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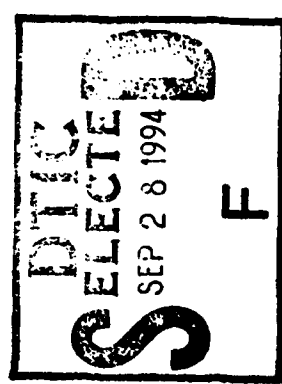
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UNITED STATES ARMY
COMMUNICATIONS-ELECTRONICS COMMAND

AD-A284 869



FORT MONMOUTH, NEW JERSEY

ADVANCE PLANNING
BRIEFING FOR INDUSTRY

"POWER SOURCES CHALLENGES TODAY AND TOMORROW"

SHERATON EATONTOWN HOTEL AND CONFERENCE CENTER

SEPTEMBER 13, 1994

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UNITED STATES ARMY COMMUNICATIONS-ELECTRONICS COMMAND



FORT MONMOUTH, NEW JERSEY

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"POWER SOURCES CHALLENGES TODAY AND TOMORROW"

SHERATON EATONTOWN HOTEL AND CONFERENCE CENTER
SEPTEMBER 13, 1994

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REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
HEADQUARTERS, US ARMY COMMUNICATIONS-ELECTRONICS COMMAND
AND FORT MONMOUTH
FORT MONMOUTH, NEW JERSEY 07703-5000



Office of the Commanding General

Ladies and Gentlemen:

On behalf of the Communications-Electronics Command (CECOM), I am pleased to present these proceedings of the "Power Sources Challenges Today and Tomorrow" Advance Planning Briefing for Industry (APBI). The objective of this APBI is to ensure a mutual understanding of our goals and continuing efforts in the power sources arena.

Due to today's limited resources, Government and Industry must continue to communicate and work together as a team to ensure state-of-the-art power sources are provided to our soldiers in the most efficient and cost effective manner.

I welcome your participation in our APBI program.

Sincerely,

Otto J. Guenther
Major General, U.S. Army
Commanding

NOTICE

This publication contains the briefings presented during this Advance Planning Briefing for Industry (APBI). Following the APBI, you may obtain a Proceedings Book for a minimum fee, by contacting the Defense Technical Information Center (DTIC). The telephone number is (800) 225-3842 (Option 5).

We hope that the above publication proves beneficial to your long-range planning efforts. If you have any additional questions and/or suggestions, please contact the Program Analysis and Evaluation Directorate, AMSEL-PE-OD, ATTN: Mari Aufseeser, (908) 532-5054.

DISCLAIMER

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ADVANCE PLANNING BRIEFING FOR INDUSTRY

SEPTEMBER 13, 1994
SHERATON EATONTOWN HOTEL AND CONFERENCE CENTER
EATONTOWN, NEW JERSEY

MEETING CHAIRMAN
MR. KENNETH M. MORGAN
DIRECTOR, SYSTEMS MANAGEMENT, CECOM

AGENDA

TUESDAY, SEPTEMBER 13, 1994

0700 REGISTRATION - SHERATON

0815 INTRODUCTORY REMARKS
 Mr. Kenneth M. Morgan
 Director, Systems Management, CECOM

0825 WELCOMING REMARKS
 Mr. Colin F. MacDonnell, Jr.
 Director, C3I Logistics and Readiness Center, CECOM

0835 KEYNOTE ADDRESS
 Mr. James B. Emahiser
 Assistant Deputy Chief of Staff for Logistics
 U.S. Army Materiel Command (AMC)

0905 U.S. ARMY TRAINING AND DOCTRINE COMMAND (TRADOC)
 FUTURE NEEDS/REQUIREMENTS

 BATTERY REQUIREMENTS/MODERNIZATION STRATEGY
 CW2 Kenneth Sanborn
 Technology Modernization Office
 U.S. Army Combined Arms Support Command (CASCOM)

0930 QUESTION AND ANSWER PERIOD

0940 BREAK

1000 U.S. ARMY RESEARCH LABORATORY (ARL)
 POWER REQUIREMENTS

 PORTABLE POWER SOURCES
 Dr. Robert P. Hamlen
 Electronics and Power Sources Directorate, ARL

1035 POWER EFFICIENT ELECTRONICS
 Mr. Robert Heuner
 Electronics and Power Sources Directorate, ARL

1055 U.S. ARMY COMMUNICATIONS-ELECTRONICS COMMAND (CECOM)
AMC BATTERY FOCAL POINT

BATTERY PROGRAM
Mr. Richard Rizzo
AMC Battery Focal Point
Systems Management Directorate, CECOM

1130 DIRECT VENDOR DELIVERY
Mr. Robert Pearson
Materiel Management Directorate, CECOM

1140 QUESTION AND ANSWER PERIOD

1150 LUNCH

1315 U.S. ARMY SIMULATION, TRAINING AND INSTRUMENTATION
COMMAND (STRICOM)
FUTURE EFFORTS

BATTERY POWER FOR MANWORN PERSONNEL DETECTION DEVICE
TRAINING SYSTEM
Mr. Steve Milburn
Deputy Product Manager for Combat Support Training
Devices, STRICOM

1350 QUESTION AND ANSWER PERIOD

1400 BREAK

1420 U.S. ARMY TANK-AUTOMOTIVE AND ARMAMENTS COMMAND
(TACOM)
BATTERY PROGRAM

POWER AND ENERGY STORAGE REQUIREMENTS FOR
MILITARY VEHICLES
Mr. John F. Bush
U.S. Army Tank-Automotive Research, Development and
Engineering Center
TACOM

1440 FUZE POWER SUPPLY REQUIREMENTS
Mr. Alan C. Reiter
Armament Research, Development and Engineering Center
TACOM

1505 SMART MUNITIONS BATTERY REQUIREMENTS
Dr. Clifford D. Shook
Armament Research, Development and Engineering Center
TACOM

1535 QUESTION AND ANSWER PERIOD

1545 CLOSING REMARKS
Mr. Kenneth M. Morgan
Director, Systems Management, CECOM

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WELCOMING REMARKS

Mr. Colin F. MacDonnell, Jr.

Director

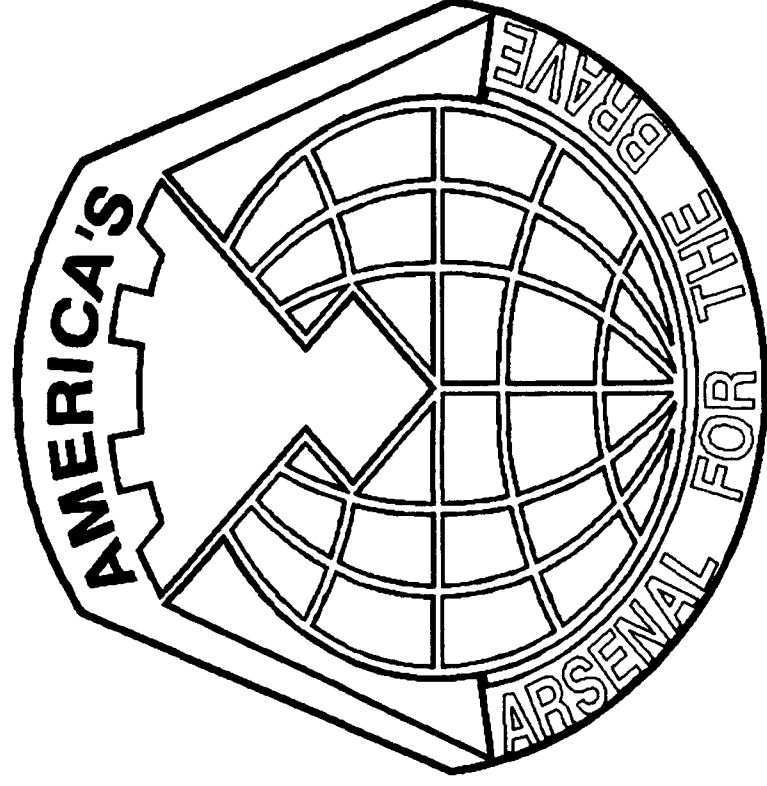
C3I Logistics and Readiness Center

CECOM

NOTES

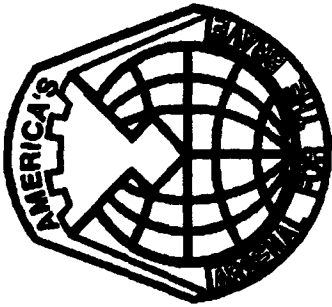
KEYNOTE ADDRESS

**Mr. James B. Emahiser
Assistant
Deputy Chief of Staff
for Logistics
AMC**



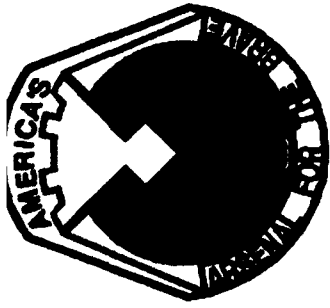
MR. JAMES B. EMAHISER
US ARMY MATERIEL COMMAND
ASSISTANT DEPUTY CHIEF OF STAFF
FOR LOGISTICS

UNCLASSIFIED



OUTLINE

- **OVERVIEW OF AMC**
 - * **WHO IS AMC?**
 - * **AMC'S VISION**
 - * **ACHIEVING THE VISION**
- **POWER SOURCES**
 - * **CONCERNS**
 - * **CHALLENGES**
 - * **INITIATIVES**



A COMMON OBJECTIVE

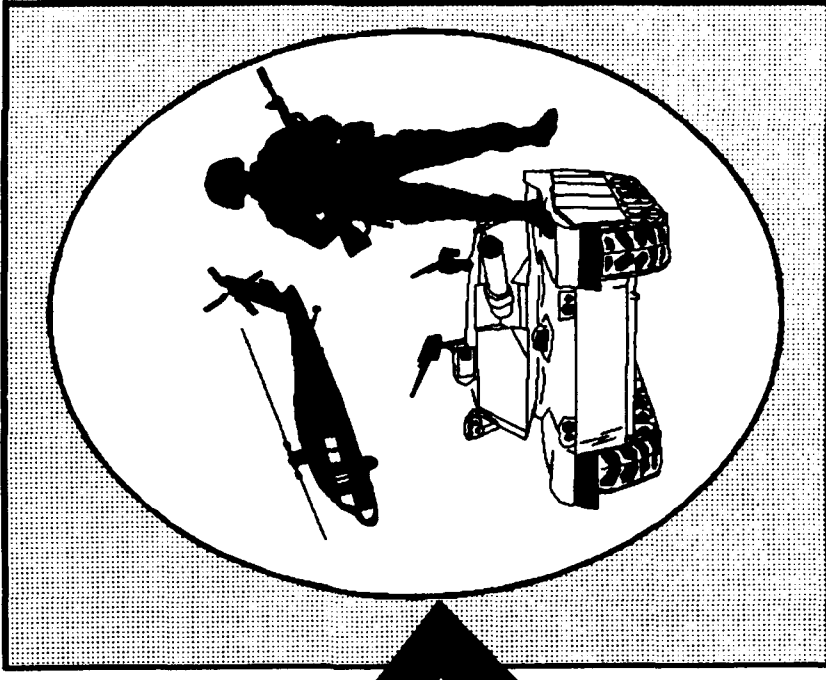
THE ARMY VISION

AMERICA'S ARMY, TRAINED AND READY, A STRATEGIC FORCE, SERVING THE NATION HOME AND ABROAD, CAPABLE OF DECISIVE VICTORY INTO THE 21ST CENTURY

AMC'S STRATEGIC VISION

THE LEADER IN EQUIPPING AND SUSTAINING AMERICA'S ARMY THROUGH SUPERIOR TECHNOLOGY AND RESPONSIVE SUPPORT, ASSURING WORLD WIDE POWER PROJECTION AND DECISIVE VICTORY.

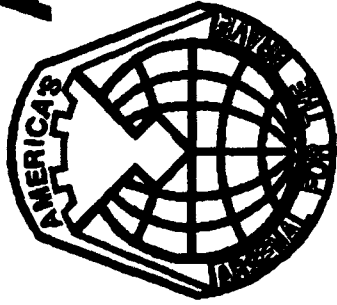
STRATEGIC FORCE



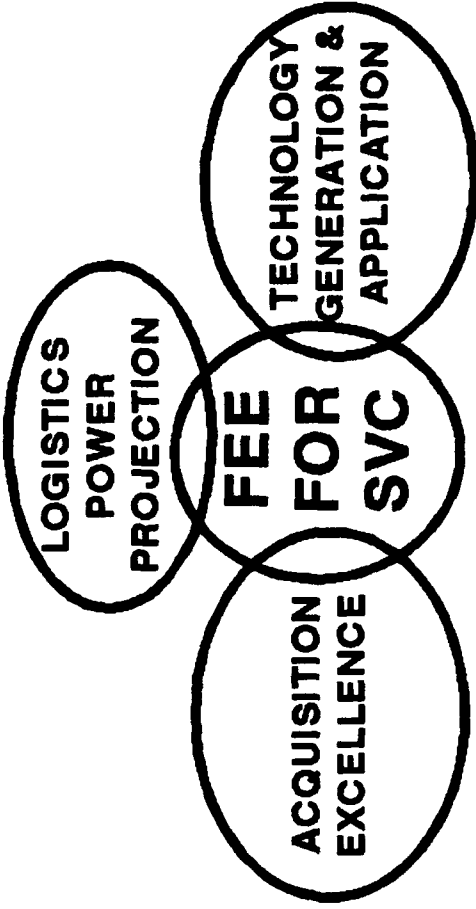
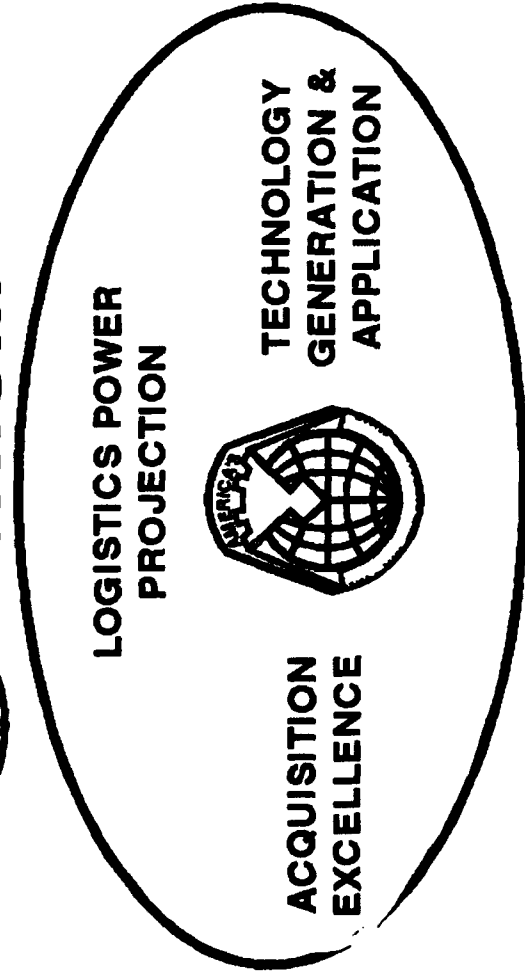
DECISIVE VICTORY

ALL THAT WE DO MUST BE DRIVEN BY THIS

AMC'S CORE COMPETENCIES -- A POWERFUL SYNERGY



THIS... NOT THIS...



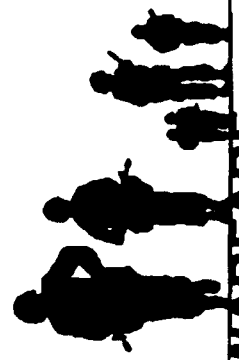
**AMC'S
CORE
COMPETENCIES**

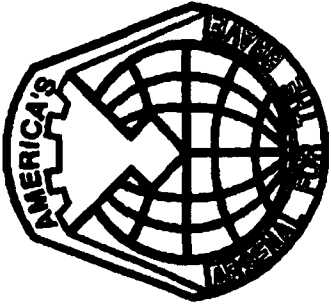
A POWERFUL SYNERGY THAT...

- PROVIDES SIGNIFICANT CONTRIBUTION TO THE ARMY
- CANNOT BE IMITATED OR DUPLICATED
- WITHOUT PRESENTS UNACCEPTABLE RISK TO THE ARMY

**SUPPORTING
AMERICA'S ARMY**

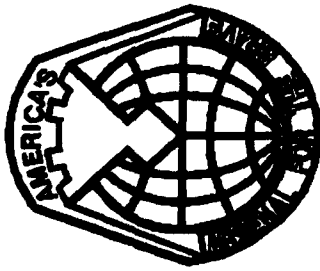
**LAND WARFARE
DOMINANCE**





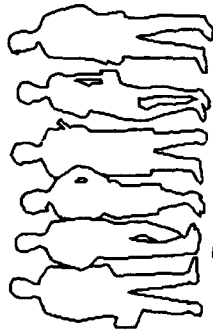
AMC'S MISSION

- ★ **EQUIP AND SUSTAIN A TRAINED
READY ARMY**
- ★ **CONVERT USER'S REQUIREMENTS
INTO WEAPON SYSTEMS**
- ★ **DEFINE, DEVELOP AND ACQUIRE
SUPERIOR TECHNOLOGIES**
- ★ **DEVELOP AND MANAGE THE ARMY'S
INDUSTRIAL PREPAREDNESS
PROGRAM**



AMC IS ...

