	311	517	2402	2590	5820
D261	Fiber Optics Guidance	0	0	8614	7081	Continuing	Not Applicable
D262	Indirect Fire Two-Way Link	0	0	0	1297	Continuing	Not Applicable
D271	Very High Speed Integrated Circuit (VHSIC) -Quiet Radar	0	0	0	3244	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Mission Area Analysis (MAA) deficiencies stated by the US Army Training and Doctrine Command (TRADOC) exist which require materiel development solutions for product improvements to existing systems and new system concepts to provide: countermeasures for laser-guided weapons; reduced vulnerability to the antiradiation missile threat; cost reduction and improved reliability and maintainability for fielded air defense missile systems; and a survivable ground- or air-launched antitank system to meet the emerging threat. This Program Element provides the mechanism to prove that hardware and software components developed in exploratory development demonstrate capabilities suitable for transition into materiel acquisition. Projects to be funded in FY 1983 are: (1) To develop and demonstrate laser counter-countermeasure techniques and devices to protect electro-optical and infrared (EO/IR) missile systems against laser threats, (2) to demonstrate a concept to improve air defense missile systems by insertion of state-of-the-art microelectronics into radar signal/data processor subsystems. Most of the electronics in current developmental and fielded missile systems were developed during the 1950's and 1960's and are bulky, capacity limited, and have slow computation speed, (3) to demonstrate a concept which uses a missile layable fiber optics link with an imaging seeker to provide Electronic Countermeasure (ECM) immunity via the link, in-flight target acquisition, and greatly improved accuracy for indirect fire against armor targets.

Program Element: #6.33.13.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Missile/Rocket Components
Budget Activity: #2 - Advanced Technology Development

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The projects of this Program Element: (1) complete a laser counter-countermeasure task to develop and demonstrate methods for providing missile domes that are transparent in sensor guidance bands but opaque to laser jamming and still radio frequency jamming resistant; (2) continue the technology insertion program to capitalize on the maturity of microelectronic circuit developments as applied to missiles/rockets and accelerate the development of product improvements related to large improvements in reliability, availability, and maintainability as well as cost reduction for air defense missile systems; (3) initiate demonstration of a fiber optics guidance concept which will allow for highly survivable indirect fire antitank engagement from a ground or air launch platform.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	4229	311	9181	14024	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5113	311	530	-	Continuing	Not Applicable

(U) D121 - Guidance Control System - FY 1982 submission of $5,113,000 for FY 1981 was reduced to $4,229,000 in reprograming actions for higher priority Army requirements.

(U) D087 - Missiles/Rocket Components - FY 1982 submission of $311,000 for FY 1982 and $530,000 for FY 1983 has been shifted to the new project number of D259, Microelectronics for Air Defense Demonstrator, in order to provide visibility of defined effort. Additionally, $50,000 has been placed in D087, Missile/Rocket Components, for a one-year task in laser counter-countermeasures.

(U) D259 - Microelectronics for Air Defense Demonstrator - Established as a new project to continue the effort previously programed for D087, Missile/Rocket Components.

(U) D261 - Fiber Optics Guidance - A new project for FY 1983 through FY 1985.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.33.13.A
Title: Missile/Rocket Components
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

F. (U). DETAILED BACKGROUND AND DESCRIPTION: This is the Army missile and rocket nonsystems advanced development effort. Its broad objective is to capitalize rapidly on technological innovations and advancements that have shown promise to make significant improvements in the capabilities or cost of existing systems or provide attractive new system capabilities. This program focuses on demonstration of technology to be employed in air defense, fire support, and close combat missions. The primary thrusts are in the technical areas of laser countermeasures; microelectronics; fiber optics, laser, and radio frequency data links for missiles; and survivable and countermeasure-resistant radar for air defense applications. The demonstration quiet radar will incorporate advances in Very High Speed Integrated Circuits (VHSIC) being developed in the DOD-managed tri-Service VHSIC program. The continuing effort for application of microelectronics to existing air defense missile systems will provide the insertion of new technology yielding improvements in capability, reliability, and maintainability at a lesser cost. A nonsystem advanced development effort will demonstrate the use of fiber optics guidance in the attack of high-value point targets (e.g., tanks) without exposing the launch platform to direct fire. A special one year effort is the laser counter-countermeasures task which will include analyses and tests of techniques to protect missiles against out-of-band lasers. These programs are needed to provide integrated demonstration of technologies which will protect the US technological lead in missiles and rockets and provide the Army a critical capability to: (1) acquire the best missile/rocket systems at the least life cycle cost; (2) provide for technological development in areas where there is little or no industry incentive due to lack of commerical applications; (3) provide a quick response in time of crisis; and (4) to preclude technological surprises by potential enemies.

G. (U) RELATED ACTIVITIES: This Program Element is related to efforts conducted in Program Element #6.23.03.A, Missile Technology; Program Element #6.34.52.F, Very High Speed Integrated Circuits; and Program Element #6.37.61.A, Project Number D235, Missile Countermeasure Technology. Duplication is avoided by active participation of laboratory personnel in interagency working groups, liaison visits to agencies/activities involved in related efforts, the free exchange of information among agencies, and the structuring of the program toward unique Army needs in tactical missiles. As noted below, feasibility work accomplished in Missile Technology feeds directly into this Program Element. Also, the Very High Speed Integrated Circuits effort, managed by DOD with participation from US Army Missile Laboratory personnel, provides technology.

H. (U) WORK PERFORMED BY: Contractors for these advanced development projects are undetermined at this time and will, in main, be selected as a result of competive solicitations. The US Army Missile Laboratory, US Army Missile Command, Redstone Arsenal, AL, will be the lead Army laboratory and will play a strong integrating role in each of these projects. One project in particular, Fiber Optics Guidance, will be performed with major in-house involvement in design and evaluation phases.

Program Element: #6.33.13.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Missile/Rocket Components
Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The Hemisphere Coverage Antenna effort was conducted from FY 1974 through FY 1978 with resulting technology being fully and successfully demonstrated. The Tri-Service Active Radio Frequency Seeker effort was conducted from FY 1976 through FY 1978 with the delivered hardware being tested and evaluated for Army and Navy application. The tube-launched, optically tracked, wire-guided (TOW) missile warhead and the Defense Advanced Research Projects Agency (DARPA) Assault Breaker Program will be improved by the air defense and land combat concept under Advanced Munitions effort.

2. (U) FY 1982-FY 1984 Planned Program: The laser counter-countermeasure (CCM) effort will develop and demostrate techniques, applications, and validation of the protective methods to enhance terminal homing sensor survivability. Complementary and continuing work in this area beyond FY 1983 will be carried out in another Program Element, #6.37.61.A, Project Number D235, Missile Countermeasures Technology. The microelectronics for air defense demonstration effort will: (a) analyze Army Air Defense Systems to define signal/data processor microeletronics requirements, define architecture, a. initiate preliminary design for implementation of Very High Speed Integrated Circuits (VHSIC)-based processor; (b) determine potential system performance, maintainability, and reliability improvements for processor insertion in weapon systems and refine architectures and design of processor with the highest air defense payoff; (c) select an air defense demonstration system, determine system specifications for proper insertion design of VHSIC processors, and initiate procurement of microelectronics hardware; (d) develop breadboard processors and test hardware with recorded data base and optimize design in preparation for test with selected air defense system. The three-year fiber optics guidance advanced development program starts in FY 1983. During FY 1983, the concept definition for the Fiber Optic Guided Missile (FOG-M) will be completed. Wind tunnel tests of airframe configurations and the design of a test missile and gunners station for demonstration of the closed loop target acquisition and guidance will be undertaken. Critical experiments to resolve basic technology issues related to the flight demonstration will be completed. Flight trajectory and system effectiveness studies will begin. During FY 1984, fabrication and component-level testing of flight demonstration missile system, fiber-optics data link, gunner's station, and components will be completed. System software for gunner aid, missile guidance, and fire control will be designed, programed, and validated. Interfaces between missile components, data links, and gunner's station will be built and tested. Launch concept mechanizations for both helicopter and ground launch will be tested. Seeker captive tests will be performed, and integration efforts and hardware-in-the-loop simulation will be performed. Limited environmental testing of the missile configuration will be performed. Evident at this time are new starts for FY 1984: Project Number D262, Indirect Fire Two-way Link, and Project Number D271, Very High Speed Integrated Circuit (VHSIC) Quiet Radar. Providing th the user need continues and the technology base matures, the Indirect Fire Two-way Link effort will develop a system simu tion and requirement analysis to select system concept, data link, and sensor to allow for lock-on-after-launch antitank

Program Element: #6.33.13.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Missile/Rocket Components
Budget Activity: #2 - Advanced Technology Development

engagement. The VHSIC Quiet Radar effort in FY 1984 will generate specifications and technical requirements for upgraded Track-While-Scan Quiet Radar utilizing VHSIC and will initiate the target classification and processing study. This concept will allow achievement of vulnerability reduction to antiradiation missile (ARM) attack of air defense radars.

3. (U) Program to Completion: During FY 1985 and FY 1986, the microelectronics for air defense demonstration hardware will be fabricated and field tested. During FY 1985, Fiber Optics Guided Missile testing will be completed demonstrating weapon systems concepts based upon fiber optics data links. Weapon system performance envelopes will be established for FY 1986 systems development applications. During FY 1985 through FY 1987, the VHSIC Quiet Radar effort will conclude design, fabrication, and testing of the demonstration hardware, and the Indirect Fire Two-Way Link effort will culminate in multiple free-flight demonstration to prove the existence of a technology base capable of achieving lock-on-after-launch adverse environment antitank engagement. This Program Element is a continuing program. Individual project numbers are established as the need is stated by the user and the technology base appears to present a solution. It is planned that as early as possible in the FY 1985-1987 period, a number of advanced technology development efforts will be initiated to take advantage of technology base developments. Currently, programs are planned to demonstrate: 1) an adverse environment seeker for lock-on-before-launch or lock-on-after-launch applications that will be compatible with the fire control radar of the Advanced Attack Helicopter; 2) hypervelocity antitank rocket and guided missile capabilities; 3) components for minimum emission signature, fire-and-forget air defense capability; 4) adverse environment antitank capability; and 5) Very High Speed Integrated Circuit (VHSIC) applications to lock-on-after-launch antitank and air defense roles.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: # D261 Title: Fiber Optics Guidance
Program Element: # 6.33.13.A Title: Missile/Rockets Components
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: To engage enemy armor from ground or precision platforms with present guided munitions usually requires that a line of sight be established between the two adversaries. In the usual mode of operation, this direct line of sight must be held until the precision-guided munition destroys its target. This requirement severely reduces survivability. Fiber optics guidance technology provides a means of avoiding this problem and will permit long-standoff-range, lightweight missile systems with inherent target acquisition capability and pinpoint accuracy. The indirect fire will keep the launch platform totally out of line-of-sight of enemy on the ground, thereby significantly increasing its survivability. The fiber optics offer the potential to operate in adverse weather and in battlefield obscurants. In particular, the methods of using fiber optics and other links to transmit target image information to a gunner during the missile's flight will be demonstrated as will the fire control capabilities of the gunner when supported by sophisticated data processing. Gunners' equipment, launch systems, seeker, data links, and missiles will be designed, fabricated, and tested. The performance capabilities of a weapon system based upon the same principles will be determined. This program is needed to permit the rapid movement of emerging technology into weapon system applications either in stand-alone systems or as supplementary elements of existing systems. These development efforts are in response to user requirements stated in the form of science and technology objectives and are supported further by developing letters of agreement.

B. (U) RELATED ACTIVITIES: This program element is related to efforts conducted in Program Element #6.23.03.A2I4, Missile Technology; Program Element # 6.27.01.AH92, High Strength Rapid Pay-Out Fiber Optic Cable; Program Element # 6.37.07.D246, Integrated Fiber Optic Communications Link for Missile Pay-Out. This program element progresses the Fiber Optics Technology from Exploratory Development to Advanced Development. Duplication is avoided by active participation by laboratory personnel in interagency working groups, liaison visits to agencies/activities involved in related efforts, the free exchange of information among agencies, and the structuring of the program toward unique Army needs in tactical missiles.

C. (U) WORK PERFORMED BY: This effort will be conducted as an in-house demonstration effort by the US Army Missile Laboratory, US Army Missile Command, Redstone Arsenal, AL. Supporting services and components will be procured from industry as required. Specific sources have not yet been determined.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

UNCLASSIFIED

Project: # D261 Title: Fiber Optics Guidance
Program Element: # 6.33.13.A Title: Missile/Rockets Components
DOD Mission Area: #553 - Engineering Technology (ADT) Budget Activity: #2 - Advanced Technology Development

1. (U) FY 1981 and Prior Accomplishments: Not Applicable.

2. (U) FY 1982-FY 1984 Program: This program starts in FY 1983. FY 1983: The concept definition for the fiber optics guided missile will be completed. Configuration wind tunnel tests, initial design of a test missile and gunner's station for demonstration of the closed loop target acquisition and guidance will be undertaken. Critical experiments to resolve basic hardware selection issues related to the flight demonstration will be conducted. Flight trajectory and system effectiveness studies will begin. FY 1984: Fabrication and component-level testing of flight demonstration missile system, fiber-optics data link, and gunner's station components will be completed. System software for gunner aid, missile guidance, and fire control will be designed, programed, and validated. Interfaces between missile components, data links, and gunner's station will be built and tested. Launch concept mechanizations for both helicopter and ground launch will be tested. Seeker captive tests, integration efforts, and hardware-in-the-loop simulation will be performed. Limited environmental testing of the missile configuration will be performed.

3. (U) Program to Completion: FY 1985: Final missile system integration testing will be completed. Hardware-in-the-loop and system analysis simulations will be finished. A series of flight tests will be performed to demonstrate feasibility of the fiber optics guidance concept of aided target acquisition and missile guidance. Post-flight analysis will be performed. The feasibility of weapon systems based upon fiber optics will be demonstrated, and the realistically attainable weapon system performance envelopes will be established for FY 1986 systems development applications.

4. (U) Major Milestones: Not Applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	0	0	8614	7081	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	Not Applicable					

This is a new project starting in FY 1983.

UNCLASSIFIED

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.33.14.A Title: HE Laser Components
DOD Mission Area: #554 - Directed Energy Technology Budget Activity: #2 - Advanced Technology Development (ATD)

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	(6222)	(11130)	33116	42581	Continuing	Not Applicable
D056	Fwd Area Laser Weapon	(5099)	(8530)	19308	31272	Continuing	Not Applicable
D057	Cls Cbt Laser Aslt Weapon	(1123)	(2600)	13808	11309	Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Laser weapons will be the first revolutionary weapons systems in the last forty years. Laser weapons offer a potentially decisive breakthrough in countering the numerical superiority of the Warsaw Pact forces. The capability to promises a significant force multiplier in overcoming this imbalance. Two near-term systems are proposed: Forward Area Laser Weapon (FALW) and Close Combat Laser Assault Weapon (CCLAW). The FALW is a high energy laser weapon which will It will have a dual capability for close combat and air defense and the mobility and protection to survive in the forward battlefield. The CCLAW is a close combat laser weapon and will be a subsystem of existing combat vehicles such as the Fighting Vehicle System (FVS), Improved TOW Vehicle (ITV), and helicopters. The CCLAW will

Program Element: # 6.33.14.A Title: HE Laser Components
DOD Mission Area: #554 - Directed Energy Technology Budget Activity: 2 - Advanced Technology Development (ATD)

C. BASIS FOR FY 1983 RDTE REQUEST: Technology demonstrations are planned for both the Forward Area Laser Weapon (FALW) and the Close Combat Laser Assault Weapon (CCLAW) programs. The initial phase of the FALW program is the development of a technology demonstrator called the Forward Area Laser Weapon-Demonstrator (FALW-D). In FY the design of the FALW-D will be completed, and long-lead hardware will be ordered. The CCLAW program starts with the development of an demonstrator called ROADRUNNER. In FY the design of the ROADRUNNER will be completed, long-lead items will be procured, and fabrication will be initiated.

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1982 Submission
FALW		
Initiate Field demonstration		None
Complete field demonstration		None
Initiate system development		None
Complete system development		None
CCLAW		
Initiate field demonstration		None
Complete field demonstration		None
Initiate system development		None
Complete system development		None

Program Element: # 6.33.14.A Title: HE Laser Components
DOD Mission Area: #554 - Directed Energy Technology Budget Activity: 2 - Advanced Technology Development (ATD)

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	(6222)	(11130)	33116	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	(6222)	(11930)	0	Continuing	Not Applicable

The two laser system programs (Forward Area Laser Weapon, FALW, and the Close Combat Laser Assault Weapon, CCLAW) were initiated under PE #6.23.07.A, in FY 1981 and have been transferred to this PE in FY 1983. The decrease in FY 1982 is due to a Congressional reduction to the PE #6.23.07.A.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.33.14.A Title: HE Laser Components
DOD Mission Area: #554 - Directed Energy Technology Budget Activity: 2 - Advanced Technology Development (ATD)

F. DETAILED BACKGROUND AND DESCRIPTION: This non-systems advanced development program is the result of the Army Laser Weapon Technology Assessment (ALAWTA) which was completed in FY 1980. Two efforts were initiated in FY 1981 under the Laser Weapons Technology, PE 6.23.07.A, to demonstrate the feasibility of laser weapons on the future battlefield. These two efforts have been transferred to this program, High Energy Laser Components, in FY 1983. Future Laser Weapons Systems Components will be required to detect, acquire, and negate the

To prove the concepts, two brassboard demonstrators, the Forward Area Laser Weapon-Demonstrator (FALW-D) and the Close Combater Laser Assault Weapon Demonstrator (ROADRUNNER), are to be designed, fabricated, and field tested in the FY timeframe. The existing technology has ample near-term growth potential (no breakthroughs necessary) upon which to base low-risk systems development decisions.

G. (U) RELATED ACTIVITIES: The Army Laser Weapon Technology Assessment (ALAWTA) was completed in FY 1980 under PE #6.23.07.A, Laser Weapon Technology, which identified near-term High Energy Laser system applications that ... it brassboard system demonstrations. Initiation of the brassboard system demonstrators was accomplished in FY 1981 under PE 6.23.07.A, Laser Weapon Technology.

H. (U) WORK PERFORMED BY: The top five contractors are as follows: AVCO, Boston, MA; TRW Inc., Redondo Beach, CA; Hughes Aircraft Co., Culver City, CA; Raytheon Corp., Boston, MA; and Ford Aerospace and Communications Corp., Newport Beach, CA. The principal Government organization conducting this program is the Directed Energy Directorate, US Army Missile Laboratory, US Army Missile Command, Redstone Arsenal, AL. Other Government organizations performing tasks under this program are: US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, and the US Army Electronics Research and Development Command, Adelphi, MD, and Ft Monmouth, NJ.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: This program was initiated under P.E. 6.23.07.A in FY 1981.

2. FY 1982-FY 1984 Planned Program: Preliminary design of the Forward Area Laser Weapon-Demonstrator (FALW-D) will be completed in Initiation of a detailed design, fabrication, and integration effort will begin in

for the selected technology, either repetitively pulsed electric discharge or continuous wave chemical laser. Detailed design will be completed in and fabrication will continue throughout FY Test planning to support the FALW-D program will run concurrently with the hardware development program. ROADRUNNER detailed design will be completed by Fabrication and integration will occur in FY with concept validation testing to begin in Test planning and development efforts to support the Close Combat Laser Assault Weapon (CCLAW) program will be conducted throughout this time period. A ROADRUNNER to CCLAW transition plan will be developed to support a weapon systems development decision in FY

3. Program to Completion: Forward Area Laser Weapon-Demonstrator (FALW-D) fabrication and integration will be completed during FY with concept validation and demonstrations by Transition plans will be generated, and weapon system development will be initiated in FY with completion in FY ROADRUNNER concept validation and demonstrations will be completed by leading to a decision in FY to proceed with weapon system development. Close Combat Laser Assault Weapon (CCLAW) system development will be completed in FY

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D056 Title: FWD Area Laser Weapon
Program Element: #6.33.14.A Title: HE Laser Components
DOD Mission Area: # 554- Directed Energy Technology (ATD) Budget Activity: # 2 - Advanced Technology Development (ATD)

A. DETAILED BACKGROUND AND DESCRIPTION: The Forward Area Laser Weapon (FALW) has evolved from the FY 1980 Army Laser Weapon Technology Assessment (ALAWTA) in which the applicability of laser weapons was assessed against user-identified missions and the projected threat. A critical mission area is the defense of division manuever elements FALW has the unique capability to rapidly engage and destroy targets at long ranges and is appropriate for this mission area. It will be mounted on a dedicated tracked vehicle. The technology demonstrator for the FALW concept is called The Forward Area Laser Weapon - Demonstrator (FALW-D). The objective of the FALW-D is to demonstrate the overall technical feasibility and of the FALW and to show that technology near-term growth potential will permit a low-risk systems development decision. The FALW-D program will demonstrate laser weaponry effects including rapid engagement and retargeting times against representative battlefield targets The FALW-D will be installed on a single flatbed trailer for transportability to test ranges during the testing phase. This program will form the basis for a weapon system development decision in FY

B. (U) RELATED ACTIVITIES: The Army Laser Weapons Technology Assessment (ALAWTA) was completed in FY 1980 and identified near-term High Energy Laser system applications that merit demonstration. Initiation of the FALW-D program has been accomplished under PE 6.23.07.A, Laser Weapon Technology.

C. (U) WORK PERFORMED BY: Primary contractors performing work under this project effort are TRW, Inc., Redondo Beach, CA; Ford Aerospace & Communications Corporation, Newport Beach, CA; Hughes Aircraft Company, Culver City, CA; AVCO, Boston, MA; and Raytheon Company in Boston, MA. Four additional contractors provide support as subcontractors to those identified. The developing organization responsible for this project is the Directed Energy Directorate, US Army Missile Laboratory, US Army Missile Command, Redstone Arsenal, AL. It is supported by the US Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA.

Project: #D056 Title: FWD Area Laser Weapon
Program Element: #6.33.14.A Title: HE Laser Components
DOD Mission Area: # 554- Directed Energy Technology (ATD) Budget Activity: # 2 - Advanced Technology Development (ATD)

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: This program was initiated under PE 6.23.07.A in FY 1981.

2. FY 1982-FY 1984 Program: The Preliminary Design will be completed An evaluation of the two competing device technologies, repetitively pulsed electric discharge and continuous wave chemical, will be made, and one will be selected for initiation of the Forward Area Laser Weapon-Demonstrator (FALW-D) detailed design in Also, long-lead hardware procurement will be initiated during this phase. A critical design review will be conducted in late FY . Hardware fabrication will continue throughout FY . A test planning effort will be initiated and run concurrently with the FALW-D hardware development program.

3. Program to Completion: Hardware fabrication and system integration will be accomplished during FY . Acceptance testing will be accomplished in . Concept validation and demonstration will be completed by . A decision regarding system development will be made in FY , leading to deployment of the FALW system in the .

4. Major Milestones:

Major Milestones	Current Milestones Dates	Milestone Dates Shown in FY 1982 Submission
Conduct field demonstration		None
Complete field demonstration		None
Initiate prototype development		None
Complete prototype development		None

Project: #D056 Title: FWD Area Laser Weapon
Program Element: #6.33.14.A Title: HE Laser Components
DOD Mission Area: # 554- Directed Energy Technology (ATD) Budget Activity: # 2 - Advanced Technology Development (ATD)

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	(5099)	(8530)	19308	31272	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	(5099)	(8530)	0	0	Continuing	Not Applicable

This effort was accomplished under PE 6.23.07.A in FY 1981 and FY 1982 and is being transferred to this new project in FY 1983.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D057 Title: Close Combat Laser Assault Weapon
Program Element: #6.33.14.A Title: HE Laser Components
DOD Mission Area: #554 - Directed Energy Technology (ATD) Budget Activity: #2 - Advanced Technology Development (ATD)

A. DETAILED BACKGROUND AND DESCRIPTION: The Close Combat Laser Assault Weapon (CCLAW) has evolved from the FY 1980 Army Laser Weapon Technology Assessment (ALAWTA) and represents the application for laser weapons on the modern battlefield. The CCLAW will serve as a complementary weapon system on an existing weapon platform. , thus destroying or degrading enemy combat capability. It operates at . The name Roadrunner has been given to the technology demonstration brassboard whose object is to provide demonstration and concept validation of the CCLAW. This program will demonstrate key subsystems, including acquisition of uncooperative threat targets and destruction of threat . Experience gained from previously demonstrated hardware will be integrated into the Roadrunner design to reduce cost and demonstrate the ability of laser weapons to operate reliably under battlefield conditions. The Roadrunner will be installed in the Infantry Fighting Vehicle for testing although other applications using several aircraft and ground vehicle platforms are being considered for the CCLAW. This program will form the basis for a weapon system development decision.

B. (U) RELATED ACTIVITIES: The Army Laser Weapons Technology Assessment (ALAWTA) was completed in FY 1980 under PE 6.23.07.A, Laser Weapon Technology, and identified near-term high energy laser system applications that merit demonstration. Initiation of the Roadrunner Program has been accomplished under PE 6.23.07.A, Laser Weapon Technology.

C. (U) WORK PERFORMED BY: The primary organization conducting this program is the Directed Energy Directorate, US Army Missile Laboratory, US Army Missile Command, Redstone Arsenal, AL. Other Government agencies participating in this program include the US Army Mobility Equipment Research and Development Command (MERADCOM), Fort Belvoir, VA; the US Army Electronics Research and Development Command (ERADCOM), Adelphi, MD; and the US Army Tank Automotive Command (TACOM), Warren, MI.

Project: #D057 Title: Close Combat Laser Assault Weapon
Program Element: #6.33.14.A Title: HE Laser Components
DOD Mission Area: #554 - Directed Energy Technology (ATD) Budget Activity: #2 - Advanced Technology Development (ATD)

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: This program was initiated under PE 6.23.07.A in FY 1981.

2. FY 1982-FY 1984 Program: Roadrunner hardware design will be completed and long-lead items ordered during FY . Hardware fabrication and system integration will take place during FY . Concept validation testing will commence in FY to ensure availability of required data for a weapon system development decision in FY . A test planning and technical support effort will be initiated and run concurrently with the Roadrunner hardware development program. Roadrunner to Close Combat Laser Assault Weapon (CCLAW) transition program planning will be initiated in FY . Support will be obtained from the Mobility Equipment Research and Development Command (MERADCOM) and the Electronics Research and Development Command (ERADCOM) in evaluation of approaches for satisfying prime power and laser device requirements.

3. Program to Completion: The Roadrunner concept validation and demonstration program will be completed in FY . CCLAW systems development will be completed in FY , leading to deployment of the CCLAW around .

4. Major Milestones:

Major Milestones	Current Milestone Dates	Milestone Dates Shown in FY 1982 Submission
Initiate field demonstration		None
Complete field demonstration		None
Initiate prototype development		None
Complete prototype development		None

Project: #D057 Title: Close Combat Laser Assault Weapon
Program Element: #6.33.14.A Title: HE Laser Components
DOD Mission Area: #554 - Directed Energy Technology (ATD) Budget Activity: #2 - Advanced Technology Development (ATD)

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	(1123)	(2600)	13808	11309	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	(1123)	(3400)	0	0	Continuing	Not Applicable

This effort was accomplished under PE#6.23.07.A in FY 1981 and FY 1982 and is being transferred to this new project in FY 1983. The decrease in FY 1982 is due to a Congressional reduction to PE #6.23.07.A.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.33.24.A
DOD Mission Area: #551 - Electronic and Physical Sciences

Title: High Technology Test Bed
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT			10711	8261	Continuing	Not Applicable
D180	HTTB-Distributed Data Test Bed	-	-	7431	8261	Continuing	Not Applicable
D273	HTTB-Road Runner	-	-	397	0	Continuing	Not Applicable
D274	HTTB-Netted Radar	-	-	2286	0	Continuing	Not Applicable
D278	HTTB-Low Cost Vehicle Navigation	-	-	597	0	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element responds to the requirement to significantly improve the combat capabilities of the light infantry division through accelerated fielding of new technology. The testbed will use equipment developed under exploratory research programs, equipment in advanced or engineering development, and off-the-shelf equipment to evaluate concepts and accelerate the fielding process. Initial emphasis will address the requirement to reduce the vulnerability of currently centralized command post operations to physical attack. The command post consists of the personnel and communications necessary to plan, coordinate, and execute the battle plan under the direction of the tactical commander. This centralized operation presents a lucrative target which can be easily identified and

located by physical or electronic means, and subsequently attacked or destroyed. This program principally serves to overcome this deficiency by distributing command post operations and associated Command, Control, Communications, and Intelligence elements among mutually supportive modular cells integrated by advanced communicative techniques including video, voice, data, and graphics while maintaining operational efficiency. The overall program includes phased design, experimentation, and system testing in the High Technology Test Bed, leading to evolution of improved capabilities for implementation in tactical divisions.

C. (U) BASIS FOR FY 1983 RDTE REQUEST:

1. The majority of the funds for FY83 are required to initiate purchase, loan, and/or lease of video, graphics, data processing, and communications equipment for development of software, investigation of system integration problems, and conduct of experiments to define modules of a distributed command post. Initiation of on-site testbed support will occur. Software development and communication system design will be started. An advanced technology demonstrato called ROAD RUNNER, which is being developed under another program element, will be mounted on a combat vehicle.