PEOPLE



78,285 CIVILIANS
6,707 MILITARY

355 LOCATIONS

66 INSTALLATIONS
40 STATES
6 COUNTRIES



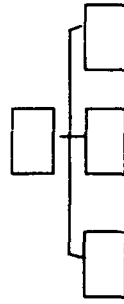
105 ORGANIZATIONS

ARSENALS

DEPOTS

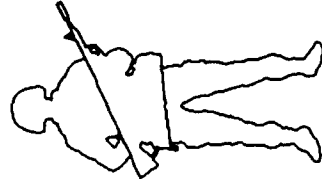
LABORATORIES

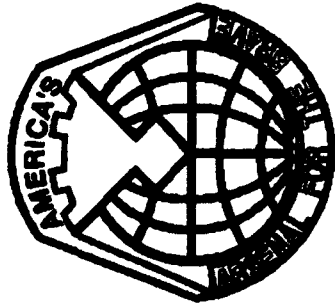
AMMO PLANTS



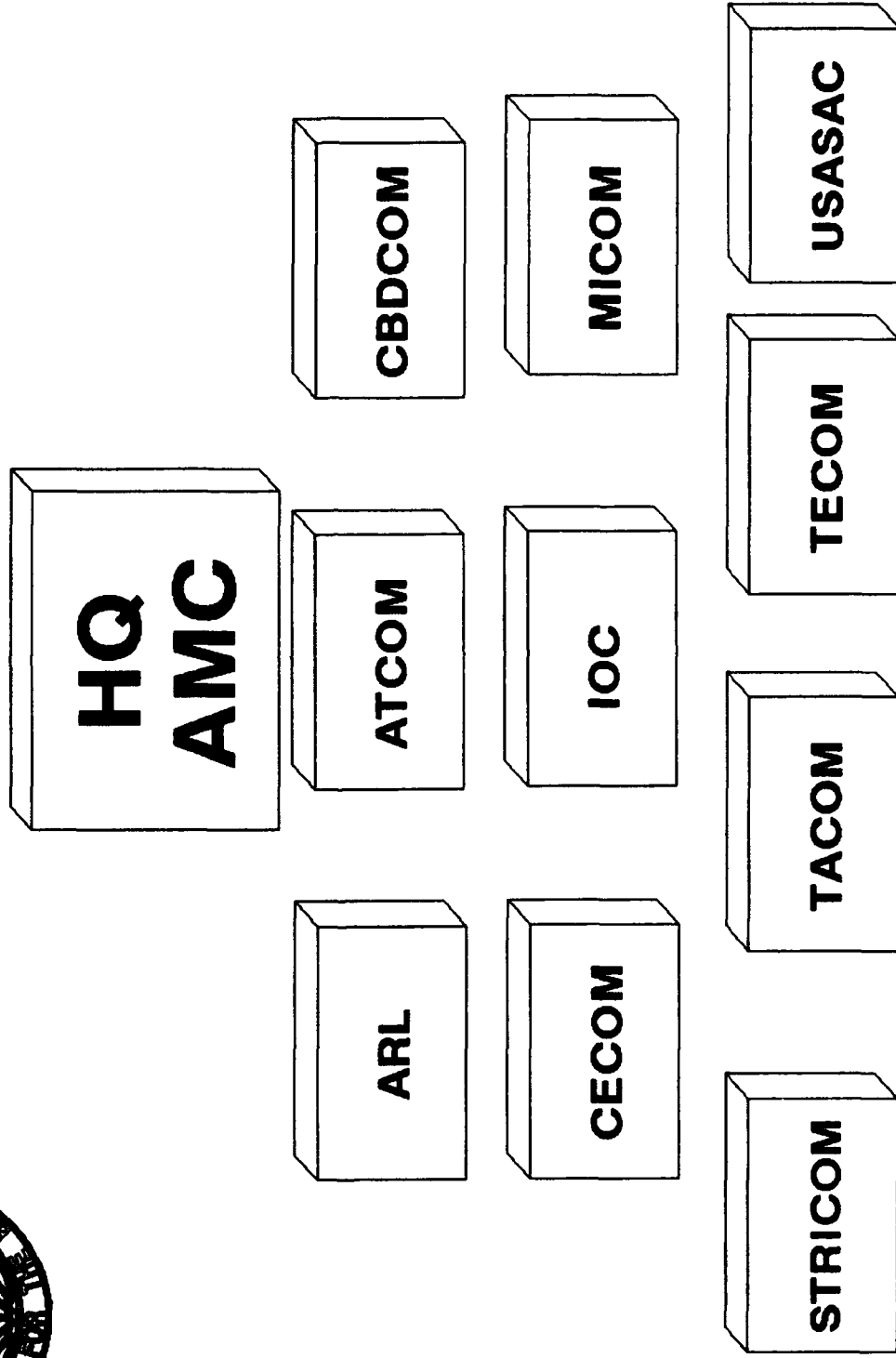
WITH TROOPS

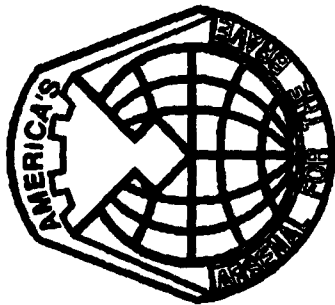
1,141 PEOPLE
55 OFFICES





AMC ORGANIZATION





AMC LOCATIONS

CBD COM TACOM

IOC

AMC
EUROPE

CECOM

ARL

TECOM

HQ AMC
USASAC

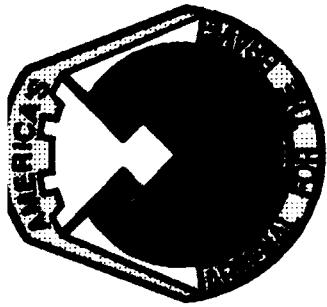
MICOM

STRICOM

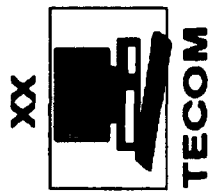
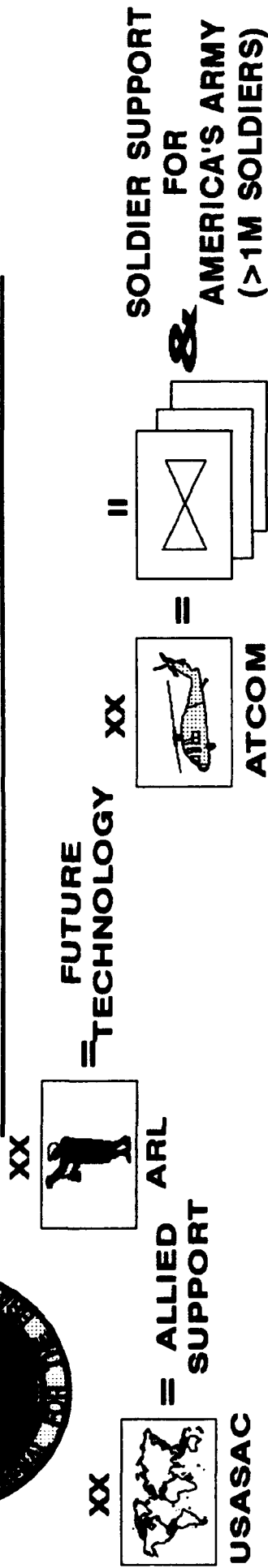
AMC
SA

ATCOM

AMC
FAR EAST



WHAT AMC DRIVES IN THE ARMY'S TABLE



XX

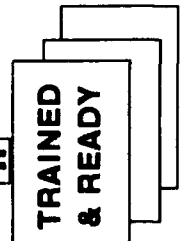
= BEST POSSIBLE WEAPONS SYSTEM X

G3 TRAINING

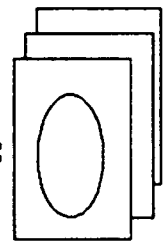
X



STRICOM XX

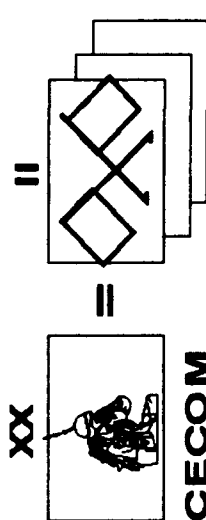
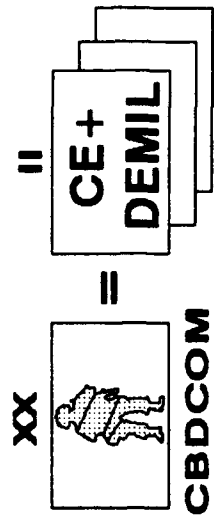


II

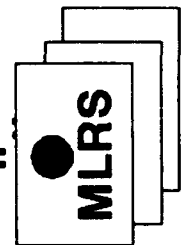
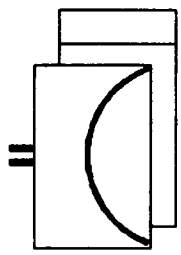


TACOM

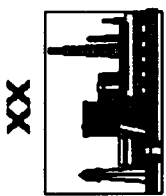
USING THE SYNERGY PROVIDED BY ITS CORE COMPETENCIES, AMC PROVIDES 'LIFE CYCLE MANAGEMENT' FOR ALL THE ARMY'S WEAPONS SYSTEMS ORIENTED TO 'PROMPT AND SUSTAINED LAND COMBAT'



SUSTAINING BASE INDUSTRIAL OPERATIONS



MICOM

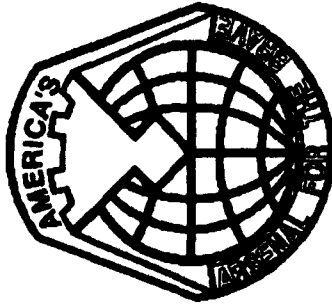


XX



XX





ARMY - AMC VISION

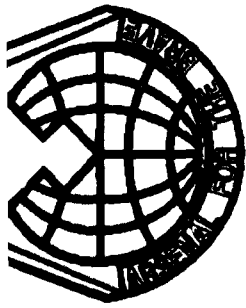
ARMY

AMERICA'S ARMY, TRAINED & READY,
A STRATEGIC FORCE, SERVING
THE NATION, AT HOME AND ABROAD,
CAPABLE OF DECISIVE VICTORY...INTO
THE 21st CENTURY

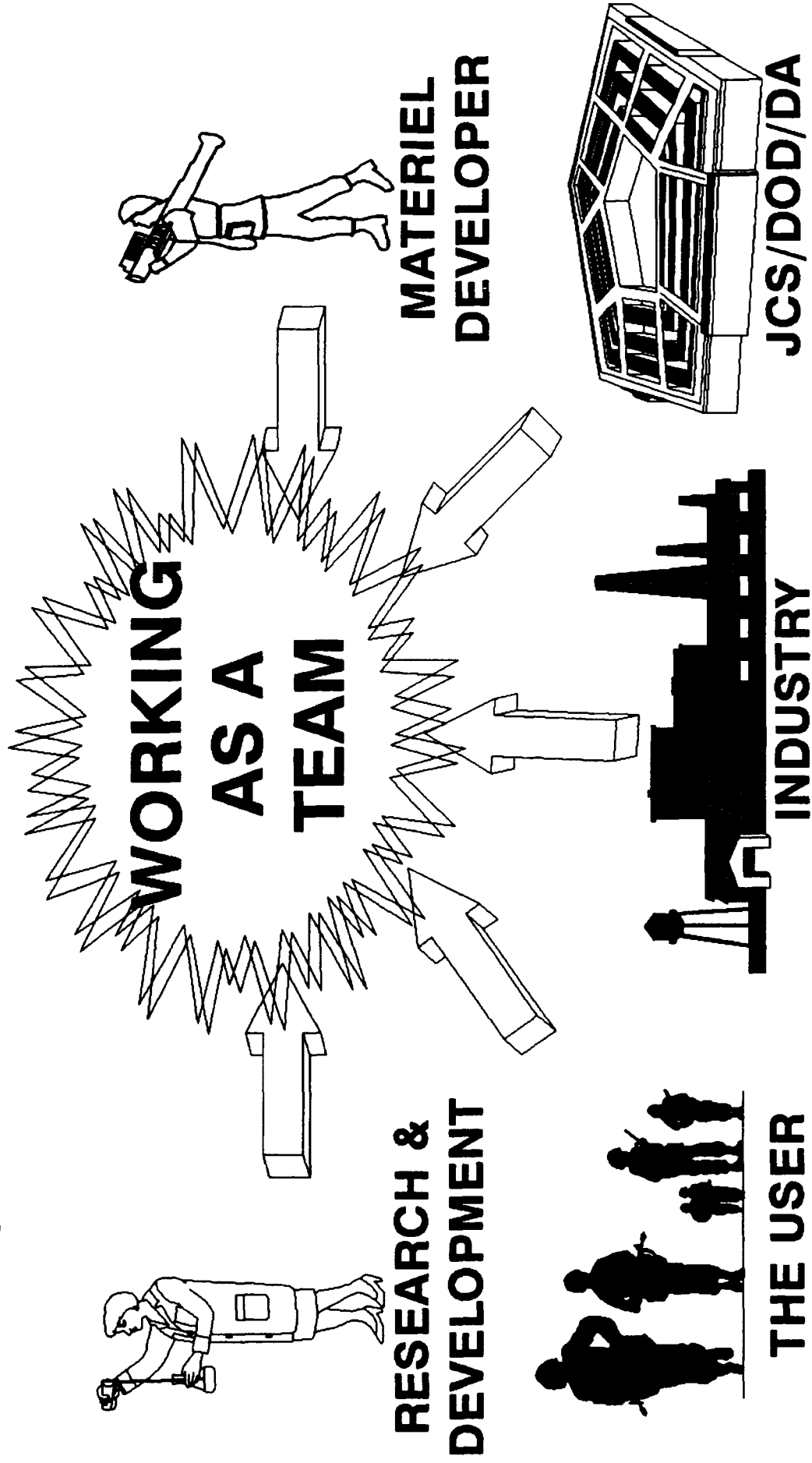
AMC

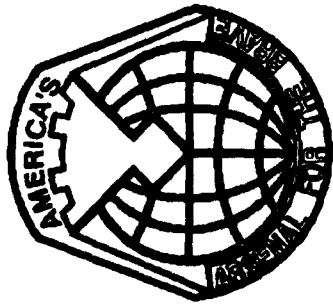
THE LEADER IN EQUIPPING AND
SUSTAINING AMERICA'S ARMY
THROUGH SUPERIOR
TECHNOLOGY AND RESPONSIVE
SUPPORT ASSURING WORLD
WIDE POWER PROJECTION AND
DECISIVE VICTORY.

"STRATEGIC FORCE...DECISIVE VICTORY"



ACHIEVING THE VISION





AMC CONCERNS

**EXTERNAL
INFLUENCES**

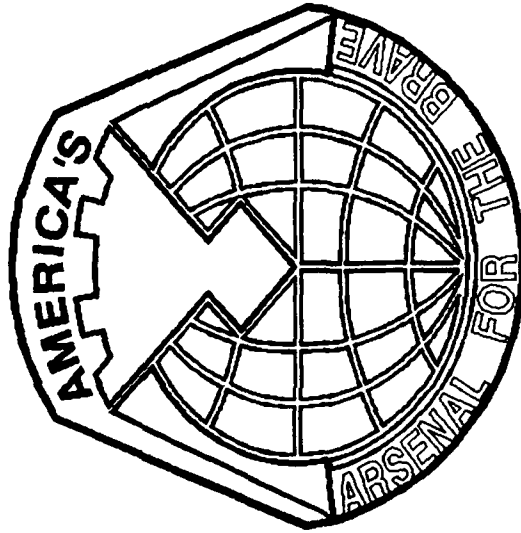
FORCE XXI

**LOUISIANA
MANEUVERS**

**ACQUISITION
REFORM**

**SHRINKING
BUDGETS**

BATTLE LABS



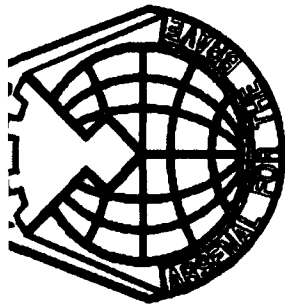
**INDUSTRIAL
BASE**

**MAINTAIN
SUPERIOR
TECHNOLOGY**

**MODERNIZATION
STRATEGY**

**ARMY WAR
RESERVES**

**INVENTORY
REDUCTION
PROGRAM**



READINESS OF AMERICA'S ARMY

WITH THE UNITS

LOG ASST REPS: 825
LOG ASST OFF: 41
COUNTRIES: 9

PANAMA, HONDURAS, GERMANY,
ITALY, MACEDONIA, KUWAIT,
SWA, KOREA, US

UNIT STATUS REPORTS

> 5,200 REPORTING UNITS
= 24 MAJOR COMBAT UNITS
DA 2715
DA 2406 EQUIP SHORTAGES
DA 1352 MAINT STATUS

EQUIPMENT READINESS

ALL REPORTABLE ITEMS: JUNE 94
419,000 (93% FMC)
REPORTABLE LINE ITEMS:
429 (306 MEET GOAL - 71%)
REPORTABLE SYSTEMS:
158 (91 FMC - 58%)
MAJOR WEAPON SYSTEMS:
16 (14 UP [PATRIOT, UH-60])

TOTAL PACKAGE FIELDING SYSTEMS FIELDIED AS OF

APR 94: 2598 EA
LIKE: SINGGARS, RADIC INST,
HMMMWW

MATERIAL MANAGEMENT: JUN 94

SUPPLY AVAILABILITY: 88.2% (GOAL 85%)
NON MSN CAPABLE SPLY 9.2% (28K OF 307K
AUTH STOCKAGE LIST % ZERO BAL
12% (GOAL 8% - LAST 6 MO AVG = 12.4%)

NEW EQUIPMENT TRAINING

888 CLASSES FY94
25,414 TRAINED

DEPOT MAINTENANCE

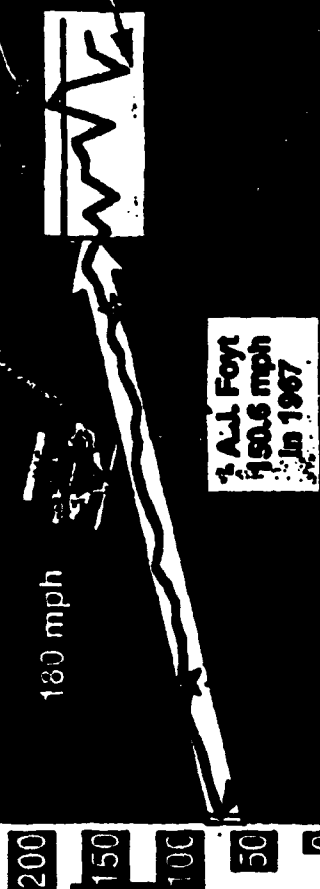
OVERHAUL: (M109 HOW. PATRIOT
CHINOOK, BRADLEY)
CONVERSIONS: (M113A2 TO M113A)
REPAIR: (APACHE, BRADLEY, OH-58)
REFURBISH: (BLACKHAWK)
UPGRADE/MODERNIZE: (M1 TO M1A2)
- \$716M FUNDED FY94
- WORKLOAD OF \$1.28B

LOGISTICS SUPPORT ACTIVITY

MAINTENANCE TROUBLE SHOOTING
PS MAGAZINE 130,000 ISSUES/MO
ARMY OIL ANALYSIS - 28 LABS
91,660/MO (AVG; GRND + AIR)
LOG INTEL FILES (LIE) (459K/MO AVG)
PLI/ASL DEVELOPMENT
MORE...

Indy... Leveraging Technology To Break The "Barriers"

Indianapolis 500 Winning Speed Averages



A.J. Foyt
150.6 mph
in 1967

1111122223333
12488924892489
Year

Peter De Paolo
Breaks
100 mph Barrier 1925

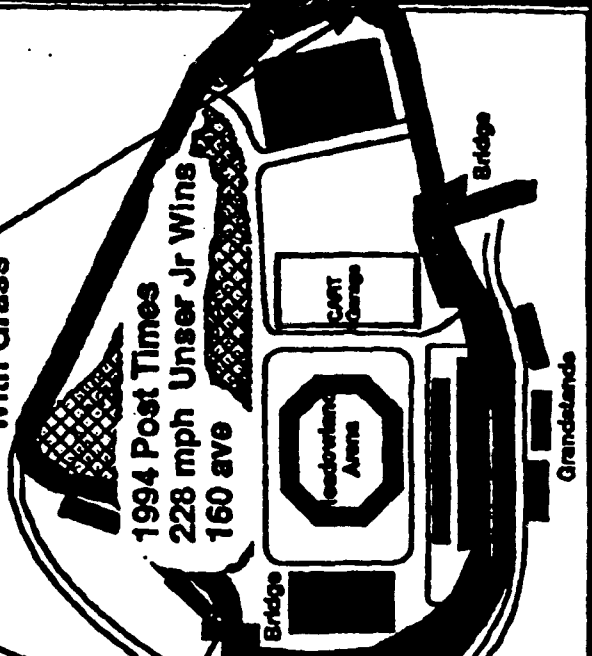
Ray Harroun
Wins
(6-42-06 -
74.59 mph)

185.9 in 1990 - Arie Luyendyk
Qualifying time was 223.3 mph

1992: Al Unser Jr. at 134.7 mph
Guerrero Wins Pole Position With 232.48 mph
12 Of 33 Cars finish
10 Crashes Claimed 13 Cars; 13 Drivers Injured

Slow Down

1993: New Rules with 157.2 mph
- Longer Chassis
- Engine "Boost" restrictions
- Carbon Fiber "Tubs" for Drivers
- Apron On Curves Replaced With Grass



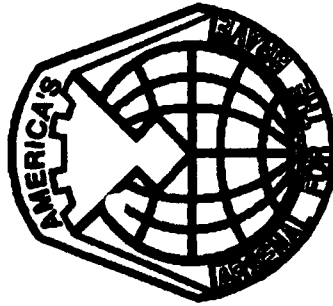
How You Go Fast On A "Slower" Track

4 Tons Of
Lateral G
Force

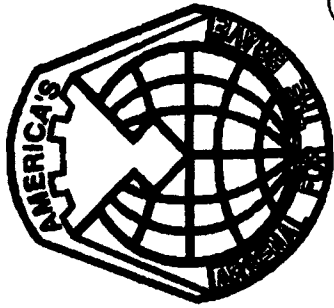
40 / 60
Weight Dist
Composite "Tub"

Redesign Front & Rear
Wings: 2 Tons Total
Down Force

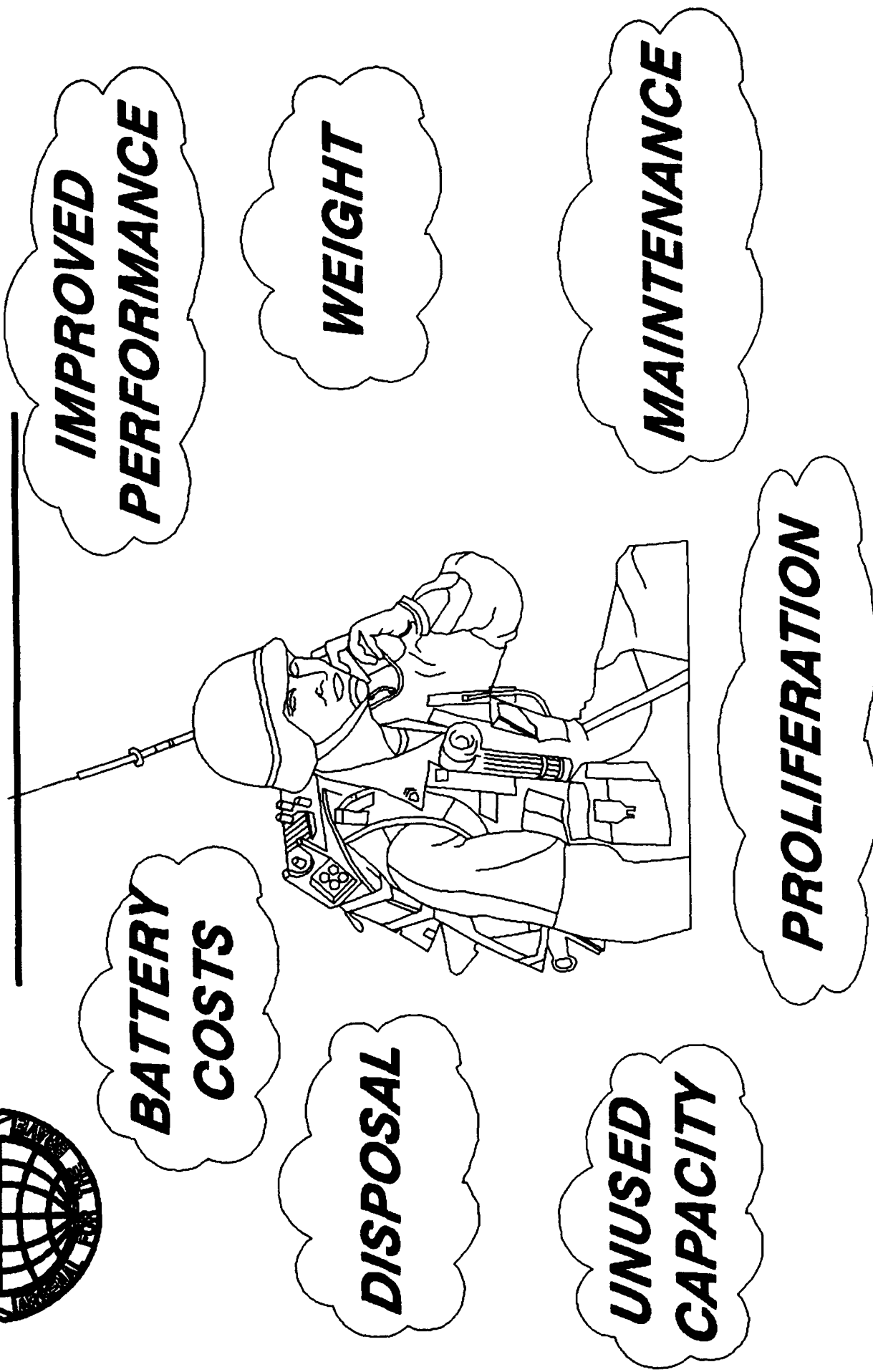
Smaller Engines
Horsepower
Air Intake
Compression

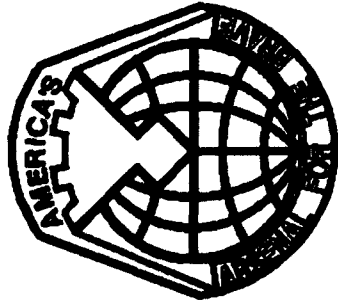


POWER SOURCES



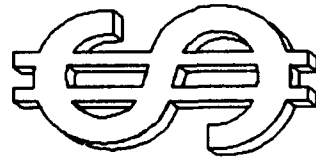
FIELD CONCERNS



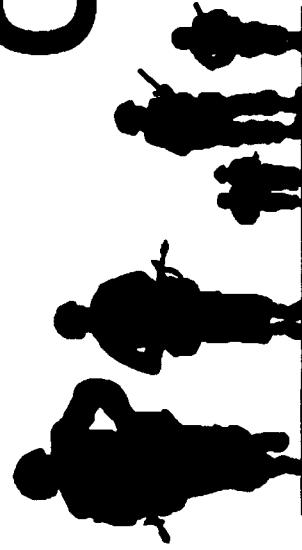


BATTERY RELATED OPERATION & SUPPORT COSTS

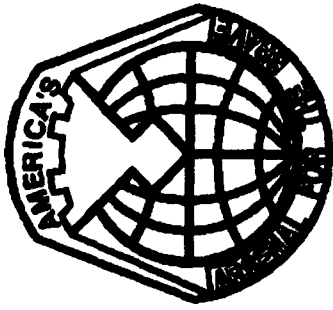
BATTERY RELATED



COSTS ARE OF INCREASING CONCERN TO



THE FIELD COMMANDERS



AMC POWER SOURCES CHALLENGES

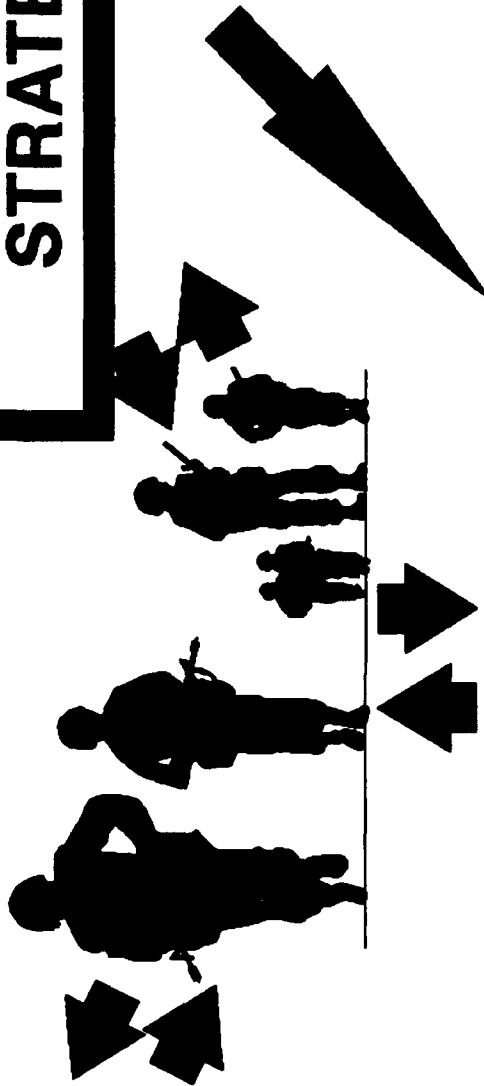
-  **REDUCE O&S COSTS**
-  **DEVELOP IMPROVED, COST
EFFECTIVE POWER SOURCES**
-  **INFLUENCE END ITEM DESIGN**
-  **REDUCE NUMBER OF UNIQUE BATTERIES**
-  **DEVELOP/FIELD POWER SOURCES BASED
ON DUAL USE TECHNOLOGIES**
-  **PRESERVE/BUILD AN INDUSTRIAL BASE**



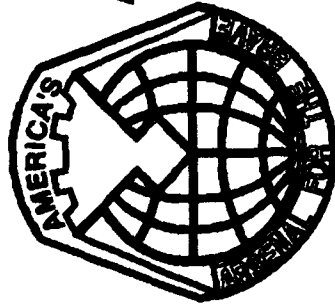
ANSWERING THE CHALLENGE

**AMC
BATTERY
FOCAL
POINT**

**ARMY
BATTERY
MODERNIZATION
STRATEGY**



INDUSTRY



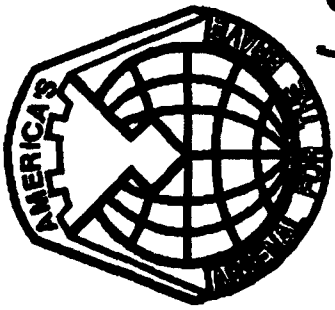
ANSWERING THE CHALLENGE

ARMY BATTERY MODERNIZATION STRATEGY

- * PERFORMANCE
- * SYSTEM DESIGN
- * PROGRAM MGT
- * CONTROL
- * PROLIFERATION
- * SAFETY

AMC BATTERY FOCAL POINT

- * IMPLEMENT STRATEGY
- * COORDINATE AMC
ACTIONS
- * INTERFACE WITH USERS
- * INTERFACE WITH INDUSTRY



WHY ARE YOU HERE?

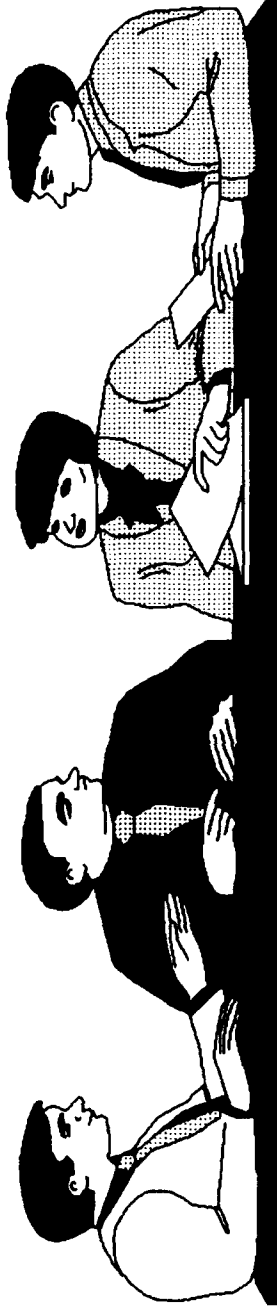
✓ OPEN COMMUNICATIONS

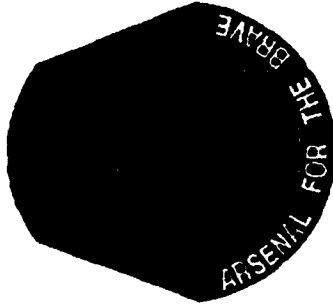
✓ LEARN WHERE WE ARE GOING

✓ MEET FUTURE CHALLENGES TOGETHER

✓ PROVIDE IDEAS/SUGGESTIONS

✓ BUSINESS OPPORTUNITIES





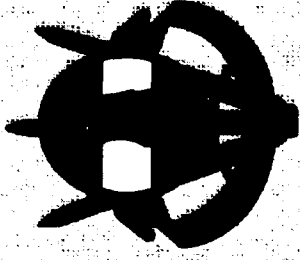
SUMMARY

- ▶ **POWER SOURCES ARE OF SIGNIFICANT CONCERN TO THE ARMY**
- ▶ **AMC IS BEING PROACTIVE IN RESOLVING THESE CONCERNS**
- ▶ **INDUSTRY ASSISTANCE IS REQUIRED**

NOTES

**U.S. ARMY TRAINING AND
DOCTRINE COMMAND
(TRADOC)
FUTURE
NEEDS/REQUIREMENTS**

**THE UNITED STATES ARMY
COMBINED ARMS SUPPORT COMMAND**



BATTERY REQUIREMENTS/MODERNIZATION STRATEGY

**FT LEE VA
23801-6000**

**CW2 KEN SANBORN
(804)734-0583**

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The Land Warrior System

Communication and Computer System

- Computer
- Intrasquad Radio
- Intersquad Radio
- GPS (SAASM)
- Handheld Flat Panel Display
- Video Camera
- Video Capture Software
- Compatible With Combat ID Component
- * GFE Software

Protective Clothing and Individual Equipment

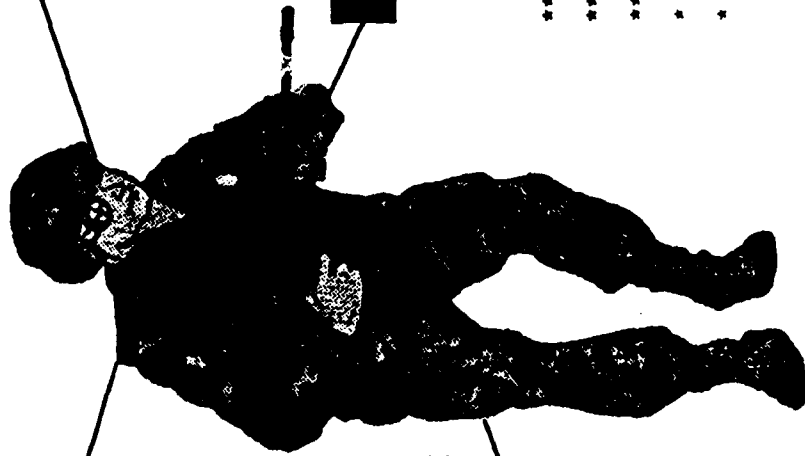
- Advanced Load Carrying Capability
- Improved Body Armor
- Laser Detector
- Improved Combat Uniform
- ** M45 Protective Mask
- ** Chem/Bio Garment/Glove/Boot
- * Ballistic/Laser Eye Protection
- * Other Existing CIE
- † Combat ID Receiver (PM-CID)

Integrated Headgear

- Lightweight Helmet With Suspension System
- Head/Helmet-Mounted Display Image Intensifier (I²) With Integrated Flat Panel Display

Weapon System

- Laser Rangefinder
- Digital Compass
- Wiring Harness
- ** Modular Weapon System
- ** Thermal Weapon Sight (TWS)
- ** Close Combat Optic
- * AN-PAQ4B - IR Laser Aiming Light
- * Other Existing Weapons & Accessories



BLACK = LW Development and Integrated Into LW by Contractor
 RED** = GFE to K (Still Being Developed); Integrated Into LW System
 ORANGE* = GFE to K (Already Type Classified); Integrated Into LW System
 GREEN† = Separate Program Interface With LW

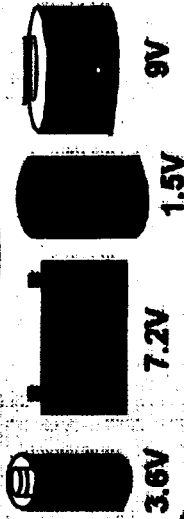
THE BATTERY CHALLENGES

MANAGEMENT



System design is done. Now we need a new battery

STANDARDIZATION



9V

1.5V

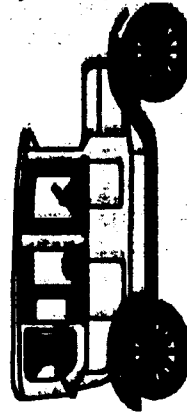
7.2V

3.6V

\$\$\$

\$14.3 M spent for 6TL batteries annually

OUTDATED TECHNOLOGY



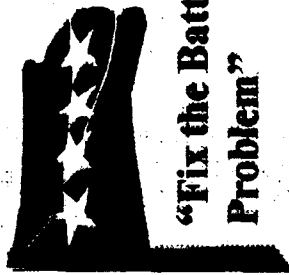
Vented lead-acid automotive batteries are older technology

HIGH USAGE

IN EXCESS OF 250,000 USED ANNUALLY BY TACOM

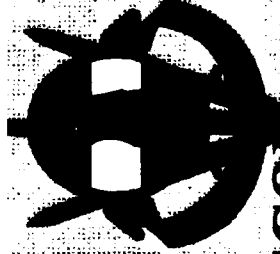


CG TRADOC



"Fix the Battery Problem"

GUIDANCE



CG CASCOM



**Identified and Assessed
Field Cdr's Concerns
Established an**

ARMY

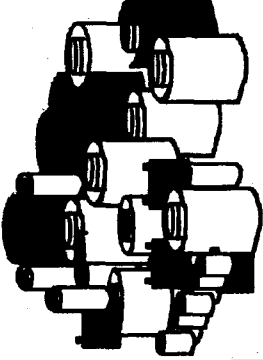
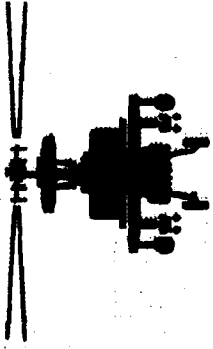
BATTERY