2. (U) A Netted Radar control console developed by Lincoln Laboratory will be relocated to the High Technology Test Bed (HTTB). The prototype model nets all sensor systems, airborne or ground, into one source collection point for a.. 'vsis. This increases the overall operational effectiveness by coordinating operations of individual sensors. Target analysis is therefore improved and results automatically displayed and sent to the Tactical Fire Direction System (TACFIRE) for engagement. The control console consists of commercial computers and display devices. Finally, four Heading Reference Sets, which have recently completed Development/Operational Test II, will be refurbished and installed in combat vehicles. Various levels of tactical deployment can be examined, and the effectiveness of the system in assisting the vehicle commander in maintaining his orientation during periods of limited visibility can be evaluated.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands): Not applicable. This is a new program start in FY 1983.

E. (U) OTHER APPROPRIATIONS FUNDS: Not applicable.

Program Element: #6.33.24.A
DOD Mission Area: #551 - Electronic and Physical Sciences

Title: High Technology Test Bed
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Present Command Post Operations are conducted by the Division Tactical Operations Center and the Tactical Command Post. The elements of the command post, including operations, intelligence, fire support, and combat service support, work together to develop the information needed for the commander to plan, control, and sustain the battle to reach its ultimate objective of defeating the enemy. Information is exchanged with higher headquarters and subordinate units' quasi-fixed multichannel switched trunking systems, voice and message nets. It is this centralization of command operations that creates a highly vulnerable, and not readily defensible, target for attack and disruption by the enemy. The electronic complex provides an easy target for interception and location by electronic surveillance techniques. The mass of equipment provides an easily identifiable aggregate of shelters, trucks, and supporting equipment. The present system is being augmented by advanced communication and data processing elements. The ongoing improvements include automated voice and message switched systems, tactical facsimile, tactical satellite facilities, and data processing systems such as the Tactical Fire Direction System, tactical computer systems and terminals, and a fusion center. Timeliness and accuracy will be substantially enhanced; however, the overall command structure will still terminate in a centralized nodal complex. This vulnerability can only be overcome by dispersion of the elements of the command post into smaller units or cells over a broader area, thus inhibiting identification and surveillance. However, design of the cells must be such that the information interchanges are responsive to changing battle situations, force structure, and command disciplines. Effectiveness of face-to-face interchanges cannot be lost, and redundancy and support among cells must be preserved to assure continuity of operations if loss of any one element occurs. Since the modular distributed concept must provide the equivalent of close proximity operations, there is a requirement to carefully define the characteristics of the visual, graphical, voice, and data facilities that must be provided. It is also necessary to develop the symbology, message standards, data storage, and retrieval requirements for providing ready access to mutually supportive information required for operation of the individual cell or module. Further, design of communication nets and networks to support increased requirements for interchanging information among dispersed elements and collating data from multiple sensors must be revised. Finally, selected prototype systems are to be evaluated in the High Technology Test Bed to validate concepts and their potential suitability for field operations.

G. RELATED ACTIVITIES: This program supports the Army's overall initiative to improve combat readiness and effectiveness by infusion of available technology into tactical units through High Technology Test Bed operations. Related technology developments include: Program Element #6.47.27, Command and Control, Project #D184, Tactical Computer System/Terminal; Program Element #6.37.23, Command and Control, Project #D185, Military Software Standardization; Program Element #6.37.23, Command and Control, Project #D186, Military Computer Family; Program Element #6.37.13, Joint Tactical

Program Element: #6.33.24.A
DOD Mission Area: #551 - Electronic and Physical Sciences

Title: High Technology Test Bed
Budget Activity: #2 - Advanced Technology Development

Information Distribution System, Project D370, ADDS; Program Element #6.37.46, Project #D555, SINCGARS; Program Element #2.37.26, Project #D322, Advanced Field Artillery Tactical Data System; Program Element #6.47.12, ACCS Systems Engineering, Project #D323, System Engineering for Tactical C3 Systems; Program Element #6.27.01, Project #AH92, Communications Technology; Program Element #6.27.46, Project #A094, Tactical ADP Technology; Program Element #6.37.07, Communication Development, Project #D246, Tactical Communications Development; Program Element #2.37.35, Combat Vehicle Improvement Program, Project DE01, M60A1 Tank PIP; Program Element #6.27.03, Project DH93, CSTA and Identification; and many other programs. There is no unnecessary duplication of effort within any of the Army DOD programs.

H. (U) WORK PERFORMED BY: US Army Communications-Electronics Command, Ft Monmouth, NJ, in cooperation with the 9th Infantry Division, Ft Lewis, WA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Not applicable.

2. (U) FY 1982-FY 1984 Program:

a. (U) Emphasis will be devoted to modification and delivery of near-term (existing military and commercial prototype) hardware to the High Technology Test Bed (HTTB) to explore technical and operational feasibility and to develop optimum architecture for Cellular/Modular Command Post operations. Cell-to-cell communication facilities such as fiber optics and millimeter wave radio multichannel links (TV and voice) and packet technology for data distribution will be used. A state-of-the-art fiber optics video-conferencing capability will also be implemented. R&D is necessary to enhance delivered video-conferencing system to provide encryption, to develop distributed video switching, and to include 12-channel voice interconnects with tandem switching capabilities. Through user/developer concept tests at the HTTB, a dispersed network will evolve capable of yielding substantially improved performance with available hardware.

b. The ROAD RUNNER weapon demonstrator will be mounted in a ground combat vehicle and will function as part of a friendly combined arms team. Tactical scenarios will be developed to simulate European theater engagements. Data on acquisition and simulated engagement will be collected and evaluated to determine the resultant increased unit effectiveness.

Program Element: #6.33.24.A
DOD Mission Area: #551 - Electronic and Physical Sciences
Title: High Technology Test Bed
Budget Activity: #2 - Advanced Technology Development

c. (U) By netting radars and other sensor systems, both air and ground, and displaying the data in one location, a commander can use all target acquisition means more effectively to rapidly evaluate the battlefield and employ offensive action against opposing forces. The prototype model will be used in the High Technology Test Bed to evaluate this concept in a genuinely tactical environment. Improvements in targeting processes will be evaluated. Increased effectiveness during periods of reduced visibility and adverse weather will be of particular interest.

d. (U) Four research and development model Heading Reference Sets will be provided to the High Technology Test Bed. The sets have recently completed Development/Operational Test II. The sets will be refurbished and installed in 9th Division vehicles. The Heading Reference Set is intended to be deployed in frontline tactical vehicles. The set provides the vehicle heading to the driver and the vehicle commander. The advantages and effectiveness of such a system will be evaluated, as will various levels of tactical employment; i.e., each vehicle, platoon leader only, etc.

3. (U) Program to Completion: Continue developemnt of new high-technology projects dedicated to the specific purpose of providing dispersed survivable command, control, and communications systems for the 1990's. Continued research is required to develop architecture and tandem switching capabilities so that voice, video, and data traffic can be appropriately distributed within command post clusters, throughout a unit's dispersed command post, and to activities external to a maneuver element without use of a critical, central node. Reliance on centralized nodes for filtering, correlation, and distribution of data degrades overall survivability of the Army command and control system; this program will continue high-technology infusion and evaluation to accelerate distribution techniques, thereby reducing vulnerability of the Army command and control structure.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D180 Title: Distributed Data Test Bed
Program Element: #6.33.24.A Title: High Technology Test Bed
DOD Mission Area: #551 - Electronic and Physical Sciences Budget Activity: #2 - Advanced Technology Development

A. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Present Command Post Operations are conducted by the Division Tactical Operations Center and the Tactical Command Post. Elements of the command post including operations, intelligence, personnel management, and combat service support, together with fire support, air support, and airspace management elements work together to develop the information needed for the commander to plan, maintain operational control of maneuver units, and sustain the battle to reach its ultimate objective (engage and defeat the enemy). The information is provided by quasi-fixed multichannel switched trunking systems (interfacing with Corps, DISCOM, Bde, DIVARTY, etc.) and voice and message nets. The netting is primarily voice and message traffic which is distributed through the message centers and switched centers to the centrally located shelters containing the command post and operations center. It is this centralization of command operations that creates a highly vulnerable and not readily defensible target for disruption by a potential enemy. The electronic complex provides an easy target for interception and location by electronic surveillance techniques. The mass of equipment provides an easily identifiable aggregate of shelters, trucks, and supporting equipment that can be pinpointed by visual means. Thus, destruction of the command post could be accomplished by conventional or advanced weapons launched from ground-based systems or attack aircraft. The present system is being augmented by advanced communication and data processing elements. The ongoing improvements include automated voice and message switched systems, tactical facsimile, tactical satellite facilities, and data processing systems (TACFIRE, tactical computer systems and terminals, and the fusion center). Timeliness and accuracy will be substantially enhanced; however, the overall command structure will still terminate in a centralized nodal complex. This vulnerability can only be overcome by dispersion of the elements of the command post into smaller units or cells over a broader area that will not permit easy identification and surveillance. However, the design of the cells must be such that the information interchanges are responsive to changing battle situations, force structure, and command disciplines. The effectiveness of face-to-face interchanges cannot be lost, and redundancy and mutual support among cells must be preserved to assure continuity of operations if loss of any one element occurs. Since the modular distributed concept must provide the equivalent of close proximity operations, there is a requirement to carefully define the characteristics of the visual, graphic, voice, and data facilities that must be provided. It is also necessary to develop the symbology, message standards, and data storage and retrieval requirements for providing ready access to mutually supportive information required for operation of the individual cell or module. Further, design of communication nets and networks to support increased requirements for interchanging information among dispersed elements must be revised to support the new more stringent requirement (distributed video, and distributing the integration of nets with higher, lateral, and subordinate units). Specifically, the program objectives will include:

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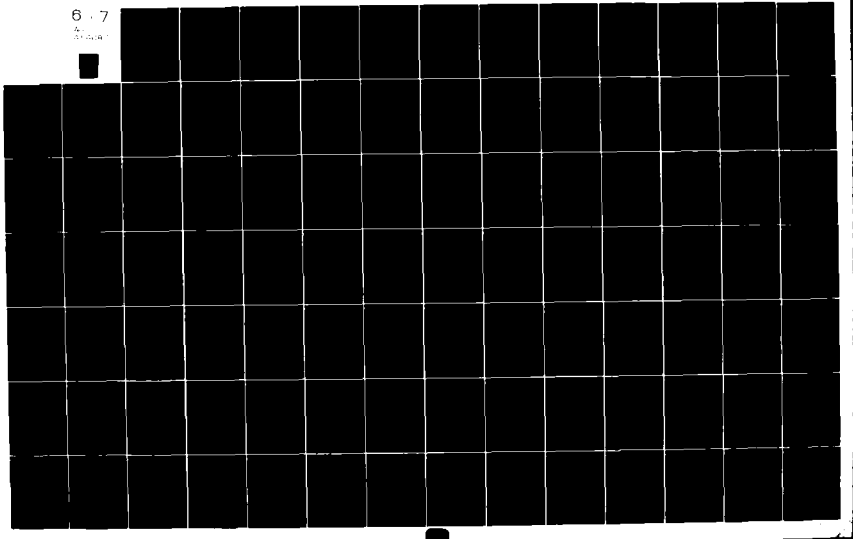

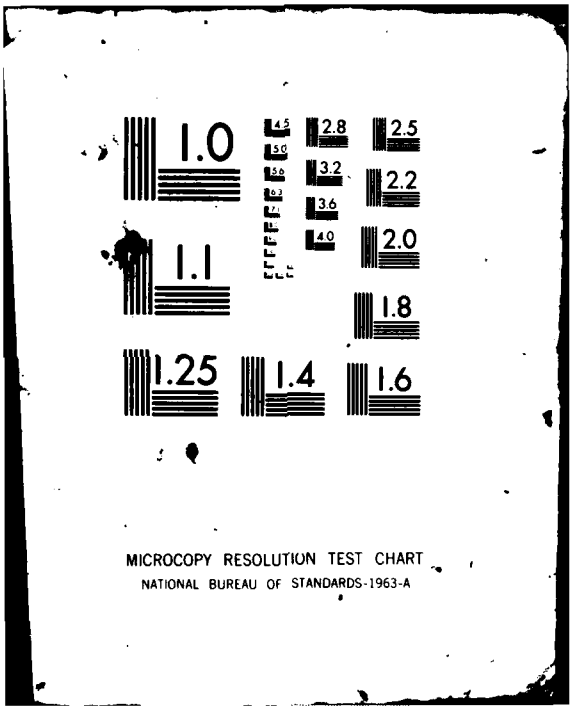
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Project: #D180 Title: Distributed Data Test Bed
Program Element: #6.33.24.A Title: High Technology Test Bed
DOD Mission Area: #551 - Electronic and Physical Sciences Budget Activity: #2 - Advanced Technology Development

1. (U) Validation of the characteristics of dispersed modular cells of the command post consistent with survivability and continuity of operations.

2. (U) Establishing the characteristics of the terminal and input/output facilities for video, voice, message, data, and/or graphics processed within and among cells, and interchanged with headquarters, staff and command elements to higher echelons, lateral, and subordinate units.

3. (U) Establishing the design constraint for net/network structure for integration among modular-cellular command post elements and interfaces to higher echelons, lateral, and subordinate units with emphasis on survivability.

4. (U) Phased development of prototype modular components of the distributed command post.

5. (U) Integration and evaluation of the prototype system in the High Technology Test Bed to validate conformance to requirements and suitability for field operations.

B. (U) RELATED ACTIVITIES: This program supports the overall Army's initiative to improve combat readiness and effectiveness by infusion of available technology into tactical units through High Technology Test Bed operations. Related technology developments include: Tactical Computer System Terminal Develoment, Project No. 6.47.27,D184; Military Computer Family, Project No. 6.37.23, D186; Military Software Standards, Project No. 6.37.23, D185; PLRS JTIDS Hybrid, Project No. 6.37.12, D370; SINCGARS-V, Project No. 6.37.46, D555; Advanced Field Artillery Data System, Project No. 6.37.56, D430; Communicative Systems, Project No. 6.47.01, D240; System Engineering for Army Tactical C3 System Design, Project No. 6.47.12, D323; Communications Electronics (Wireless Command Post; fiber optic secure, long-haul, multiplexed cable/telephone systems); System Architecture and Specifications, Project No. 6.27.01, AH92; Tactical ADP Technology with microprocessor-controlled video (discs), Project No. 6.27.46, A094; Tactical Communications Radio System, Project No. 6.37.07, D437; and many other communications, command, and control programs. There is no unnecessary duplication of effort within any of the Army or DOD programs.

C. (U) WORK PERFORMED BY: US Army Communications-Electronics Command, Ft Monmouth, NJ, in cooperation with the 9th Infantry Division, Ft Lewis, WA.

Project: #D180 Title: Distributed Data Test Bed
Program Element: #6.33.24.A Title: High Technology Test Bed
DOD Mission Area: #551 - Electronic and Physical Sciences Budget Activity: #2 - Advanced Technology Development

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: New start; no prior accomplishments.

2. (U) FY 1982-FY 1984 Planned Program: During FY82, initial efforts will be devoted to establishing the technical and operational characteristics of the individual modules (cells) and the feasibility of operational concepts for distribution of Command Post components. Experimentation with candidate hardware purchased or leased from commercial sources will be used to define components of the modules. Development of software for computer graphics and data transmissions from cell to cell and cell to external world operations will also be initiated. Development of the technology for distribution of video, to include conferencing, will be emphasized. In FY83, the actual development of the prototype cells will be carried out to include communications. This work will result in the fabrication of the first modules for initial evaluation by the HTTB/9ID facility in FY84.

3. (U) Program to Completion: This advanced development phase will be continued, resulting in the construction of up to five cells that can be used in simulated Division exercises of the 9ID.

4. (U) Major Milestones: Not applicable.

5. (U) Resources (Project Listing): ($ in thousands)

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
RDTE						
Funds (current requirements)	-	-	7431	8261	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	-	-	-	-	-	-

This project is a new start in FY 1983.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.02.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	34008	9217	7767	30865	Continuing	Not Applicable
D118	Combat Vehicle Technology	4121	9217	7767	30865	Continuing	Not Applicable
D188	High Survivability Test Vehicle	29887	0	0	0	0	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element constitutes the critical step in defining combat vehicle systems of the future. The objective is to demonstrate and evaluate innovative future combat vehicle technology in vehicle testbed hardware to determine initial feasibility and military potential. Prior to FY82 this Program Element also funded the High Survivability Testbed Vehicle - Lightweight (HSTV-L) and High Mobility Agility Testbed (HIMAG), which have led to definition of the Mobile Protect Gun.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Funds continuation of the tank testbed in FY 1983. The Tank Test Bed is being developed to explore options for advanced vehicle designs which significantly increase tank survivability and operational characteristics through innovative integration of the current component and technology base. The testbed will be utilized to provide system evaluation of the following technologies and issues; advanced *optics/sensing* for surveillance and target acquisition, automatic loading for 120mm gun, and reduced crew size/new tank assignments. The chassis of the M1 will be the basis of the testbed, and a goal of the program will be to develop options [illegible] will preserve the M1 facilities and utilize M1 components to the maximum degree possible.

Program Element: #6.36.02.A Title: Advanced Land Mobility System Concepts
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST:

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	34008	9217	7767	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	34008	9242	16614	Continuing	Not Applicable

FY82 decrease is due to the application of revised inflation indices. FY83 decrease is due to Army decision to fund higher priority needs.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.36.02.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Advanced Land Mobility System Concepts
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The Army has a continuing need to increase its ground combat vehicle technology base through examination of innovative concepts and unique weapons systems. While theoretical studies provide a great deal of information, it is mandatory that hardware testbed vehicles be fabricated which can be evaluated under actual field conditions. This Program Element encompasses development and evaluation of experimental testbed vehicles to be used in achieving an objective of increasing the combat effectiveness of future combat vehicles while decreasing developmental costs, risk, and time. Continuous upgrading of the technology is essential for the United States to regain and maintain qualitative superiority over combat vehicles fielded by other countries.

G. (U) RELATED ACTIVITIES: Specific programs related to the technical areas of this program element (PE) are: PE 6.11.02.A, Defense Research Sciences; PE 6.21.05.A, Materials; PE 6.26.01.A, Tank Automotive; PE 6.26.03.A, Large Caliber and Nuclear Technology; PE 6.27.33.A, Mobility Equipment Technology; PE 6.26.18.A, Ballistics Technology; PE 6.31.02.A, Materials Scale-Up; PE 6.32.01.A, Aircraft Power Plants; PE 6.26.08.A, Tank Gun Development and Tank Ammunition; PE 6.36.21.A, Combat Vehicle Propulsion Systems; PE 6.36.31.A, Combat Vehicle Turret and Chassis; and PE 2.37.35.A, Combat Vehicle Improvement Program. Close coordination is maintained with other Services and Governmental agencies to preclude duplication of effort. Research and development information concerning combat, tactical, and special-purpose vehicles is also being exchanged via data exchange agreements with allied countries. Close coordination prior to any budgetary decision is maintained, and exchange of technical reports through the data exchange agreements is achieved.

H. (U) WORK PERFORMED BY: Primary in-house efforts will be performed by the US Army Tank-Automotive Command, Warren, MI. Other in-house efforts will be performed by the US Army's Armament Research and Development Command, Dover, NJ. Contractors involved are: Pacific Car and Foundry Co., Renton, WA, and Lockheed Missiles and Space Co., Inc., Huntsville, AL.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Completed fabrication and initiated testing of the High Mobility/Agility (HIMAG) test vehicle, High Survivability Testbed Vehicle - Lightweight and initiated a 90mm gun/ammunition program. Completed 3000-pound test rig utilizing the Loopwheel concept and demonstrated obstacle performance and reduction in absorbed power for given speed versus tracked test rig baseline. Elevated Kinetic Energy (KE) Weapon continuing. The 75mm cannon was test fired and testbed assembly/integration was initiated. The Tank Test Bed Program was initiated in FY81 with completion of in-house concept studies, mock-up evaluations, and generation of performance specification resulting in release of a Request for Proposal to industry.

Program Element: #6.36.02.A Title: Advanced, Land Mobility System Concepts
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Planned Program: Fabrication of the Elevated KE Weapon will be completed, and testing will be completed. Tank Test Bed planning for 1982 includes award of up to two contracts for design and fabrication of experimental testbeds. Major activities include preliminary design work, brassboard testing, and surrogate vehicle field experiments to provide early engineering assessments of the critical issues. Loopwheel program will be terminated as it has failed to sucessfully demonstrate adequate component life. Final design and fabrication of the tank testbed will begin in FY83 based on the results of the design studies and test results of the brassboard components and surrogate vehicle field tests. In FY84 fabrication of the Tank Test Bed will be completed, and engineering and operational testing will begin. A future Infantry Fighting Vehicle will begin contractor design and analysis and mock-up; this effort will exploi advanced technology in unique infantry fighting vehicle configurations to determine application to combined arms fighting vehicles. The design and fabrication of an Integrated Countermeasure (CM) Test Bed will begin; the testbed will incorporate passive and active countermeasure devices and disciplines into a lightweight combat vehicle configuration.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4345	10768	9324	11335	Continuing	Not Applicable
D006	Landmine Warfare Development	599	1947	2976	5970	Continuing	Not Applicable
D608	Countermine & Barrier Development	3746	8821	6348	5365	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides for advanced development of mine componentry and concepts applicable to landmine warfare, the family of scatterable mines (FASCAM), and improved conventional and special-purpose mines. *Mines continue to provide a formidable obstacle to assist in overcoming the massive tank threat posed by the Warsaw Pact.* Mines are required to fortify natural obstacles such as defiles, rivers, and urban areas in order to delay, canalize, and interdict attacking forces and enhance the performance of direct and indirect fire weapons. Efforts include a microcomputer, sensors, fuzes, target discrimination logic and anticountermeasure devices to improve the overall effectiveness of mines and make minefields more difficult to traverse. New concepts include controllable minefields to allow for greater battlefield mobility of friendly troops, and an off-route antitank mine for use along highways and roads and in urban terrain. Identified components, when integrated, will provide a system of mines and delivery means meeting Army requirements. Soviet and Warsaw Pact doctrine advocates the large-scale use of landmines in both offensive and defensive operations. In support of this doctrine, the Soviets have developed mechanized devices which rapidly lay minefields having a variety of complex mine fuzes. Mutually supporting countermine devices and techniques are required to meet the threat. *This program* element also improves the Army countermine capabilities by investigating and exploiting materials, techniques, and equipment evolving from exploratory development. These investigations will ultimately lead to enhanced tactical mobility by neutralizing the barrier potential of enemy minefields. Also, improved field fortifications techniques are being devised and evaluated to improve battlefield survivability of friendly forces by hardening combat positions.

Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Continue efforts on: improved lethal mechanisms, counter-countermeasure components, increased area mine system components, target signature analysis, controllable minefield components, and analysis of systems effectiveness; an improved fuel-air explosive mine neutralization system, a remote minefield detection system, a dedicated counterobstacle vehicle and a cleared lane minefield marking system (CLAMS) as long-range efforts to counter threat mines and minefields; and development of a family of improved combat shelters.

D. (U) COMPARISON WITH FY82 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	4345	10768	9324	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4784	10799	9518	Continuing	Not Applicable

The FY81 decrease is the result of reprograming to higher priority Army programs. FY82 decrease is a result of inflation index and pay raise adjustments. The FY83 decrease results from inflation index adjustment and minor program realignment.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The family of scatterable mines (FASCAM) is being developed utilizing baseline antitank and antipersonnel mines which can be emplaced by multiple delivery means. This objective is accomplished through new developments in mine sensing and discriminating logic, lethal mechanisms, fuzing, and improved resistance to enemy countermeasures. Efforts supported by this program are then integrated into ongoing and new mine hardware systems in order to meet the requirements for Army barrier systems. This program supports efforts for new landmine warfare concepts and to demonstrate concept feasibility. The long-range goal of this program is to provide truly controllable barriers, highly lethal to enemy forces. Also, this program contains tasks designed to provide the Army with a family of mutually supporting countermine devices and techniques to meet the identified threat. Mine detection and neutralization are examined based on tactical scenarios and conditions and translated into prototype developmental items by exploiting technology achieved during Exploratory Development, P.E. 6.26.03.A, Large Caliber and Nuclear Technology. Detection thrust has transitioned from the meticulous point-to-point search to methods of detecting minefields from remote locations. Neutralization has been redirected from a slow defuzing process to one of rapid neutralization to permit maneuver commanders to "breach in stride." Surface-Launched Unit Fuel Air Explosive (SLUFAE) introduced the first potential for standoff neutralization. Barrier efforts are being directed towards the use of the most advanced technology to deny or reduce enemy mobility on the battlefield with a goal of a quantum reduction in barrier system logistics. A family of combat shelters is being developed to provide for survival of weapons and personnel during periods of indirect fire. Frame and fabric structures with earth cones are proposed for future development.

G. (U) RELATED ACTIVITIES: Exploratory development for this program is conducted in Program Elements 6.26.03.A, Large Caliber and Nuclear Technology, and 6.27.33.A, Mobility Equipment Technology. Systems advanced development for landmine warfare/barrier systems is performed in Program Element 6.36.19.A, Landmine/Barrier Systems. Engineering development of items and concepts in this program is performed in Program Elements 6.46.12.A, Countermine & Barriers, and 6.46.19.A, Landmine Warfare. Developmental information is coordinated and exchanged between the Services by the Tri-Service Joint Technical Coordination Group for Bombs, Mines, and Clusters to avoid duplication of effort. The Department of Defense Armaments Munitions Requirements and Development Committee monitors the scatterable mine program with a view towards avoiding Service duplication. Countermine efforts are closely coordinated with the Armament Systems Directorate, ARRADCOM, Dover, NJ, the responsible agency for the Army Mine Program.

H. (U) WORK PERFORMED BY: Armament Systems Directorate, US Army Armament Research and Development Command (ARRADCOM), Dover, NJ, is responsible for management of Landmine Warfare systems and components. The US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, is assigned responsibility for Countermine and Barriers.

Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Prior to FY 1976, helicopter-delivered and artillery-delivered antitank and antipersonnel mine systems were validated and moved into engineering development. Components for the Ground-Emplaced Mine Scattering System (GEMSS) were successfully developed. Power supply and sensors were developed. Investigations on remote control components for minefield command arm/disarm were initiated. In FY 1976, design work on improved power sources and influence sensors was conducted, and and a prototype command and control module for scatterable mines was developed. During FY 1977, efforts were initiated on a microprocessor for mine sensor logic to assist in target discrimination and to improve lethal probability. Advanced development on the Modular Pack Mine System (MOPMS) was completed. Command and control functions for the employment of scatterable mines were categorized. A long-standoff sensing mechanism was investigated. During FY 1978, efforts continued on a microprocessor for mine sensor logic and on counter-countermeasures for antitank sensors. Work was initiated on improved lethal mechanisms and off-route mine components. During FY80, work on the microprocessor for mine sensor logic was completed. During FY81, warhead testing for a top attack/bottom attack mine was conducted, and conceptual efforts for an antipersonnel influence sensor were completed. In the area of mine detection, the potential of pulse radar, X-ray, and gamma ray excitation, passive infrared devices, microwave techniques, and trace gas detection devices were evaluated. The ability of dogs to detect the explosives in landmines and booby traps was successfully demonstrated, and a canine mine detection manual was completed. A prototype evaluation of the vehicle-mounted roadmine detector was conducted. In mine neutralization, fuel-air explosives (FAE) were shown to be an effective minefield clearance device. Work was initiated on a portable projected line charge for antipersonnel minefields and hardening of vehicle components to resist mine damage. A variety of shelters from exploratory development, P.E. 6.27.33.A, were demonstrated.

2. (U) FY 1982-FY 1984 Planned Program: Develop an antitank electronic assembly containing a microcomputer and multiple influence sensors and an influence sensor for an antipersonnel mine. Continue development efforts on improved lethal mechanisms, counter-countermeasure components, increased area mine system components, target signature analysis, controllable minefield components, mine sensor components, analysis of systems effectiveness, improved fuel-air explosives and an improved combat shelter. Continue development on a dedicated counterobstacle vehicle. Initiate development in remote minefield detection. Initiate efforts on an M1 tank integrated countermine system and electromagnetic scatter sensor.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D608 Title: Countermine & Barrier Development
Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: Provides for advanced development of improved countermine and barrier capabilities exploiting materials, techniques, and equipment evolving from exploratory development in 6.26.03.A, Large Caliber and Nuclear Technology, and 6.27.33.A, Mobility Equipment Technology. Threat mine warfare doctrine is well developed for both offensive and defensive operations. In the offense, threat doctrine calls for resolute offensive operations with the intent of driving through defending force formations and penetrating deep into rear areas. Mines will be employed extensively along the attacking force flanks to disrupt or prevent counterattacks. Mines are expected to be laid as economy of force measures to concentrate forces at another location and in rear areas to block lines of communication. In the defense, the threat forces are expected to employ mines extensively in fields or belts in depth to delay, disrupt, and canalize attacking forces into kill zones. Minefields are expected to be encountered throughout the threat defensive zones. To win on the next battlefield, US Army maneuver elements must be capable of maintaining freedom of movement and be able to minimize the effects of mined obstacles to that capability. Early detection of mined areas will be a must, and neutralization must be accomplished without maneuver disruption. Current Army systems are handheld, mechanical, and incapable of supporting the needs of the maneuver force on the modern battlefield. Emerging systems, notably the Surface-Launched Fuel Air Explosive (SLUFAE) system offer a standoff breaching capability. However, remote detection remains a vexing problem. To insure survivability on the modern battlefield, a mutually supporting family of detection and neutralization systems is required. Minefields will have to be located from standoff distances, and to the extent possible, breaches made without exposing the breaching capability to mine field protective fires. The present project entails tasks designed to provide the Army with a family of mutually supporting countermine devices and techniques including the following items: a countermine capability for the M1 tank that facilitates the attachment of mine rollers and plows; a Remote Minefield Detection (RMD) capability for rapid and safe detection from airborne platforms; a dedicated counterobstacle vehicle that provides a countermine/counterobstacle and obstacle emplacement capability; and an improved fuel-air explosive technology that will significantly enhance standoff explosive minefield clearance capability. Also under this project, a family of combat shelters is being developed to provide for survival of weapons and personnel during periods of indirect fire.