CONFEDERATION

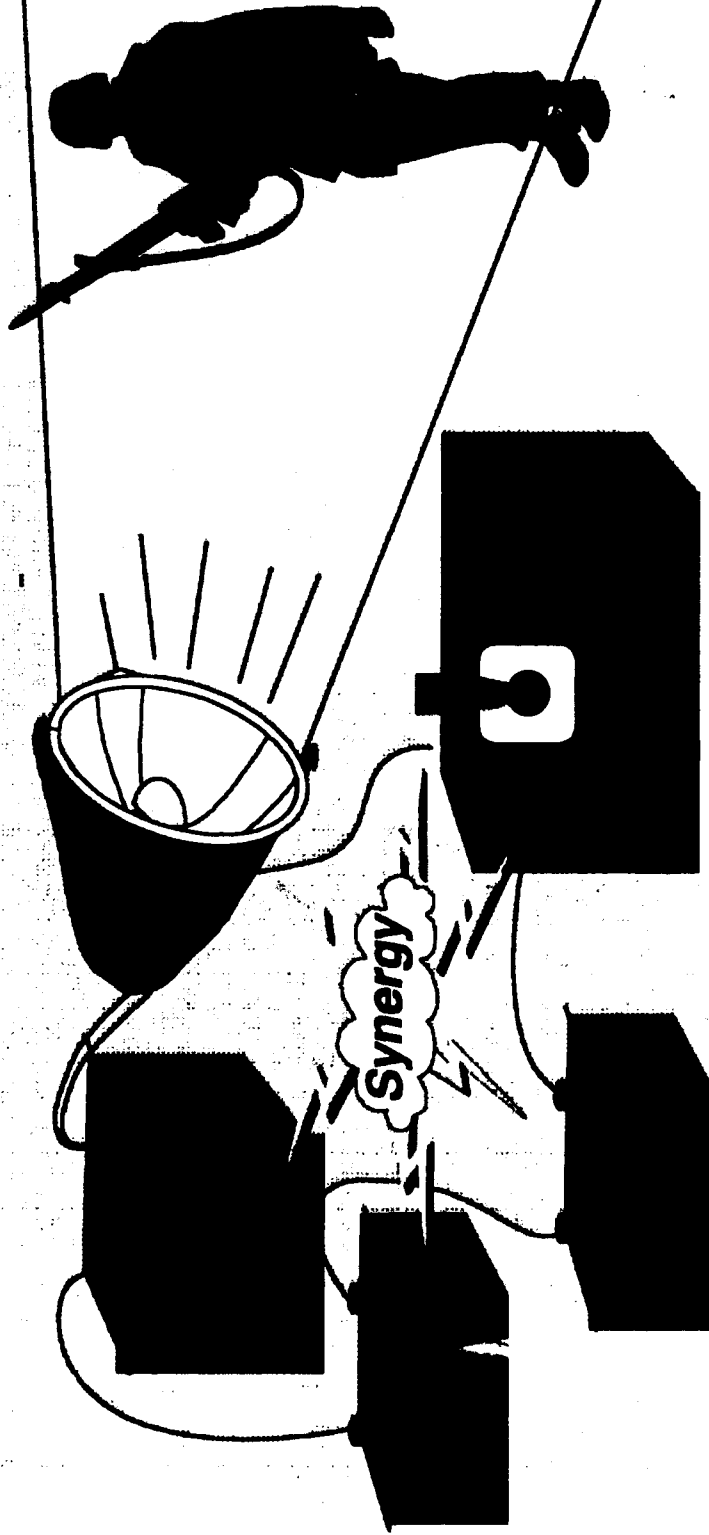
- AMC(CECOM)
- TRADOC(CASCOM)
- FORSCOM

Prepared a Battery

**Modernization
Strategy**



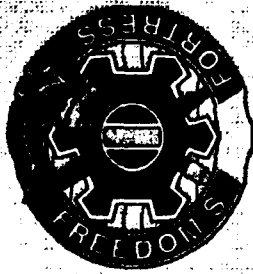
Key Players



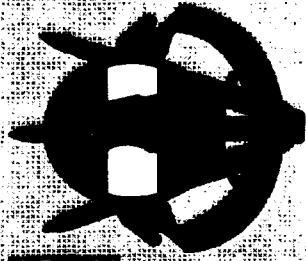
Providers

Users

...sum of the parts is greater than the whole...

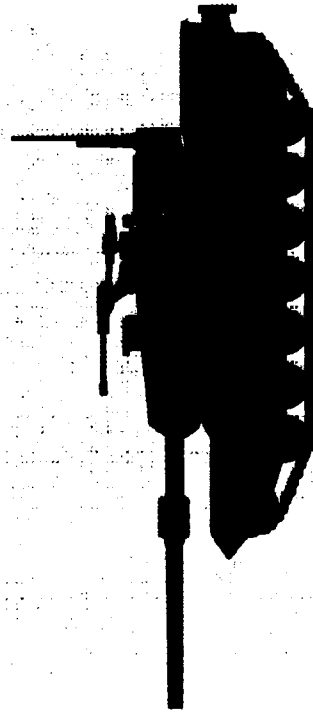
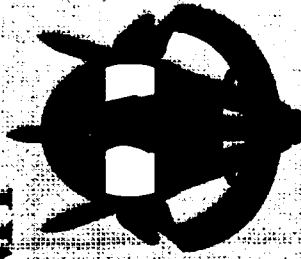


Army Battery Center of Excellence

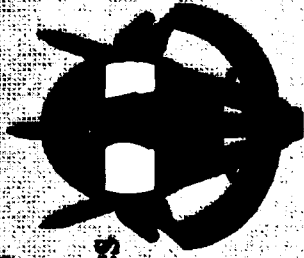
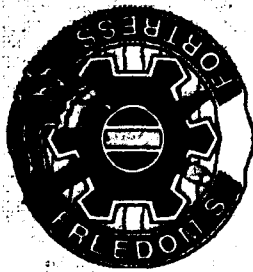


- Formed as a part of the Army Battery Modernization Strategy
- Short term goals established.
- Major short term goal: Establishment of a Program Manager for batteries.
- Members
 - TRADOC(CASCOM)
 - AMC(CECOM)
 - Forces Command

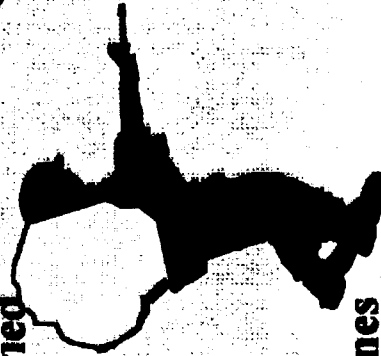
BATTERY NEEDS OF THE ARMY



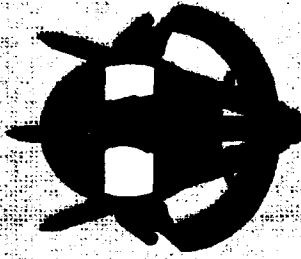
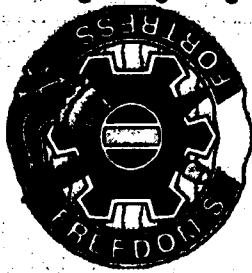
OVERALL BATTERY CONCERNS



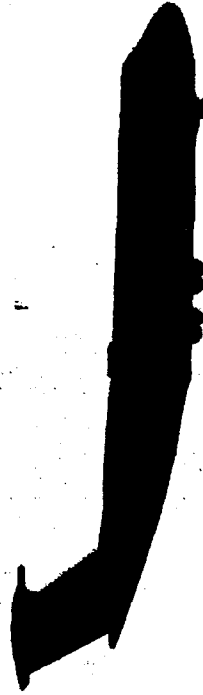
- Limited number of uses of primary batteries
- Old battery technology
- Spare batteries must be carried
- Hazardous waste disposal
 - Handling
 - Transportation
 - Costs
- EPA fines
- Constantly changing guidelines
- 3 demands in 90 days to be kept on hand
- Resupply of unique batteries difficult



OVERALL BATTERY CONCERNS



- Too many different types
- Special handling for deployments
- Contingency and wartime surge
e.g. Chemical Alarm Batteries
- Retrograde Operations
Desert Shield/Storm
Operation Restore Hope
- Health Hazards/Fatalities
Short Term
Long Term
- State of charge indicators very limited





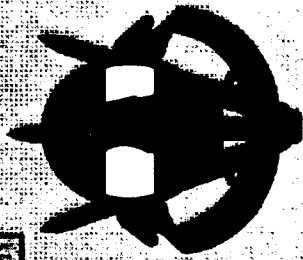
WATERCRAFT BATTERY NEEDS

- **Technology demonstration at Ft Eustis using nickel-cadmium batteries.**
- **Currently using lead acid batteries.**
 - **6 volt and 12 volt**
 - **Changed twice a year.**
- **Need one standard battery for watercraft**
 - **Hot and cold climate capability**
 - **Low rate of self discharge**
 - **Low or No maintenance requirements.**

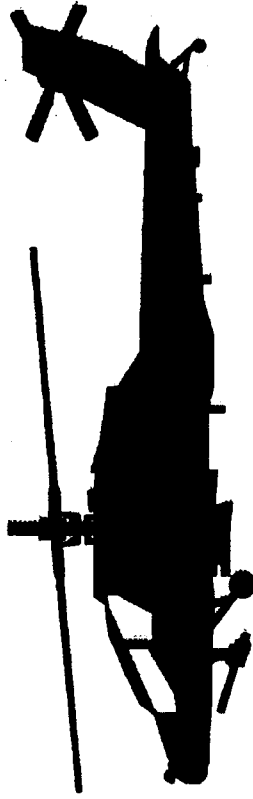


- Increased power and mission requirements have made the current 6TL lead-acid batteries ineffective.
- Mounted Battle Lab Under Armor APU designed to meet requirements. Two 6TL batteries cannot start the tank without APU assistance.
- Newer technology battery needed just for the APU and the M1 tank.
- Study done in 1993 shows batteries number one item needing constant attention on the M1 tank.

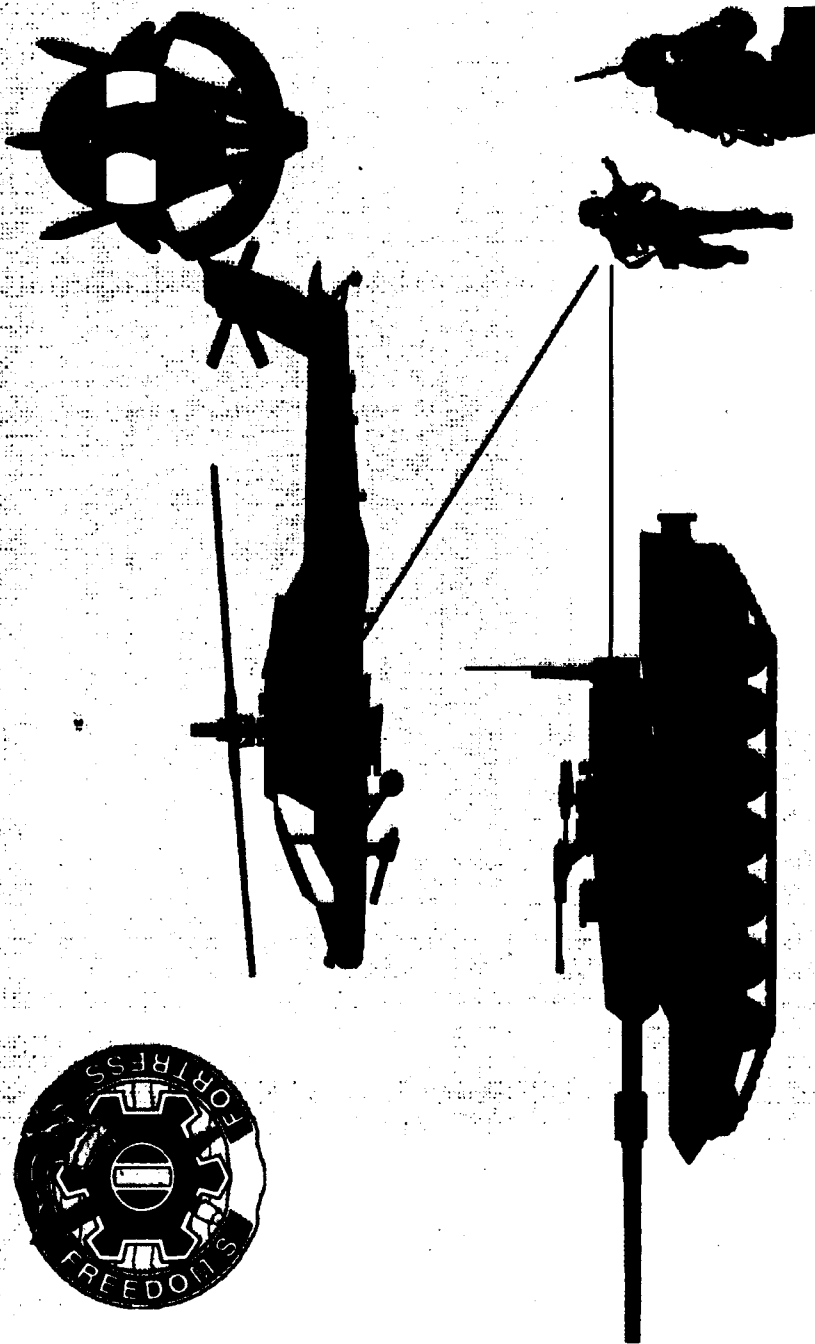
AVIATION BATTERY NEEDS



- Army aviation is using vented nickel-cadmium batteries.
- High failure rate results in:
 - Excessive down time
 - Effects mission readiness
- Newer technology battery needed to reduce maintenance and increase readiness.
- A standard battery for aviation is needed.

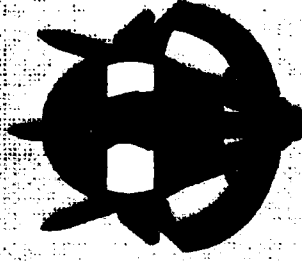


COMMUNICATIONS AND ELECTRONICS



For now need batteries that have high power, longer shelf lives, increased number of uses(Primary) and cycles lives (Secondary) to do the mission..

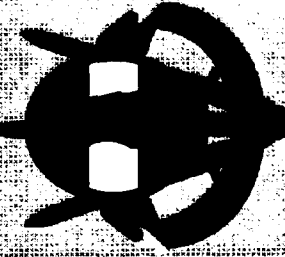
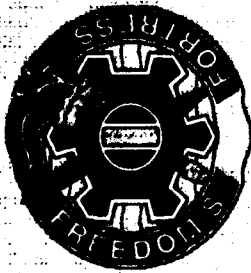
ARMY EFFORTS



Combat Developers emphasis of:

- **Multiple adapter configuration to use different primary and rechargeable batteries.**
- **Insertion of new technology.**
- **Reduction of military standards in equipment.**
- **Dual use technology.**
- **Power reduction circuitry.**
- **Power management circuitry.**
- **Direct Vendor Delivery.**
- **Investigation of technology from agencies such as NASA and DOE laboratories.**

NAV SYSTEMS PRODUCTS CORPORATION



- **Requirements Documents**
 - **Use Commercial Off the Shelf**
 - **Army Preferred**
 - **Power Mgt Techniques**
 - **Power Reduction Circuitry**
 - **State of Charge Indicator**
- **Training**
 - **Safety**
 - **Battery Maintenance**
 - **Hazardous Waste**
- **Command Emphasis**
 - **Training**
 - **Lowest Level**

INDUSTRY FUTURE

Industrial Development of:

- **Lighter, high energy, increased cycle life for primary and rechargeable batteries.**
- **Multi-chemistry/fast/smart battery chargers.**
- **Environmentally friendly chemistries.**
- **Surge requirements.**
- **Reduce battery purchase cost.**
- **Recycling facilities for newer chemistries**
- **Batteries and/or cells that can be used in multiple configurations.**

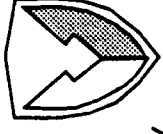
NOTES

ARMY RESEARCH LABORATORY (ARL)

POWER REQUIREMENTS



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MATERIEL COMMAND

PORTABLE POWER SOURCES

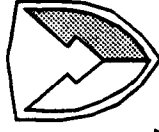
DR R.P. HAMLEN
Director, Power Sources Division
Electronics and Power Sources Directorate

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BATTERY RELATED FUNCTIONS

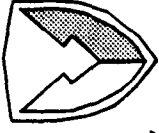


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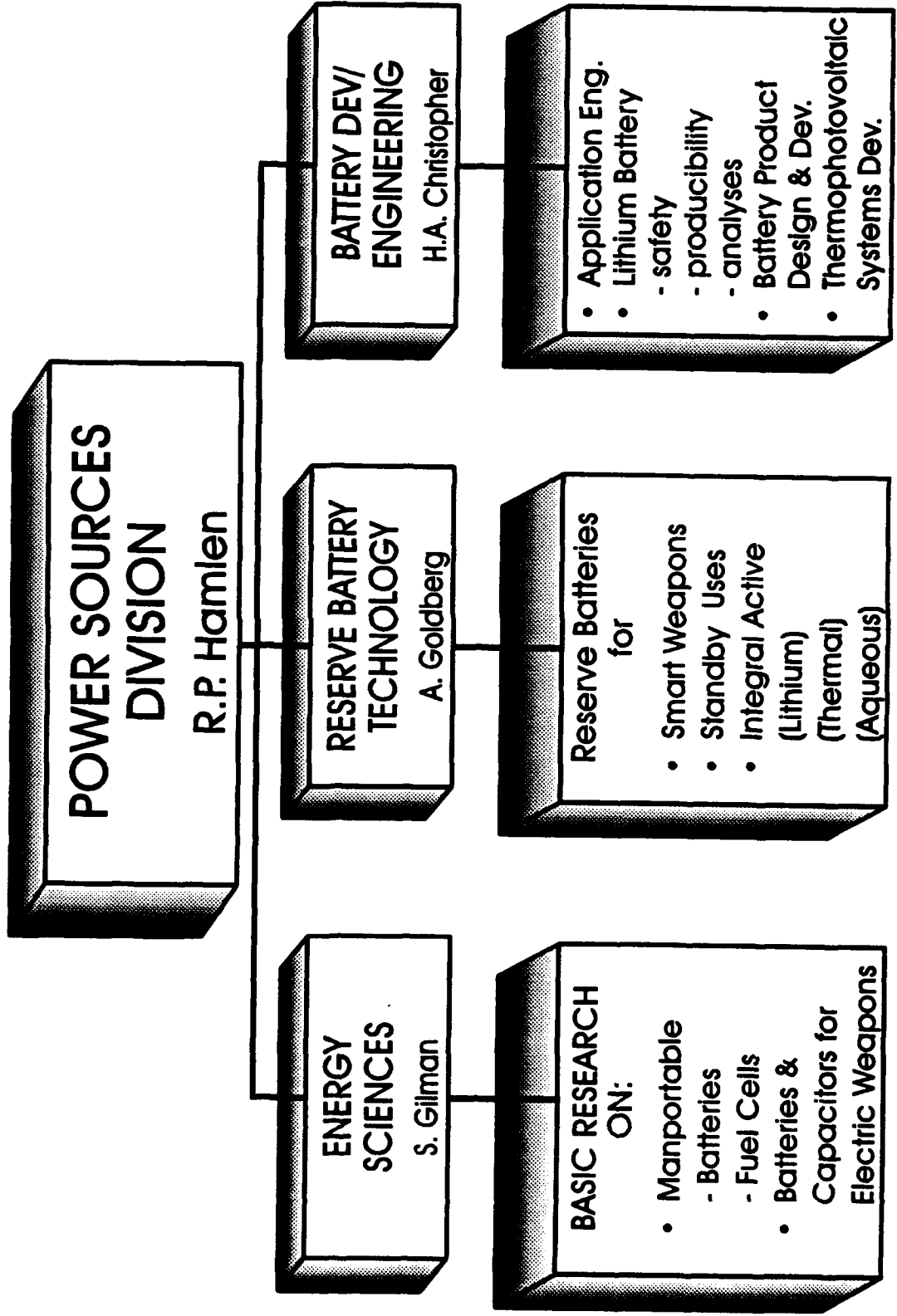
- CONDUCT R&D ON FUTURE BATTERIES
- DEVELOP IN CONJUNCTION WITH CONTRACTORS
- APPROVE NEW TYPES FOR USE
- QC TESTING ON LITHIUM BATTERIES