B. (U) RELATED ACTIVITIES: This project is supported by exploratory development conducted in Program Element 6.26.03.A, Large Caliber and Nuclear Technology, and forms the basis for systems advanced development in Program Element 6.36.19.A, Landmine/Barrier Systems. Engineering development of items and concepts developed in this program is performed under Program Element 6.46.12.A, Countermines and Barriers.

Project: #D608 Title: Countermine & Barrier Development
Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

C. (U) WORK PERFORMED BY: The US Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, is assigned responsibility for Countermine and Barriers. Contractors include: Martin Marietta, Orlando, FL; IIT Research Institute, Chicago, IL; BMY Corp, York, PA; Israel Military Industries, Israel Aircraft Industries and ORDAN Industries of Israel.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: In mine detection, pulse radar, X-ray, and gamma ray excitation, passive infrared devices, microwave techniques, and trace gas detection devices were evaluated. The ability of dogs to detect the explosive in landmines and booby traps was successfully demonstrated, and a canine mine detection manual was completed. A prototype evaluation of the Vehicle-Mounted Road Mine Detector (VMRMD) was conducted. In mine neutralization, fuel-air explosives (FAE) were shown to be an effective minefield clearance device. Work was initiated on a portable projected line charge for antipersonnel minefields, and hardening of vehicle components to resist mine damage. A variety of combat shelters from exploratory development, PE 6.27.33.A, were demonstrated, and work was initiated on the dedicated counterobstacle vehicle, and a remote minefield detection and cleared lane marking system.

2. (U) FY 1982-FY 1984 Program: Continue advanced development efforts on improved fuel-air explosives, continue work on the counterobstacle vehicle (COV), accelerate work on the remote minefield detection program, continue efforts on improved combat shelters, and initiate work on countermine attachments for the M1 tank.

3. (U) Program to Completion: This is a continuing program.

Project: #D608 Title: Countermine & Barrier Development
Program Element: #6.36.06.A Title: Landmine Warfare/Barrier Development
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

4. (U) Major Milestones:

	Milestone Event	Current Milestone Dates	Milestone Dates Shown in FY 1982 Submission
Cleared Lane Marking System (CLAMS)	CEP Test	2QFY82	2QFY82

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	3746	8821	6348	5365	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	3143	8847	3476	Not Shown	Continuing	Not Applicable
Quantities (current requirements)	Not Applicable					
Quantities (as shown in FY 1982 submission)	Not Applicable					

FY81 increase results from Army restructuring within the PE, applying additional funds to the Counterobstacle Vehicle and the improved Line Charge. The FY82 decrease results from inflation index adjustment. FY83 increase results from PE restructuring applying additional funds to the Counterobstacle Vehicle and Airborne Minefield Detection.

Other Appropriations: Ammunition Procurement, Army - funds and quantities to be determined.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.07.A
Title: Joint Service Small Arms Program (JSSAP)
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1999	5487	3466	3934	Continuing	Not Applicable
D627	Joint Service Small Arms Prog	0	5487	3466	3934	Continuing	Not Applicable
D640	Crew Served Weapon Dev	1999	0	0	0	0	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This effort provides a coordinated program for the advanced development of the small arms weapon systems required by the joint services to meet the threat on the battlefield of the foreseeable future. The associated technology advancement in small arms will provide a capability to respond to present and projected requirements to insure that the US fighting man will be adequately armed on the modern battlefield.

C. (U) BASIS FOR THE FY 1983 RDTE REQUEST: Current Small Arms Weapon Systems are aging and are based on outdated technology. Increased capability must be pursued because of the high probability of a threat numerical advantage, continuous advances in threat equipment, and changes in our operational modes; i.e., Rapid Deployment Force, Military Operations in Built-Up Areas, mobile armored battlefield, and improvements in personal protection. The Joint Service Small Arms Program Management Committee provides the mechanism to assure overall harmonization, coordination, and control of this effort. The program facilitates consideration of diverse joint service needs, optimum utilization of limited resources (funds, facilities, and small arms expertise in government and industry), and accurate prioritization of tasks to best counter threat advances and changes in operation modes. The funds will support advanced development of six high-priority joint service items. These are: General-Purpose Heavy Machine Gun System (both weapon and advanced ammunition to meet the modern threat), Submachine Gun, Close Assault Weapon (near-term), Saboted Light Armor Penetrator, Medium Support Machine Gun and Advanced Long-Range Rifle.

Program Element: #6.36.07.A Title: Joint Service Small Arms Program (JSSAP)
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (Current requirements)	1999	5487	3466	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	0	3529	0	Continuing	Not Applicable

D640 (Crew Served Weapon Dev.) - FY81: Net increase of $1999K represents funds reprogramed for a Squad Automatic Weapon (SAW) effort leading to Type Classification of the following: XM249E1 weapon, XM855/856 ammunition, and XM27 link. D627 (Joint Service Small Army Program) - FY82: Net increase of $1958 for program element was the result of a Congressional increase to be used for enhancing the Joint Service small arms efforts. FY83: Net increase of $3466K reflects the fact that the initial descriptive summary establishing this project addressed resources for only the first year (FY82), although paragraph I.4., FY 1983 Planned Program, was provided. Outyear guidance had not yet been established for this continuing program.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.36.07.A Title: Joint Service Small Arms Program (JSSAP)
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The Joint Service Small Arms Program Management Committee was chartered as directed by a memorandum from the Deputy Under Secretary of Defense for Research and Engineering (Research and Advanced Technology) designating the Army as Executive Agent to establish exploratory development/nonsystem advanced development (6.2/6.3A) program elements and program funds. The Management Committee, chaired by the Army, has a voting member from each of the Military Services (Army, Navy, Air Force, Marine Corps) and a representative of the Coast Guard (Department of Transportation). This joint service program was created to provide the means to assure that there is no duplication of small arms research and development effort within the Department of Defense. The basic approach is to use: Joint Service Memorandum of Agreement, Joint Service Operational Requirements, frequent meetings, and continuing liaison to assure complete interservice awareness of the total research and development program in the area of small arms and related technology, and also provide a focal point for contact with the private sector. This effort provides advanced development of enhanced performance weapon systems for small operating units and individual combatants of all services in concert with the demands of the modern and projected battlefield, weapon systems involved are all types of small arms to include individual and crew-served weapon systems used to defeat existing and projected improvements in body armor and related hard targets expected on the modern battlefield. Also under this project is the development of low-signature weapons, improved individual fire control for effective target acquisition and engagement, application of modern lightweight/high-strength materials, high-performance light armor penetrators, and application of newly developed weapon technologies. The work contributes to modernization of this class of weapon system leading toward the immediate objectives of significant gains in individual firepower and in battlefield sustainability and survivability. Projects transitioning to 6.3A evolve from exploratory development conducted under a memorandum of agreement executed by the Joint Service Small Arms Program Management Committee. The program addresses deficiencies and shortcomings in current small arms weapon systems being identified in ongoing user mission analyses.

G. (U) RELATED ACTIVITIES: The technical areas in the program are related primarily to Program Element #6.26.17.A, Fire Control and Small Caliber Armaments Technology, Project #AH19A, Small Caliber and Fire Control Technology through FY 1981, and initiating in FY 1983, to a separate Program Element #6.26.23.A, Joint Service Small Arms Program (JSSAP), Project #AH21, JSSAP. As detailed in paragraph F. above, the Joint Service Small Arms Program (exploratory development - 6.2/nonsystem advanced development - 6.3A) was created to provide the means to assure that there is no unnecessary duplication of small arms effort within the Department of Defense.

H. (U) WORK PERFORMED BY: This program of 6.3A, Nonsystem Advanced Development, is under the management of the Joint Service Small Arms Program. The prime in-house developing organization responsible for the program is the US Army Armament Research and Development Command, Dover, NJ, with other major efforts at the Naval Weapon Support Center, Crane, IN, and Air Force Armament Technology Laboratory, Eglin Air Force Base, FL.

Program Element: #6.36.07.A Title: Joint Service Small Arms Program (JSSAP)
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The result of the Squad Automatic Weapon (SAW) program under D640, Crew Served Weapon Development (not managed under the Joint Service Small Arms Program), includes: selection of Fabrique Nationale MINIMI (SM249) manufactured by Fabrique Nationale, Herstal, Belgium (from among four competing light machine guns), as the weapon to be matured for future production; efforts leading to Type Classification of: The matured XM249E1 weapon, the heavy bullet 5.56mm ammunition XM855/856 (US designator for second NATO standard caliber) and the associated XM27 link. This weapon and ammunition combination will provide a significant increase in firepower, range, and effectiveness of the rifle squad.

2. (U) FY 1982-FY 1984 Planned Program: Based on User-expressed interest, verification of performance levels of the General Purpose Heavy Machine Gun with advanced ammunition as to range effectiveness and lethality against modern threat targets will be completed. In addition, versatility of caliber conversion will be demonstrated. This information will form the basis of a Joint Service Operational Requirement (JSOR) for system transition in FY84. An Advanced Submachine gun will be demonstrated to the User based on identified need characteristics which include extended range and accuracy over the current M3A1/Cal .45 system. This advanced approach will also include silenced capability and effectiveness against body armor. Design and performance data collected from the User demonstration will form the basis for a JSOR and item transition to systems development in FY84. The Close Assault Weapon will be demonstrated for the User which provides immediate incapacitating fire in quick threat situations to include operations in built-up areas, dense forests and jungles, security situations, and base defense. This system will provide for improved controllability, firepower, compactness, day/night capability and extended range ammunition over existing versions of converted military shotguns. A JSOR will be provided to support transition to systems development in FY84. A lightweight version of the M60 machine gun will be demonstrated for verification of performance levels and determination of improved versatility resulting from lighter weight. The 7.62mm Saboted Light Armor Penetrator (SLAP) ammunition will transition into 6.3A in FY83. This will provide increased penetration capability against light armor.

3. (U) Program to Completion: This is a continuing program providing for the transition of small arms systems to full-scale development through demonstration of design performance characteristics and preparation of JSOR's. Systems transitioning from 6.2 beyond FY84 include an Advanced Combat Rifle, lightweight, high-performance medium machine gun, manportable grenade launcher, extended range sniper system, and improved hard target penetrators.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.21.A
Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4475	12897	12918	17622	Continuing	Not Applicable
DG07	Combat Vehicle Engine	2630	10068	9199	13183	Continuing	Not Applicable
D395	Combat Vehicle Transmission	1845	2829	3719	4439	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for advanced technology demonstration of combat vehicle propulsion systems and components. Due to extreme operational requirements, propulsion systems intended for military use must possess high output, low volume and weight, multifuel capability, and efficiency and durability not normally available on the commercial market. Ancillary components, such as air filtration and cooling systems, must also be provided to enable these systems to operate in a unique military environment. Combat vehicle propulsion systems are among the longest leadtime development items associated with ground combat vehicles. This program insures that state-of-the-art propulsion systems technology unique to military needs is adequately demonstrated. This program also develops key improvements to existing propulsion systems. The Tank Automotive Command, responsible for this program, maintains continuous dialogue with government agencies and commercial contractors to preclude any duplication of effort. Below 500 hp, commercial engines are exploited for ground vehicle applications.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Funds are requested to continue development of three tasks in the combat vehicle engine Project (DG07) and to continue development of two tasks and initiate two new tasks in the combat vehicles transmission project (D395). Engine tasks are the adiabatic engine, self-cleaning air filtration systems, and a Future Close Combat Vehicle Propulsion System. The AGT 1500 turbine fuel economy program (FEP) component hardware was fabricated and rig tested in FY81. One complete engine was assembled and tested with a 10% mission fuel consumption reduction. For FY82, a contract extension funded by Program Manager's Office M1 will permit testing with interchange of FEP and production modules. Transmission tasks are the CVX650 transmission, a 1000-hp transmission for combat vehicles in the 45-ton range, transmission

Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

component development, a Future Close Combat Vehicle Propulsion System and the Electric-Hybrid transmission. A more detailed description of the FY83 program can be found in paragraph I.2. and the descriptive summary for project DG07.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

RDTE	FY 1981	FY 1982	FY 1983	Additional To completion	Total Estimated Cost
Funds (current requirements)	4475	12897	12918	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4550	12935	19514	Continuing	Not Applicable

FY81 decrease due to Congressional reduction applied to Combat Vehicle Engines (DG07). FY82 decrease due to revised inflation indices. FY83 decrease due to Army decision to fund near-term readiness needs.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: To be effective, ground combat vehicles must be able to move far and rapidly with a high degree of reliability. The unique operational requirements of combat vehicles most often dictate that propulsion systems and other components be developed under government auspices. To insure that such systems and components are available for integration into present and future ground combat vehicles, power train systems and components are developed within this program. The program's goals are to develop cost-effective systems and components that will: (1) increase fuel tolerance; (2) improve fuel economy; (3) improve horsepower-to-ton ratio; (4) improve compactness; (5) improve reliability, availability, maintainability, and durability; and (6) improve control and driveability.

G. (U) RELATED ACTIVITIES: Program Elements (PE): PE 6.26.01.A, Tank and Automotive Technology; PE 6.36.02.A, Advanced Land Mobility System Concepts; PE 6.21.05.A, Materials; PE 6.27.33.A, Mobility Equipment Technology; PE 6.32.01.A, Aircraft Power Plants and Propulsion; PE 6.31.09, Fuels and Lubricants Advanced Development; PE 6.31.02.A, Materials Scale-Up; PE 6.36.26.A, Advanced Diesel Engine Technology; and PE 2.37.35.A, Combat Vehicle Improvement Program. Foreign state-of-the-art trends in military propulsion systems are monitored by the Tank Automotive Command, and data are exchanged with allied countries via data exchange agreements. Inter/Intra-Service/Department duplication of effort is prevented through active planning and coordination of this program at all levels of organization. Program content is subject to continuous review.

H. (U) WORK PERFORMED BY: United States Army Tank-Automotive Command, Warren, MI, is responsible for the development of this program. Major contractors are: Donaldson Corporation, Minneapolis, MN; Cummins Engine Company, Columbus, IN; Detroit Diesel Allison, Indianapolis, IN.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The adiabatic engine successfully demonstrated that it is the most efficient engine in the world. The AGT 1500 fuel economy program demonstrated 10% mission fuel savings. Phase II prototype self-cleaning air filters were constructed and environmental tests conducted along with finalization of the design for vehicle installation in early 1982. A Future Close Combat Vehicle Propulsion System Program was defined. Two CVX-650 transmission prototypes were built and functional and performance tests conducted. A concept study was conducted on a 1000-hp 6-speed hydrokinetic transmission for combat vehicles.

Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Program: A commercial block 250-hp diesel will be upgraded to a 500- to 1000-hp uncooled adiabatic engine. As a first step, the 250-hp diesel engine is being converted to an uncooled adiabatic diesel engine for testing and demonstration in a 5-ton truck. The detailed design, fabrication, and subsystem evaluation of the next-generation adiabatic engine will be started. Also, the advanced diesel will be demonstration tested in the laboratory at 1000 hp. Component integration and performance testing will be conducted. A self-cleaning air filter will be tested in an M1 Abrams Tank. The CVX-650 transmission development effort includes extensive durability testing of one prototype in the laboratory and in-vehicle testing of the second. A compendium of worldwide transmissions for combat vehicles will be completed, and the results utilized for additional concept work for a high-power-density 1000-hp transmission for combat vehicles. A design analysis of a Future Close Combat Vehicle Propulsion System will be initiated. The Automotive Gas Turbine (AGT) 1500 Fuel Economy Program (FEP) contract extension was funded by Program Manager's Office M1 to demonstrate performance of FEP and current production engines with modules interchanged. Plans include continued development of an adiabatic (low heat transfer) engine. This engine is being developed from a commercial base and has already demonstrated that it has exceptional fuel efficiency. The Self-Cleaning Air Filter will have been installed and tested in a testbed. The Pulse Jet Air Cleaner will continue to be developed. The Army will begin preliminary design of a Future Close Combat Vehicle Propulsion System incorporating technology advancements. This effort is aimed at producing a power pack ready for integration into the main battle tank in the 1990's. The CVX-650 transmission will be given extensive in-vehicle testing leading to completion of advanced development in FY84. Two concept studies will be completed for a 1000-hp transmission for combat vehicles. Vehicle evaluation of selected transmission component improvements will be conducted; candidates include improved brakes, extended range-torque converters, synthetic fluids, and electronic controls. An Advanced Main Battle Tank transmission will be completed with the Future Close Combat Vehicle Propulsion System effort for a totally integrated system; goals include increased capacity, if needed, smaller size, electronic controls, and improved total propulsion systems improvement through early integration to candidate engine systems. Feasibility of an electric hybrid transmission will be examined; this option is being reviewed in light of current energy considerations and recent advancements in electric technology. Refer to the descriptive summary for project DG07 for more detail. Advanced development of the adiabatic engine with fabrication of prototype engines will continue leading to a demonstration of a 750-1000-hp version. Testing of the Self-Cleaning Air Filter for the turbine engine will be completed leading to a final design. Work on a ceramic recuperator, more temperature-tolerant turbine blades, and improved oil/bearing temperature tolerance for the AGT 1500 will begin. Component development for the Future Close Combat Vehicle Propulsion System will begin. Component development for alternate fuels use will be initiated. Testing of transmission components will continue; design updates will start. Critical components for

the Advanced transmission will be fabricated. A development contract will be awarded for a 1000-hp transmission based on the results of the previously conducted concept studies. Concepts for electric hybrid transmissions will be formulated.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #DG07 Title: Combat Vehicle Engines
Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to provide engines to meet Army ground combat mobility goals. Problems and needs resulting from the fuel shortage are among the most acute to be attacked. Major objectives include: improved fuel economy and fuel tolerance of future engines, improved survivability through higher horespower-to-weight ratios resulting in enhanced agility, and reduced weight and volume resulting in lower silhouettes. The approach involves development of advanced technologies in major components; these components are then applied to a total propulsion system to demonstrate performance improvements. Upon successful completion of demonstrator tests, full-scale development is undertaken. The Tank-Automotive Command, responsible for this program, maintains continuous dialogue with government agencies and commercial contractors to preclude any duplication of effort.

B. (U) RELATED ACTIVITIES: Program Element (PE): PE 6.26.01.A, Tank and Automotive Technology; PE 6.36.02.A, Advanced Land Mobility Systems Concepts; PE 6.21.05.A, Materials; PE 6.27.33.A, Mobility Equipment Technology; PE 6.32.01.A, Aircraft Power Plants and Propulsion; PE 6.31.09.A, Fuels and Lubricants Advanced Development; PE 6.31.02.A, Materials Scale-Up; PE 6.36.26.A, Advanced Diesel Engine Technology; and PE 2.37.35.A, Combat Vehicle Improvement Program. Foreign state-of-the-art trends in military propulsion systems are monitored by the Tank-Automotive Command, and data are exchanged with allied countries via data exchange agreements. Inter/Intra-Service Department duplication of effort is prevented through active planning and coordination of this project at all levels of organization. Project content is subject to continuous review.

C. (U) WORK PERFORMED BY: United States Army Tank-Automotive Command, Warren, MI, is responsible for the development of this program. Major contractors are: AVCO Lycoming, Stratford, CT; Donaldson Corporation, Minneapolis, MN; Cummins Engine Company, Columbus, IN.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The adiabatic engine successfully demonstrated that it is the most fuel-efficient engine in the world. The advanced diesel engine demonstrated a 1000-hp output without turbo-compounding from a commercial base engine. The AGT 1500 fuel economy program demonstrated a 10% mission fuel savings. Phase II prototypes were constructed and environmental tests conducted along with finalization of the design for vehicle installation in early 1982. A Future Close Combat Vehicle Propulsion Program was defined.

Project: #DG07 Title: Combat Vehicle Engines
Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Program: A commercial block 250-hp diesel will be upgraded to a 500-1000-hp uncooled adiabatic engine. As a first step, a 250-hp diesel engine is being converted to an uncooled adiabatic diesel engine for testing and demonstration in a 5-ton truck. The detailed design, fabrication and subsystem evaluation of the next adiabatic engine will be started. Also, the advanced diesel engine with turbocompound system will be demonstration tested in the laboratory at 1000 hp. Component integration, performance, and durability testing will be conducted with this engine. A self-cleaning air filter will be tested in an M1 Abrams Tank. A design analysis of a Future Close Combat Vehicle Propulsion System will be initiated. In FY 1983 plans include continued development of an adiabatic (low heat transfer) engine. This engine is being developed from a commercial base and has already demonstrated exceptional fuel efficiency. The development of the advanced diesel 1000-hp engine will continue with turbomachinery system and combustion optimization. The self-cleaning air filter will have been installed and tested in a testbed. The pulse jet air cleaner will continue to be developed. The Army will begin preliminary design of a Future Close Combat Vehicle Propulsion System incorporating technological advancements. This effort is aimed at producing a power pack ready for integration into the main battle tank in the 1990's. The laboratory performance test validation phase of the improved fuel economy version of the AGT 1500 turbine will be initiated. In FY 1984 advanced development of the adiabatic engine with fabrication of prototypes will continue leading to a demonstration of a 750-hp version. Development of the advanced diesel 1000-hp engine will continue with preparations being made for a vehicle test rig demonstration. Testing of the Self-Cleaning Air Filter for the turbine engine will be completed leading to a final design. Work on a ceramic recuperator, more temperature-tolerant blades and improved oil/bearing temperature tolerance for the AGT 1500 will begin. Component development for the Future Close Combat Vehicle Propulsion System will begin. Component development for alternate fuels will be initiated.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

Project: #DG07 Title: Combat Vehicle Engines
Program Element: #6.36.21.A Title: Combat Vehicle Propulsion Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	2630	10068	9199	13183	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	59	10098	13915	0	Continuing	Not Applicable

Increase of $2,571 thousand in FY 1981 funding level is a result of a Congressionally approved reprograming to offset a previous reduction by Congress of the Combat Vehicle Engine Program. FY 1982 decrease is due to the application of revised inflation indices. FY 1983 decreases are due to the Army decision to fund near-term readiness needs.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.36.31.A
Title: Combat Vehicle Turret and Chassis
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	3225	7854	11146	12935	Continuing	Not Applicable
D014	Combat Vehicle Hull & Turret	1632	4117	3986	7652	Continuing	Not Applicable
D424	Combat Vehicle Track & Suspension	1593	3737	7160	5283	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for advanced technology demonstration of components associated with ground combat vehicle hull, turret, track, and suspension subsystems. Such systems are militarily unique and therefore must be developed through US Army research and development. Major thrust of this program is to acquire the technology necessary to produce more lethal and survivable vehicles. Common goals of all program tasks are increased performance, enhanced reliability, availability, maintainability and durability, and reduced cost. Results of the program will often lead to product improvements to current Army combat vehicles as well as innovations to be incorporated into new vehicle systems as they are being developed.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Provides for funding of the following tasks: Advanced Countermeasures, Advanced Techniques for Electrical Power Systems, Fire Control Integration, Automatic Fire Detection, a 20-40-ton track program, Fluidic Dampers, Independent External Suspension, Mine-Hardened Track for Special Applications and Track Retention Control. The increase in funding for Combat Vehicle Track and Suspension in FY83 over FY82 is reflective of a renewed emphasis on improving the Army's combat vehicle track.

Program Element: #6.36.31.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Combat Vehicle Turret and Chassis
Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	3225	7854	11146	Continuing	Not Applicable
Funds (as shown in FY 1982)	4973	7876	13442	Continuing	Not Applicable

FY 1981 decrease due to reprograming to higher priority Army requirements.
FY 1982 decrease due to application of revised inflation indices.
FY 1983 decrease due to Army decision to fund near-term readiness needs.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.36.31.A Title: Combat Vehicle Turret and Chassis
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program element contains two projects, D014, Combat Vehicle Hull and Turret, and D424, Combat Vehicle Track and Suspension. Both provide: fully tested and validated components and subsystems for application to combat vehicles; long-lead components available for adaption to new combat vehicle concepts as well as existing vehicles; and component building blocks for increasing performance, survivability, RAM-D, reducing costs, and providing new capabilities to combat vehicles of the future.

G. (U) RELATED ACTIVITIES: Program Elements (PE): PE 6.21.05.A, Materials; PE 6.31.02.A, Materials Scale-Up; PE 6.21.20.A, Nuclear Weapons Effects/Fluidics; PE 6.26.01.A., Tank Automotive Technology; PE 6.36.02.A, Advanced Land Mobility Systems Concepts; PE 6.26.17.A, Small Caliber and Fire Control Technology; PE 6.27.02.A, Night Vision Investigations; PE 6.27.16.A, Human Factors in Military Systems; PE 6.26.18.A, Ballistics Technology; and PE 2.37.35.A, Combat Vehicle Improvement Program. Foreign state-of-the-art trends in military propulsion systems are closely monitored, and technology information is exchanged with allied countries via data exchange agreements. Close coordination and continuous discussion with other Services/Departments preclude duplication of efforts.

H. (U) WORK PERFORMED BY: The Army Tank-Automotive Command, Warren, MI, is responsible for the development and system integration of this program. Major contractors for the program elements include Chrysler, Huntsville Electronics Division, Huntsville, AL; Santa Barbara Research Center, Coleta, CA; Graviner Incorporated, Mountainside, NJ; Standard Products Company, Port Clinton, OH; Goodyear Tire and Rubber Company, St. Mary's OH; Northrup Corporation, Anaheim, CA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Advanced Countermeasures/Vehicle Integrated Defense System Program demonstrated several subsystems for detection reduction and laser warning. Active and passive countermeasures were evaluated in joint programs with the USAF. The Advanced Techniques for Electrical Power System (ATEPS) task established technical requirements for tank development; ATEPS is a multiplexed power distribution and control system to simplify combat vehicle wiring at the same time permitting a diagnostic/prognostic capability and an instantaneous readiness status. The ATEPS installation includes the use of segmented wiring components which is the essential technology to improve future combat vehicle maintainability. A Fire Control Integration program was initiated in FY 1980; its goal is to combine advanced fire control efforts into integrated packages for demonstration in combat vehicles. The Automatic Fire Detection and Suppression program developed specifications for standardized fire suppression components. Advanced development testing of a fluidic damper was conducted; this system has a goal of improving gun platform stability, RAM-D, mobility, and a 50% increase in mean miles between failure.

Program Element: #6.36.31.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Combat Vehicle Turret and Chassis
Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Planned Program: The integrated defense system will be mounted on a combat vehicle and evaluated. Laser warning receivers will be interfaced with the turret main weapon drive to evaluate a return-fire capability. ATEPS hardware/software will be installed and tested. Fire Control Integration will include initiation of a fire control design for a main battle tank. The Fire Control Integration activity was initiated in FY 1980 to combine new fire control technologies into integrated systems for demonstration in combat vehicles. An analytical method using modeling techniques with modern control theory was developed for evaluating fire control designs/configurations. Testing of Automatic Fire Detection and Suppression will continue. Six sets of a new, longer, midweight class (20t-40t) track will be fabricated. Fluidic dampers will be fabricated and field tested. Design of a mine-hardened track will begin; this program has a goal of reducing vulnerability of Army tracked vehicles to landmines. In FY 1983, testing and refinement of the Advanced Countermeasures system will continue, demonstrating countermeasure combinations that will have significant survivability payoffs. Fabrication of Advanced Techniques for Electrical Power Systems (ATEPS) prototype hardware for turret use will be completed and will be tested in a vehicle; reliability and cost effectiveness information will be gathered. Integration of the fire control system for an M1 demonstration will continue. Explosive testing will be conducted with the Automatic Fire Detection and Suppression System. 20T-40T track will be tested to confirm design. Fluidic dampers will be fabricated and tested. Track retention and control advanced designs will be initiated. An Independent External Suspension System will be transitioned to advanced development to provide an improved suspension system for 45-65T tracked vehicles; efforts will include fabrication of componentry. The Mine-hardened Track program will fabricate prototypes, conduct blast and mobility analysis. Continue prognostic technology development by test data acquisition, data analysis, design and build new hardware (VMS II). Develop in brassboard-type hardware a concept demonstrator for Advanced Diagnostic techniques. Total commonality and interchangeability of components for all types of fire detection and extinguishing systems for both active and passive systems will be accomplished. Fire Control/Weapons System Integration plans call for the integration of two new technological developments into vehicular applications; namely, STARTLE Millimeter Wave Radar System and the proposed Improved Conventional Armament System (ICAS) and for coordination of fire control systems development for the long-range Future Close Combat Vehicle Program. In FY 1984, crew interface displays of threat warning sensors and reactions will be developed. Countermeasure techniques will be integrated to reduce detection and recognition by all sensory threats. Testing of ATEPS will continue to completion for current design. The fire control system for M1 technology demonstration will be completed. A future fire control system based on ongoing studies will be initiated. A fast fire extinguisher system and improved optional sensors will be evaluated. Third-generation 20t-40t track will be fabricated based on previous testing. Fluidic damper testing will be completed, and a design for an M1 coupatible damper will be started. Fabrication and evaluation of track retention and control systems will be performed. Independent External Suspension fabrication will be completed and testing will begin. Based on prior testing, mine-hardened track will be redesigned leading to a decision for its use.