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POWER SOURCES PROGRAMS



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THROWAWAY BATTERIES

- NEXT GENERATION PRIMARY
- SOLDIER SYSTEM PRIMARY

RECHARGEABLE BATTERIES

- IMPROVED ENERGY DENSITY
- LOW COST

RESERVE BATTERIES

- LI-BASED SYSTEMS
- LONGER MISSION LIFE

PULSE BATTERIES AND CAPACITORS

- ELECTRIC GUN
- ELECTRIC DRIVE VEHICLE

FUEL CELLS

- SOLDIER SYSTEMS
- TANK SILENT WATCH
- FIELD POWER GENERATION

ALTERNATIVE POWER SOURCES

- THERMOPHOTOVOLTAIC ENERGY
GENERATION



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POWER SOURCES DIVISION



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KEY BATTERY CONCERNS

I. PERFORMANCE

- ENERGY, POWER, WEIGHT, TEMPERATURE
- SAFETY-TRANSPORTATION, USE, DISPOSAL
- SMART CHARGER, STATE-OF-CHARGE

II. COST

- PEACETIME TRAINING

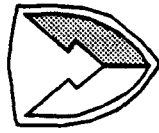
III. PROLIFERATION OF BATTERY TYPES

- PRIOR TO LITHIUM-LITTLE CONTROL
- NOW - STANDARD FAMILY



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POWER SOURCES DIVISION



ARMY
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KEY BATTERY CONCERNS

(Continued)

IV. DIVERSIFIED APPLICATIONS

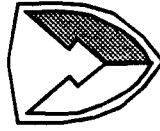
- COMMUNICATIONS-ELECTRONICS
- TANK STARTING AND SILENT WATCH
- PULSE POWER
- AIRCRAFT STARTING

V. INDUSTRIAL BASE



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FAMILY OF STANDARD BATTERIES



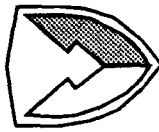
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CAPACITY CURRENT VOLTAGE	NON RECHARGEABLE LOW POWER Li/SO ₂	RECHARGEABLE LOW POWER Ni-Cd	NON RECHARGEABLE HIGH POWER Li/SO ₂	RECHARGEABLE HIGH POWER Ni-Cd
3	BA-5567/U			
6	BA-5372/U		BA-5847/U	BB-X847/U
12	BA-5588/U	BB-588/U		
24			BA-5590/U	BB-590/U

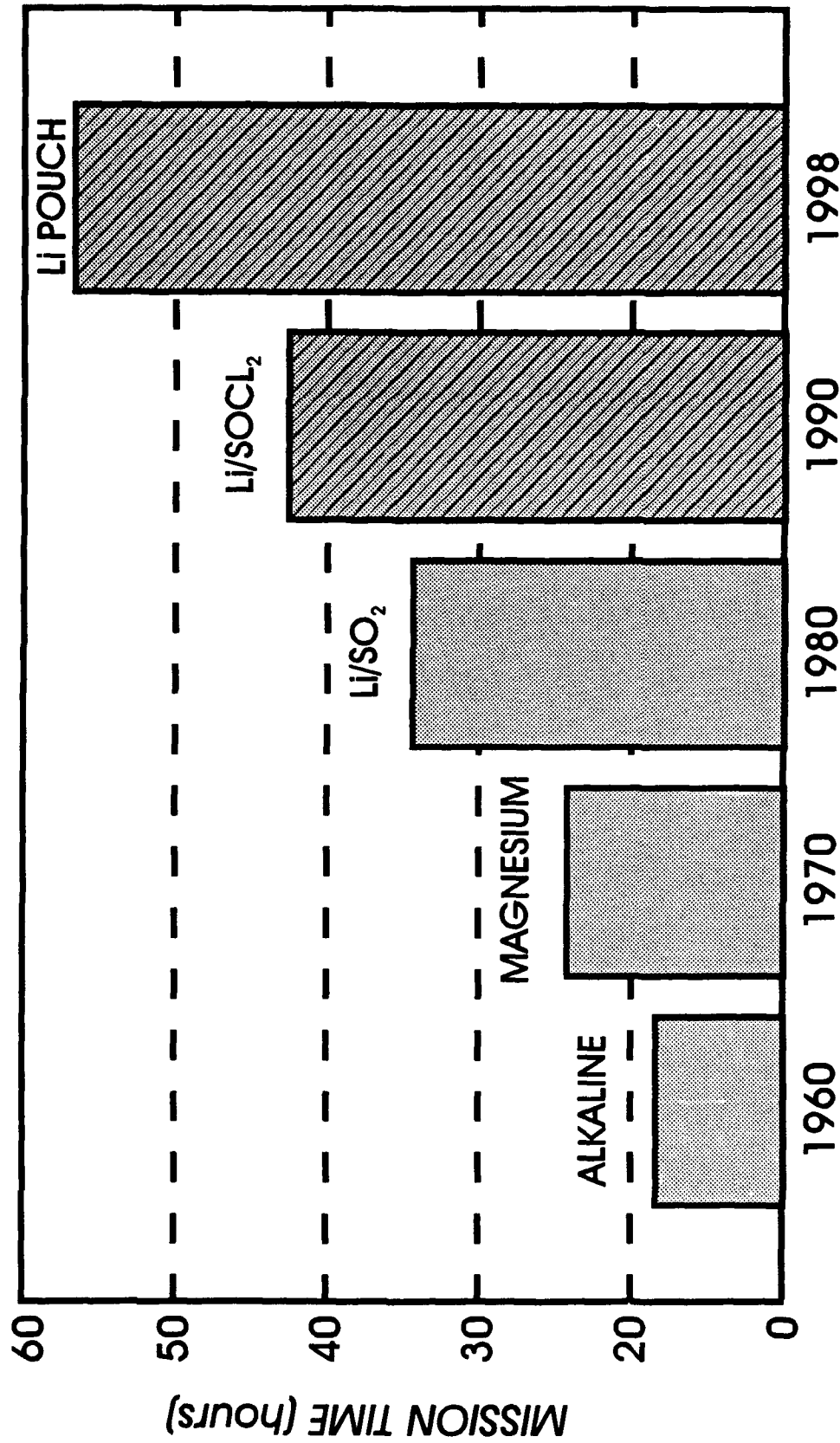


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ADVANCES IN PRIMARY BATTERIES FOR HIGH POWER DENSITY APPLICATIONS*



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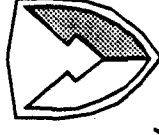


* SPECIFIC DATA FOR THE BA-5590/U IN THE SINGARS RADIO



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LITHIUM-MANGANESE DIOXIDE PRIMARY BATTERIES



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CYLINDRICAL CELLS

- SMALL CELLS- AVAILABLE: CAMERAS, SMOKE ALARMS
- D CELLS - AVAILABLE: SEARCH AND RESCUE BEACONS (8 Ahrs.)

POUCH CELLS

- MAXIMIZE USE OF AVAILABLE BATTERY VOLUME
- MORE ENERGY PER UNIT OF VOLUME
- EASIER/CHEAPER TO MANUFACTURE THAN SPIRAL WOUND CELLS
- FOIL CONSTRUCTION - NO SHRAPNEL
- POUCH CELL FOR BA-XX90/U 14 Ahrs.

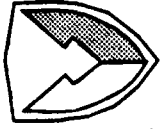
TECHNICAL CONCERNS

SAFETY, LOW TEMP OPERATION, SHELF LIFE



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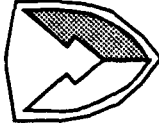
RECHARGEABLE BATTERIES

- TRAINING
- SOF
- TANK STARTING/SILENT WATCH
- AIRCRAFT STARTING



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SINCGARS ALTERNATIVES AVAILABLE TODAY

BA-5590/U BB-590/U BB-490/U
LITHIUM S02 (P)* NICKEL-CADMIUM (R)** LEAD-ACID (R)

BATT/MISSION (8 hrs)	1	2	2
MISSIONS/BATT	3.1	0.79	0.55
WT/MISSION	2.2 LBS	7 LBS	6.8 LBS.
COST/YR	\$4,393	\$496	\$2675
DISPOSAL/YR	\$238	\$3	\$0

* (P) PRIMARY

** (R) RECHARGEABLE



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COMPARISON OF EXISTING AND FUTURE RECHARGEABLE BATTERIES

BB590/U SIZE, 2.45"x5"x4.4"-24V.



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<u>PRODUCTS AVAILABLE</u>	<u>Wh/Kg</u>	<u>AH</u>	<u>SAFETY</u>	<u>CYCLES</u>	<u>COMMENTS/LIMITATION</u>
Ni Metal Hydride	42	3.4	+	200+	Potential For Improvement
NiCd	30	2.0	+	250+	Heavy/Low Mission Life
Lead-Acid	25	1.6	+	100	Heavy/Lower Mission Life



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COMPARISON OF EXISTING AND FUTURE RECHARGEABLE BATTERIES

BB590/U SIZE, 2.45"X5"X4.4"-24V.



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Continued

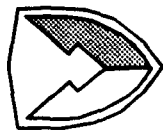
<u>FUTURE CANDIDATES</u>	<u>Wh/Kg</u>	<u>AH</u>	<u>SAFETY</u>	<u>CYCLES</u>	<u>COMMENTS/LIMITATION</u>
Li-ion	88	4.5	?	200+	Safety in Large Sizes
Metallic Li	110	5.0	?	50	Safety/Risk
Metallic Li/Polymer	150	7.0	?	50	Safety/Risk TBD
Rech. Alkaline	60	4.5*	+	10-30	Power/Temp. Limited

* Low Rates Only

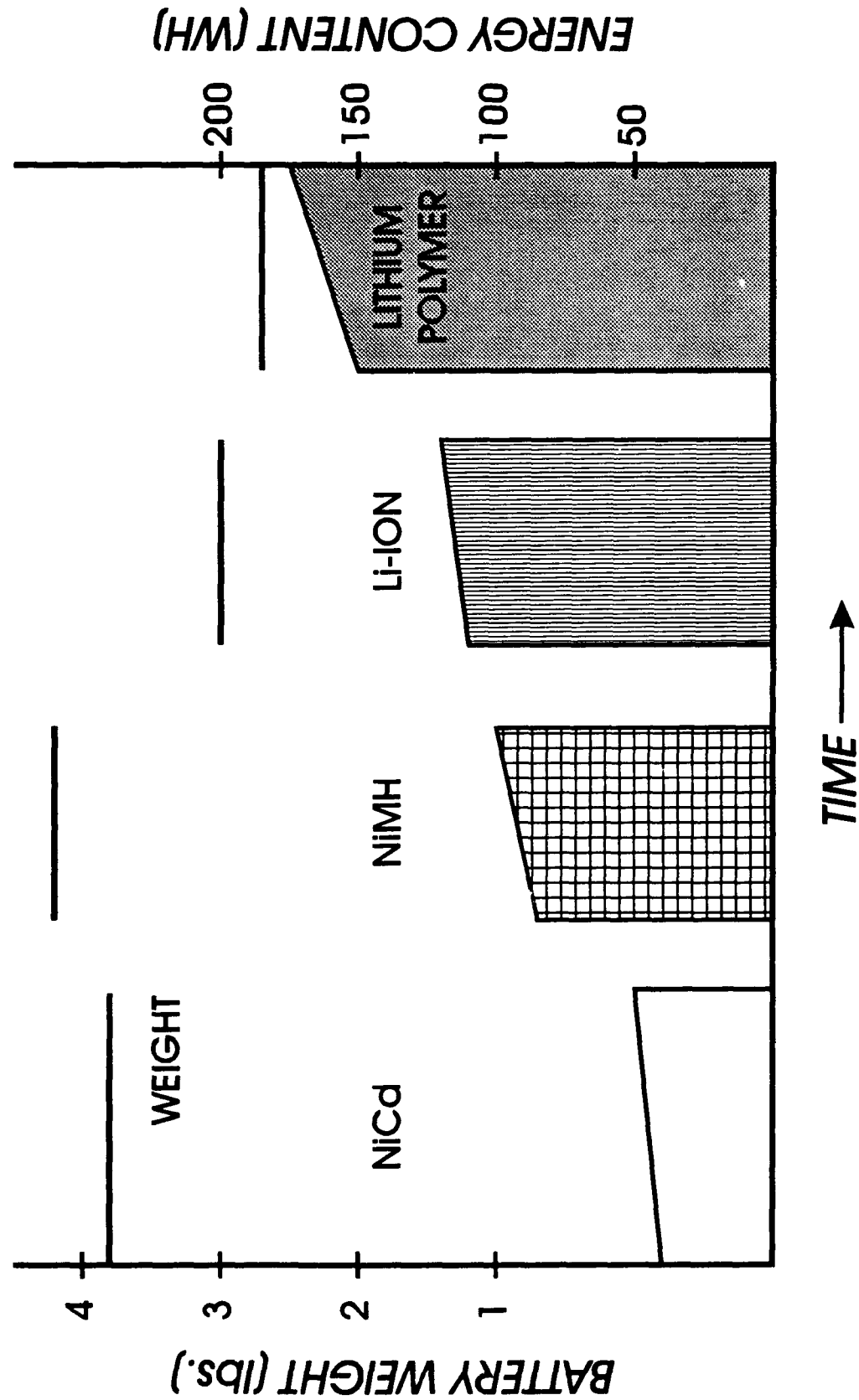


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RECHARGEABLE BB590/U TYPE BATTERY FOR SOF C-E APPLICATIONS



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MATERIEL COMMAND



ELECTROCHEMICAL RESEARCH

GOAL	IMPACT/APPLICATIONS
RECHARGEABLE LITHIUM BATTERIES	- 1/10 cost of throwaway battery - Over 2 1/2x energy density of secondary battery - Reduced logistics if primary charging source available
ELECTROCHEM CAPACITORS	- Hybrid or electric vehicles: acceleration, dynamic braking - Conventional vehicles: engine starting
PULSE POWER BATTERIES	- Electric guns - Hybrid or electric vehicles
FUEL CELLS	- Manpack power source for long-duration microclimate cooling - Power Source for special operations - Stealth vehicles



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RECHARGEABLE LITHIUM BATTERIES



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BASELINE TECHNOLOGY

- Ni/Cd (ENERGY DENSITY = 40 Whr/kg)
- Ni/METAL HYDRIDE (ENERGY DENSITY = 60 Whr/kg)

GOAL

- MATERIALS AND BASIC TECHNOLOGY FOR:
 - ENERGY DENSITY > 100 Whr/kg, ALL-TEMP OPERATION
 - DUAL USE, HIGHEST USER SAFETY

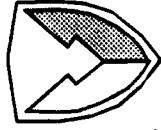
APPROACH

- IMPROVED LIQUID ELECTROLYTES FOR "Li-Ion"
(I.E. LiC_6 ANODES) BATTERIES
- IONICALLY CONDUCTING POLYMER ELECTROLYTES
FOR SOLID-STATE BATTERIES



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RECHARGEABLE LITHIUM BATTERIES



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ACCOMPLISHMENTS

- HIGH CONDUCTIVITY LIQUID ELECTROLYTES AVAILABLE FOR "Li-Ion" BATTERIES
- NEW POLYMER ELECTROLYTES FORMULATED

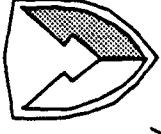
FUTURE WORK

- LIQUID ELECTROLYTES: STABILITY WITH Li_xC_6
- POLYMER ELECTROLYTES: FORMULATION/ DEMONSTRATION OF PROTOTYPE CELLS
- EXPLORATION OF CARBON FIBER CATHODES



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POWER MANAGEMENT



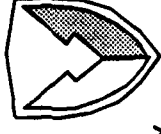
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- **SIGNIFICANT POWER/ENERGY SAVINGS CAN BE ACHIEVED IN ELECTRONIC EQUIPMENT BY:**
 - Applying emerging device and architectural technologies
 - Low voltage analog/digital microelectronics
 - Reconfigurable parallel and pipelined architectures
 - Employing judicious engineering principles throughout the requirements/design/development process
 - Automatic shutdown, adaptive "sleep" modes, etc.



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RESEARCH LABORATORY

POWER MANAGEMENT



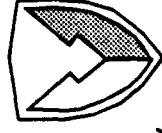
ARMY
MATERIEL COMMAND

- CUMULATIVE EFFECT: POWER SAVING RANGING FROM 10% TO 90%
DEPENDING UPON:
 - Willingness to incur moderate increases in NRE and production costs
 - System-Specific Performance and Operational Use
- ACQUISITION COST INCREASES CAN BE EASILY RECOVERED BY SAVINGS IN BATTERY COSTS WITHIN 1 TO 3 YEARS



US ARMY
RESEARCH LABORATORY

POWER SOURCES DIVISION



ARMY
MATERIEL COMMAND

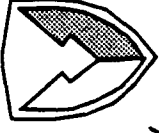
KEY OBJECTIVES FOR FUTURE

- IMPROVED PRIMARY BATTERIES FOR SOLDIER SYSTEMS, NEXT GENERATION C4I THROWAWAY, LASER, RADAR AND NV SYSTEMS
- IMPROVED NEAR-TERM (NiMH) AND LONG-TERM (Li-ION) RECHARGEABLE BATTERIES (C4I, SOLDIER SYSTEM, TANK)
- RESERVE/ACTIVE BATTERIES FOR LONGER-LIVED, SMART MUNITIONS



US ARMY
RESEARCH LABORATORY

POWER SOURCES *DIVISION*



ARMY
MATERIEL COMMAND

KEY OBJECTIVES FOR FUTURE

Continued

- HIGH RATE BATTERIES AND CAPACITORS FOR ELECTRIC WEAPONS AND VEHICLES
- FUEL CELLS FOR LONG-LIFE PORTABLE USE, TANK SILENT WATCH
- PORTABLE THERMOPHOTOVOLTAIC POWER GENERATORS



US ARMY
RESEARCH LABORATORY

BUSINESS OPPORTUNITIES



ARMY
MATERIEL COMMAND

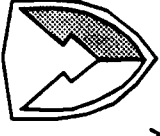
SMALL BUSINESS INNOVATIVE RESEARCH (SBIR)

- PHASE I AND PHASE II
- SOLICITATIONS: SEP-OCT 94, MAY 95
- ESTIMATED AWARD DATES: 4 MONTHS AFTER SOLICITATION
- POSSIBLE TOPICS
 - Li / MnO₂ Cylindrical Cell Batteries
 - Li-ion / Polymer Electrolyte Rechargeable Batteries
 - Manportable PEM Fuel Cells
 - Electrochemical Capacitors
 - Thermophotovoltaic (TPV) Devices
 - Pulse Power Batteries



US ARMY
RESEARCH LABORATORY

BUSINESS OPPORTUNITIES (Cont.)