Program Element: #6.36.31.A Title: Combat Vehicle Turret and Chassis
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

Prognostic technology development by expansion of vehicle test to new vehicles. Test new VMS II hardware and incorporate ATEPS algorithm. Validate hardware, algorithms, and diagnostic test procedures on the military fleet.

3. (U) Program to Completion: This is a continuing Program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D424 Title: Combat Vehicle Track and Suspension
Program Element: #6.36.31.A Title: Combat Vehicle Turret and Chassis
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to provide combat vehicle track and suspension components which meet Army ground combat mobility goals. Problems and needs resulting from higher vehicle speeds, increasing hardware and maintenance cost, plus improving survivability, are the most acute to be attacked. Major objectives include: Near-term thrusts to increase track durability and reduce the maintenance burden and life cycle cost and long-term thrust to develop a common track system for specific weight classes of vehicles. The approach involves use of laboratory simulation tests, computer math modeling and full-scale vehicle test rigs to demonstrate the performance improvement and verify the technology data base being established. Upon successful completion of demonstrator tests, components are incorporated into future vehicle programs and product improvement programs for existing vehicles. The Tank-Automotive Command, responsible for this program, maintains continuous dialogue with government agencies and commercial contractors to preclude any duplication of effort.

B. (U) RELATED ACTIVITIES: Program Element (PE): PE 6.26.01.A, Tank and Automotive Technology; PE 6.36.02.A, Advanced Land Mobility Systems Concepts; PE 6.27.33.A, Mobility Equipment Technology; PE 6.36.32.B, Armored Combat Support Vehicle Family; PE 6.37.35.A, Combat Vehicle Improvement Program. Foreign state-of-the-art trends in military suspension systems are monitored by the Tank-Automotive Command and data are exchanged with Allied countries via NATO and data exchange agreements. Inter/Intra-Service Department duplication of effort is prevented through active planning and coordination of this project at all levels of organization. Project content is subject to continuous review.

C. (U) WORK PERFORMED BY: United States Army Tank-Automotive Command, Warren, MI, is responsible for the development of this program. Major contractors are: Goodyear, St. Marys, Ohio; Firestone, Noblesville, IN; Standard Products, Port Clinton, OH; TRITEC, Inc., Columbia, MD; and Chrysler, Centerline, MI.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Field testing of the heavy class track (45 T - 65 T) demonstrated improved lateral stability and guiding with redesign initiated to reduce weight. Field testing of the lightweight track (15T - 18T) successfully demonstrated increased life and improved performance. Brassboard testing of a fluidic damper continued and fabrication of advanced development prototype dampers initiated. The long-term track improvement for the XT-160 track (45T - 65T) was initiated. Also, procurement initiated for analytical data base hardware applicable to all weight class tracks.

Project: #D424 Title: Combat Vehicle Track and Suspension
Program Element: #6.36.31.A Title: Combat Vehicle Turret and Chassis
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Program: In FY82 redesign and analysis to reduce the weight of the 45T - 65T weight class track XT-152 will continue. Laboratory simulation testing and a computer program will be initiated for generation and validation of new mathematical models to provide an in-house capability for dynamic computer-aided track component and systems design and analysis. Field testing of 15T - 18T weight class track to be completed. Fabrication of advanced development prototype fluidic dampers and field testing of the 20T - 40T class track will be initiated. In FY83 fabrication of prototype XT-160 track will be initiated. Field testing of prototype fluidic dampers applicable to heavy weight class 45T - 65T vehicles will be initiated. A track retention and control program will be initiated to automatically adjust and control track tension. Design of a mine-hardened track will begin. This program has a goal of reducing vulnerability of Army tracked vehicles to landmines. An independent External Suspension System will be transitioned to advanced develpment. This effort will provide an improved suspension system for 45T - 65T tracked vehicles; efforts will include fabrication of componentry. During FY84 field testing of XT-160 prototype track on Abrams and M60 tanks will be conducted. Laboratory and field testing of heavy weight class damper will be completed, and field testing of a fluidically controlled rotary damper will be initiated. Fabrication and evaluation of a track retention and control system will be performed. The Mine-Hardened Track Program will fabricate prototypes, conduct laboratory and development test, and conduct blast and mobility analysis. Independent External Suspension fabrication will be completed and testing will begin.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	Fy 1984 Estimate	Additional To Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	1593	3737	7160	5283	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1854	3748	4781	-	Continuing	Not Applicable

Project: #D424 Title: Combat Vehicle Track and Suspension
Program Element: #6.36.31.A Title: Combat Vehicle Turret and Chassis
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

FY81 reduction due to Army decision to fund near-term readiness needs. FY82 reduction due to application of revised inflation indices. FY83 increase due to increased emphasis on track development.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.36.36.A
Title: Combat Vehicle Armor/Antiarmor
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	0	10888	11233	Continuing	Not Applicable
D221	Combat Vehicle Survival-Armor	0	0	4949	5137	Continuing	Not Applicable
D223	Combat Vehicle Antiarmor	0	0	5939	6096	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The program objectives are to develop and demonstrate (1) vehicle armor which will provide adequate protection for combat vehicles against anticipated ballistic (kinetic energy and shaped charge) threats in the 1988-1998 timeframe and (2) the capability to defeat threat armor in the same timeframe with kinetic energy projectiles and shaped charge (direct fire and top attack) warheads. This program supports the Army's close combat mission area by increasing the survivability of our combat vehicles, through improved protective armor and by increasing the lethality of our direct and indirect fire antitank systems with improved warheads and projectiles.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: This program is a new start. It is being brought about to satisfy a technology requirement. That requirement is to use technology to make our combat vehicles more survivable and more lethal in a relative sense. Specifically, that is to ensure that our relative position compared to the threat is significantly improved on the future battlefield. The addition of this program will also allow for a smooth progression through the research and development cycle for vehicle armor, kinetic energy projectiles, and shaped charge warheads. The programed funds for FY 1983-1984 will allow for the development and demonstration of improved armors, advanced kinetic energy penetrators, and improved shaped charge warheads which have or will have completed exploratory development (6.2).

Program Element: # 6.36.36.A Title: Combat Vehicle Armor/Antiarmor
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	0	0	10888	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	0	0	0	Continuing	Not Applicable

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.36.36.A Title: Combat Vehicle Armor/Antiarmor
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of the vehicle armor portion of the program is to develop and demonstrate armor which will provide adequate protection for combat vehicles against anticipated Soviet tank guns and anti-tank missiles in the 1988-1998 timeframe. These armors are also to be lighter weight than present-day armors in order to increase vehicle mobility. The objective of the antiarmor portion is to develop and demonstrate the capability to defeat threat armor as represented by the Next Soviet Tank (NST) and the Future Soviet Tank (FST). This involves (1) demonstrating a 105mm kinetic energy round to defeat the NST, (2) demonstrate for, use on lightweight vehicles, the penetration capability of a soft launch kinetic energy round, (3) demonstrate the penetration capability of a 100-125mm top attack warhead, and (4) demonstrate an advanced technology shaped charge warhead capable of defeating the FST.

G. (U) RELATED ACTIVITIES: The related projects at the research level (6.1) are: 6.11.02A/AH42, Research in Materials and Mechanics, at the Army Materials and Mechanics Research Center (AMMRC), 6.11.02A/AH43, Research in Ballistics, at the Ballistics Research Laboratory (BRL), 6.11.02A/AH60, Research in Large Caliber Applications, at the Large Caliber Weapons System Laboratory (LCWSL) and 6.11.02A/AH49, Missile and High Energy Laser Research, at the Missile Laboratory (MICOM). The related projects at the exploratory development (6.2) level are: 6.21.05A/AH84, Materials, (AMMRC); 6.26.18A/AH80, Ballistic Technology, (BRL); 6.26.03A/AH18, Large Caliber and Nuclear Technology, (LCWSL); 6.23.03A/A214, Missile Technology, (MICOM); and 6.26.01A/AH91, Tank and Automotive Technology, at the Tank and Automotive Command (TACOM). Finally at the nonsystem advanced development (6.3a) level: 6.31.02A/D071, Materials Scale-Up/Structure Demonstration (AMMRC); 6.33.13A/D087, Missile and Rocket Components (MICOM); and 6.36.31A/D014, Combat Vehicle Hull and Turrets (TACOM). There is no unnecessary duplication of effort within the Army in this area. Additionally, a close relationship is maintained with other Services and government agencies in order to prevent duplication. Information is also exchanged with several foreign governments under data exchange agreements, a memorandum of understanding, and The Technical Cooperation Program (TTCP). A program plan for the vehicle armor aspect has been prepared by TACOM, and for the antiarmor aspect, BRL has prepared a plan. These plans are intended to assure that the effort is fully coordinated and frequently reassessed to assure suitable progress is achieved and new discoveries are advanced expeditiously.

H. (U) WORK PERFORMED BY: The work will be performed by the US Army Materials and Mechanics Research Center, Watertown, MA; Ballistic Research Laboratory, Aberdeen Proving Ground, MD; Large Caliber Weapons Systems Laboratory, Dover, NJ; Missile Laboratory, Huntsville, AL; and US Army Tank-Automotive Command, Warren, MI. Contractors who will participate in this program have not yet been identified.

Program Element: # 6.36.36.A Title: Combat Vehicle Armor/Antiarmor
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Not Applicable.

2. (U) FY 1982-FY 1984 Program: This is a new program start in FY 1983. The vehicle armor portion of the program will initially concentrate on developing, in full-scale tests, a system known as reactive armor. Proceeding at a somewhat slower pace will be the development and full-scale testing of various forms of ceramic armor. The antiarmor portion of the program will concentrate on (1) demonstrating an improved 105mm kinetic energy round that will provide US tanks with the ability to defeat the NST threat, (2) evaluating, improving, and ballistically testing a soft launch rocket-assisted kinetic energy penetrator, (3) optimizing the design and conducting testing on 100-125mm fly-over-shoot-down warhead, and (4) designing and initial testing of a 150mm shaped charge warhead capable of defeating the FST threat.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: # D221 Title: Combat Vehicle Survival-Armor
Program Element: # 6.36.36.A Title: Combat Vehicle Armor/Anti-Armor
DOD Mission Area: # 553 - Engineering Technology (ATD) Budget Activity: # 2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this project is to develop and demonstrate vehicle armors that will provide adequate protection for combat vehicles against Soviet tank guns and antitank missiles in the 1988-1998 timeframe. The armors are also to be lighter weight than present-day armors. The accomplishment of this project will result in more mobile and more survivable combat vehicles--a major Army objective.

B. (U) RELATED ACTIVITIES: The related projects at the research (6.1) level are: 6.11.02A/AH42, Research in Materials and Mechanics, at the Army Material and Mechanics Research Center (AMMRC) and 6.11.02A/AH43, Research in Ballistics, at the Ballistics Research Laboratory (BRL). The related projects at the exploratory development (6.2) level are: 6.21.05A/AH84, Materials, (AMMRC); 6.26.18A/AH80, Ballistic Technology (BRL); and 6.26.01A/AH91, Tank and Automotive Technology, at the Tank-Automotive Command (TACOM). Finally at the nonsystem advanced development (6.3a) level: 6.37.02A/DO71, Materials Scale-Up/Structure Demonstration (AMMRC), and 6.36.31A/DO14, Combat Vehicle Hull and Turret (TACOM). There is no unnecessary duplication of effort within the Army in this area. Additionally, a close relationship is maintained with other Services and government agencies in order to prevent duplication. Information is also exchanged with several foreign governments under data exchange agreements and a memorandum of understanding. A program plan has been prepared by TACOM to assure that this effort is fully coordinated and frequently reassessed to assure that suitable progress is achieved and new discoveries are advanced expeditiously. A steering board is being formed to further assure that there is no duplication and that useful research tasks are being exploited.

C. (U) WORK PERFORMED BY: The US Army Tank-Automotive Command, Warren, MI, has the responsibility for management and implementation of this program. Other Army in-house organizations who provide major support to this program are the US Army Materials and Mechanics Research Center, Watertown, MA, and the Ballistic Research Laboratory, Aberdeen Proving Ground, MD. Contractors who will participate in this program have not yet been identified.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Not applicable.

Project: # D221 Title: Combat Vehicle Survival-Armor
Program Element: # 6.36.36.A Title: Combat Vehicle Armor/Anti-Armor
DOD Mission Area: # 553-Engineering Technology (ATD) Budget Activity: # 2-Advanced Technology Development

2. (U) FY 1982-FY1984 Program: This is a new program start in FY 1983 which will develop and demonstrate new technologies that have maximum potential for exploitation in new and current combat vehicles. Once the technologies are developed, they will be demonstrated in full-scale tests. Initially, efforts will concentrate on a system known as "reactive armor," which appears to have the greatest potential. This technology has the potential to provide protection against ballistic threats in the 1988-1998 timeframe. The other technology, which is currently less mature, is ceramic armor. It will initially be brought on at a somewhat slower rate. It is envisioned that it will be able to both complement and supplement reactive armor without unacceptable weight and space penalties.

3. (U) Program to Completion: This is a continuing program that will respond to increased ballistic threats with increased protection/survivability techniques.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981	FY 1982	FY 1983	FY 1984	Additional To Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	0	0	4949	5137	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	N/A	N/A	N/A	N/A	Not Applicable	Not Applicable

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #D223 Title: Combat Vehicle Antiarmor
Program Element: #6.36.36.A Title: Combat Vehicle Armor/Antiarmor
DOD Mission Area: #553-Engineering Technology (ATD) Budget Activity: #2 - Advanced/Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to develop and demonstrate the capability to defeat threat armor as represented by the Next Soviet Tank (NST) and the Future Soviet Tank (FST). The four phases of the program are as follows: (1) demonstrate in two years an improved kinetic energy round that will enable the M1, M60A1 and M60A3 tanks to defeat the NST, (2) demonstrate the penetration capability of soft launched, rocket-assisted, kinetic energy penetrators against the frontal armor of the FST, (3) demonstrate the penetration performance of a top attack warhead that is suitable for 100-125mm missiles or projectiles, and (4) demonstrate a large HEAT (shaped charge) warhead capable of defeating the frontal armor of the FST.

B. (U) RELATED ACTIVITIES: The related projects at the research (6.1) level are: 6.11.02A/AH42 "Research in Materials and Mechanics" at the Army Materials and Mechanics Research Center (AMMRC), 6.11.02A/AH43 "Research in Ballistics" at the Ballistic Research Laboratory (BRL), 6.11.02A/AH60 "Research in Large Caliber Applications" at the Large Caliber Weapons System Laboratory (LCWSL), and 6.11.02A/AH49 "Missile and High Energy Laser Research at the Missile Laboratory (MICOM). The related projects at the exploratory development (6.2) level are: 6.21.05A/AH84 "Materials" (AMMRC), 6.26.18A/AH80 "Ballistic Technology" (BRL), 6.26.03A/AH18 "Large Caliber and Nuclear Technology" (LCWSL) and 6.23.03A/A214 "Missile Technology" (MICOM). Finally the related projects at the nonsystem advanced development (6.3a) level are: 6.31.02A/D071 "Materials Scale-Up/Structures Demonstration" (AMMRC) and 6.33.13A/D087 "Missile/Rocket Components" (MICOM). There is no unnecessary duplication of effort within the Army regarding this area. A close working relationship is also maintained with other services and government agencies in order to prevent duplication. Additionally, information is exchanged with several foreign governments under data exchange agreements and The Technical Cooperation Program (TTCP). A program plan has been prepared by BRL to assure that this effort is fully coordinated and frequently reassessed to assure suitable progress is achieved and new discoveries are pursued.

C. (U) WORK PERFORMED BY: US Army Armament Research and Development Command has responsibility for management and implementation of this program. Other Army in-house organizations who will provide major support to this program are the Ballistics Research Laboratory, Aberdeen Proving Ground, MD; US Army Materials and Mechanics Research Center, Watertown, MA; Large Caliber Weapons System Laboratory, Dover, NJ; and Missile Laboratory, Huntsville, AL. Contractors who will participate in this program have not yet been identified.

Project: #D223 Title: Combat Vehicle Antiarmor
Program Element: #6.36.36.A Title: Combat Vehicle Armor/Antiarmor
DOD Mission Area: #553-Engineering Technology (ATD) Budget Activity: #2 - Advanced/Technology Development

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Not applicable.

2. (U) FY 1982-FY 1984 Program: This is a new program start in FY 1983 that will demonstrate and improved capability to defeat threat armor through the exploitation of two technologies--kinetic energy technology and shaped charge technology. The kinetic energy aspect will concentrate on (1) demonstrating an improved 105mm armor piercing fin stablized discarding sabot (APFSDS) round that will provide US tanks the ability to defeat the NST threat, and (2) evaluate, improve, and ballistically test a soft launch rocket assisted kinetic energy penetrator for use by light combat vehicles such as envisioned for use with the Rapid Deployment Force. The shaped charge technology exploitation aspect of this program involves (1) optimizing the design and conducting both static and rocket track testing of a 100-125mm top attack warhead, and (2) designing and conducting initial rocket sled testing of an advanced technology shaped charge warhead capable of defeating the FST threat.

3. (U) Program to Completion: This is a continuing program which will respond to improvement in vehicle armor with increased penetration capabilities for kinetic energy penetrators, shaped charge warheads and top attack projectiles.

4. (U) Major Milestones: Not applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	0	0	5939	6096	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	N/A	N/A	N/A	N/A	Not Applicable	Not Applicable

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	17896	35617	30224	34816	Continuing	Not Applicable
DK70	Night Vision Advanced Development	12313	23722	19057	20305	Continuing	Not Applicable
DK86	Night Vision Airborne Systems	710	4642	3278	7599	Continuing	Not Applicable
DK87	Night Vision Combat Vehicles	4873	7253	7889	6912	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army needs an improved capability to fight at night and during periods of limited visibility. The pinpoint accuracy and massive firepower currently available are valuel ss unless targets can be acquired, identified, and accurately located. The objective of this program continues to be to appiy recent advances in technology to reduce the life cycle costs and improve the performance of night sights to provide the Army with the necessary improved night and limited visibility fighting ability. This improved performance will effectively multiply US ground combat power. With this capability, the Army will be able to successfully counter a foe who plans and trains to continue operations during all visibility conditions. The night vision and electro-optics systems developed are used by the individual soldier, missile systems, helicopters, and combat vehicles. While the current common module Forward Looking Infrared (MOD FLIR) systems can and do provide extremely high performance for surveillance, target acquisition, and fire control, the technology places a severe limitation on the size and weight below which manportable thermal sights may not be reduced. Fielding over 20,000 systems with less size, weight, and cost than the current devices will allow the Army to meet and counter the threat. To reduce the time of target acquisition, identification, and engagement, while increasing survivability and the accuracy of fire control for both aircraft and combat vehicles, will require development and integration of new technology thrusts in automation (auto-cue, auto-track, etc.), IR focal planes, millimeter wave devices, and lasers. A

Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

critical portion of this technology thrust is the implementation of counter-countermeasures to all methods whereby the fire control systems can be rendered ineffective. This program bridges the gap between the efforts of Night Vision Investigation (PE 6.27.09.A) and Night Vision Devices (PE 6.47.10.A).

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Development within thermal technology will continue to concentrate on prototypes of second-generation manportable thermal imaging systems primarily for the individual and crew-served weapons and for manportable air defense systems such as Stinger. Advanced far infrared technology will be applied to driver's viewer and commander's viewer. The development of prototypes of CO2 laser rangefinders and millimeter wave radars will be continued, and the prototype will be evaluated for combat vehicles applications. Development of hardening componentry to modify Mercury Cadmium Telluride Common Module FLIR Systems to harden against laser threats will be continued.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	17696	35617	30224	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	20537	35715	34908	Continuing	Not Applicable

The decrease in FY 1981 ($2641) was due to program realignment and transfer to higher priority projects. The decrease in FY 1982 ($98) reflects reprograming to fund higher priority projects. The decrease in FY 1983 ($4684) was due to program realignment and reprograming to fund higher priority projects.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Far infrared capability represents a first order improvement over image intensification technologies in that systems made using infrared are light-level independent, exhibit dust, smoke, and fog penetration, and allow for rapid acquisition of targets. The Night Vision & Electro-Optics Laboratory development of Army Forward-Looking Infrared (FLIR) Common Modules has made this technology affordable for the Army; systems for antiarmor and tank applications are now in production. Packaging and integration efforts must still be undertaken to permit infrared capability to be incorporated into combat vehicle driving devices. The application of infrared technology to devices for the individual soldier is not possible with the current technology. Devices of sufficient compactness and lightness are possible only through the use of thermoelectrically cooled 3- to 5-micron second-generation FLIR technology, now in development in the technology base. These devices, thermal weapons sights, include the Infrared Rifle Sight, the Long-Range Weapon Sight for crew-served applications, and a surveillance capability for the infantry commander. In addition, the use of this technology will be investigated as an independent sight for the combat vehicle commander. The commander is currently constrained to share a sight with the gunner, thus eliminating the possibility of employing the hunter-killer tactical concept. Under extremely adverse weather conditions, wherever FLIR's are ineffective, it may be possible to secure tactical superiority through the use of millimeter wave radar. A prototype device has been tested and has demonstrated the utility of this approach. At the present time, laser rangefinders are adversely affected by adverse atmospheric conditions that are invisible to infrared sights. A CO2 laser rangefinder will solve this problem. Such a device will be integrated with a tank thermal sight during this period.

G. (U) RELATED ACTIVITIES: The Army's Night Vision Laboratory has been assigned the responsibility for coordination of all night vision technology-based programs within the three Services to avoid duplication and to insure that maximum use is made of resources and capabilities within the Department of Defense (DOD) community. Additionally, active international technical interchange is maintained with North Atlantic Treaty Organizations (NATO) through Panel VI (Combat Intelligence) of the NATO Army Armaments Group (NAAG). The Federal Republic of Germany Memorandum of Understanding (MOU) for the sale and coproduction of the DOD Standardized Common Modules is being executed. Germany's plan to use Common Modules on their LEOPARD I & II, MARDER, and LUCHS vehicles is a significant step forward in NATO standardization for Thermal Imaging Systems. Negotiations are in progress within NATO on another Memorandum of Understanding (MOU) with Germany and the Netherlands for sale and coproduction of common modules. Development of an all-weather capability for the Army Remotely Piloted Vehicle is funded under program element 6.37.25.A,DK61 Remotely Piloted Vehicles.

H. (U) WORK PERFORMED BY: Work is performed by the United States Army Night Vision and Electro-Optics Laboratory, Fort

Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

Belvoir, VA, with contractor assistance. Representative contractors include: International Telephone and Telegraph Corporation, Fort Wayne, IN; Varian Associates, Palo Alto, CA; Texas Instruments, Inc., Dallas, TX; Aeronutronics Ford Corporation, Newport Beach, CA; Hughes Aircraft, Culver City, CA; Honeywell, Lexington, MA; Martin Marietta, Orlando, FL; and Rockwell International, Anaheim, CA.

1. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Tubes for low-cost Night Vision Aids were developed and tested, and contracts awarded for fabrication of the aids (goggles) using these tubes. Improvements to the first generation of Infrared Common Modules have been completed. These improvements provide increased durability and maintainability. The battery-powered cooler for the Night Observation Device, Long Range (NODLR) was developed. A neodymium laser rejection filter for image intensifiers was developed. Advanced development of third-generation Pilot's Night Vision Goggles (ANVIS) was completed. A FLIR-augmented Cobra TOW Sight (FACTS) was developed, tested, and transferred to AVRADCOM. Advanced development of the low-cost night vision aids was completed.

2. (U) FY 1982-FY 1984 Program: Advanced Development of the thermoelectrically cooled Thermal Weapon Sight will continue with primary emphasis on the intermediate range for crew-served weapons. Advanced Development of the Independent Commander's viewer will be continued to completion and transitioned to Program Manager (PM) M1. Advanced Development of the Thermal Driver's Viewer for application of combat vehicles will be completed, and DT/OT will be conducted for validation prior to entering Engineering Development. Advanced Development will be completed on the CO_2 Laser rangefinder, and it will transition to the PM for product improvement of the MK II XM1. Develop an Autocuer/tracker for integration with M1 subsystems. Initiate Advanced Development of an elevated sensor platform for use by artillery battalion observation post. Start development of a prototype Advanced Aviation Sensor (forward looking infrared (FLIR) sensor and image processing). Conduct Advanced Development of a Passive Wide Area Alerting System (IR Search Set) and start development of a high-resolution ground-to-air FLIR system. Continue development of automated sensors such as the Prototype Automatic Target Screener and the Automatic Target Cuer. Millimeter wave radar for combat vehicles will undergo various evaluations prior to the development of a tank all-weather system. Advanced Development will be initiated on automation modules for add-on to existing FLIR systems. Detector fabrication using the liquid phase epitaxy (LPE) process will continue with emphasis on second-generation focal planes. Development of Helmet-mounted Display and image processing subsystems will be continued. Development of stabilization techniques for second generation FLIR sensors and of a technology demonstrator for light

vehicle/airborne applications will be initiated. Initiate the development of hardening componentry which incorporates current technology improvements in a form that permits the modification of Mercury Cadmium Telluride Common Module FLIR Systems to harden against laser threats.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #DK70 Title: Night Vision Advanced Development
Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics and Physical Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The Army has the need for a cost-effective ability to fight during periods of darkness and limited visibility with a relative combat capability that equals that during daylight. This project applies new techniques, components, and devices to produce significant cost reductions and performance improvements for night vision devices to meet that need. The combat capability is required to counter the threat of a foe that plans to continue combat operations during periods of darkness and limited visibility. The objective of this project is the advanced development of night vision components and devices which have applications independent of specific weapons systems or vehicles. This is the base project for the program element and includes infrared, laser, image intensification and MM wave technologies.

B. (U) RELATED ACTIVITIES: Related Projects are Program Element 6.37.10.A, Project DK86, Night Vision Airborne Systems, and Program Element 6.37.10.A, Project DK87, Night Vision Combat Vehicles. These latter projects were established to increase management visibility of specific applications. The Army's Night Vision and Electro-Optics Laboratory has been assigned the responsibility to coordinate all night vision technology-based programs within the three services to insure maximum use is made of resources and capabilities within the Department of Defense (DOD). Active international technical interchange is maintained within the North Atlantic Treaty Organization (NATO) Army Armaments Group. Configuration control is maintained for common modules produced for United States systems as well as those produced under the Memorandum of Understanding with the Federal Republic of Germany.

C. (U) WORK PERFORMED BY: Work is performed by the United States Army Night Vision and Electro-Optics Laboratory, Fort Belvoir, VA, with contractor assistance. Representative contractors include: International Telephone and Telegraph Corporation, Fort Wayne, IN; Varian Associates, Palo Alto, CA; Texas Instruments, Dallas, TX; Hughes Aircraft, Culver City, CA; Martin Marietta, Orlando, FL; and Honeywell, Lexington, MA.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: First Generation Infrared Common Modules have been standardized within the three Services and are in production for such items as the AN/TAS-4, TOW Night Sight, and AN/VSG-2, Tank Thermal Sight, and the Gunner's Primary Sight (GPS) for the XM1. A forward looking infrared (FLIR)-Augumented COBRA TOW Sight (FACTS) was

Project: #DK70
Program Element: #6.37.10.A
DOD Mission Area: #551 - Electronics and Physical Sciences (ATD)

Title: Night Vision Advanced Development
Title: Night Vision Advanced Development
Budget Activity: #2 - Advanced Technology Development

developed, tested, and transitioned to the COBRA PM for engineering development. High sensitivity third-generation Image Intensification Tubes have been fabricated and given limited field testing. Advanced development of an Av ator's Night Vision Imaging System (ANVIS) was completed and transitioned into engineering development. The performance qualification of first-generation infrared common module competitive infrared common modules was initiated. A neodymium base rejection filter for image intensifiers was demonstrated. A battery-powered closed cycle cooler for manportable thermal sight was developed to replace the current compressed-gas-powered cooler, and a thermoelectric cooler for lightweight sights has been initiated. Conducted field testing of the Surveillance and Target Acquisition Radar for Tank Location and Engagement (STARTLE) prototypes, which were completed under a 6.2 effort (PE 6.27.09). Advanced development was begun on the second-generation 3-5 micron thermoelectrically cooled systems to provide thermal imaging systems for the individual soldier and lightweight weapon applications. Initiated the fabrication of common module detectors from a new process called liquid phase epitaxy to increase yield and decrease cost of this component. Development will continue on second-generation fccal planes, their hardening and system analysis for advanced systems.

2. (U) FY 1982-FY 1984 Program: The Advanced Development of the Thermal Weapon Sight (TWS) will progress through design reviews, Developmental and Operational Testing (DT/OT) I, and Validation In-Process Review. The TWS will then transition to Engineering Development (ED). Initiate Advanced Development of a Passive Wide Area Alerting System (IR Search Set) that will passively acquire/track enemy aircraft to cue air defense weapon systems. Start Advanced Development of a high-resolution ground-to-air FLIR system with image processing to assist an Identification Friend or Foe (IFF) function. Continue development of automated sensors by upgrading the Prototype Automatic Target Screener (PATS) for operational testing on the Advanced Attack Helicopter, and field testing and evaluating the Automatic Target Cuer (ATC). Target acquisition, tracking, and countermeasures/counter-countermeasures evaluations will be completed on the STARTLE prototypes. Advanced Development will be initiated on automation modules for add-on to existing forward-looking infrared (FLIR) systems. Detectors fabricated from liquid phase epitaxy (LPE) process will be evaluated for production transition decision. Detector fabrication will continue with emphasis on second-generation focal planes. Second-generation focal planes will be integrated into existing first-generation systems. Helmet-mounted display will be fabricated for application to aircraft and combat vehicles and tested prior to integration into advanced systems. Advanced Development of image processing subsystems for use with FLIR systems will be continued in the form of a Digital Scan Converter and an Automatic Target Recognizer. Start development of stabilization techniques for second-generation FLIR sensors to reduce platform error. Start development of a technology demonstrator utilizing staring focal planes in stabilized systems for light vehicle/airborne

Project: #DK70 Title: Night Vision Advanced Development
Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics and Physical Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

applications. Initiate the development of hardening componentry which incorporates current technology improvements in a form that permits the modification of Mercury Cadmium Telluride Common Module FLIR systems to harden against laser threats.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	12313	23722	19057	20305	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	13074	23788	20834	0	Continuing	Not Applicable

The decrease in FY 1981 and FY 1982 was due to reprograming to fund higher priority projects. The decrease in FY 1983 ($1777) was due to program realignment and reprograming to fund higher priority projects.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #DK87 Title: Night Vision Combat Vehicles
Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: The Army has a need for a cost-effective means to fight during periods of darkness and limited visibility with a relative combat capability that equals that during daylight. Far infrared capability represents a first order improvement over image intensification technologies in that systems using infrared are light-level independent, exhibit dust, smoke, and fog penetration, and allow for rapid acquisition of target. This project encompasses efforts in the areas of Forward-looking Infrared (FLIR) common modules, millimeter wave radar, and laser rangefinding. The use of FLIR technology will be investigated as an independent sight for the combat vehicle commander. The commander is currently constrained to share a sight with the gunner, thus eliminating the possibility of employing the hunter-killer tactical concept. Under extremely adverse weather conditions, wherever FLIR's are ineffective, it may be possible to secure tactical superiority through the use of millimeter wave radar. A prototype device is being configured for testing to determine the utility of this approach. At the present time, laser rangefinders are adversely affected by atomspheric conditions that are invisible to infrared sights. A CO2 laser rangefinder will solve this problem. Such a device will be integrated with a tank thermal sight during this period.

B. (U) RELATED ACTIVITIES: Related projects are Program Element 6.37.10A Project DK86, Night Vision Airborne Systems, and Project DK70, Night Vision Advanced Development. While DK70 concentrates on development of night vision components and devices which have applications independent of specific weapons systems or vehicles, DK86 gives management visibility to night vision applications to airborne systems. The Army's Night Vision and Electro-Optics Laboratory has been assigned the responsibility to coordinate all night vision technology-based programs within the three services to insure maximum use is made of resources and capabilities within the Department of Defense (DOD). Active international technical interchange is maintained within North Atlantic Treaty Organization (NATO) Army Armaments Group. Configuration control is maintained for common modules produced for United States Systems as well as those produced under the Memorandum of Understanding with the Federal Republic of Germany.

C. (U) WORK PERFORMED BY: Work is performed by the United States Army Night Vision and Electro-Optics Laboratory, Fort Belvoir, VA, with contractor assistance. Representative contractors include: Martin Marietta Aerospace, Orlando, FL; Hughes Aircraft, Culver City, CA; Magnavox, Mahwah, NJ, Texas Instruments, Dallas, TX; Honeywell, Lexington, MA; and Rockwell International, Anaheim, CA.

Project: #DK87 Title: Night Vision Combat Vehicles
Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Advanced Development of the Thermal Driver's Viewer was initiated in FY80. Advanced Development of the CO2 laser rangefinder was started in FY80. Development of a prototype system for the tank commander was initiated. Prototype development of millimeter wave radar systems demonstrated integration with tank Forward Looking Infrared Sights. Advanced Development of the CO2 laser rangefinder for combat vehicles continued. Initiated development of a combat vehicle self protect system.

2. (U) FY 1982-FY 1984 Program: Millimeter wave radar for combat vehicles will be evaluated and a determination made as to how to proceed with a tank all-weather system. Advanced Development for the Thermal Driver's Viewer will be completed. Advanced Development of the CO2 laser rangefinder will be completed and transitioned to Program Manager M1. Initiate Design/Development of Autocuer/Tracker for M1 subsystems. Advanced Development of the Independent (Tank) Commander's Viewer will be continued to completion and transitioned to Program Manager M1. Initiate integration of Autocuer/Tracker for M1 subsystems. Initiate Advanced Development of an elevated sensor platform (TV, laser, radio direction finder) for use by artillery battalion observation post. Development of the Combat Vehicle Self-Protect System will be continued at the Electronic Warfare Laboratory and will be funded under Program 6.37.62 DK16 starting in FY 1983.

3. (U) Program to Completion: This is a continuing program.

4. (U) Major Milestones: Not Applicable.

Project: #DK87 Title: Night Vision Combat Vehicles
Program Element: #6.37.10.A Title: Night Vision Advanced Development
DOD Mission Area: #551 - Electronics & Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

5. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	4873	7253	7889	6912	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4256	7273	7662	0	Continuing	Not Applicable

The increase in FY 1981 ($617) was for a Combat Vehicle Self-Protect System with the work to be done at the Electronic Warfare Laboratory. The decrease in FY 1982 was due to reprograming to fund higher priority projects. The increase in FY 1983 ($227) was for the Elevated Sensor Platform.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT QUANTITIES	5125	4508	4166	6600	Continuing	Not Applicable
DK61	Remotely Piloted Vehicles/ Drones	5125	4508	4166	6600	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides an Advanced Development base for improvements to the Remotely Piloted Vehicle (RPV) System being developed under Program Element (PE) 6.47.30.A and for the development and demonstration of additional RPV mission capabilities. RPV's are required to extend the eyes of the Brigade and Division commanders to the range of their artillery, increase the effectiveness of their direct support firepower, and provide laser designation for laser-guided weapons. Sophisticated enemy air defense systems preclude the use of manned aircraft performing such penetration missions. Projected improvements to the RPV system include night/adverse weather sensors utilizing Forward Looking Infrared (FLIR) and millimeter radar technology, improved command control techniques such as multiple air vehicle control from a single ground station and extended range of operation, survivability simulations and studies, eye-safe laser and air traffic control/identification friend or foe. Additional penetration missions identified in the ROC for the Remotely Piloted Vehicle include electronic warfare, meteorological sensor, communication relay platform, radiac survey, and decoy operations.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: RPV sensor developments will continue with heavy emphasis on development and demonstration of a night/adverse weather sensor capability for mini-RPV applications. The survivability enhancement program will address survivability for multicontrol and extended range missions. The United Kingdom (UK) Remotely Piloted Vehicle Study will continue as an effort to take advantage of mutual exchange of data in propulsion, command and control, sensor and survivability techniques through the US/UK Memorandum of Understanding. Rationalization, Standardization, and Interoperability (RSI) interface with other countries, particularly Germany, is planned. Development of Multiple Aguila Control System (MACS) for multiple control and extended range will continue. Continued flight testing of equipment resulting from RPV supporting technology programs will be conducted in manned aircraft in order to reduce technological and schedule risks in ongoing RPV programs.

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5125	4508	4166	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4849	4514	7333	Continuing	Not Applicable

FY 1981 funding increase was due to reprograming to conduct studies for an alternate data link for the RPV. The FY 1982 and FY 1983 decrease was due to reprograming of funds to higher priority Army projects.

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands). Not Applicable.

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of the Army RPV program is to field a series of lightweight, small-sized RPV's that operate in a tactical environment to accomplish a broad range of mission capabilities. Initial efforts are oriented on the early fielding of an RPV with daylight television and laser designator/rangefinder to meet the need for target acquisition, adjustment of artillery fire, laser target designation and reconnaissance beyond the Forward Line of Troops area (FLOT) and past the range of ground observers. Follow-on efforts are oriented at providing this system with improved night/adverse weather sensors and improved command and control capabilities that permit multiple air vehicle operations from a single ground control station as well as operations at greater ranges. In a parallel effort, the development of other mission capabilities for mini-RPV's is being pursued to provide a broad range of capabilities for use beyond the FLOT. This program provides an advanced Development base for improvements to the RPV. Commonality of components within the Army programs and with other service programs is being pursued. The major activities to date have been the Aquila System Technology Demonstrator Program, which completed testing in FY78, and its associated supporting technology programs. The Aquila Program transitioned to Full-Scale Development (FSD) in 1979.

G. (U) RELATED ACTIVITIES: Within the Army, Exploratory Development of RPV technology is conducted under Program Element (PE) 6.27.32.A, RPV Supporting Technology. Full-scale development (FSD) of the first-generation RPV is conducted under PE 6.47.30.A, Remotely Piloted Vehicles. This program element (6.37.25.A) provides an Advanced Development base for transitioning Supporting Technology programs into Engineering Development. Air Force RPV programs consisting of PE 6.37.39.F, Advanced RPV's, and PE 6.47.46.F, Expendable Drones, are being monitored to preclude duplication of effort and provide commonality of design where possible. The Army, Air Force, and the Navy RPV Program Managers and Marine Corps liaison officer meet to preclude duplication of efforts between the services. Interoperability is being pursued through a Memorandum of Understanding with the United Kingdom (UK). There is no duplication of effort in mini-RPV's within the Services.

H. (U) WORK PERFORMED BY: US Army Aviation Research and Development Command, St Louis, MO; Combat Surveillance & Target Acquisition Laboratory, US Army Electronics Research and Development Command, Fort Monmouth, NJ; Research and Technology Laboratories, Aero Mechanics Lab, Moffett Field, CA; Applied Technology Lab, Fort Eustis, VA; and the US Army Night Vision and Electro-Optics Laboratory, Fort Belvoir, VA. Contractors actively participating in the RPV development are Lockheed Missiles and Space Company, Inc., Sunnyvale, CA; Honeywell, Lexington, MA; Harris Corporation, Melbourne, FL; and Norden Systems, Norwalk, CT.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: In FY 1973 and FY 1974, the Remotely Piloted Aerial Observer/Designator System (RPAODS) program yielded parametric data in such areas as detectability, survivability, target search and acquisition,

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

and target tracking. In FY76, a demonstration was conducted using the Aeronutronics Ford (formerly Philco Ford) PRAIRIE II RPV to laser designate a tank target for a laser-seeking Cannon-Launched Guided Projectile (COPPERHEAD). A direct hit was scored. Based on general requirements derived from the Remotely Piloted Aerial Observer/Designator System (RPAODS) program, the Aquila System Technology Demonstration Program was established in FY75. Contractor flight testing of Aquila was initiated in mid-FY 1976. Aquila flew 218 flights and successfully demonstrated automatic launch, flight, and navigation; semiautomatic net recovery in an unimproved site; target detection, recognition, and laser rangefinding/designation; artillery adjustment and handoff of control from one Ground Control Station to another. A second RPV laser designation for the COPPERHEAD precision-guided munition was successfully performed in FY78. Formal user testing was conducted in simulated field conditions. User and developer testing was concluded in FY78. Information acquired from this program was used in the development of the system Required Operational Capability. The RPV was approved to enter Full-Scale Development (FSD) by Headquarters, Department of the Army (HQDA) in late FY78 and has been transitioned to Program Element (PE) 6.47.30.A, Remotely Piloted Vehicles. An antijam data link program was initiated in FY76 to provide an improved command and control capability. The resulting hardware consisted of two airborne data terminals integrated in Aquila RPV's and one ground station. Flight testing was successfully concluded in FY78. The resulting system provided the baseline for the data link that is being developed for use on the FSD RPV under PE 6.47.30.A. Survivability/vulnerability studies, testing and simulations were conducted in FY78. These included live firing ballistic weapon tests as well as infrared (IR) and radar tracking tests and simulations. Work is continuing in this area. Additional efforts included night sensor Forward Looking Infrared (FLIR) tests on manned aircraft; flight testing of tunable and barrage jammers; parachute recovery tests and engine and propeller test and evaluation. Contracts were issued for two FLIR sensors of Mini-RPV size and weight. One contract has subsequently been cancelled; however, laboratory testing of a serial scan FLIR is nearing completion, and extended flight testing is scheduled during FY82. Survivability initiatives include IR tracking susceptibility tests using an instrumented STINGER seeker head and air-to-air detection tests. The United Kingdom (UK) vertical take-off and landing RPV program was monitored up to its cancellation. Monitoring of the subsequent RPV study effort continued under the purview of the US/UK Memorandum of Understanding (MOU) on RPV interoperability.

2. (U) FY 1982-FY 1984 Planned Program: During 1Q FY 1982, the FLIR Mission Payload System (FMPS) contractor will deliver a flightworthy FLIR MPS system to the government for test and evaluation in a manned aircraft. FMPS performance will be evaluated both day and night under simulated tactical conditions. FMPS imagery of operational tank and truck targets will be assessed under ambient environmental conditions. After successful completion of these FLIR imagery tests, competitive efforts will be initiated to upgrade the payload to include precision laser designation, auto-focus, auto-track and auto-boresight. Testing under a simulated tactical environment will be conducted to support the FY83 In-Process Review (IPR). Pre-FSD activities will commence with the approval of an FMPS modification to the RPV ROC in December 1982. This will result in Army coordination of the development specification and the solicitation of a contract change notice to

Program Element: #6.37.25.A Title: Remotely Piloted Vehicle (RPV's)/Drones
DOD Mission Area: #551 - Electronic & Physical Science (ATD) Budget Activity: #2 - Advanced Tech Development

Lockheed Missiles and Space Company (LMSC) to manage the FMPS Development. LMSC will competitively solicit proposals, assist in the source selection, and manage the development, test, and integration of the FMPS into the RPV system. Pre-FSD activities will include the issuance of a draft Request for Proposal late in the fiscal year. Contracts will be awarded of the Multiple Aquila Control System (MACS). This effort is directed toward fulfilling multicontrol and extended range growth requirements for the RPV system. This effort will include wide band multiple control antenna hardware and algorithm development fabrication of a demonstration model and integration with components of the Modular Integrated Communications and Navigation System (MICNS) RPV data link. The Memorandum of Understanding (MOU) with the United Kingdom was extended for two years to continue the data exchange. An investigation of radar missile acquisition and fuzing performance vs RPV will be initiated. The millimeter wave radar development will advance from PE 6.27.32.A with emphasis on designing this adverse weather sensor subsystem to meet the size and weight constraints of an RPV payload. Survivability studies as applicable to new RPV missions will continue.

3. (U) Program to Completion: Evaluation of the Multiple Aquila Control System (MACS) mission capability will be completed. Fabrication of a prototype millimeter radar suitable for adverse weather operations will continue. Survivability testing of future mission configurations will continue. Talks will continue under the UK Memorandum of Agreement as well as interface activity with other friendly foreign countries.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.31.A
Title: Manpower and Personnel
DOD Mission Area: #552 - Environmental & Life Sciences
Budget Activity: #2-Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3359	4103	9747	12077	Continuing	Not Applicable
A792	Manpower and Personnel	3359	4103	9747	12077	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: One of the Army's most critical missions is to man the force. To accomplish this, adequate numbers of capable individuals must be attracted into the officer and enlisted ranks and their abilities used appropriately. Effective manning of the force becomes difficult as the number of available military-age youth declines, while new military systems and other equipment continue to require increasing numbers of highly trained soldiers. As a result, there is a need for the development of methods to improve the selection and utilization of soldiers and to determine the impact of the manpower demand of new systems upon the available manpower pool. The proposed research is designed to: (1) restructure Army enlistment criteria through the validation of the new Armed Services Vocational Aptitude Battery (ASVAB) based on field performance; (2) develop procedures to increase recruiter productivity; (3) develop techniques for more valid selection and placement of officer trainees; (4) develop procedures that would increase enlisted and officer retention; (5) develop procedures for maintaining and increasing organizational cohesion; and (6) develop better ways of matching available personnel to new systems in a cost-effective manner.

C. (U) BASIS FOR FY 1983 RDTE REQUEST:

1. (U) The requested increase for FY 1983 will support the Army portion of a DOD-wide effort to relate recruiting criteria to on-the-job operational performance. This research will also develop a system to link personnel resources with personnel requirements. Research under this program will also focus on other high priority Army manpower problems, specifically recruiting and retention. This research will develop improved assessment center techniques for selecting

Program Element: #6.37.31.A
DOD Mission Area: #552 - Environmental & Life Sciences

Title: Manpower and Personnel
Budget Activity: #2-Advanced Technology Development

effective recruiters and identify means for broadening the population base for Army recruiting (e.g., lateral entry). Research will also develop procedures that will insure that manpower and personnel resource planning is included early in the design stage of new weapons and materiel systems. Other research efforts will: determine factors enhancing cohesion in military units; develop personnel management methods designed to reduce attrition of first-tour soldiers; evaluate tools and techniques to increase the personnel effectiveness of organizations; and determine the impact of selected personnel management variables on individual readiness.

2. (U) No research planned in FY 1982 was cancelled or deferred in this program.

3. (U) The Army has a continuing requirement to man and maintain the force. This research effort reflects the need to develop and validate effective selection techniques such as the ASVAB; to increase recruit productivity in a changing cultural environment; to develop more valid selection and placement techniques for officer trainees; to match personnel requirements for new systems to the available personnel pool, and to maintain (and increase) organizational cohesion.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	3359	4103	9747	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	2963	4614	6360	Continuing	Not Applicable

Increase of $396 thousand in the FY 1981 funding level is the result of Developing Agency reprograming to initiate DOD-directed triservice research on the validation of the Armed Services Vocational Aptitude Battery (ASVAB) against performance on the job. The funding decrease of $511 thousand in FY 1982 is the result of the amended budget request, the application of a revised inflation pricing index, and a Congressionally directed change in the program. The funding increase of $3387 thousand in FY 1983 is the result of Army program realignment to meet two high-priority Army requirements:

Program Element: #6.37.31.A
Title: Manpower and Personnel
DOD Mission Area: #552 - Environmental & Life Sciences
Budget Activity: #2-Advanced Technology Development

(1) improved soldier-job matching through improved selection tests, i.e., the ASVAB, and (2) modernization of the Army personnel data system through application of information and microelectronic technology.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.31.A
DOD Mission Area: #552 - Environmental & Life Sciences

Title: Manpower and Personnel
Budget Activity: #2-Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: With an all-volunteer force, the Army faces continuing and increasing pressure to meet recruiting quotas. Competition from the academic community, private industry, and the other Services is creating an increasingly competitive situation during a time when the population pool from which recruits are drawn is decreasing. The proposed research will develop recruiter performance aids, desk-top procedural manuals, as well as management tools for the US Army Recruiting Command to use in the management of their recruiting and guidance counselor force. Other recruiting research is concerned with the design of systems that use automation techniques to counsel, classify, and commit desired positions to potential recruits. Another line of research is concerned with refined techniques for assessing potential soldier's abilities in a consistent and reliable manner for an appropriate person-to-job match. Means for using cross-service selection measures and system-specific assignment techniques will be perfected to achieve a more efficient assignment process. Research will be performed to validate the Armed Services Vocational Aptitude Battery (ASVAB) 8, 9, 10, and other measures of Army applicants as predictors of success in the Army and on the job. Selection and evaluation techniques for programs leading to officer commissioning will also be developed. A third line of research is concerned with personnel retention. Because of increasingly limited manpower resources and the extensive Army investment in training, retention of personnel has become a high priority objective. Research will evaluate the efficiency and cost effectiveness of existing retention programs. Management techniques for use in lowering attrition and increasing reenlistment of qualified soldiers will be developed. Research will be conducted to determine means for enhancing the attractiveness of overseas assignments. A fourth line of research is directed at looking at manpower as a potentially limiting factor in weapon system performance. There must be identification of man-machine functions that will enable trade-offs among training, equipment design and personnel requirements. Research will develop a system to integrate manpower, personnel, and training considerations throughout the weapon system development cycle to assure effective use of projected manpower resources. A fifth line of research will study the factors that work to reduce the cohesiveness of Army units. Personnel turnover is an easily identified factor; less evident are problems related to socialization of new unit members. Research will develop feedback techniques for managing socialization of soldiers during Initial Entry Training and will develop procedures to increase work productivity.

G. (U) RELATED ACTIVITIES: Through the Department of Defense, this work is coordinated with Naval Personnel Support Technology, P.E. 6.27.63N; Navy Manpower Control System Development, 6.37.07.N; Air Force Personnel Utilization Technology, 6.27.03.F. Technology input is provided by the related Army Program Element 6.27.22A (Manpower, Personnel, and Training). Interservice coordination is effected through triservice Technical Advisory Groups (TAG) in such areas as education and training, manpower, personnel, and organizational effectiveness. The purpose of the TAG is to coordinate Service

Program Element: #6.37.31.A
DOD Mission Area: #552 - Environmental & Life Sciences

Title: Manpower and Personnel
Budget Activity: #2-Advanced Technology Development

developments and eliminate undesirable overlap and duplication of effort. Cooperative research efforts with the Navy and Air Force are being conducted in areas of selection and the ASVAB.

H. (U) WORK PERFORMED BY: (Primary Contractors) Human Resources Research Organization, Alexandria, VA; Dynamics Research Corp., Wilmington, MA; Applied Science Associates, Inc., Valencia, PA; Center for Educational Technology, Tallahassee, FL; and Arthur Young & Co., Washington, DC. There are three (3) additional contractors; the total value of the additional contracts is $68,000. The in-house developing organization responsible for this program is the US Army Research Institute for the Behavioral and Social Sciences (ARI), Alexandria, VA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: An improved method to assign aviator trainees to advanced undergraduate training that reduces attrition costs. Preliminary specification of procedures for reducing female attrition based upon previous research in this area. Demographic, attitudinal, and other factors predictive of aviation warrant officer attrition were identified. The Navy "HARDMAN" model for assessing manpower, personnel, and training requirements of new systems was applied to several new Army weapon systems concepts (e.g., the Division Self-Propelled Weapon System (DSWS)). In the area of selection and assignment the Military Applicant Profile (MAP) test to screen out poor candidates for enlistment has resulted in a 24 percent increase in retention of lower mental category personnel. Guidelines for managing tank crew personnel turbulence has contributed to improved tank crew performance. An improved management and leadership training package for ROTC, a revised ROTC Cadet Evaluation and a Officer Selection battery were developed. Criteria for early identification of leadership development needs have been developed. An assessment of the relationship of quality-of-life to personnel readiness and retention has been completed. A revised Flight Aptitude Selection Test (FAST) to improve the success rate of Army aviators has been adopted. An evaluation of the Army's current organizational effectiveness (OE) program has been used to increase the program's efficiency.

2. (U) FY 1982-FY 1984 Planned Program: Develop a personel requirements estimation process for new Army systems. Develop guidelines and models for determining the need for additional manpower, as well as determining current personnel availability, for new system acquisition. Develop prediction models for personnel requirements and assignment during system acquisition. Develop a new set of predictors for each Military/Occupational Specialty (MOS) and career management field, that are performance-based and job-related. Develop assignment algorithms to assist recruiters in matching manpower needs

Program Element: #6.37.31.A
Title: Manpower and Personnel
DOD Mission Area: #552 - Environmental & Life Sciences
Budget Activity: #2-Advanced Technology Development

with individual aptitudes/desires. Develop officer assessment program training modules as well as a preliminary validation of performance-based officer assessment program. An evaluation of the application of socio-technical systems technology to Depot Systems Command (DESCOM) depots will be made and possible applications to other locales evaluated. This research program will also develop: improved psychomotor tests for more precise personnel testing; a commander's handbook for attrition management; methods for sustainment of military commitment; methods for easing the recruit's transition from initial entry training to unit of first assignment; a computer-based recruiting, testing and assignment system; and techniques to treat human resources as performance and cost factors during weapon system development.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.34.A
Title: Combat Engineering Systems
DOD Mission Area: #553 - Engineering Technology (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	269	2730	2127	Continuing	Not Applicable
DT08	Military Construction and Engineering	0	269	255	258	Continuing	Not Applicable
DT09	Energy Systems Tests	0	0	2475	1869	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: DT08 provides for the validation and technology transfer, in a prototype environment, of concepts and techniques developed in exploratory development programs to provide weapon effects information and combat engineering support on the battlefield. One of the mission area shortfalls is the impact of debris clouds created by exploding ordnance on electro-optical sensor systems used for target acquisition and weapon system guidance. Work in this program will address the charscterization and measurement of the debris cloud environment and the demonstration of innovative concepts and techniques for improving mobility in difficult terrains. DT09 addresses energy consumption and availability in the Base Facility Development and Installation Support Activities in the Army Base Support Mission Area. The availability pertains to energy shortfalls for facilities needed to support the Army of the 1980's and 1990's. This program is essential to support the planning, design, construction, operation, and maintenance of Army facilities worldwide. The thrust of this program is to demonstrate on Army installations the effectiveness of technologies evaluated in exploratory research. The technologies to be tested have potential for increasing the energy efficiency of new and existing Army facilities, or to permit utilizing alternate energy sources. The objectives are to provide the Army with proven technology to reduce energy costs, increase the energy independence of Army facilities, and improve the management of energy resources.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: DT08 - The funds requested in FY 1983 are required to demonstrate and verify the obscuration effect of debris clouds on electro-optical sensor systems. The results expected will provide an optimization of the effectiveness of our current electro-optical sensor systems and information on which to base designs of new systems to

Program Element: #6.37.34.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Combat Engineering Systems
Budget Activity: #2 - Advanced Technology Development

overcome battlefield obscuration. Also, funds will be used to demonstrate the feasibility and advantages of using sand-confining grids for strengthening unstable sands to improve over-the-beach trafficability. DT09 is an essential element of the Army program to reduce energy cost and conserve energy. Exploratory research in energy conservation is evaluating technologies developed by others for their potential to meet Army needs, is developing technologies which are unique to Army operations, and is developing the tools to implement the most promising technologies into the Army military construction and facilities operation and maintenance processes. Funds are required to demonstrate energy conservation technology that has been found during exploratory research to have potential for cost-effectively reducing energy consumption at Army Installations. Tests are also required of alternate source technology essential for supplementing or replacing high-cost fossil fuels. Technology Designs of energy-efficient new construction to meet FY 1985 energy goals, energy conservation retrofit packages for improving the operating efficiency of existing facilities have been developed and will be demonstrated in this Advanced development program. New technologies for improving the efficiencies of small gas and oil heating systems will be demonstrated as means of reducing the use of these critical fuels.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	0	269	2730	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	0	269	258	Continuing	Not Applicable

The FY 1981 funding request was deleted from the FY 1981 Budget by Congressional action. The program increase of $2472 thousand in FY 1983 is required to demonstrate energy-saving technology at Army installations.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.37.34.A
DOD Mission Area: #553 - Engineering Technology (ATD)

Title: Combat Engineering Systems
Budget Activity: #2 - Advanced Technolo y Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: DT08 - The visibility of the mid- and high-intensity battlefield will be obscured by smoke, debris, fog, snow, and dust propelled into the air by nature, combat operations, and explosives to the extent that the electro-optical sensors of modern weapons will be affected. This program element is to apply technological solutions developed in exploratory development to the electro-optical sensors of weapons to minimize the degradation of the sensors and allow the weapons system to function efficiently on the dirty battlefield. The aim of the program element is to rapidly transfer to the field those systems, products, and techniques that will improve the survivability and operational capability of both men and materiel in a mid- to high-intensity conflict. DT09 - The Army's facility energy costs tripled from 1973 to 1980 even though energy consumption was reduced by 30%. The facility energy costs share of the defense budget rose 50% during this time period. To reduce this rising utility cost, the Army must achieve further reductions in energy consumption without degrading mission effectiveness. Cost effective and reliable alternate energy sources, particularly for use in small boilers/furnaces which cannot be conveniently converted to burning coal, must also be explored. The exploratory research program has identified and evaluated several technologies for improving building thermal efficiency and for improving the efficiency of small boilers which could positively affect the Army's energy posture. The tools have been developed for implementing these technologies into the Army's program for new construction, for upgrading the thermal performance of existing facilities built to standard designs, and for increasing the energy-efficient operations of existing facilities. Advanced development research will demonstrate the cost effectiveness and reliability while validating the energy savings of these technologies developed under the exploratory research program.

G. (U) RELATED ACTIVITIES: DT08 - This program element will apply the exploratory development performed under Program Element 6.27.19.A, Mobility & Weapons Effects Technology, Project AT40. Additionally, this work will be coordinated with the activities of the other services in the Tri-Service Plan for Atmospheric Transmission R&D. The lead laboratory for the Army Atmospheric Transmission R&D Program is the Atmospheric Sciences Laboratory, whereas the lead laboratories for the Navy and Air Force in this area are the Naval Research Laboratory and Air Force Geophysics Laboratory. DT09 - This project is coordinated on an interservice basis with the Navy, Air Force, and Marine Corps through the activities of the Joint Services Civil Engineering Research and Development Coordinating Group, and with other government agencies through Workshops. Joint programs with the Air Force include the Energy Audit Program and technology transfer of the Building Loads Analysis and Systems Thermodynamics (BLAST) Program. Related programs include: Program Element 6.11.02.A, Defense Research Sciences, Project AT23 - Basic Research in Military Construction, US Army Construction Engineering Research Laboratory, Champaign, IL; Program Element 6.27.31.A, Military Facilities Engineering Technology, Project AT41 - Military Facilities Engineering Technology, US Army Construction Energy Research Laboratory, Champaign, IL; and Program Element 6.27.81.A, Energy Technology Applied to Military Facilities, Project AT45 - Energy Technology Applied to Military Facilities, US Army Construction

Program Element: #6.37.34.A Title: Combat Engineering Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

Engineering Research Laboratory, Champaign, IL. In cooperation with the Department of Energy, the US Army has been assigned lead responsibility for coordinating DOD energy activities in solar heating and cooling, computer programs to determine energy characteristics of buildings, wood-fired boilers, energy storage and distribution, energy conservation, and advanced heating and air conditioning systems.