ARMY
MATERIEL COMMAND

BROAD AGENCY ANNOUNCEMENT (BAA)

- ARL
 - TOPICS: Compact, High Energy Density Reliable Batteries
Reliable and Efficient Fuel Cells
- EPSD
 - TOPICS TBD Based On Customer Funding



US ARMY
RESEARCH LABORATORY

BUSINESS OPPORTUNITIES (Cont.)



ARMY
MATERIEL COMMAND

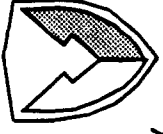
FOREIGN MATERIEL EXPLOITATION (D650)

- ARL / EPSD PROPOSALS SUBMITTED FOR FY95
 - Primary Lithium Batteries
 - Rechargeable Batteries
 - Fuel Cells
- PROPOSAL ACCEPTANCE / REJECTION DUE SEP 94
- TOPICS TBD BASED ON ACCEPTED PROPOSALS
- FUNDING PROVIDED IN 1Q FY95
- ESTIMATED AWARD(S) DATE(S): 2Q FY95



US ARMY
RESEARCH LABORATORY

THERMOPHOTOVOLTAIC POWER GENERATION



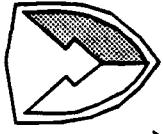
ARMY
MATERIEL COMMAND

- NIGHT-TIME USE OF SOLAR PANELS
- MULTI-FUEL CAPABILITY
- SILENT OPERATION
- REMOTE BATTERY CHARGING



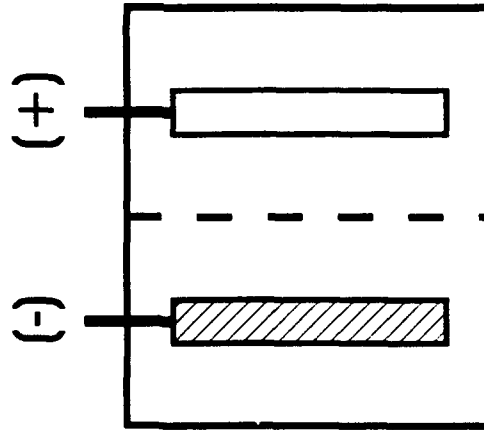
US ARMY
RESEARCH LABORATORY

BATTERIES vs FUEL CELLS

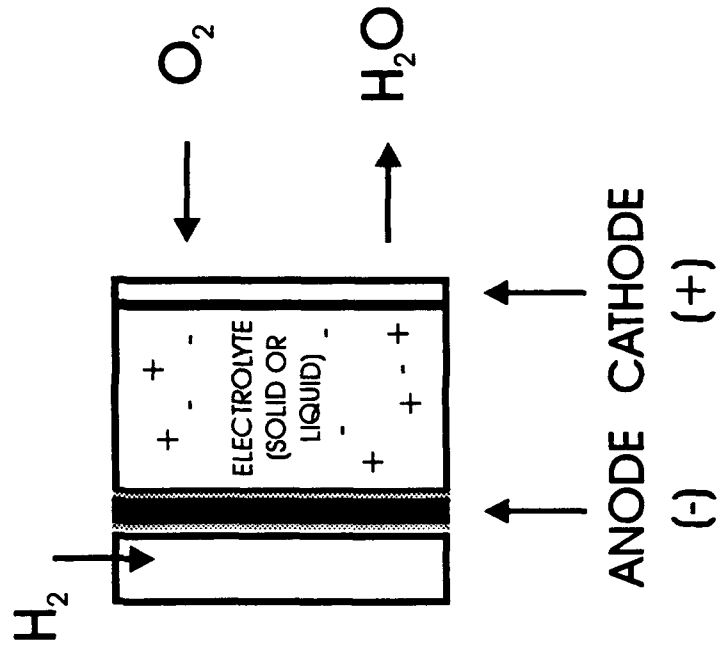


ARMY
MATERIEL COMMAND

BATTERY
SELF CONTAINED



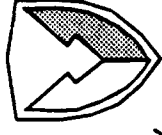
FUEL CELL
CONTINUOUS FEED





US ARMY
RESEARCH LABORATORY

FUEL CELLS



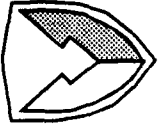
ARMY
MATERIEL COMMAND

- BATTERY CHARGER
- LONG-DURATION C4I MISSIONS
- SOLDIER SYSTEMS
- TANK SILENT WATCH
- SILENT VEHICLES



US ARMY
RESEARCH LABORATORY

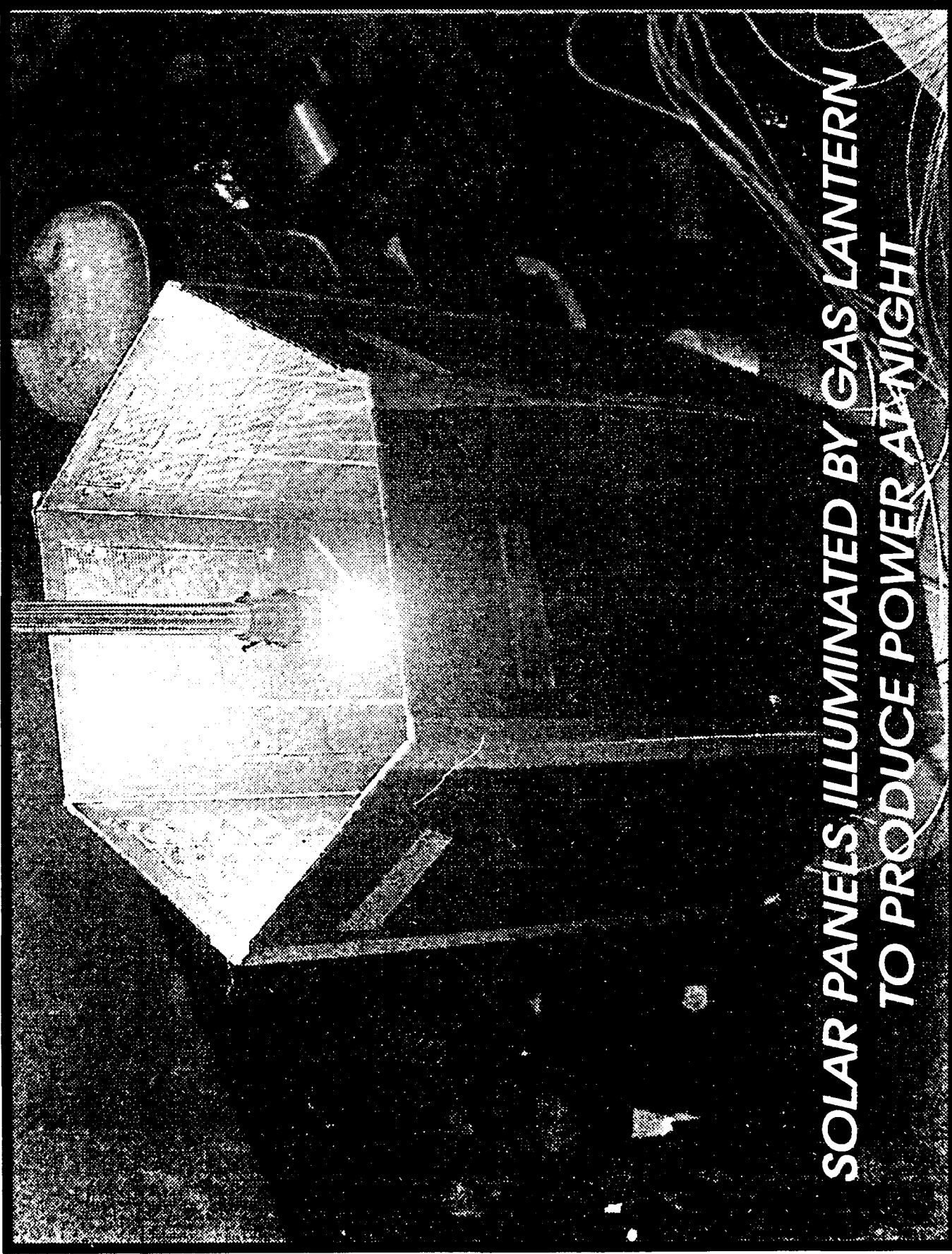
FUEL CELLS



ARMY
MATERIEL COMMAND

CURRENT PROGRAM

- IMPROVED MEMBRANES FOR POLYMER ELECTROLYTE MEMBRANE (PEM)
- IMPROVED ELECTROCATALYSTS FOR H₂ AND METHANOL FUEL CELLS
- HIGH POWER DENSITY H₂/PEM FUEL CELL STACKS

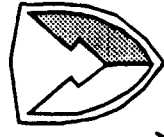


**SOLAR PANELS ILLUMINATED BY GAS LANTERN
TO PRODUCE POWER AT NIGHT**

NOTES



US ARMY
RESEARCH LABORATORY



ARMY
MATERIEL COMMAND

POWER EFFICIENT ELECTRONICS

ROBERT HEUNER
ARMY RESEARCH LABORATORY

UNCLASSIFIED



US ARMY
RESEARCH LABORATORY

LOW POWER/LOW VOLTAGE SYSTEMS AND CIRCUITS INDUSTRY STATUS



ARMY
MATERIEL COMMAND

- Rapid Growth In Various Commercial Sectors

- Systems:

Notebook And Laptop PCs, Cellular Phones, Pagers, ...

- Components

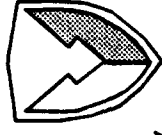
3 Volt Parts From Multiple Suppliers

- Gate Arrays, FPGAs, Standard Cell Families
- High Efficiency Regulators
- Portable PCs And Telecomm



US ARMY
RESEARCH LABORATORY

LOW POWER/LOW VOLTAGE SYSTEMS AND CIRCUITS INDUSTRY STATUS



ARMY
MATERIEL COMMAND

- Wide Spread Information Exchange
- 1st IEEE Low-Power Electronics Workshop - Jul 93
- IEEE-IEDM Short Course On Low Voltage/Low Power - Dec 93
- 1994 ISSCC Focuses On Low Power - Feb 94
- 1st IEEE Symposium On Low Power - Oct 94



US ARMY
RESEARCH LABORATORY

BENEFITS OF REDUCED POWER



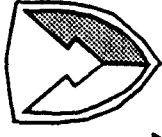
ARMY
MATERIEL COMMAND

- Extend Battery Life, Other Chemistries
 - Increase Functionality Of Electronic Systems
 - Simplify Heat Sinking And Cooling Requirements
 - Reduce Cost, Size, Weight
 - Enhance Soldier Capability
- Power Reduction Goal $\geq 30\%$



US ARMY
RESEARCH LABORATORY

SEEKING INDUSTRY IDEAS AND SUPPORT



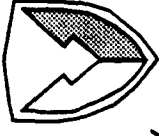
ARMY
MATERIEL COMMAND

- Power Reduction Techniques
- Maximizing Commercial State-Of-The-Art Use
- Implementing In Portable Army Systems



US ARMY
RESEARCH LABORATORY

CMOS POWER DISSIPATION



ARMY
MATERIEL COMMAND

$$P = 1/2 CV_{dd}^2 F + V_{dd} I_L$$

Operating Power	Standby Power
--------------------	------------------

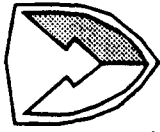
Power Dissipation Reduction Factors

C = Load Capacitance
V = Supply Voltage (Squared)
F = Operating Frequency
I = Leakage Current

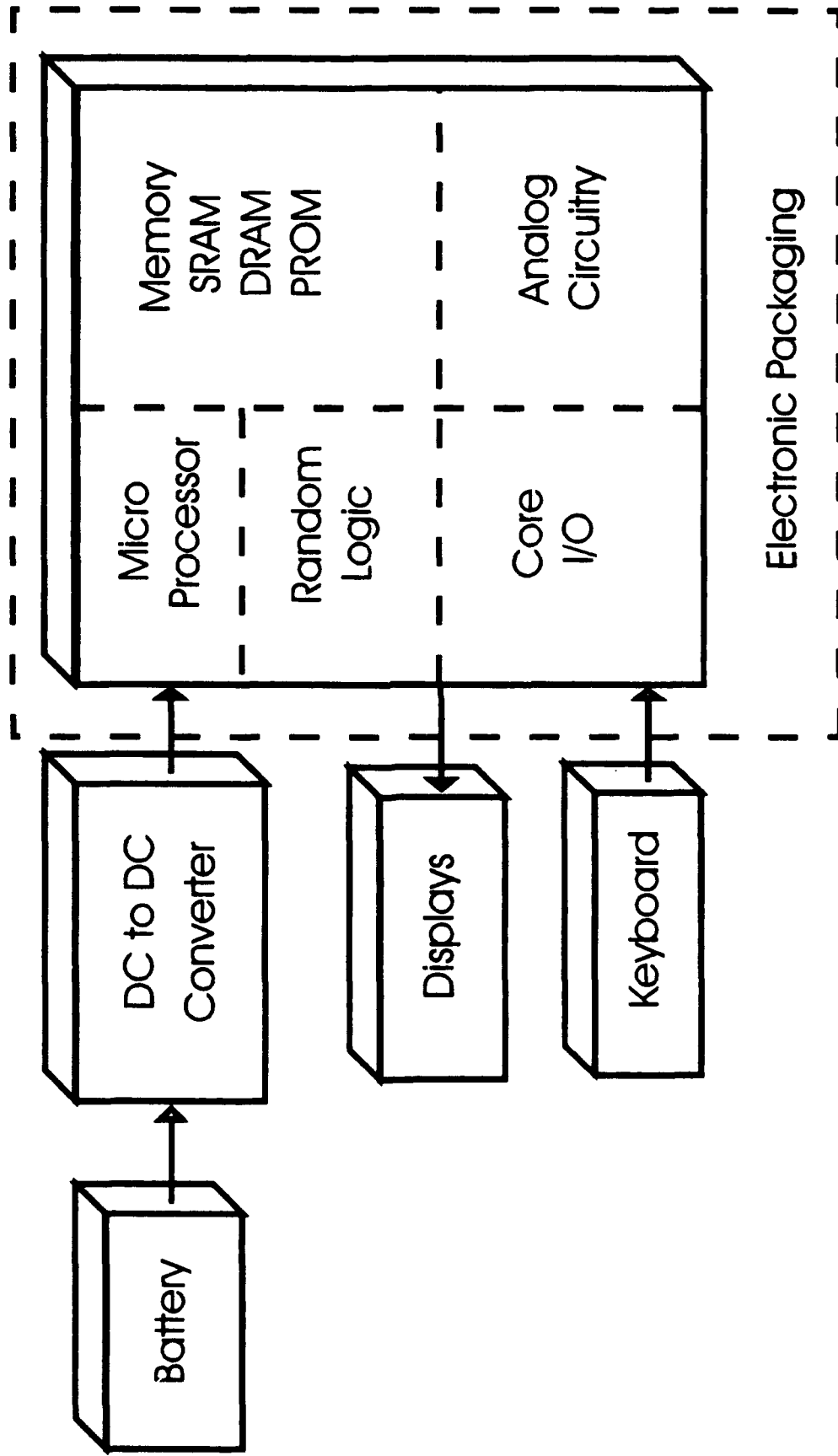


US ARMY
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LOW POWER MUST BE ADDRESSED FROM AN ENTIRE SYSTEM POINT OF VIEW



ARMY
MATERIEL COMMAND





US ARMY
RESEARCH LABORATORY

POWER REDUCTION - GENERAL



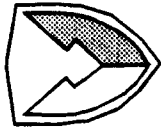
ARMY
MATERIEL COMMAND

- Sleep And Idle Clock Modes
- Power Gating
- Reduced Voltage
- Reduced Load Capacitance
- Advanced Packaging



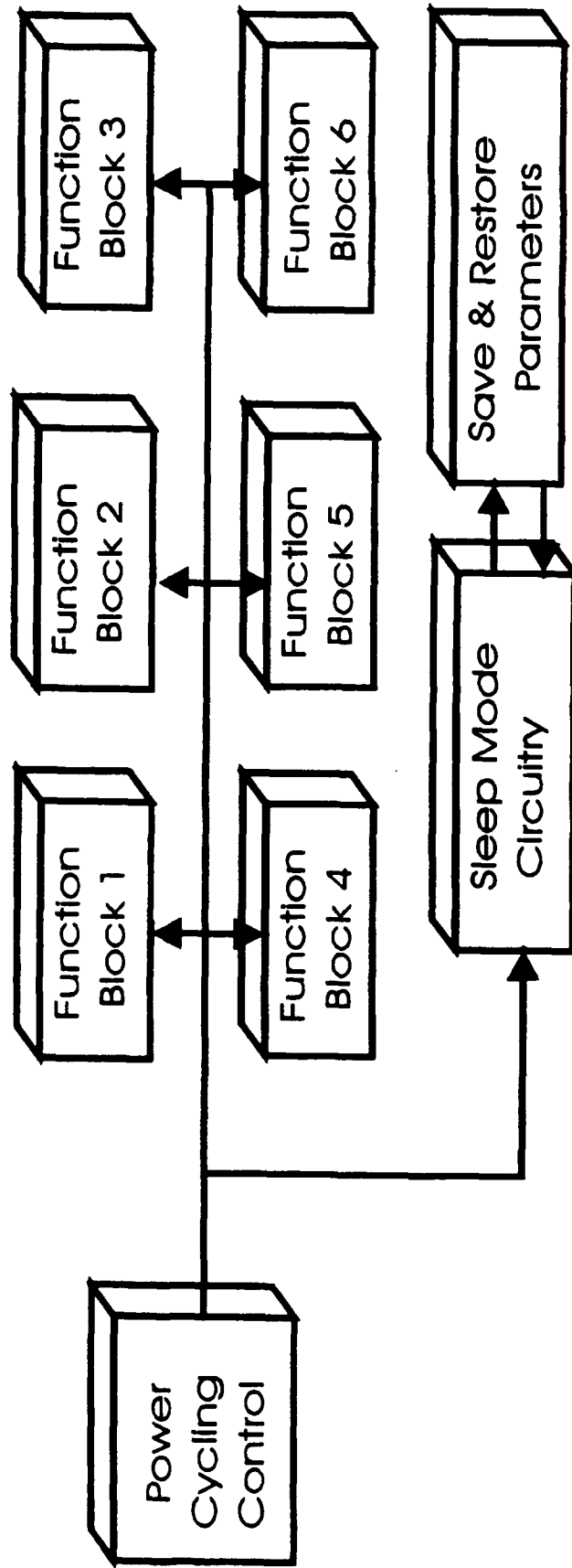
US ARMY
RESEARCH LABORATORY

POWER CYCLING



ARMY
MATERIEL COMMAND

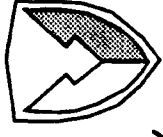
System should be partitioned to provide power savings thru the use of power cycling or sleep mode circuits. Good partitioning permits most functions to be powered down.





US ARMY
RESEARCH LABORATORY

POWER REDUCTION STRATEGY



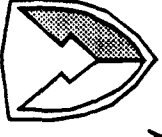
ARMY
MATERIEL COMMAND

-
- Microprocessor
Software Controlled Power Management
 - Random Logic
Adaptive Clocking Schemes
Clock Idle Mode
Gated Clock
Power Cycling
Design Synthesis For Optimization
 - Clocking Schemes
Gated Clock Distribution
Clock Frequency Control
Control Skew To Eliminate Glitches



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POWER REDUCTION STRATEGY



ARMY
MATERIEL COMMAND

- Memory

S-RAM

Multi-Divided Memory Structure

Load Optimization

Functional Block Gating

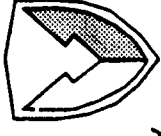
D-RAM

Decrease Required Refresh Frequency



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POWER REDUCTION STRATEGY



ARMY
MATERIEL COMMAND

- Peripherals

Simplify Peripheral I/O

Eliminate Keyboard
Coded Inputs
Voice Activation

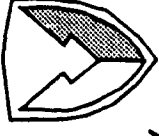
Eliminate Displays Where Feasible
Display On-Demand Only
Shared Displays
Simplified Visuals

- Analog Circuitry
Combine With Digital Circuitry
Use Digital Power Supply



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POWER REDUCTION STRATEGY



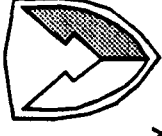
ARMY
MATERIEL COMMAND

- **DC To DC Converter**
Improve Efficiency
Eliminate Converters Where Feasible
Direct Battery Operation
(Watch Applications)
Combined Digital And Analog Power Supplies
(Digital +3V, 0V; Analog +3V, -3V)



US ARMY
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OTHER FACTORS



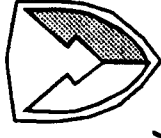
ARMY
MATERIEL COMMAND

- Aggressively Scaled Submicron CMOS
- Insulating Substrates
- Dominant Power Mode (Operating vs Standby)



US ARMY
RESEARCH LABORATORY

CONCLUSIONS



ARMY
MATERIEL COMMAND

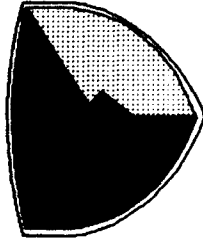
- Develop And Promulgate A Power Efficient Culture
- Low Power Systems And Components, In General Are More Costly And Probably Less Robust
- Need Comprehensive Design Tools
- Potential Efforts
 - Engineering Handbook:
 - Applications Guide For Systems, Boards, Modules, Microcircuits
 - Pilot Demo Program
 - Commercial Spin-On
 - Adopt Methods, Architectures, Components

NOTES

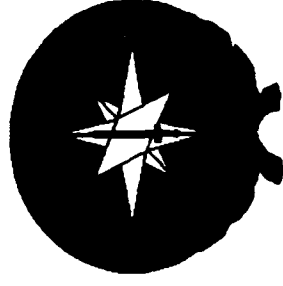
**U.S. ARMY COMMUNICATIONS-
ELECTRONICS COMMAND
(CECOM)**

AMC BATTERY FOCAL POINT

AMC



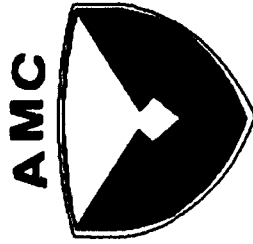
BATTERY PROGRAM



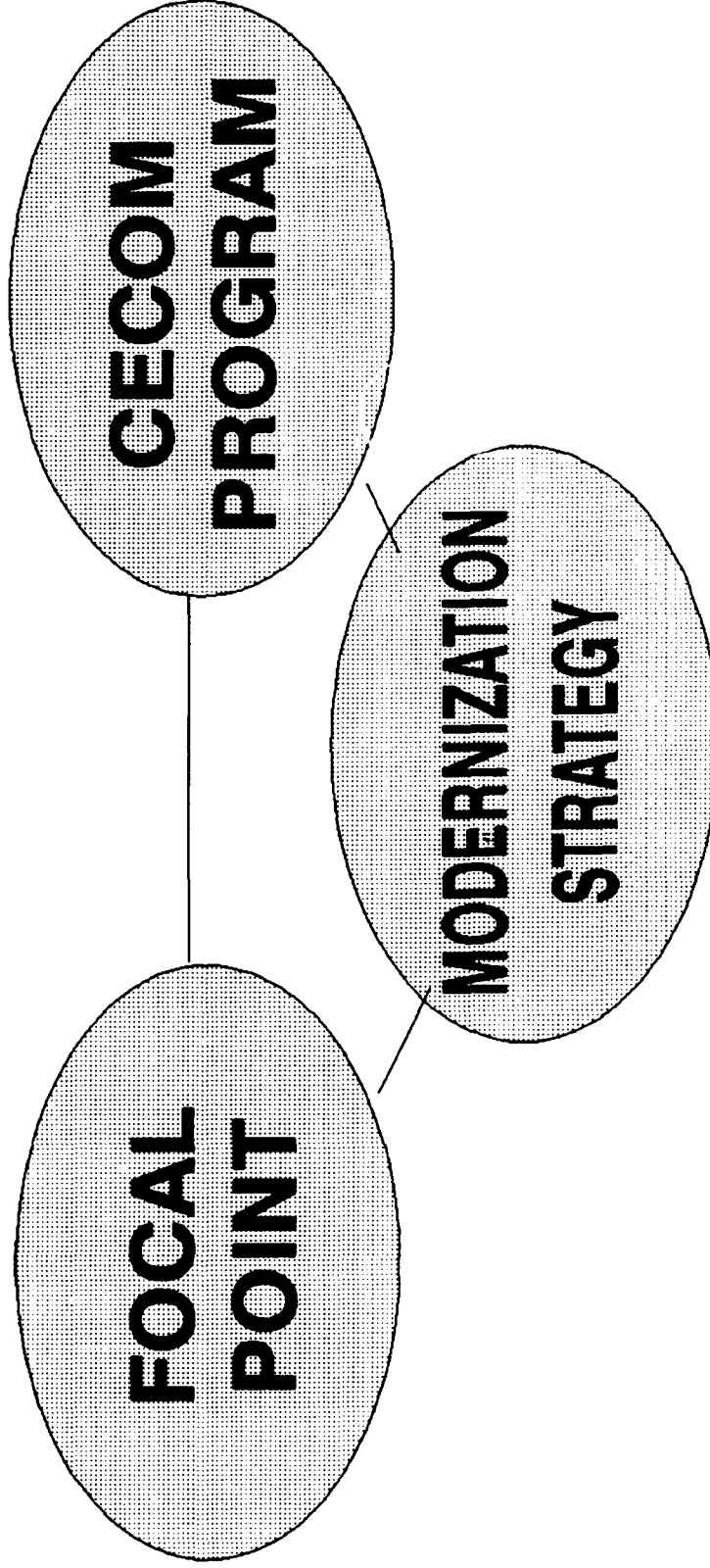
MR. RICHARD RIZZO

**US ARMY COMMUNICATIONS-
ELECTRONICS COMMAND
SYSTEMS MANAGEMENT DIRECTORATE**

UNCLASSIFIED

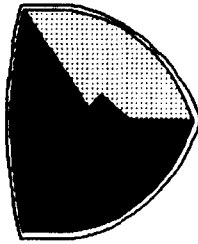


POWER SOURCES **INITIATIVES**

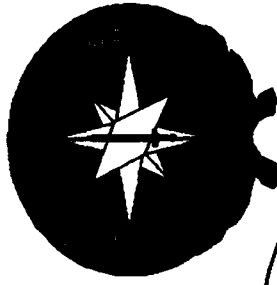


REDUCE O&S COSTS

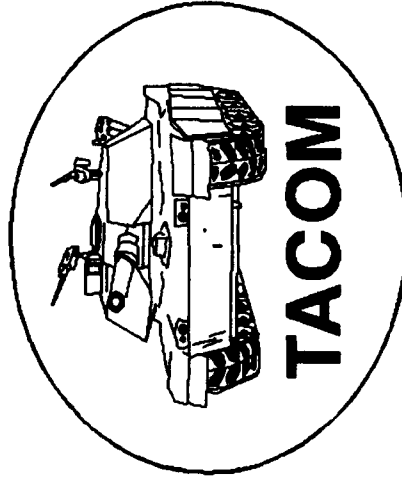
AMC



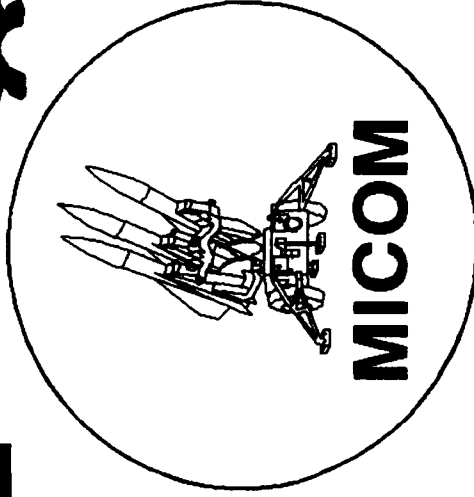
BATTERY MANAGEMENT - THE WAY IT WAS



CECOM

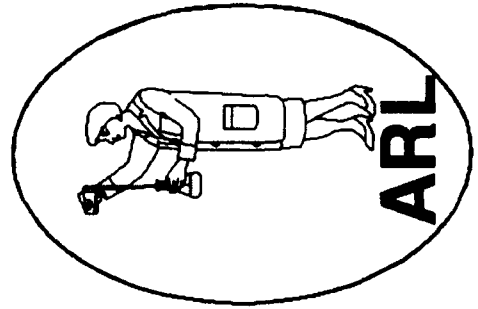


TACOM

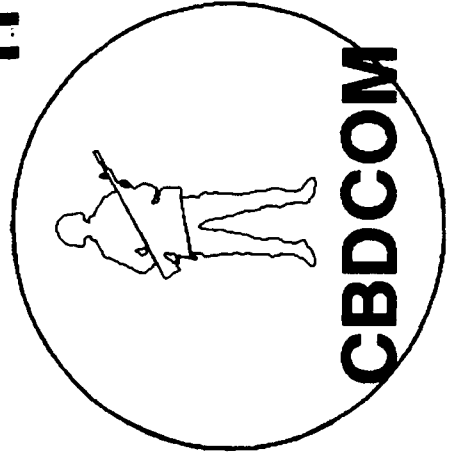


MICOM

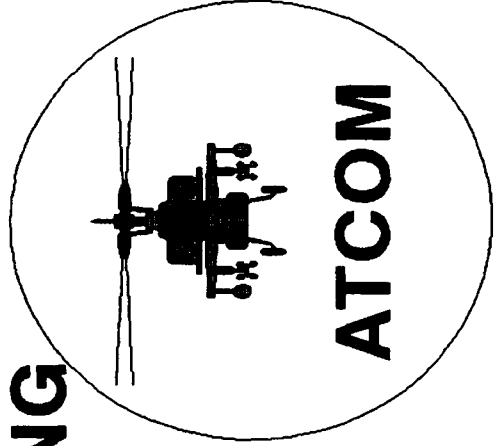
**EVERYONE DOING THEIR OWN
THING**



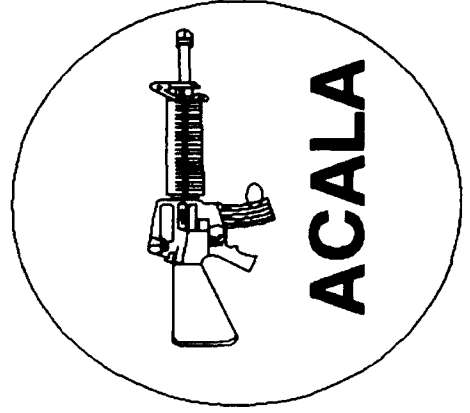
ARL



CBDCCOM

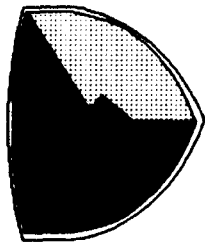


ATCOM



ACALA

AMC



REDUCE

O&S

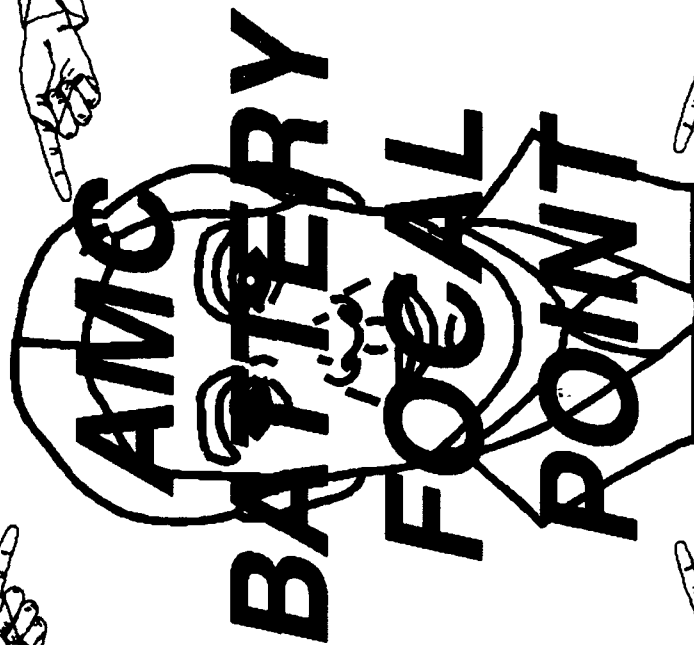
COSTS



COORDINATE

AMC BATTERY

EFFORTS



REPRESENT

AMC

BATTERY

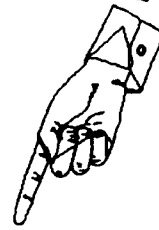
PROGRAM



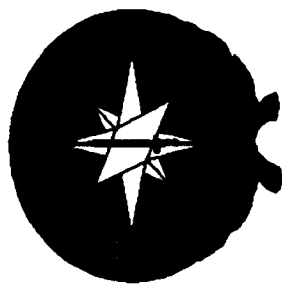
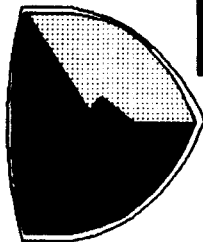
ARMY

MODERNIZATION

STRATEGY



AMC



STEERING COMMITTEE FUNCTIONS TEAM APPROACH

CHAIR - CECOM

ARL

TECOM

ATCOM

AMC

TACOM

MICOM

BATTERY

TEAM

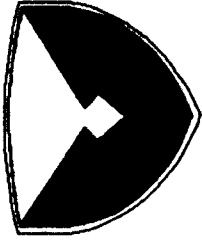
IOC

CBDCOM

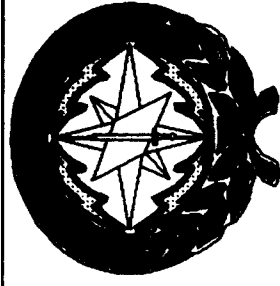
STRICOM

USASAC

- ▶ IMPROVE ARMY'S BATTERY AND BATTERY RELATED PROGRAM
- ▶ REDUCE O&S COSTS
- ▶ COORDINATE, EXCHANGE DATA/INFO

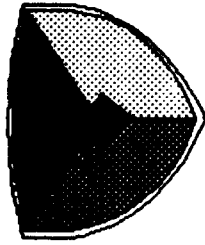


AMC BATTERY STEERING COMMITTEE

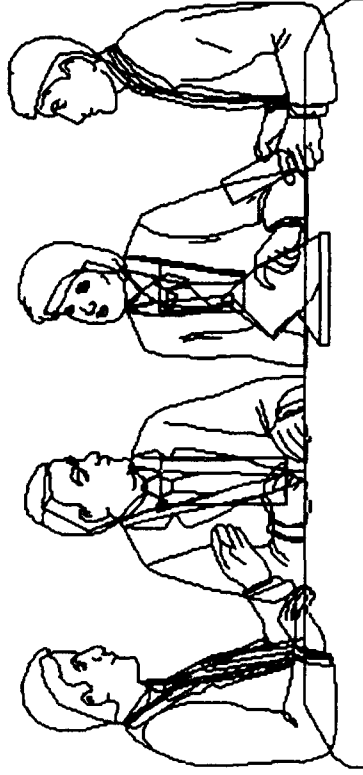
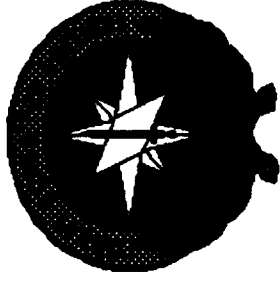


<u>MSC</u>	<u>POC</u>	<u>TELEPHONE</u>
CECOM (CHAIR)	RICH RIZZO	908-532-8941
ARL	DR. HAL CHRISTOPHER	908-544-4246
ATCOM	GIL KRENER	314-263-1100
CBD COM	TIM PEDRICK	410-671-5601
IOC	RUTH DELL	717-267-8474
MICOM	DR. BARRY ALLEN	205-876-3732
STRICOM	ARCHIE DULEY	407-381-8274
TACOM	JOHN BUSH	810-574-5297
TACOM (LOG)	ROSCOE SPENCER	309-782-8045
TACOM (RDEC)	CLIFF SHOOK	201-724-4378
TECOM	MAJ CRAIG KENT	410-278-1329

AMC



CECOM BATTERY OFFICE



AMC

BATTERY

FOCAL

POINT

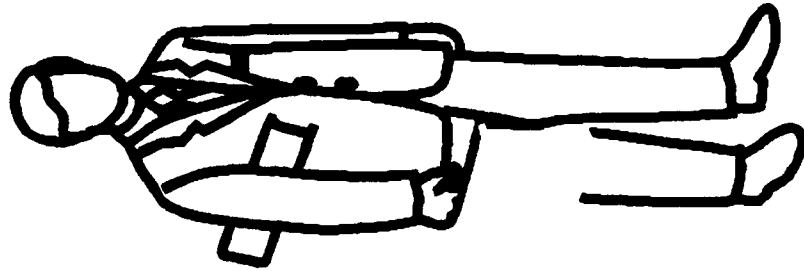
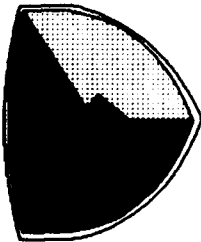
MANAGE