H. (U) WORK PERFORMED BY: *DT08* - The US Army Engineer Waterways Experiment Station, Vicksburg, MS, performs 50% of the work in-house. Another 10% of the in-house work is performed by the Atmospheric Science Laboratory, White Sands Missile Range, NM. The remaining 40% of the work is performed by contractors selected in accordance with Defense Acquisition Regulation Procedures. DT09 - Approximately 30% of project funds will be for in-house effort at the US Army Construction Engineering Research Laboratory with participation by the US Army Facility Engineer Support Agency, Fort Belvoir, VA. The remaining 70% is to be performed by contractors selected in accordance with Defense Acquisition Regulation Procedures.

1. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: DT08 - This project was not funded in FY 1980 and FY 1981. DT09 - Not Applicable. This is a new project in FY 1983.

2. (U) FY 1982-FY 1984 Program: DT08 - In FY 1982 field tests will be conducted to demonstrate the adequacy of analytical methods for identifying and quantifying clouds of debris which are thrown into the air during combat operations and to illustrate how predicted debris cloud characteristics can be used for evaluating and optimizing electro-optical equipment. In FY 1983, debris cloud simulation procedures and electro-optical equipment performance predictions under obscured battlefield conditions will be verified and optimized. Grid hardware will be procured, and arrangements will be made to secure a site for demonstrating, in the field, full-scale sand-confining grid systems for enhancing over-the-beach mobility of wheeled vehicles. In FY 1984, the efficiency of sand-confining grid systems for enhancing over-the-beach mobility of wheeled vehicles will be demonstrated at a test site of a US military base using field troops and equipment to simulate an actual combat support operation. Interim procedures developed in the technology base for identifying ground water from satellite and tactical high-altitude imagery will be demonstrated in Southwest Asia using state-of-the-art ground-based geophysical techniques augmented by test wells. DT09 - The planned demonstrations of advanced technology include: (1) validation of the ability to design, construct, and operate energy-efficient new buildings at Army installations to achieve energy-use reduction goals; (2) tests at Army installations of energy conservation options for existing buildings built to Army standard designs; (3) tests of the energy savings potential of upgraded heating, ventilating, and air conditioning

Program Element: #6.37.34.A Title: Combat Engineering Systems
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

control systems; (4) test of the installation-wide application of new technology for significantly upgrading the energy-efficient operation of existing buildings; and (5) test the use of well-water heat pumps and pulsed combustion/condensing furnaces to replace small heating plants.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.37.A Title: Antiradiation Missile Countermeasures (ARM-CM)
DOD Mission Area: #551 - Electronic and Physical Sciences (Advanced Technology Demonstrations) Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	4343	5305			Continuing	Not Applicable
D181	Antiradiation Missile Countermeasures	4343	5305			Continuing	Not Applicable

B. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:

This program element provides the broad, nonsystem-specific technology base for the development of countermeasures to the antiradiation missile threat. The program is oriented at developing countermeasures applicable to ground surveillance, counterbattery, and air defense radars, along with special classes of communications terminals. The effort addresses five areas of activity: threat evaluation and simulation; countermeasures development; laboratory simulation and testing; establishment and maintenance of a triservice field test capability; and support of Tri-Service Joint Working Group on Antiradiation Missile Countermeasures (ARM-CM).

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Continue analysis of threat information to provide simulations of enemy systems for the evaluation of ARM-CM effectiveness; update capabilities of generic seeker to emulate enemy systems and initiate reconfiguration of generic seeker to include postulated ARM seeker design responses to present ARM-CM's; provide field test instrumentation, field test support, and data reduction for planned field tests of advanced development models of ARM-CM's for

Program Element: #6.37.37.A Title: Antiradiation Missile Countermeasures (ARM-CM)
DOD Mission Area: #551 - Electronic and Physical Sciences (Advanced Technology Demonstrations) Budget Activity: #2 - Advanced Technology Development

Air Force TPS-43E and Marine Corps TPS-59 radars; continue development and test of passive decoy concept and a low-cost modular decoy (MODEC); continue development of postulated continuous wave (CW) ARM systems and development of countermeasures applicable to CW systems; continue analysis of anti-ARM radar technique for application to future radar system design; continue development of mainbeam ARM definition and countermeasures; continue analysis and development of active ARM-CM techniques; provide support to the Tri-Service ARM-CM Working Group and NATO ARM-CM analysis.

D. COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	4343	5305		Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	4570	5321		Continuing	Not Applicable

Decrease in FY 1981 resulted from reprogramming to higher priority programs. Decrease in FY 1982 reflects minor adjustments due to changes in inflation indices. Funding difference in FY 1983 is attributable to program realignment.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.37.37.A
DOD Mission Area: #551 - Electronic and Physical Sciences (Advanced Technology Demonstrations)

Title: Antiradiation Missile Countermeasures (ARM-CM)
Budget Activity: #2 - Advanced Technology Development

F. DETAILED BACKGROUND AND DESCRIPTION: The Army has fielded and has under development a variety of emitters which are susceptible to attack by location and tracking systems which utilize the radiation of the emitter as a tracking signature. These emitters are

. These systems are relatively complex and expensive, and serve a critical role for the Army in the field. All are susceptible to enemy antiradiation missile attack in varying degrees. Given their criticality and susceptibility, it is imperative that ARM countermeasures be developed and tested vis-a-vis the known and projected threat. The objectives of this program are to characterize and simulate the known and projected threat missile systems, to develop appropriate countermeasures to provide laboratory and field test instrumentation, and to provide triservice data exchanges.

G. (U) RELATED ACTIVITIES: Development of antiradiation missile countermeasures is conducted by the three services with the Army being the lead service. The threat data and simulations, countermeasure technology, and field test instrumentation developed within this program are utilized within the specific ARM-CM development activities done in Program Elements 6.43.07.A (PATRIOT), 2.37.31.A (Improved Hawk), 6.43.09.A (ROLAND), and 6.37.29.A (Counterbattery Radar). The Navy has conducted work in Program Element 6.35.16N (Radar Surveillance Equipment), and the Air Force in 6.39.18F (Electronic Warfare Technology) and 6.37.50F (Counter-Countermeasures Advanced Development). The field test instrumentation and simulations developed under project D181 directly support the Navy and the Air Force work. The three services routinely coordinate their respective programs via the Tri-Service Joint Working Group on ARM-CM.

H. (U) WORK PERFORMED BY: The present contractors utilized in accomplishing this program are TRIAD Microsystems, Inc., Huntsville, Alabama; General Dynamics, Pomona, California; HRB-Singer, State College, Pennsylvania; Brunswick Corporation, Defense Division, Costa Mesa, California; System Planning Corporation, Huntsville, Alabama; Malibu Research Associates, Inc., Santa Monica, California; Technology Services Corporation, Santa Monica, California, and Silver Spring, Maryland; General Electric Corp, Syracuse, New York; and ESL Inc., Sunnyvale, California. The in-house developing organizations responsible for executing the program are Harry Diamond Laboratories, US Army Electronic Research and Development Command (ERADCOM), Adelphi, Maryland; US Army Missile Command (MICOM), Redstone Arsenal, Alabama, Naval Weapons Center (NWC), China Lake, California.

Program Element: #6.37.37.A
Title: Antiradiation Missile Countermeasures (ARM-CM)
DOD Mission Area: #551 - Electronic and Physical Sciences (Advanced Technology Demonstrations)
Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: A generic seeker was developed for laboratory instrumentation; digital simulations of friendly ARM's were completed, and threat ARM simulation was initiated; analysis on the passive decoy concept was started; and a study of hardening techniques was performed. In FY79 the generic seeker was utilized in the Radio Frequency Source Simulator at MICOM, and hardware-in-the-loop simulations were performed in support of evaluation of ARM-CM techniques for the HAWK and PATRIOT systems. The generic seeker was modified for mounting in the nose of a test aircraft with a realtime computer control to provide a "flyable" generic ARM seeker (FGAS) capability. A fighter aircraft-mounted instrumentation pod to be utilized with the FGAS was also developed for future field tests. The low-cost modular decoy concept (MODEC) analysis, specification, and tube development were completed, and breadboard hardware design started. In FY 80 the FGAS was integrated in an A-3 aircraft with the instrumentation pod and utilized in a HAWK ARM-CM field test. Analysis of anti-ARM radar techniques for future radar design was initiated. Analysis of CW ARM homing methods and CW techniques against CW ARM's was started. Feasibility analysis of the main beam ARM concept and dual-mode seeker technology continued. Field test measurements relative to analysis of active ARM-CM techniques were made. Support in ARM-CM analysis to NATO and the Tri-Service ARM-CM Working Group was provided. The flyable generic ARM seeker (FGAS) was modified to improve its performance and provide additional discriminants relative to projected ARM seeker design. Field test support was provided for ARM-CM tests of FIREFINDER (AN/TPQ-37).

2. (U) FY 1982-FY 1984 Planned Program: THREAT ARM simulation will continue. Data will be collected on the active ARM-CM technique air target fuzing requirements. Computer simulations of several threat ARM seekers will be made modular so that various R.F. emitters, ARM-CM devices, and ARM seeker combinations may be selected for analysis. Computer models of the Passive Decoy and CW ground reflections will be refined. The FGAS and the instrumented aircraft will support the Air Force TPS-43E in spring FY82 and the Marine Corp TPS-59 in the summer of FY82. The development of a modular decoy's (MODEC) lightweight magnetron will be completed and tested in FY82. The PATRIOT program will use the technology developed under this program to begin development of their engineering design model. Analysis of anti-ARM radar techniques for future radar design will be completed. Analysis of CW ARM homing methods and development of CM techniques against CW ARM's will continue. Analysis of the main beam, angle binning, and navigating ARM concepts and dual-mode seeker technology as well as possible countermeasures against these projected threats will continue. Field test measurements relative to analysis of active ARM-CM techniques will continue, and an analysis of the feasibility of an anti-ARM missile system will be performed. Modest efforts on determining the threat of a remotely piloted vehicle-ARM (RPV/ARM) combination will be initiated. CW countermeasure development will be initiated as well as countermeasures development for the projected threats of main beam ARM and the dual-mode ARM. A feasibility analysis of a high-energy radio frequency kill concept will be initiated. An assessment of the

Program Element: #6.37.37.A Title: Antiradiation Missile Countermeasures (ARM-CM)
DOD Mission Area: #551 - Electronic and Physical Sciences (Advanced Technology Demonstrations) Budget Activity: #2 - Advanced Technology Development

impact of advanced ARM threats including main beam ARM's and RPV ARM's will be started. The design and construction of an Advanced Generic seeker and support instrumentation as a test instrument to emulate projected threats will be completed and tested.

Test support for new ARM-CM techniques will be provided. The passive decoy brassboard hardware will be developed and evaluated. Support for NATO and the Tri-Service ARM-CM Working Group will be continued.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.39.A Title: Human Factors in Training and Operational Effectiveness
DOD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1948	3111	3755	6496	Continuing	Not Applicable
A793	Human Factors in Training and Operational Effectiveness	1948	3111	3755	6496	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Force modernization will be one of the Army's critical objectives over the next decade. The Army has over 200 new systems, including 40 major systems, programed for acquisition in the next 10 years. The soldier is an integral part of these weapon systems and must be designed into the system early in development. Rapidly changing technology and doctrine require new tools and methods to ensure that system are designed to be compatible with soldier capabilities. Techniques to measure total system effectiveness, including the human operator, must be tailored to the specific operational use for which the system is intended. Shortcomings in designing equipment to match human capabilities will require the additional development of performance aids in order for the system to achieve full performance capacity. This program is also concerned with operator performance in automated command and control systems that will become increasingly important on the battlefield of the future. There is also a requirement for human factors evaluations of systems during the acquisition process and operational tests.

C. (U) BASIS FOR FY 1983 RDTE REQUEST:

1. (U) The battlefield of the future Army will be significantly different from that of the present. Distributed operations, high-lethality weapons, and rapid and complex communications will demand a greater emphasis on the human operator in systems design. Research will be conducted to determine the best methods for allocating tasks between the human operator

Program Element: #6.37.39.A Title: Human Factors in Training and Operational Effectiveness
DOD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

and the system hardware. This research will also be concerned with procedures for analyzing the tasks required of operators in systems under development, with special emphasis on the operator's role in automated command and control systems. This research program will also be concerned with human factors evaluations of major armor, infantry, artillery, and air defense systems. Results of the research program can be used by TRADOC system managers and DARCOM project managers to establish operating and maintenance procedures, to define duties of individual crew members, and to assess workload requirements for determining numbers and skill levels of personnel needed for specific weapon systems. Guidelines will also be furnished for human factors evaluation of weapons and equipment during operational testing. Demonstrated improvements in field operating procedures and techniques can then be incorporated into training and doctrinal material.

2. (U) There was no research projected for FY 1982 that was canceled or deferred in this program.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1948	3111	3755	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	2314	3118	3777	Continuing	Not Applicable

Reduction of $396 thousand in the FY 1981 funding level is a result of reprograming to higher priority Army requirements. The funding decrease of $7 thousand in FY 1982 is a result of the amended budget request and the application of revised inflation pricing index. The funding decrease of $22 thousand in FY 1983 is a result of program realignment.

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: #6.37.39.A Title: Human Factors in Training and Operational Effectiveness
DOD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: Development and fielding of new weapon systems imposes a critical need to determine if soldier abilities and acquired skills are sufficient for effective system employment. Automated systems continue to be developed under the Army's Command and Control Master Plan to handle and manage battlefield information and to aid in increasingly complex combat decisions. Command, control, communications and intelligence (C3I) systems provide the technological context for tactical analyses and battle management. This research program can be divided into three parts. Battlefield Automation: This part of the research program will: Provide guidelines and procedures for managing information in future battlefield command and control systems and develop a methodology for examining design trade-offs between level of automation and the need for human involvement; provide guidelines for improving three major aspects of intelligence production: collection planning, information extraction, and more complete and accurate intelligence analysis; provide recommendations for improved automated display formats and for more easily interpreted battlefield display symbols; develop a comprehensive set of human factors guidelines and evaluation criteria for the design of user/operator transactions in battlefield automated systems. New System Design: The determination of "personnel affordability" for new systems can only be achieved through the use of analytical tools during system design. The difficulty is in the selection of appropriate criteria for determining the contribution of the human to system effectiveness prior to system engineering. This part of the program will: Develop a comprehensive method for operational test and evaluation of human resource considerations in new systems; develop a soldier/computer task allocation methodology; develop procedures for analyzing personnel requirements for new weapon systems; and develop recommendations for increasing the effectiveness of command and control systems by improving operator selection procedures. Weapon Systems Employment: Dynamics of the battlefield require that weapon systems be effectively employed singly and collectively. Techniques of tactical employment of a weapon system require a full appreciation of its capabilities and how the performance of the human operator influences overall system effectiveness. This part of the program will: Develop techniques to help aviators, both Active Army and Reserve, enhance and maintain their combat readiness in attack helicopters and validate an improved communications procedure for nap-of-the-earth flights.

G. (U) RELATED ACTIVITIES: Coordination of research is accomplished through annual DOD budget and apportionment reviews and through membership on tri-service committees such as the Human Factors Engineering Technical Advisory Group, the Human Factors Test and Evaluation Subgroup, and the DOD/NASA Simulation Working Group. Additional coordination is obtained through participation on the NATO Working Group on Fidelity Requirements of Flight Simulation and the Technical Cooperation Program Panel on Human Factors in Command and Control Systems. In addition, there is direct coordination with similar DOD research organizations, such as the Air Force Human Resources Laboratory (AFHRL), Naval Personnel Research and Development Center (NPRDC), Army Project Manager for Training Devices (PM TRADE), Army Human Engineering Laboratory (HEL) and the Naval

Program Element: #6.37.39.A Title: Human Factors in Training and Operational Effectiveness
DOD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

Training Equipment Center (NTEC) to cover related research in visual displays, training simulation, human factors in operational testing, and aviation crew performance. Data exchange among Army Research Institute, related Army agencies and other services is used to eliminate unnecessary duplication of research.

H. (U) WORK PERFORMED BY: (Primary Contractors) Synthetics Corp., Fairfax, VA; Vector Research, Inc., Ann Arbor, MI; Applied Science Associates, Valencia, PA; Dunlap and Associates, Darien, CT; and Human Resources Research Organization, Alexandria, VA. There is one additional contract that has a value of $53,000. The in-house developing organization responsible for this program is the US Army Research Institute for the Behavioral and Social Sciences (ARI), Alexandria, VA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Past efforts have produced: Procedures for analyzing operating and maintenance requirements for armor, artillery, air defense and automated communications systems; a provisional set of human factors design guidelines for battlefield automated systems; a handbook for a human resources test and evaluation system; an Individual Ready Reserve (IRR) combat maneuver training program for aviators; an analytical model for evaluating routing and processing of information in command, control, and intelligence systems; improved procedures for intelligence collection planning and intelligence analysis; human factors analysis of four battlefield automated systems during operational test; recommendations for optimum formats for portraying terrain relief on maps; recommendations for color coding of computer displays, reducing human error by 30%. Human factors and training analysis recommendations for design of an automated tactical data system testbed.

2. (U) FY 1982-FY 1984 Planned Program: Develop analytic procedures in automated intelligence systems. Develop standard design criteria for assessing soldier-computer interface requirements in automated battlefield systems. Conduct the human factors analysis of M-1 unit-conduct-of-fire trainer. Develop and evaluate methods, materials and devices to maintain aviator flight proficiency and combat skills in units. Evaluate aviator performance in Advanced Attack Helicopter training. Develop procedures for computerized support for evaluating enemy-course-of-action and collection planning in automated intelligence systems. Develop techniques for measuring human performance aspects of operational weapons use. Develop guides for user-computer aspects of battlefield automated systems. Determine display and symbology requirements for future battlefield automated systems. Develop measures of individual and team performance for improved prediction of weapon system performance in a realistic context.

Program Element: #6.37.39.A Title: Human Factors in Training and Operational Effectiveness
DOD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.42.A
Title: Advanced Electronic Devices
DOD Mission Area: #551 - Electronics & Physical Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	0	2233	4006	4902	Continuing	Not Applicable
DF32	Advanced Electron Devices	0	2233	4006	4902	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEEDS: This advanced development program in electronic devices, component assemblies, and subsystems will resolve critical major defects common to several high-priority Army systems such as M1 Tank, Remotely Piloted Vehicles, Signals Intelligence Systems, and radars. It will provide preplanned/"technology insertion" product improvements into a substantial number of systems currently under development or in initial production in order to assure qualitative superiority to Soviet systems in the field. The highest priority research and exploratory development devices for which feasibility has been successfully demonstrated on technology base programs will be completed and demonstrated to meet specific Army needs in accordance with established system schedules. This program will permit--through major technology advances--the latest performance or cost improvements to be incorporated into ongoing systems developments so that technologically obsolete systems will not be fielded. Completion of these devices will provide enhanced combat performance, improved reliability levels, and cost effectiveness. New components will be completely developed and tested so that program managers can use them with acceptable risk rather than rely on 5-15-year-old technology. To obtain a commitment from system managers, it is vital that demonstrations of advanced devices and subsystems as called for in advance development funding be carried out.

C. (U) BASIS FOR FY 1983 REQUEST: The Army needs a substantially better capability to fight a land war under the limited visibility conditions of a contemporary battlefield. Accordingly, one of our highest priority exploratory development programs has been the development of millimeter wave devices to provide the capability to detect and recognize battlefield targets through smoke, dust, and adverse climatic conditions. Higher power electron tube transmitters are essential for ground

Program Element: #6.37.42.A
DOD Mission Area: #551 - Electronics & Physical Sciences (ATD)

Title: Advanced Electronic Devices
Budget Activity: #2 - Advanced Technology Development

data links to communicate with Remotely Piloted Vehicles (RPV's). In the microelectronics area, the design, fabrication, and final evaluation of advanced microelectronic circuits, modules, and subsystems will be completed for insertion into advanced Electronic Warfare systems, and Electronic Warfare Intelligence Systems. A high-resolution, reliable, lightweight display will be completed and the technology demonstrated to replace present unreliable, heavy, and "power hungry" displays. The first prototype of a highly reliable Traveling Wave Tube (TWT) will be retrofitted into the AN/TPQ-36 Radar to provide a significant improvement in the mean time between failure of these systems.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	0	2233	4006	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	0	2239	4397	Continuing	Not Applicable

Funding differences between Congressional Descriptive Summaries submitted last year (1982) and this year are as follows:

1. (U) FY 1981 - Congress zeroed out the planned funding but subsequently allowed the Army to reprogram residual FY 80 funds to continue to provide the electronic devices support critical to high-priority Army systems.

2. (U) FY 1983 - Reduction due to civilian pay and inflation adjustments between the amended FY 1981 budget submit and the present.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.37.42.A
DOD Mission Area: #551 - Electronics & Physical Sciences (ATD)

Title: Advanced Electronic Devices
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is to complete the development of electronic devices, assemblies, and subsystems for application and technology insertion in military systems. Devices proven feasible are scheduled into specific system applications. The approach will include the development of a sufficient number of devices/modules to determine reliability, performance, and reproducibility with major emphasis on greater commonality of application of such devices and lower life cycle costs. This program is critical to the planned improvement of fielded Electronic Warfare (EW), Radar, and Communications Systems.

G. (U) RELATED ACTIVITIES: Coordination is achieved with other government agencies through participation in the activities of the Department of Defense Advisory Group on Electron Devices (AGED). This, and other informal coordination, ensures no unnecessary duplication of effort in this area.

H. (U) WORK PERFORMED BY: In-house: The Electronics Technology and Devices Laboratory, ERADCOM, Fort Monmouth, NJ. Principal contractors are: Sanders Associates, Merrimack, NJ; Varian Associates, Palo Alto, CA; Hughes Aircraft, Fullerton and Torrance, CA; United Technology Research Center, Hartford, CT; TRW, Redondo Beach, CA; Litton, San Carlos, CA; Bendix Corp., Towson, MD; Texas Instruments, Dallas, TX; Norden Systems, Norwalk, CT; and RCA, Camden, NJ.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Traveling wave tubes (TWT's) have been developed for use in artillery and mortar-locating radars which have a life extension of 300% to 500% over presently used TWT's, providing significant cost reduction potential. A development model of a high-contrast cathode ray tube has been built using sapphire faceplate technology; this device is intended for use in the AN/APR-39 Radar Warning Receiver. Semiconductor diode devices have been developed that produce significant levels of millimeter-wave energy. These millimeter wave sources are required in radar transmitters for the M1 tank to provide the capability to see through smoke and fog on the battlefield. A significant improvement in the stability of electronic oscillators has been demonstrated using surface acoustic wave technology. This development will meet the stringent frequency and bandwidth requirements imposed by the Federal Republic of Germany on Army meteorological radiosondes. An improved one-cubic-inch, temperature-controlled miniature crystal oscillator has been developed for tactical use. It has an order of magnitude improvement in size, power consumption, and warmup time over present models providing precision timekeeping capability for secure, jamproof operation required by a wide range of system developers, including the Single Channel Ground and Airborne Radio and Joint Tactical Information Distribution System.

Program Element: #6.37.42.A
DOD Mission Area: #551 - Electronics & Physical Sciences (ATD)

Title: Advanced Electronic Devices
Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Program: Urgently needed is a low-cost capability to detect and recognize battlefield targets through smoke, adverse weather, and camouflage at line-of-sight distances of up to 5 km. Millimeter-wavelength equipment can satisfy this requirement at cost savings over present technology, and devices to generate millimeter-wave energy will be developed and improved for use in weapons and communications systems. Improved, frequency-stable surface acoustic wave oscillators will be tested and delivered as replacement models to resolve radiosonde frequency interference problems in Germany. The remaining Large and Very Large Scale Integrated Circuit Modules (3 each) for Advanced QUICKLOOK and GUARDRAIL Electronic Warfare and Intelligence Systems will be designed, fabricated, and tested for insertion into the systems. The initial design and prototype models of slow frequency-hopping synthesizer to improve the security of the Remotely Piloted Vehicle data links will be completed. A reliable, increased output infrared source will be developed to protect Army aircraft against heat-seeking missiles, as will an affordable full antijam band electronic jammer amplifier to protect Army aircraft against enemy air defense radars. Development will begin on a conformal "all electronic" scanning antenna which can be applied to the surface of tanks (M1) to reduce silhouette which is also applicable to the surface of terminal homing shells and missiles to eliminate mechanical gimbals. Ruggedized millimeter wave Integrated Circuit Receiver and Transmitter Modules will be delivered for evaluation in terminally guided munitions and for other military applications; i.e., Remotely Piloted Vehicles and missiles.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.43.A
Title: Education and Training
DOD Mission Area: #552 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	7807	9361	9764	9820	Continuing	Not Applicable
A794		7807	9361	9764	9820	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Army today must train soldiers to operate and maintain a number of vastly more complex and more lethal weapon and support systems than at any time in the past. They must also train them to become effective crew members. At the same time there are increasing constraints to effective training. One possible means of providing solutions to the Army's training problems is through the appropriate use of advanced electronic and information technology. There are advanced technologies such as the microprocessor and video discs that can be applied to the solution of Army training problems. Small, relatively inexpensive, technology-based methods can be developed to provide the training necessary to maximize the operational effectiveness of the Army's new complex weapon and support systems. Research conducted under this program element is directed at the development and application of innovative training programs, methods, and techniques for cost effective individual and collective (crew, team and unit) training. It is also concerned with the application of technology to assess individual and collective proficiency, as well as to improve the management of training.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: This continuing program represents a comprehensive research effort to develop instructional technologies to meet both current and future training challenges. Two special emphases will be evident in the FY 1983 program: increased exploitation of advanced information technology for more cost-effective training and the development of systems for providing feedback to senior Army leaders on the status of Army training. Technology will be exploited for training methods in the following areas of application: basic skill training for lower aptitude personnel, maintenance training for new systems, training tailored to trainee aptitude, decisionmaking training for combat leaders, crew/team training for weapon system operation, assessment of individual and collective proficiency, and feedback of

Program Element: #6.37.43.A Title: Education and Training
DOD Mission Area: #552 - Environmental and Life Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

training information to both training material developers and persons concerned with the status of personnel readiness. Successful application of technology will lead to reduced training resource requirements, reduction in training time, higher skill levels, and greater ease of cross-training within a unit setting.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	7807	9361	9764	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	7902	9382	9748	Continuing	Not Applicable

Reduction of $95 thousand in the FY 1981 funding level is a result of reprograming to higher priority Army requirements. The funding decrease of $21 thousand in FY 1982 is a result of the amended budget request and the application of a revised inflation pricing index. The funding increase of $16 thousand in FY 1983 is the result of minor program realignment.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.43.A
DOD Mission Area: #552 - Environmental and Life Sciences (ATD)

Title: Education and Training
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The challenge facing the Army training community has increased significantly. The demands of job-specific training are requiring increasing training resources. Crews/teams and units must be trained to operate, maintain, and employ new, more sophisticated weapon systems, using doctrine geared to new wartime scenarios. The overall objective of this program is to conduct research and development on training methods/techniques/systems that will lead to more effective, more efficient training. The specific objectives of research under this program element are directed at the development and evaluation of training methods and techniques for: (1) basic skills training; (2) job-specific training, with special emphasis on maintenance, combat skills, and Army aviation; (3) collective training for the combat arms; (4) measuring individual and collective proficiency; (5) determining the training effectiveness of new training systems; and (6) the management of training, with special emphasis on management within the unit. New information technologies will be used where it can be clearly demonstrated that they will lead to more cost-effective training.

G. (U) RELATED ACTIVITIES: The results of Exploratory Development research conducted under Program Element/Project 6.27.22A791 (Manpower, Personnel and Training) transition to this Advanced Development project. Duplication of effort within the Army is avoided by annual Technology Base Reviews chaired by the Director of Army Research and within the Department of Defense by annual Apportionment Reviews chaired by a representative of OUSDRE. Coordination is furthered within DOD through DOD Topical Reviews and participation on the Education and Training Technical Advisory Group (and the Job-Site Training Sub-TAG). Education and training research is coordinated directly with other service R&D organizations, such as the Air Force Human Resources Laboratory (AFHRL), the Naval Personnel Research and Development Center (NPRDC), the Army's Project Manager for Training Devices (PM TRADE), and the Naval Training Equipment Center (NTEC) on a continuing basis.

H. (U) WORK PERFORMED BY: (Primary Contractors) Human Resources Research Organization, Alexandria, Virginia; Anacapa Sciences, Inc., Santa Barbara, California; American Institutes for Research, Washington, DC; McFann & Gray Associates, Monterey, California; and Litton Systems, Inc., Sunnyvale, California. There are four (4) additional contractors; the total value of the additional contracts is $377,000. The in-house developing organization responsible for this program is the US Army Research Institute for the Behavioral and Social Sciences (ARI).

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

Program Element: #6.37.43.A
Title: Education and Training
DOD Mission Area: #552 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

1. (U) FY 1981 and Prior Accomplishments: Research under this program element has led to the following products, grouped into six research thrust areas: Basic Skills Training: Guidelines for development of functionally oriented, job-related training curricula. Individual Training: Nap-of-the-earth (NOE) helicopter training program (reduced pilot errors by 33%). Method of NOE training for nighttime operations during daylight. "Sight picture" training handbook for tank gunners (increased performance 22%). Basic rifle marksmanship training program. A combat vehicle identification training program. Adaptive Computerized Training System (ACTS) for maintenance training in schools. Helicopter pilot communications training program. AN/TSQ-73 "Missile Minder" air defense system training program (reduced training time by 25%). Collective Training: "How-to-train" guidance for use with Multiple Integrated Laser Engagement System (MILES). Prototype Battle Drill training packages for infantry squads. Refresher/transition training program for Army Reserve tank crews. Proficiency Measure: Procedures for unit scoring of Skill Qualification Tests (SQT). Performance measurement and grading system for UH-1 helicopter instrument trainer. *Training Effectiveness Assessment:* Training program evaluation aids. Model for training technology transfer. Computerized aids for training program development. Training Management: An automated instructional management system (AIMS). Maintenance performance system (MPS) for determining training needs in maintenance units.

2. (U) FY 1982-FY 1984 Planned Program: Planned results of this research program can also be divided into six research need areas. Basic Skills Training: Job-oriented baseline skills training program for low-aptitude personnel. Evaluation of Basic Skills Education Program (BSEP). Technology-based, personal learning aids for basic skills. Individual Training: Initial entry helicopter pilot simulator training program. Videodisc-based combat vehicle identification program for night vision devices. Aeroscout pilot selection and training algorithm. Techniques for improved NCO training. Decisionmaking training program for senior leaders. Collective Training: Moving tank gunnery training program. M1 tank gunnery sustainment training program. Training guidance for National Training Center (NTC). Improved machine gun crew training program Proficiency Measurement: Advanced, simulator-based aviator applicant selection system. Simulation-based methods for evaluating weapon system crew performance. Training readiness feedback system for senior Army staff. Training Effectiveness Assessment: Training adequacy feedback system for training developers. Technology-based aids for training program development. Training Management: Strategies for integrating individual and collective training. Computer-based unit maintenance training system.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.44.A Title: Training Simulation
DOD Mission Area: #552 - Environmental and Life Sciences Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1530	2212	2790	3152	Continuing	Not Applicable
A795	Training Simulation	1530	2212	2790	3152	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: There is an increasing emphasis on the development and use of simulators and training devices because of increasing costs of using operational equipment, the high cost of live ammunition, the lack of suitable training sites, and the increasing complexity of modern weapon systems. Emphasis on field training places new requirements for simulated combat environments. Each new weapon system requires the design of simulators and training devices in parallel with weapon system development. Advanced technlogy must be applied in the design of simulators and training devices for new systems coming into the inventory. A continuing effort is also necessary to improve the state-of-the-art in aviation simulation. Technology can also find application in the design of "non-system" simulators and training devices for the tactical training of combat arms unit leaders, command and control training, and generalized maintenance training. The research under this program element is intended to lead to recommendations and guidelines for US Army Training and Doctrine Command (TRADOC) training developers for the design of cost-effective simulators and training devices for the future Army.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Funds requested for FY 1983 are required to continue ongoing research and to initiate new research directed at the design of more cost-effective system and "non-system" simulators and training devices (S&TD). It is also directed at providing the tools for aiding in establishing S&TD design requirements and estimating their training effectiveness. System S&TDs: Research will be conducted to determine how S&TDs should be used as partial substitutes for training on operational systems (as has been done for years for aviator training) and for partial substitution for live artillery rounds. Research will also determine requirements for the simulation of combat missions for new Army helicopter systems. Another effort will determine to what extent simulators can be used in lieu of TH-55 and UH-1 helicopters for initial flight training. Also, another effort will develop training programs for use with flight simulators in units.

Program Element: #6.37.44.A Title: Training Simulation
DOD Mission Area: #552 - Environmental and Life Sciences Budget Activity: #2 - Advanced Technology Development

Non-System S&TDs: A research effort will be directed at determining battle simulation (war game) training for battlion command groups. A separate research effort will address how advanced technology can best be used to meet simulation requirements for cost-effective tactical training. S&TD Requirements Definition and Evaluation: One research effort will be concerned with the development of automated procedures for determining design parameters for system-related training devices. A second effort will be concerned with an automated procedure for assessing potential training device effectiveness at various design stages.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	1530	2212	2790	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	1413	2217	2822	Continuing	Not Applicable

Increase of $117 thousand in the FY 1981 funding level is a result of Developing Agency reprograming to increase amount of research on simulators and training devices to help counter effects of constraints to effective training. Decrease of $5 thousand in FY 1982 is a result of the amended budget request and the application of a revised inflation pricing index. The decrease of $32 thousand in FY 1983 is a result of minor program realignment.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.44.A Title: Training Simulation
DOD Mission Area: #552 - Environmental and Life Sciences Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: An increasing emphasis is currently being placed on the development and use of simulators and training devices. They are required where the cost of using operational equipment would be excessive, where the operational environment would be dangerous, where adequate training facilities are not available, or where the nature of the training to be given would indicate the use of less than full-fidelity simulation (e.g., part-task trainers for complex operator or maintenance tasks). Advanced information technology will probably find no greater application in Army training than in the development of improved, more cost-effective S&TDs. Modern computer technology will be at the heart of most, if not all, simulators and training devices. Other technologies that should find application are: 1) video disc, 2) voice recognition/synthesis, 3) electronic "war" games, 4) computer-generated imagery, 5) handheld personal computers, and 6) "embedded" training (using military systems' on-board computers for training). The objective of this research is to provide guidance that can be used to develop more cost-effective simulators and training devices. This research emphasizes development of alternatives to the use of high-cost operational systems for acquiring and maintaining the complex operator, maintenance, and decisionmaking skills required of a combat-ready force. This research will include the development of better procedures for specifying S&TD requirements and for estimating their potential training effectiveness during design. This research will address issues related to the design and development of improved simulators and training devices for the training and retention of: complex maintenance skills, helicopter pilot skills, M1 tank crew skills, and leader tactical skills. Also to be explored are techniques for the use of simulators and training devices to assess individual and crew/team performance.

G. (U) RELATED ACTIVITIES: The results of Exploratory Development research related to S&TDs that are conducted under Program Element/Project 6.27.17.A790 (Human Performance Effectiveness and Simulation) transition to this Advanced Development project. Duplication of effort within the Army is avoided by annual Technical Base Reviews chaired by the Director of Army Research and within the Department of Defense by annual Apportionment Reviews chaired by a representative of OUSDRE. Coordination of this research is furthered within DOD through DOD Topical Reviews and by participation on a number of subgroups of the Simulation Technical Advisory Group and membership on the Education and Training Technical Advisory Group. S&TD research is coordinated directly with other service R&D organizations, such as the Army's Project Manager for Training Devices (PM TRADE), the Air Force Human Resources Laboratory (AFHRL), the Naval Personnel Research and Development Center (NPRDC), and the Naval Training Equipment Center (NTEC) on a continuing basis.

H. (U) WORK PERFORMED BY: The contractors for this program are the Human Resources Research Organization, Alexandria, Virginia, and Honeywell, Inc., Minneapolis, Minnesota. The in-house developing organization responsible for this program is the US Army Research Institute for the Behavioral and Social Sciences, Alexandria, Virginia.

Program Element: #6.37.44.A Title: Training Simulation
DOD Mission Area: #552 - Environmental and Life Sciences Budget Activity: #2 - Advanced Technology Development

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Recent accomplishments under this program element are grouped into three research need areas. System Simulators and Training Devices: Specification of visual simulation requirements for M1 tank driver training. Training effectiveness evaluation of M1 Unit Conduct-of-Fire Trainer (U-COFT). Test plans for evaluation of Infantry/Cavalry Fighting Vehicles (IFV/CFV) U-COFTs. Specification of functional requirements for an Army aviation training research simulator. A model for optimizing the mix of flight simulator and aircraft use for aviator training. "Non-System" Simulation and Training Devices: Draft Training Circular on "How to Prepare and Conduct a Multiple Integrated Laser Engagement System (MILES) Exercise." Conduct of MILES Operational Test (OT) III. Development of an improved Army Training and Evaluation Program (ARTEP) for use with MILES. Specification of training feedback procedures for Computer-Assisted Map Maneuver System (CAMMS) battle simulation. Specification of procedures for integrating MILES and CAMMS for battalion tactical training. S&TD Requirements Definition and Evaluation: Handbook on how to determine training device requirements. Model for selecting alternative training device designs. Analysis of US Army, Europe (USAREUR) M1 tank gunnery simulation requirements.

2. (U) FY 1982-FY 1984 Planned Program: The program for FY 1982-FY 1984 can also be divided into three research need areas. System Simulation and Training Devices: Determination of physical fidelity requirements for advanced flight simulators. Flight transition training programs for CH-47 and UH-60 flight simulators. Application of advanced voice technology for improved UH-1 instructional flight trainer. Guidelines for simulation systems "embedded" in weapon systems. "Non-System" Simulation and Training Devices: Strategies for command and control training using the Computer-Assisted Tactical Training System (CATTS). Guidelines for design of general-purpose maintenance training simulators. Guidelines for the application of advanced technologies for low-cost, personal/small-group tactical training simulators. S&TD Requirements Definition and Evaluation: Automated procedures for determining simulator/training device requirements. Automated procedures for assessing simulator/training device effectiveness during design.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.48.A
Title: Advanced Development of Automatic Test Equipment and Systems
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT QUANTITIES	8392	9619	11335	11519	Continuing	Not Applicable
D329	Automatic Test Support Systems (ATSS)	7753	7491	8756	8235	Continuing	Not Applicable
D244	ATSS Language Util & Stand	639	2128	2579	3284	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element (PE) leads to production and fielding of test equipment by transferring today's automatic test equipment technology to hardware to overcome logistics problems in the field caused by the complex electronic and optical systems which are an inherent part of the advanced technology systems being fielded by the Army. Maintenance of these systems now requires highly trained repairmen, excessively large Automatic Test Equipment (ATE), or interim small-scale special purpose ATE. The objective of this PE is to achieve a substantial improvement in maintenance support by fielding the fewest variations of type classified STANDARD test equipment possible. Complementary ATE systems will be fielded to enable relatively low-skilled electronics technicians to troubleshoot and repair highly sophisticated electronic and optical systems. The Direct Support Automatic Test System (DS ATSS) will be shelter mounted and consist of a Base Station Test Facility (BSTF). A contract test set (CTS) will allow direct support maintenance on the forward battle area. A DS ATSS will allow direct support diagnosis on electronic assemblies removed at the organizational level from such systems as the Advanced Attack Helicopter and the M1 Tank. The work under this PE is consistent with the efforts to reduce ATE proliferation being sponsored by the Joint Logistics Commanders (JLC). Both the large and the small ATE's are required to reduce incorrect diagnosis and unnecessary repairs; reduce diagnostic time; reduce the variety of manual test equipment in the field; and reduce provisioning requirements and need for skilled personnel. These efforts support the Army requirements for ATE at division level and below. This PE includes vital complementary software efforts related to standard programing languages and software maintenance facilities to allow the maximum possible

Program Element: #6.37.48.A
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)

Title: Advanced Development of Automatic Test Equipment and Systems
Budget Activity: #2 - Advanced Technology Development

applications of expensive software development. The Army was requested by House of Representatives Report #96-916 that, prior to any final decision or action taken relative to consolidation or creation of a Single Manager, Test, Measurement and Diagnostic Equipment (TMDE) function, or any realignment or moves on this topic, the House Armed Services Committee be notified of the plan and provided justification. On 7 January 1981 a letter was forwarded to the Honorable Melvin Price stating that the Commander, Communications and Electronics Materiel Readiness Command (CERCOM), was designated the Single Manager of TMDE. This decision will allow the Army to achieve the goals of standardization, economy, and productivity, and provide program managers and development commands technical support to insure that system diagnostic requirements are addressed early in the program cycle. The establishment of the Single Manager for TMDE is the result of continuous management reviews and evaluation processes. An important element of this review was the "Heiser Study" completed in the fall of 1979. This study together with other quantitative reviews made by US Army Materiel Development and Readiness Command (DARCOM) resulted in the decision to locate the Single Manager for TMDE at Ft Monmouth, NJ. The implementation of the "Single Manager" Concept is still pending.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Initiate the advanced development of a shelter-mounted Directed Support Automatic Test Support System (DS ATSS) consisting of the base station test facility (BSTF) and contact test set (CTS). Production of the DS ATSS and the CTS is scheduled for FY87, and the first test sets will deploy to Europe.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	8392	9619	11335	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	8392	14355	9665	Continuing	Not Applicable

Decrease in FY82 is due to reprograming to higher priority Army requirements. FY83 increase represents additional requirements that were brought forward after the decrease in the previous year.

Program Element: #6.37.48.A
Title: Advanced Development of Automatic Test Equipment and Systems
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

E. (U) OTHER APPROPRIATION FUNDS: ($ in thousands): Not Applicable.

Program Element: #6.37.48.A
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)

Title: Advanced Development of Automatic Test Equipment and Systems
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: These efforts support the Army requirements for Automatic Test Equipment (ATE) at division level and below. The first automatic test set was the simplified Test Equipment - Internal Combustion Engines (STE-ICE) which provided the motorpool engine repairman with ATE. This test set, fielded in FY 1979, is being expanded to cover the entire vehicular electrical systems on the XM1 tank and Fighting Vehicle System. This Simplified Test Equipment-Expandable (STE-X) is being partially funded by t: ehicle development managers. The STE-X program transistions to Program Element 64746A this year. Defective electrical/electrical assemblies such as as receivers, transmitters, missile guidance systems, optics, fire control subassemblies, etc., when detected by STE-X or by other test equipment, are removed and sent to the rear for repair. This rear echelon maintenance facility, direct support, will be provid with the Modular Direct Support Automatic Test Support System (DS ATSS). The shelter-mounted DS ATSS will be specially co figured for each commodity class. For example, the missile DS ATSS will include appropriate diagnostic/alignment capabilities. Subassemblies and printed circuit boards (PCB) that are identified as faulty by the DS ATSS are sent to the General Support (GS) where other ATE Automatic Test Equipment Missile Support (ATEMS) and/or the AN/USM-410 have the diagnostic capability required to identify defective piece parts (e.g., semiconductor devices) that need to be replaced so that the subassembly/PCB can be returned to stock. This PE funds development and fielding efforts for DS ATSS and the direct support transportable contact test set. The objective of this PE is to provide the Army with standardized ATE at the direct support level.

G. (U) RELATED ACTIVITIES: Program Element 6.47.46.A, Automatic Test Support Systems, accomplishes the engineering development work.

H. (U) WORK PERFORMED BY: In-house work is performed by the US Army Communications Research and Development Command, FT. Monmouth, NJ; US Army Tank Automative Research and Development Command, Warren, MI; and US Army Missile Command, Huntsville, AL. Contractors are: RCA Corporation, Burlington, MA; University of Pennsylvania, Philadelphia, PA; Ultrasystems, Irvine, CA. The contract for DS ATSS will be awarded in 1st Quarter FY 1983.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Provided intensive and continual technical support to Army Program Managers (PM's) in the integration of ATE into their systems. Continued contractual effort to reduce test software development costs and to determine the methods of implementing a Department of Defense Standard Automatic Test Equipment language. Completed

Program Element: #6.37.48.A
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)

Title: Advanced Development of Automatic Test Equipment and Systems
Budget Activity: #2 - Advanced Technology Development

the definition of a Direct Support Automatic Test Support System (DS ATSS) and released the RFP for DS ATSS development. Withdrew solicitation of the Advanced Development contract because of high risk at that particular time. Continued contractual effort to reduce test software development costs and to determine methods of implementing DOD directives on standardization of ATE software languages. Continued to monitor DOD-wide ATE development efforts. Completed the development contract for the general purpose vehicular ATE, STE-X.

2. (U) FY 1982 Program: Release of a Request For Proposals (RFP) to industry for DS-ATSS. Complete development contract for general purposes STE-X. Source selection for DS-ATSS will begin. Continue work to establish a full transportability of ATE software and efficiency of test program set generation.

3. (U) FY 1983 Planned Program: Award the Advance Development (AD) contract for the DS-ATSS. Continue ATE requirements update on the development status of new Army systems. Begin intensive coordination with program managers to insure *maximum possible design aimed at use of DS-ATSS for system maintenance.*

4. (U) FY 1984 Planned Program: Continue Advance Development of DS-ATSS base station test facility and contact test set. Initiate DS-ATSS fielding plans and provide system specifications to program managers.

5. (U) Program to Completion: DS-ATSS will transition into engineering development and then into microprocessing, configuration, and sizing of test equipment. This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Project: #DJ29
Program Element: #6.37.48.A
Title: Automatic Test Support Systems (ATSS)
Title: Advanced Development of Automatic Test Equipment and Systems

DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) DETAILED BACKGROUND AND DESCRIPTION: This effort supports the Army requirements for Automatic Test Equipment (ATE) at Division level and below. A need exists within the Army to develop a modular, mobile direct support automatic test equipment system which will allow forward area testing and either repair on site or evacuation to the more capable General Support ATE now being procured and fielded. Without the direct support ATE capability, the operational readiness of prime weapons systems such as Advanced Attack Helicopter (AAH), TOW Fighting Vehicle Systems, Single Channel Ground and Airborne Radio System (SINCGARS) will be significantly degraded. The alternative is to let each prime system develop its own unique test equipment resulting in greater costs, proliferation of different test sets, and unacceptable level on nonoperational weapons systems. Organizational-level ATE, the Simplified Test Equipment - Internal Combustion Engines (STE-ICE), was fielded in FY 1979 to units in Europe. Further application of this diagnostic capability Simplified Test Equipment-Expandable (STE-X) is being developed so that all on-board electronic systems will be tested, with the final result that the Army will have one organizational test set to fault-isolate combat vehicles.

B. (U) RELATED ACTIVITIES: Program Element 6.47.46 (Automatic Test Support Systems) accomplishes the engineering development work.

C. (U) WORK PERFORMED BY: In-house work is performed by the Communications-Electronics Command, Fort Monmouth, NJ; contractual efforts are provided by Emerson Electric, St. Louis, MO; RCA Corporation, Burlington, MA; University of Pennsylvania, Philadelphia, PA; Ultrasystems, Irvine, CA. One contract is to be awarded in FY 1982 via competitive bid.

D. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS: Completed Operational Test (OT I) of concept of applying Automatic Test Equipment (ATE) at the General Support Field Maintenance Level. Required Operational Capability (ROC) was initiated, and the need for a Direct Support Automatic Test System (DS-ATSS) was validated. The request for proposal for the Advanced Development contract for DS-ATSS was released in FY 1980 and subsequently withdrawn in FY81 due to high risk. Award contract for general purpose Vehicular Automatic Test Equipment STE-X. The STE-X tester will transition into engineering development.

1. (U) FY 1981 and Prior Accomplishments: Determined the technical capabilities of industry in ATE and finalized the DS-ATSS requirement for the Army. Developed DS-ATSS design specifications. Withdrew solicitation Jun 81. Mission Element Need Statement (MENS) was prepared for the DS-ATSS development. Completed preparations and studies leading to advanced

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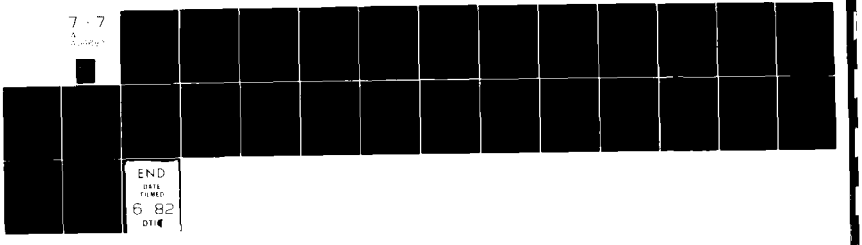

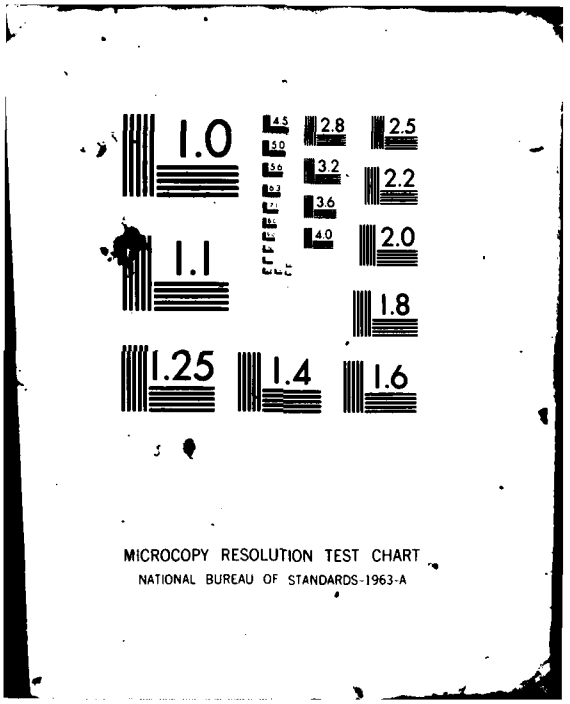
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Project: #DJ29 Title: Automatic Test Support Systems (ATSS)
Program Element: #6.37.48.A Title: Advanced Development of Automatic Test Equipment and Systems
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD) Budget Activity: #2 - Advanced Technology Development

development of Simplified Test Equipment-Expandable (STE-X). Award the Advanced Development Contract for the general purpose vehicular ATE, STE-X.

2. (U) FY 1982 Program: Release of Request for Proposals (RFP) to industry for DS-ATSS. Begin source selection process for DS-ATSS. Complete development contract for general-purpose STE-X.

3. (U) FY 1983 Planned Program: Award the Advance Development (AD) contract for the DS-ATSS. Begin intensive coordination with program managers to insure maximum possible design aimed at use of AS-ATSS for system maintenance.

4. (U) FY 1984 Planned Program: Continue Advanced Development of DS-ATSS base station test facility and contact test sets. Initiate DS-ATSS fielding plans and provide system specifications to program managers.

5. (U) Program to Completion: The DS-ATSS will transition into Engineering development and then into production capitalizing on advancements made by industry with microprocessing configuration, sizing of test equipment, and test support philosophy. This is a continuing program.

6. (U) Major Milestones: Not Applicable.

Project: #DJ29
Program Element: #6.37.48.A
Title: Automatic Test Support Systems (ATSS)
Title: Advanced Development of Automatic Test Equipment and Systems

DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

7. (U) Resources ($ in thousands):

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
RDTE						
Funds (current requirements)	7753	7491	8756	8235	Continuing	Not Applicable
Funds (as shown in FY 1981 submission)	7753	12221	7024	Not shown	Continuing	Not Applicable
Quantities (current requirements)	Not Applicable.					
Quantities (as shown in FY 1980 submission)	Not Applicable					

The decrease in FY82 is due to reprograming to higher priority developments. FY83 increase represents additional requirements that were brought forward after the decrease in the previous year.

Other Appropriations: Not Applicable.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.49.A Title: Technical Vulnerability Reduction
DOD Mission Area: #551 - Electronics and Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Costs
	TOTAL FOR PROGRAM ELEMENT	5968	12899	10198	10234	Continuing	Not Applicable
D462	Technical Vulnerability Reduction	5968	12899	10198	10234	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The need is to insure that US Army systems are hardened against current, projected, and reactive enemy threats. To meet this need, a US Army Materiel Development and Readiness Command (DARCOM) organization was established to be the single management focal point to ensure that counter-countermeasures (CCM) are incorporated into systems under development at any appropriate point from design to fielding. Through development/management of Army-wide CCM plans to counter enemy laser and RF threats, performance of selected detailed analyses, coordination and integration of various Department of Defense efforts, and evaluation of CCM progress, this program ensures that the above need is met.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The coordinated Army CCM plan will be executed, progress will be measured, and those CCM programs having low potential for payoff or in which progress is not being made will be revised or terminated. The Coordinated Army CCM plan includes technology/assessment efforts to harden electro-optics systems against high-energy laser (HEL) and other enemy E-O countermeasures threats as well as efforts to harden Command, Control, and Communications (C3), radar, Identification Friend or Foe (IFF), navigation and weapon systems against enemy location/destruction and/or jamming attempts.

Program Element: #6.37.49.A Title: Technical Vulnerability Reduction
DOD Mission Area: #551 - Electronics and Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	5968	12899	10198	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	5968	12938	3840	Continuing	Not Applicable

Decrease in FY 1982 funding is due to application of revised civilian pay and inflation indices. Increase in FY 1983 due to increase in priority and full implementation of laser CM/CCM plan.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.49.A Title: Technical Vulnerability Reduction
DOD Mission Area: #551 - Electronics and Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The objective of this effort is to provide a single management focal point within DARCOM to plan and execute an effective Countermeasures/Counter-Countermeasures (CM/CCM) program that avoids duplication while ensuring that US Army equipment and systems are sufficiently hardened against current, projected, and reactive threats. This is accomplished by coordinating and integrating the CCM assessment and technology efforts of various DARCOM agencies to ensure coverage of critical systems in light of the threat posed by the enemy to US Army combat operations. The progress of such efforts is technically evaluated and measured against such things as requirements, responsiveness to identified threat characteristics and priorities important for CCM design, completeness, current funding levels, and priorities for additional resources. Specific technical CCM problems not adequately covered by the existing efforts are solved by conducting independent studies of selected systems and/or developmental items.

G. (U) RELATED ACTIVITIES: The proper execution of a coordinated Army plan to harden its critical systems against enemy electronic warfare (EW) attempts requires interaction between the Training and Doctrine Command/Materiel Development and Readiness Command/Intelligence and Security Command (TRADOC/DARCOM/INSCOM). This program provides such interaction to insure that the newest technologies combined with optimized tactics and up-to-date intelligence provide effective and survivable weapon systems. All CCM-related efforts are contained within the overall plan which requires the additional interaction with TRADOC (requirements), the Army Medical Command, the Surgeon General, and the Army Hygiene Agency (eye protection). Within DARCOM, this office will monitor/guide the CCM-related work performed by the Office of Missile Electronic Warfare (OMEW) in PE 6.37.18.A (EW Vulnerability/Susceptibility). There is no unnecessary duplication of effort.

H. (U) WORK PERFORMED BY: Work under this program is performed by the US Army Development and Readiness Command Counter-Countermeasures (DARCOM CM/CCM) Center located at the US Army Electronics Research and Development Command (ERADCOM), Adelphi, Maryland. Specific DARCOM laboratories and Product Managers perform various parts of the work called for in the coordinated plan.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Implemented the portion of the Coordinated Army CCM plan designed to hardened US electro-optics (EO) systems damage from enemy laser threats. Hardening evaluations/techniques include hardened glass in Army periscopes, eye-protection filters for daysights, optical signature/damage reduction, and new canopy materials for helicopters. Electronic Counter-Countermeasures (ECCM) requirements were established/verified for SOTAS, AN/APS-94F, E-SCAN, MICNS and Cubic Data Links (as used with the RPV and SOTAS). The ECCM techniques resulting from these requirements will now transition into hardware. Completed electronic warfare (EW) effects model for command, control, and communications (C3) networks which will be demonstrated to the 5th Signal Command for use by US forces in Germany. Completed development of chaff model.

Program Element: #6.37.49.A Title: Technical Vulnerability Reduction
DOD Mission Area: #551 - Electronics and Physical Science (ATD) Budget Activity: #2 - Advanced Technology Development

2. (U) FY 1982-FY 1984 Program: Evaluate/harden Air Defense systems against chaff utilizing chaff model. Modify EW effects model based on inputs from US forces in Germany. Determine hardening requirements for frequency hop systems against advanced enemy threats to frequency hop systems. Develop coordinated Army CCM hardening plan covering C3, radar, navigation, IFF, and electro-optics systems (to threats not covered in existing Laser CCM Plan). Manage/update existing Laser CCM Plan. Efforts under this plan during FY 1982 will demonstrate optical signature/damage reduction for both in-band and out-of-band radiation and evaluate eye-protection devices to determine degradation (if any) caused by their use. The FY 1983 program will complete development of coordinated Army CCM hardening plan for C3, radar, navigation, Identification, Friend or Foe (IFF), and electro-optics systems; implement plan; modify electronic warfare (EW) effects model to be used in planning US Army EW missions and as a training aid for the Combat Electronic Warfare and Intelligence (CEWI) units in Europe; complete evaluation of the effectiveness of advanced frequency hop modes for Army applications; complete hardening investigation for frequency hop systems against advanced signal acquisition/location/jamming threats; complete hardening requirements evaluation for SHORADS C2; complete evaluation of hardening options for Forward-Looking Infrared (FLIR)s, image intensifiers, and daysights and incorporate into developmental/selected fielded equipment; conduct impact assessments to determine cost of incorporating previously tested CCM into existing laser-guided weapon systems; perform field tests to demonstrate effectiveness of CCM techniques in prototype E-O equipment. The FY 1984 program will manage/update coordinated Army CCM hardening plan that includes all enemy threat responses. This plan will furnish the priority and guidance for US Army CCM investigations, evaluation, hardening requirements, technology thrusts, and system applications and will ensure that critical US systems are appropriately hardened against current, projected and reactive enemy threats. All US Army equipment and weapons systems will be included covering the broad classes of C3, radar, navigation, IFF, and electro-optics.

3. (U) Program to Completion: This is a continuing program.

FY 1983 CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.52.A Title: Demilitarization Concepts
DOD Mission Area: #552 - Environmental and Life Sciences Budget Activity: #2 - Advanced Technology Development
Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTINGS): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	9467	12766	13768	Continuing	Not Applicable
A994	Demilitarization Concepts	0	9467	12766	13768	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Toxic Munitions which are obsolete or leaking agent pose a growing potential hazard to the public and the environment. Experiences with design, construction, and operation of Chemical Demilitarization facilities and equipment have confirmed the criticality for innovative and new technology to maximize safety and efficiencies and reduce costs. Energy-efficient technology must be considered and incorporated into all future chemical demilitarization designs. Current and increasingly restrictive environmental constraints require advancement in the state-of-the-art for control of emissions. A concerted effort must be devoted to maximize the safety aspects of all facets of chemical demilitarization operations. Detectors of sublethal levels of hazardous toxic agents in work area emission streams must incorporate the latest state-of-the-art technology to prevent exposure of workers, transients, and the civilian population to even minute quantities of agent. Ultimate disposal of waste products under existing and new standards must also be addressed. Concepts for future demilitarization plants to dispose of material identified for disposal will require capacities two to six times larger than the existing Chemical Agent Munitions Disposal System (CAMDS) facility. The eventual task of disposing of the current chemical agent stockpile will require capacities many times larger than even these planned facilities. Projected costs for stockpile disposal exceed $2 billion using current technology. This research area provides the technology to support the ongoing and future chemical demilitarization requirements with cost effective and less energy-intensive systems.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The funds requested for FY 1983 will complete detailed evaluations of alternative agent destruction processes and allow laboratory verification of chemical processes and reaction byproducts. Pilot design will be initiated for the most promising disposal and monitoring technologies including design, fabrication, and evaluation of prototype equipment. Pilot-scale demilitarization waste disposal system designs will be initiated.

Program Element: #6.37.52.A Title: Demilitarization Concepts
DOD Mission Area: #552 - Environmental and Life Sciences Budget Activity: #2 - Advanced Technology Development
Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	Additional to Completion	Total Estimated Cost
RDTE					
Funds (Current requirements)	0	9467	12766	Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	0	11921	7000	Continuing	Not Applicable

The funding decrease of $2454 thousand in FY 1982 is a result of a Congressionally directed change in the program. The funding increase of $5766 thousand in FY 1983 is a result of a decision to accelerate this program in order to provide needed technology for incorporation into stockpile disposal plant design scheduled for initiation in FY 1985 for Johnston Atoll.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: #6.37.52.A Title: Demilitarization Concepts
DOD Mission Area: #552 - Environmental and Life Sciences Budget Activity: #2 - Advanced Technology Development
Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program is designed to provide improved technology necessary to efficiently demilitarize existing stockpiles of obsolete chemical munitions and agents and eventually the entire current chemical stockpile. Existing facilities incorporate agent destruction processes developed more than a decade ago. This was necessitated by tight schedules and the absence of research efforts prior to process development. The eventual task of chemical agent stockpile demilitarization necessitates higher capacity and more efficient, yet environmentally safe, disposal facilities. Current developments in response to national hazardous waste disposal problems provide a multitude of potential chemical destruction processes which should be considered prior to design of future large-scale demilitarization facilities. The major thrust of this R&D effort will initially be devoted to development of alternative agent destruction processes. Current processes are labor and energy intensive and produce large quantities of byproducts which are difficult to dispose of because of environmental concerns. Emphasis will be placed on conversion to reusable materials or production of landfillable byproducts. Energy recovery concepts will be included in any alternative system. Concurrent with agent destruction studies, advanced munitions processing concepts will be evaluated and developed including more efficient methods of munition disassembly. An ultimate goal is to develop a concept for a system capable of destroying both chemicals and explosives in a single, efficient operation. In support of advanced demilitarization designs, ancillary systems must be developed to prevent hazards to personnel in work areas and insult to the environment, and more efficient methods must be developed to dispose of existing and future byproducts, preferably by recycling, and to decontaminate equipment and metal parts prior to release.

G. (U) RELATED ACTIVITIES: There are currently no related projects. No unnecessary duplication of effort will occur within the Army or the Department of Defense. Open interchange of ideas with the Environmental Protection Agency (EPA) and other non-Defense agencies is being used to avoid duplication in the hazardous materials destruction process area. Large-scale destruction of toxic chemical agents and munitions is solely the responsibility of the US Army Toxic and Hazardous Materials Agency.

H. (U) WORK PERFORMED BY: This was a new start program for FY82. Contractors will be selected by competitive procurement procedures. All contracts will be monitored by the US Army Toxic and Hazardous Materials Agency.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: None (new program in FY 1982).

2. (U) FY 1982-FY 1984 Planned Program: The primary thrust of this program will be directed toward agent destruction alternative studies to identify potential new technologies for application to chemical demilitarization process design.

Program Element: #6.37.52.A Title: Demilitarization Concepts
DOD Mission Area: #552 - Environmental and Life Sciences Budget Activity: #2 - Advanced Technology Development
Advanced Technology Development

Advanced munitions processing concepts will be initiated. Advanced methods will be evaluated for final disposition of existing demilitarization waste. Environmental monitoring and investigative studies will be initiated to identify current advanced state-of-the-art analysis techniques for incorporation into prototype monitoring systems designs. Detailed evaluation of alternative agent destruction processes will be initiated, including laboratory verification of chemical reactions efficiencies, material and energy balances, and product identification and characterization. Pilot design will commence for those technologies offering the most benefit and least risk for incorporation into planned chemical demilitarization facility design. Prototype advanced munitions processing equipment will be designed and fabricated for evaluation. Prototype environmental monitoring systems will be designed and fabricated. Pilot-scale demilitarization waste disposal demonstrations will be initiated.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.37.61.A

Title: Electronic Warfare Vulnerability/ Susceptibility Support

DOD Mission Area: #551 - Electronic & Physical Sciences (Advanced Technology Demonstrations)

Budget Activity: #2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	4450			Continuing	Not Applicable
D190	Electronic Warfare Vulnerability/Susceptibility Technical Support	0	4450			Continuing	Not Applicable
D235	Missile Counter-Countermeasure Technology	0	0			Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Since an enemy's use of electronic warfare (EW) could greatly reduce the effectiveness of US Army electronic/electro-optical dependent systems, it is vital to determine the susceptibility to EW of the US Army missile and communications-electronic systems and provide to US Army developers recommendations on electronic counter-countermeasures (ECCM) circuits and devices for missile, communications-electronic (CE) and night vision/ electro-optical (NV/EO) systems that will reduce the vulnerability of US systems to enemy EW operations. The objectives of this program are: to develop advanced technology and applications thereof for the above-mentioned EW analyses of US systems and the hardening of discovered weaknesses; to analyze foreign systems' EW vulnerabilities for US exploitation; to determine logical enemy ECCM responses to US EW; and to provide guidance to the developers of the next-generation US ECM systems.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Funds are required to: Continue the development of techniques and their applications to improve our capability to perform EW vulnerability assessments of US systems and to develop ECCM to reduce or

eliminate those vulnerabilities; and to perform EW assessments of foreign systems to provide guidance for the development of US ECM systems. Generic ECCM techniques will be analyzed/developed for communications systems. Foreign systems will be subjected to EW analyses to determine their susceptibilities. Special Electromagnetic Interference (SEMI) investigations of US systems will be conducted to determine potential problems and to recommend fixes. Infrared, ultraviolet, and millimeter wave measurements will be made on US and foreign systems to indicate potentially fruitful ECM/ECCM areas.

D. COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	0	4450		Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	Not Shown	4463		Continuing	Not Applicable

No funds are shown for FY 1981 since this Program Element (PE) is a new start. Previous work (through FY 1981) was accomplished under PE #6.37.18.A, project D267 (Air Defense Weapons System Vulnerability/Susceptibility). Funding shown for FY 1982 reflects Project D190, which was part of Program Element #6.37.18.A (Electronic Warfare Vulnerability/Susceptibility) in the FY 1982 submission. Funding difference in FY 1982 reflect minor adjustments due to changes in inflation indices. Funding difference in FY 1983 reflect new requirements based on restructuring of the project.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.37.61.A Title: Electronic Warfare Vulnerability/ Susceptibility Support

DOD Mission Area: #551 - Electronic & Physical Sciences (Advanced Technology Demonstrations) Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: This program provides for the development of advanced EW technology and for the integration of technological innovations and advancements into Army communications-electronics, electro-optical, and weapon systems. Principal products under investigation emphasize EW technology, cost reduction techniques, weapon system operation in severe EW environments, survivability enhancement, and the exploitation of technological opportunities which may counter new threats and improve the force multiplier ratio of Army combat forces. The broad objectives of the program are to: (1) Develop the technology for determining the vulnerability/susceptibility of Army systems; (2) develop counter-countermeasures (CCM) techniques to harden systems against enemy EW threats; (3) reduce development costs through simulation techniques; (4) apply EW technology to new weapon systems; and (5) using input from the Foreign Science and Technology Center (FSTC), Missile Intelligence Agency (MIA), and Foreign Technology Division (FTD), analyze foreign systems in order that their EW susceptibilities may be exploited. These objectives involve most of the scientific and engineering disciplines related to communications-electronics, electro-optical, and missile system development.

G. (U) RELATED ACTIVITIES: The work performed under this Program Element is directly related to the work being performed ' other US Electronic Research and Development Command (ERADCOM) laboratories, particularly the Electronic Warfare Laboratory, the Signals Warfare Laboratory, and the Night Vision and Electro-Optical Laboratory. In particular, this work feeds directly into Program Element (PE) #6.37.18.A (EW Vulnerability/Susceptibility, Projects #D234, (Surface/Surface Weapon EW), #D267 (Air Defense), and D626 (C3 Systems Vulnerability/Susceptibility). Results of the vulnerability/susceptibility investigations and ECCM recommendations are furnished to other Army development commands; i.e., Missile Command (MICOM) and the Communications-Electronics Command (CECOM). Efforts in this program related closely to scientific and technical (S&T) programs conducted by the US Air Force PE #6.37.18F (EW Technology), 6.37.43F (E-O Warfare), 6.37.50F (CCM Advanced Development), and 6.22.04F (Active ECM); the US Navy PE #6.27.62N (EMC) and 6.37.16N (Laser Countermeasures) (CM/CCM), and other programs within the US Army (6.23.03A (Missile Technology)). Coordination is accomplished by exchange of technical reports, attendance at scientific meetings and conferences, joint development projects, and reviews by the Department of the Army (DA) and by the Office of the Secretary of Defense (OSD) Under Secretary of Defense for Research and Engineering (USDRE). Duplication is precluded by active participation by personnel in interagency working groups, liaison visits to agencies involved in EW-related S&T work, the free exchange of information agencies via the Defense Technical Information Center, and deliberate structuring of the program to concentrate on the Army's EW needs. Where areas of potential unwarranted duplication have been identified, appropriate agreements have been effected with the command/agency concerned. Membership exists in various working groups and committees.

Program Element: # 6.37.61.A Title: Electronic Warfare Vulnerability/ Susceptibility Support

DOD Mission Area: #551 - Electronic & Physical Sciences (Advanced Technology Demonstrations) Budget Activity: #2 - Advanced Technology Development

H. (U) WORK PERFORMED BY: ERADCOM has primary responsibility for execution of project D190, and MICOM had the primary responsibility for execution of project D235. In-house research, development, and EW vulnerability/ susceptibility is conducted by ERADCOM (White Sands Missile Range (WSMR), NM). In-house generic missile ECCM research and development is conducted by MICOM, Redstone Arsenal, AL. Major contractors are: Atlantic Research Corporation, Alexandria, Virginia; Physical Science Laboratory, New Mexico State University, Las Cruces, New Mexico; and Lockheed Missiles and Space Company, Inc., Palo Alto, California. Contractors will perform approximately 15 contracts with a total dollar value of approximately $1,500,000.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. FY 1981 and Prior Accomplishments: This is a new program element (PE); however, this effort was previously performed under PE 6.37.18.A, (Electronic Warfare (EW) Vulnerability/Susceptibility), project D267, (Missile EW) (previous title). Major past accomplishments include: Providing Ultraviolet (UV) and infrared (IR)

EW vulnerability assessments. Significant input to the smoke countermeasures inventory was obtained by making spectral measurements during the Battlefield Induced Contaminants Test.

Tri-Service EW exploitation of foreign systems was supported.

2. FY 1982-FY 1984 Planned Program:

Specifications will be developed for imaging system to provide characterization of target, EOCM and background POST follow-ons. Integration of a radiometer into the measurement facility will be initiated. A study will be initiated for redesign of the mobile facility to more optimally accommodate the expanding number of types of data acquisition instrumentation.

Program Element: # 6.37.61.A Title: Electronic Warfare Vulnerability/ Susceptibility Support

DOD Mission Area: #551 - Electronic & Physical Sciences (Advanced Technology Demonstrations) Budget Activity: #2 - Advanced Technology Development

The ECCM design reference (handbook) for communication systems and combat surveillance radars will be updated. Analysis will begin of a generic ECCM technique for Army line-of-sight, troposcatter, and long-haul communication systems; perform analyses to identify potential EW vulnerability investigations.

Tri-Service exploitation will continue.

evaluations of Remotely Piloted Vehicles (RPV), improved Tube-Launched Optically Tracked Wire-guided (TOW) vehicle, and Fire Support Team (FIST) vehicle will be conducted. imaging system will be integrated into the measurement system. Characterization of aircraft and ground target EOCM background will be determined for POST follow-ons vulnerability assessments. Analysis of radar concept will begin. The generic EW vulnerability analysis of standoff jammers will be completed and areas identified which require laboratory simulation and experiments to further examine potential EW vulnerabilities.

countermeasures system design will be verified. 1749

A generic missile ECCM effort will be initiated.

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.37.62.A
Title: Electronic Warfare Feasibility Development
DOD Mission Area: #551 - Electronic and Physical Sciences
Budget Activity: # 2 - Advanced Technology Development

A. RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	0			Continuing	Not Applicable
DK15	Advanced Communications Electronic Countermeasures Demonstration	0	0			Continuing	Not Applicable
DK16	Combat Vehicle Self-Protection Demonstration	0	0			Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The effective use of electronic warfare (EW) will be one of the most effective combat multipliers on the modern battlefield. The ability to reduce the enemy's command and control by disrupting his communications and to protect our forces from detection and from radar, electro-optical, and infrared guided weapons may spell the difference between victory and defeat in any future conflict. The rapidly increasing use of precision-guided weapons necessitates a corresponding effort in the detection and countering of such threats. Investigations and developments are continuing, in close coordination with the intelligence community, to insure that the latest developmental US missile, communications, electronics and electro-optic systems will function satisfactorily in a hostile countermeasures environment. This program element provides the funding to demonstrate the feasibil ty and effectiveness of electronic warfare developments emerging from the Army's Tactical Electronic Warfare Technology program. Items successfully demonstrated in the program will then transition to advanced development.

Program Element: # 6.37.62.A
DOD Mission Area: # 551 - Electronic and Physical Sciences

Title: Electronic Warfare Feasibility Development
Budget Activity: # 2 - Advanced Technology Development

C. BASIS FOR FY 1983 RDTE REQUEST: One major effort will be to demonstrate an electronic countermeasures system against Included will be a new which will be capable of upgrading present systems such as the AN/MLQ-34 TACJAM system, and demonstration of new techniques. The other effort will be development of the STINGRAY Combat Vehicle Self-Protect System. This system will This effort was started under Program Element #6.37.10, Project DK87.

D. COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	0	0		Continuing	Not Applicable
Funds (as shown in FY 1982 submission)	Not Applicable		This is the first year for this program.		

E. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: # 6.37.62.A
DOD Mission Area: # 551 - Electronic and Physical Sciences

Title: Electronic Warfare Feasibility Development
Budget Activity: # 2 - Advanced Technology Development

F. DETAILED BACKGROUND AND DESCRIPTION: The objective of this program is the development and feasibility demonstration of tactical electronic warfare (EW) devices, systems, and techniques to be targeted against enemy communications systems associated with hostile weapons systems and units. As the enemy fields advancements in his communications and weapons systems technologies, US electronic warfare equipment must be upgraded or it will become obsolete. The concepts and equipment developed in 6.2 efforts must be demonstrated to insure that only viable equipment enters advanced development, thereby helping minimize the total cost of development, acquisition, and operation of electronic warfare equipment. In close coordination with the intelligence community, are studied and evaluated for application to ongoing efforts under the program.

G. (U) RELATED ACTIVITIES: This program is to continue the developments and conduct feasibility demonstrations of efforts begun in Program Element 6.27.15.A, Tactical Electronic Warfare Technology. Successful developments will transition to advanced development under program element 6.37.55.A, Tactical Electron Countermeasures Systems. Tri-Service technical efforts in electronic warfare receive extensive review as a result of participating in Joint-Service Technical Programs, Electronic Counter-Countermeasure Workshops and Joint Technical Coordinating Technology Coordinating Paper on Electronics and the annual reviews by the Under Secretary of Defense for Research and Engineering (USDRE).

H. (U) WORK PERFORMED BY: Elements of the US Army Electronics Research and Development Command, Adelphi, MD, consisting of the Electronic Warfare Laboratory, Fort Monmouth, NJ, and the US Army Signals Warfare Laboratory, Warrenton, VA. Contractors are still to be determined.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: FY 1983 is the first year for this program.

2. FY 1982-FY 1984 Planned Program: The system development will begin in FY 1983. It will include an In FY 1984 the will be integrated into the AN/MLQ-34 TACJAM and demonstrated. In FY 1984 development will begin on a system to provide

Initial effort will begin in 1984 to develop

Program Element: # 6.37.62.A
DOD Mission Area: # 551 - Electronic and Physical Sciences

Title: Electronic Warfare Feasibility Development
Budget Activity: # 2 - Advanced Technology Development

high-power/volume transmitters with increased efficiency and reliability. Included in the program element funding is tactical automatic data processing support. The STINGRAY Combat Vehicle Self-Protect System will be demonstrated at Fort Knox, Kentucky, on the M60 Tank. will transition from Program Element #6.27.15.A in FY 1984 and provide STINGRAY with the capability to

3. (U) Program to Completion: This is a continuing program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: #6.37.63.A
Title: Industrial Base/Biological Warfare Drugs
DOD Mission Area: #552 - Environmental and Life Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	-	-	4951	5354	Continuing	Not Applicable
807	Industrial Base/BW Drugs	-	-	4951	5354	Continuing	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is designed to develop an industrial manufacturing base within the United States for production of standard lots of pharmaceutical grade drugs and vaccines for use against known or suspected biological warfare (BW) agents. The industrial base in the United States for production of vaccines against high-hazard biological agents is extremely limited. There is presently only one small plant dedicated to producing these vaccines. It is essential that this base be expanded to (1) produce smalls lots of vaccines for administration to at-risk military personnel and (2) establish minimum stockpiles. The start of this program element is the first step in correcting this shortcoming.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: The logical progression in development of effective drugs and vaccines requires the production of pharmaceutical grade standard lots. This helps to insure that all studies meet good laboratory practice and good manufacturing practice regulations for ultimate approval for use in humans by the Food and Drug Administration.

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in Thousands) This is a new start.

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: #6.37.63.A
DOD Mission Area: #552 - Environmental and Life Sciences (ATD)

Title: Industrial Base/Biological Warfare Drugs
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: To assure strategic mobility, drugs and vaccines must be available to protect against diseases if contingency plans are activated. This program provides the source for manufacturing pharmaceutical grade standard lots of drugs and vaccines to meet specific needs of the Department of Defense (DOD). High hazard diseases which have known or potential BW importance will be given priority; for example, anthrax, botulism, Ebola, Marburg, Lassa, Q fever, and various hemorrhagic fevers.

G. (U) RELATED ACTIVITIES: This program element is supported by basic research in Program Element 6.11.02.A, Defense Research Sciences (specifically Project BS10, Military Disease, Injury, and Health Hazards), Program Element 6.27.70.A, Military Disease Hazards Technology (which consists of two projects: A870, Risk Assessment of Military Disease Hazards, and A871, Prevention of Military Disease Hazards), and Program Element 6.37.50.A, Drug and Vaccine Development. Coordination of projects among the program elements is achieved by the Commander and staff of the US Army Medical Research and Development Command (USAMRDC). Army representation on DOD coordinating committees and other government agency councils insures that the Army's medical research program complements the work of other Federal medical institutions. Overall review and control of DOD's medical research was brought under centralized management in FY 1981 by the formation of the Armed Services Biomedical Research Evaluation and Management (ASBREM) Committee.

H. (U) WORK PERFORMED BY: Work will be performed by contract.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: Not Applicable.

2. (U) FY 1982-FY 1984 Program: FY 1983 will be the first year of this advanced development effort to provide an effective medical system for maximizing safety and survivability of the soldier on the biological battlefield. The funding will support establishment of an industrial base in the United States for the production of pharmaceutical grade compounds identified in exploratory development to be effective as BW agent drugs and vaccines. Several new compounds will be studied during this period in order to provide protection for the soldier from potential BW agents such as anthrax, botulism, Ebola, Marburg, Lassa, Q fever, and various hemorrhagic fevers.

Program Element: #6.37.63.A
DOD Mission Area: #552 - Environmental and Life Sciences (ATD)

Title: Industrial Base/Biological Warfare Drugs
Budget Activity: #2 - Advanced Technology Development

3. (U) Program to Completion: It is anticipated that this effort will be a continuing program to develop new drugs and vaccines identified through basic research and exploratory development efforts in the medical biological defense program.

FY 1983 RDTE CONGRESSIONAL DESCRIPTIVE SUMMARY

Program Element: # 6.37.65.A
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)

Title: Nontactical ADP Technology
Budget Activity: #2 - Advanced Technology Development

A. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1981 Actual	FY 1982 Estimate	FY 1983 Estimate	FY 1984 Estimate	Additional To Completion	Total Estimated Cost
	Total for Program Element	0	0	495	492	Not Applicable	Not Applicable
DY13	Nontactical ADP Technology	0	0	495	492	Not Applicable	Not Applicable

B. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Army managers of software systems need decision-aiding tools that will facilitate the planning, control, and reporting of projects throughout the Automated Data Systems Life Cycle. This program is a combined effort between the Army Institute for Research in Management Information and Computer Sciences (AIRMICS) and Support Group Fort Lee with a primary objective of developing on a microcomputer interactive decision support system (DSS) for assisting software life-cycle planning and management, and a secondary objective of demonstrating DSS capabilities within the Army. The program element provides the necessary follow-on advanced development of an Automated Requirements System and Automated Project Management System originating in program element 6.27.25.A, Computer and Information Sciences, Project DY10. Specific needs being addressed by this program include: Design, develop, test, and evaluate a prototype Automated Requirements System which will assist the user, proponent, and developer in formulating, stating, analyzing, and validating system requirements; design, develop, test and evaluate a prototype Automated Project Management System which will significantly aid software project managers in the allocation, scheduling, and control of resources during the software development life cycle.

C. (U) BASIS FOR FY 1983 RDTE REQUEST: Funds are required to initiate design and development tasks for the prototype Automated Project Management System (APMS). Feasibility of design and development tasks has been verified in test and evaluation activities of experimental systems developed under the Army's Computer and Information Sciences program. Design task in FY 1983 will incorporate the Ada programing language as well as requirements for the Ada Programing Support Environment (APSE). Prototype designs will incorporate results of earlier test and evaluation of ARS and APMS experimental systems.

Program Element: # 6.37.65.A
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)

Title: Nontactical ADP Technology
Budget Activity: #2 - Advanced Technology Development

D. (U) COMPARISON WITH FY 1982 RDTE REQUEST: ($ in thousands)

	FY 1981	FY 1982	FY 1983	Additional To Completion	Total Estimated Cost
RDTE					
Funds (current requirements)	0	0	495	Not Applicable	Not Applicable
Funds (as shown in FY 1982 submission)	0	0	0	Not Applicable	Not Applicable

E. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: # 6.37.65.A
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)

Title: Nontactical ADP Technology
Budget Activity: #2 - Advanced Technology Development

F. (U) DETAILED BACKGROUND AND DESCRIPTION: The Army Institute for Research in Management Information and Computer Sciences (AIRMICS) Requirements Engineering Research efforts are aimed at developing an experimental automated system of existing and newly developed tools to aid the user and developer in formulating, stating, analyzing, and evaluating requirements. Rapid prototyping has recently been recognized as needed for validation of system requirements. Current rapid prototypes are built using powerful programing languages in which the system prototype is implemented. AIRMICS work had sucessfully demonstrated the changes needed in current requirements languages, specifically, Problem Statement Language, and Problem Statement Analysis (PSL/PSA), in order to execute them to produce a functional model of the system specified. A processor has been built to execute the PSL-extended language and produce functional prototypes for small applications. An experimental version of a Decision Support System (DSS) for software managers has been developed. This DSS is based on a color graphics-computer that gives the software manager the capability to interactively schedule projects and respond to "what if" questions. The capability to answer questions and the use of color go well beyond anything else currently available from any source. This project addresses the problems of project coordination, scheduling, and control which currently limits the ability of Army software managers to successfully manage software development and maintenance. This advanced development program has two primary thrusts: Develop a prototype Automated Requirements System (ARS) which will be implemented in the Ada Language systems and will be compatible with Ada Programing Support Environment (APSE). ARS will provide an interactive, computer-assisted requirements development capability for Army Proponent Agencies and Responsible Agents (i.e., software developers) which is specifically oriented to large Management Information systems. This system will be employed in Post Deployment Software Support (PDSS) and other development centers for both the development and maintenance of software. The integrated ARS environment will provide greater system reliability and usability. Requirements will be more easily collected from end-user, analyzed, and mapped into a formal requirements language validation. A capability will be provided to analyze requirements for ambiguities, consistency, and completeness. ARS will provide rapid feedback to the user regarding implications of his requirements enabling effective validation of their correctness and reduction of errors and subsequent maintenance requirements in fielded systems. This advanced development effort will produce a set of well-defined functions that, when used in close interaction between users and developers, will yield high quality requirements and will result in lower maintenance costs as well as improved responsiveness to user needs. 2) Develop a prototype Automated Project Management System (APMS) applying Decision Support System (DSS) concepts to provide Army software project managers decision-aiding tools and capabilities which will improve the planning, control, reporting, and management of resources during the software development life cycle. This interactive, color graphics, microcomputer-based DSS will integrate recent results from research in the behavioral sciences, computer science, and operations/research/systems analysis. The APMS prototype will be implemented in the Ada programing language and will be compatible with the APSE to support PDSS centers and other software project managers.

Program Element: # 6.37.65.A
Title: Nontactical ADP Technology
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

G. (U) RELATED ACTIVITIES: The Army's Military Computer Family program (MCF Pject No. 6.37.23.A/D101) Hardware, Software, and Instruction Set Architecture Product Planning is developing a compatible computer family and a high order language, Ada, has application in advanced information systems. The Army's Computer and Information Sciences program (PE and Project No. 6.27.25.A/DY10) developed the initial experimental systems which form a basis for the advanced development effort under this program. Interest expressed by NASA, Departments of Energy, Navy and Air Force has resulted in continuing liaison with those departments concerning this program.

H. (U) WORK PERFORMED BY: External contractor will be determined through competitive selection in FY 1983. In-house developing agency is the US Army Institute for Research in Management Information and Computer Sciences, Atlanta, GA.

I. (U) PROGRAM ACCOMPLISHMENTS AND FUTURE PROGRAMS:

1. (U) FY 1981 and Prior Accomplishments: The Army Institute for Research in Management Information and Computer Sciences (AIRMICS) in support of the Army's Computer and Information Sciences Program (Program Element: 6.27.25.A, Project: DY10, R&D in Multicommand Data Systems) has developed the initial experimental systems which form a basis for the advanced development effort under this program. AIRMICS has instigated the experimental use of the Problem Statement Language and Problem Statement Analyzer (PSL/PSA) requirements language in the US Army Computer Systems Command (USACSC) and provided advice and assistance. PSL/PSA is being used by two system developers in USACSC. AIRMICS effectively has demonstrated the capability of Input/Output Requirement Language (IORL) to translate and analyze requirements for a Standard Army Multicommand Management Information System (STAMMIS); i.e., Standard Army Maintenance Systems (SAMS). The feasibility of an executable requirements language was demonstrated with an experimental system sketch for rapid prototyping. Metrics and Life-Cycle Planning Research has produced an experimental Automated Project Management System (APMS) to improve software cost estimation tools into the APMS. Experimental APMS for software managers underwent test and evaluation. AIRMICS completed design of experimental system sketch which can produce rapid prototype of realistic-size systems.

2. (U) FY 1982 FY 1984 Planned Program: This advanced development will begin in FY 1983 and will consist of two primary tasks in FY 1983 and FY 1984: Develop a comprehensive requirements document (i.e., a Letter Of Agreement (LOA)) for the Automated Requirements System (ARS) incorporating results from experimental system test and evaluation. Experimental ARS will transition from PE 6.2 to this PE 6.3 in FY 1983. Complete demonstration of experimental ARS. Actual system design for the prototype ARS will begin in FY 1984. Complete development of system sketch and integrate into ARS in FY

Program Element: # 6.37.65.A
Title: Nontactical ADP Technology
DOD Mission Area: #551 - Electronic and Physical Sciences (ATD)
Budget Activity: #2 - Advanced Technology Development

1984. Begin development of program specification generation techniques. Develop a comprehensive requirements document (i.e., an LOA) for the Automated Project Management System (APMS) incorporating results from research in experimental system test and evaluation. Experimental APMS will transition from PE 6.2 to this PE 6.3 in FY 1983. Develop preliminary design for Advanced Development System. Develop, test, and evaluate prototype system. Prototype system design will be completed in FY 1984, and development will commence prior to the end of FY 1984.

3. (U) Program to Completion: This is a continuing program. Develop a data base for resource estimation and an automatic estimator. Identify and evaluate Decision Support System (DSS) design/development methodologies. Demonstrate DSS concept applicability and savings in the Army. Automated Project Management System (APMS) will have applicability to all services. Interest has been expressed by the services as well as other government agencies. The anticipated results of the future projects are: Demonstrating color-graphics applications and quantitative tools to aid managers and decisionmakers; a Developmental system which can be engineered into a configuration compatible with the Ada Programing Support Environment (APSE) and Army plans for Post-Deployment Software Support (PDSS).

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