CECOM

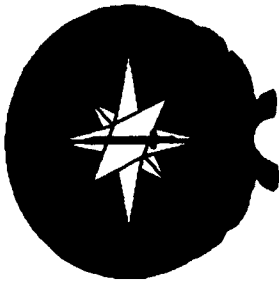
BATTERY

PROGRAM

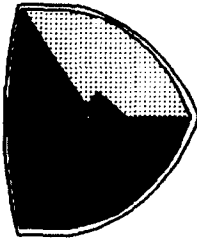
AMC



CECOM BATTERY PROGRAM

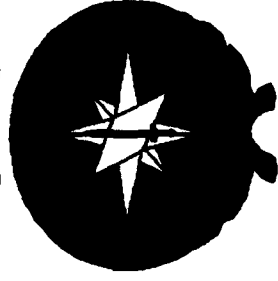


AMC



OVERALL GOALS

CECOM BATTERY PROGRAM



TODAY

**MILITARY
UNIQUE
TECHNOLOGY**

**DEDICATED
PRODUCTION
BASE**

**HIGH
O&S
COSTS**



TOMORROW

**1. LOWER O&S
COSTS**

**2. IMPROVED
PERFORMANCE**

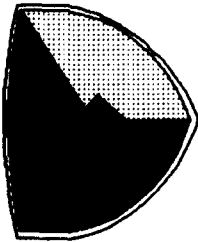
3. DUAL USE TECH

4. STANDARDIZED

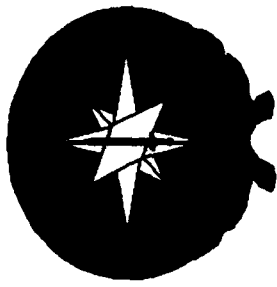
5. SAFE

**6. REDUCED DISPOSAL
COST**

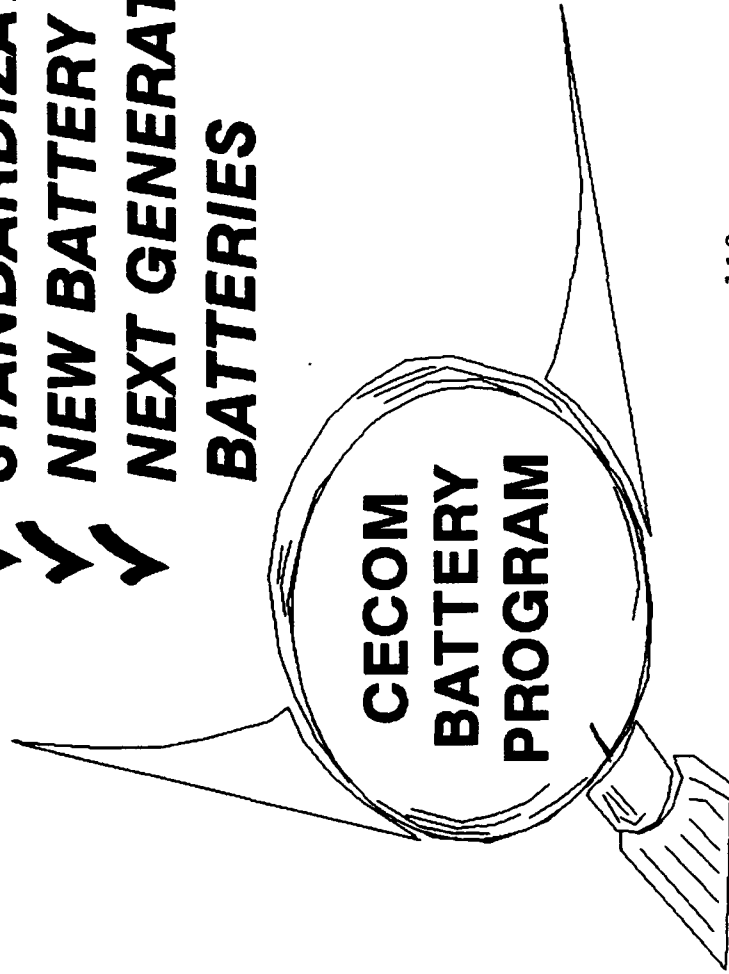
AMC



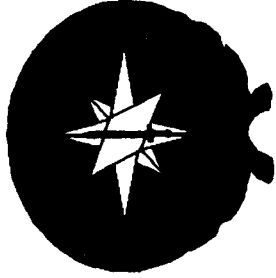
FOCUS - REDUCE O&S COSTS



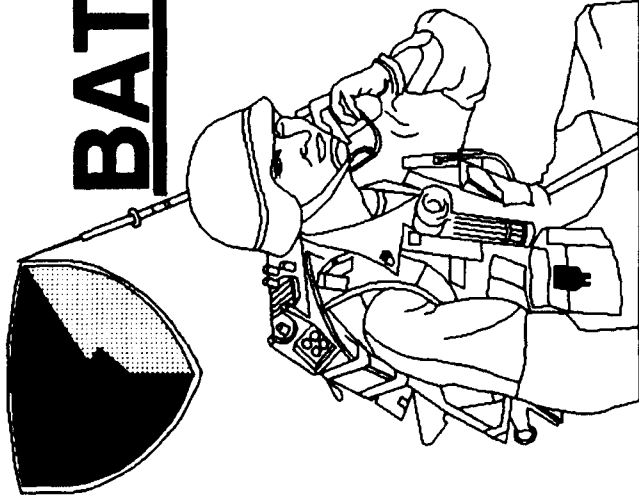
- ✓ DESIGN SOLUTIONS
- ✓ STANDARDIZATION
- ✓ NEW BATTERY CHARGERS
- ✓ NEXT GENERATION BATTERIES



AMC



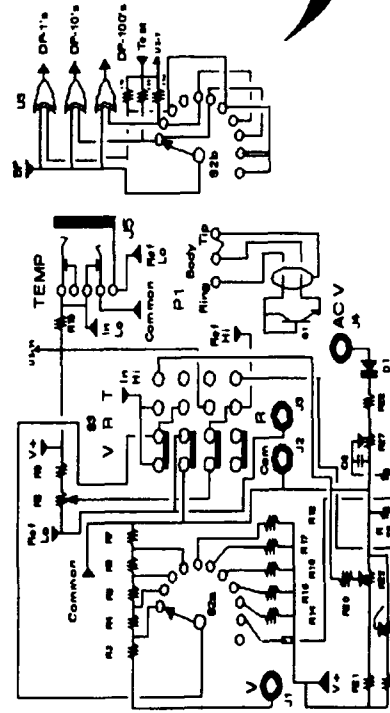
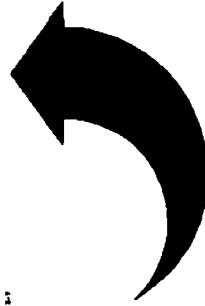
BATTERY COST DRIVERS



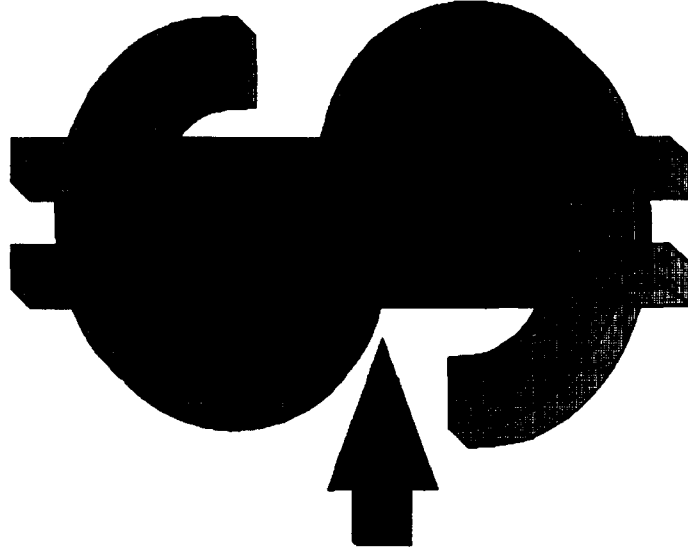
**USER
REQUIREMENTS**



**MILITARY
UNIQUE
BATTERIES**

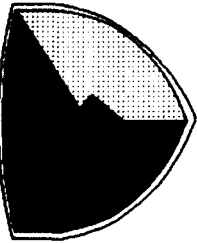


DESIGN SOLUTIONS

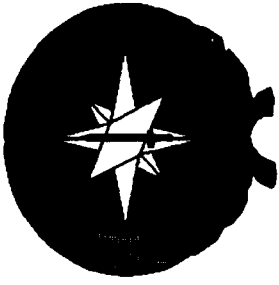


**O&S
COSTS**

AMC



SYSTEM DESIGN INFLUENCES



INDUSTRY

POWER

MANAGEMENT



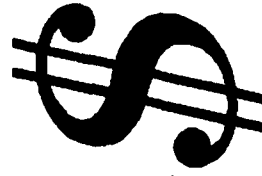
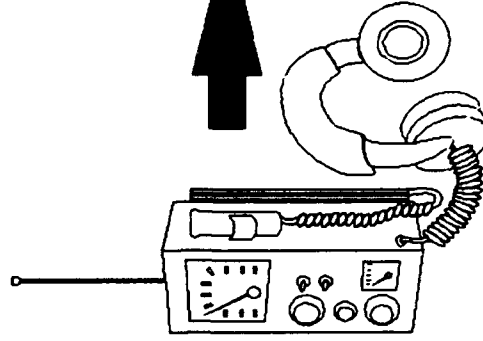
BATTERY

TRADE OFFS



REQUIREMENTS

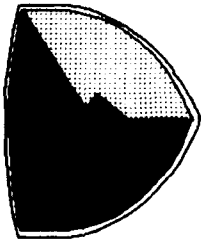
IN ORD



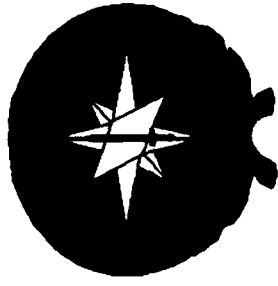
**O&S
COSTS**

GOVERNMENT

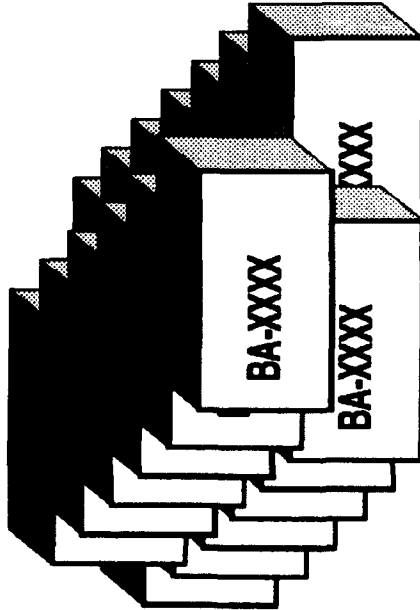
AMC



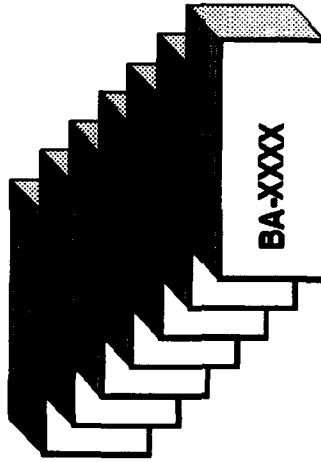
C/E BATTERY STANDARDIZATION



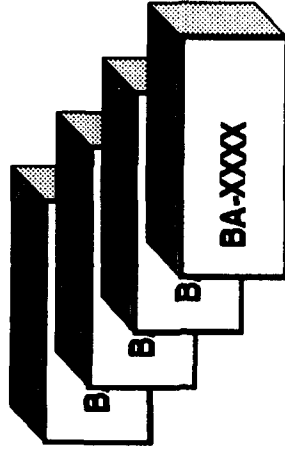
YESTERDAY



TODAY



TOMORROW



UNCONTROLLED
PROLIFERATION

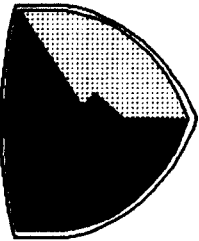
12 STD LITHIUM
BATTERIES

5 PRIMARY LITHIUM
BATTERIES

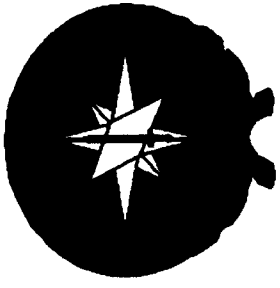
15+
RECHARGEABLE
BATTERIES

3 RECHARGEABLE
BATTERIES

AMC



BATTERY STANDARDIZATION GOALS



**REDUCE NUMBER
OF BATTERIES**

**ONE BATTERY
PER VOLTAGE**

**INFLUENCE END
ITEM DESIGN**

**ELIMINATE BATTERY
PROLIFERATION**

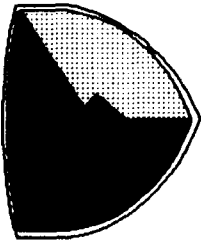
**REDUCE BATTERY
RELATED O&S
COSTS**



**STANDARD
CHEMISTRIES &
CONFIGURATIONS**



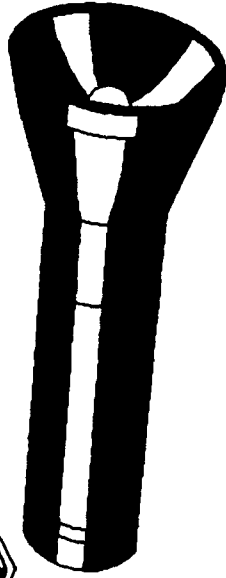
AMC



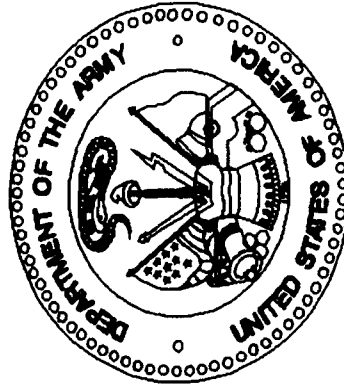
BATTERY SELECTION



COMMERCIAL
OFF THE SHELF
(COTS)



BATTERIES
MILITARY PREFERRED
BATTERY LIST

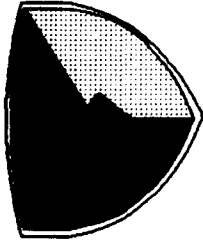


(BA-5590, BA-5588,
BA-5567, BA-5847, BA-5372,
BB-590, BB-588, BB-2847)



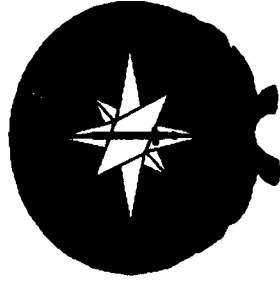
**NO
UNIQUE**

AMC



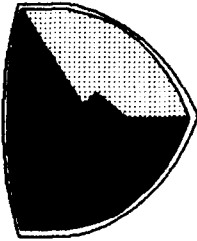
POWER SOURCES

STATEMENT OF WORK

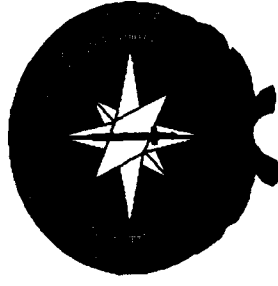


- ✓ USE OF POWER MANAGEMENT
- ✓ USE OF CONSUMER OR MILITARY
PREFERRED BATTERIES
- ✓ BATTERY ASSIGNMENT PROCESS
- ✓ INCORPORATED IN ALL NEW DESIGN AND
PRODUCT IMPROVEMENT CONTRACTS

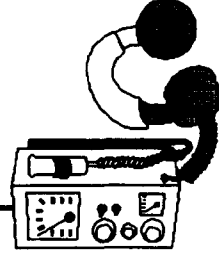
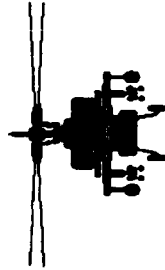
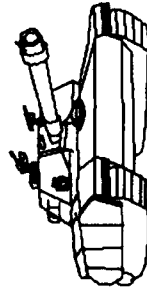
AMC



BATTERY CHARGER MODERNIZATION

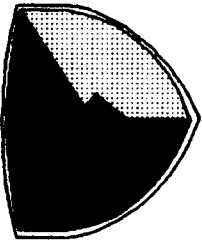


GOAL: COST EFFECTIVE MODERNIZATION
OF THE BATTERY CHARGER INVENTORY

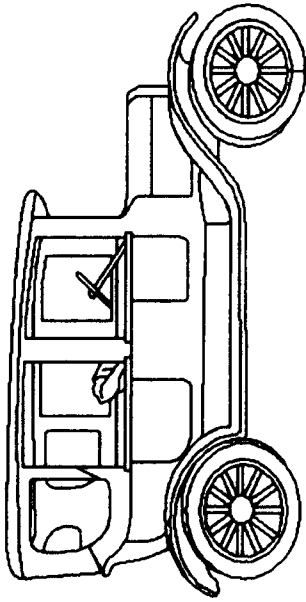


<u>UNIT LEVEL</u>	<u>BATTERY SHOP</u>	<u>UNIT LEVEL</u>	<u>BATTERY SHOP</u>
* "FLEET" STYLE	* AUTOMATIC	* PORTABLE	* AUTOMATIC
* LOW COST	* PROGRAMABLE	* DUAL BATTERY	* PROGRAMABLE
* COTS	* MULTIPLE BATTERY	CHARGE ABILITY	* MIN OF 5 BATTERY
	CHARGE ABILITY	* 2 HR CHARGE	CHARGE ABILITY
	* COTS	* COTS	* 2 HR CHARGE
			* COTS

AMC

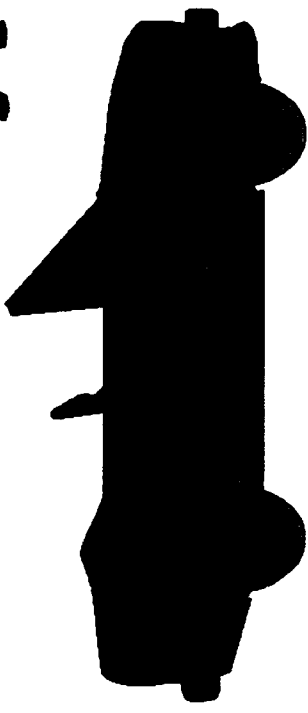


THE NEXT GENERATION



TODAY

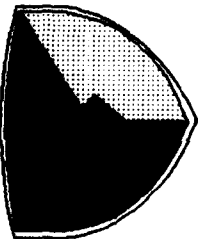
- * HIGH O&S COSTS**
- * MILITARY UNIQUE**
- * DISPOSAL COSTS**



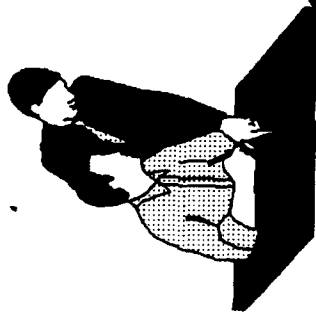
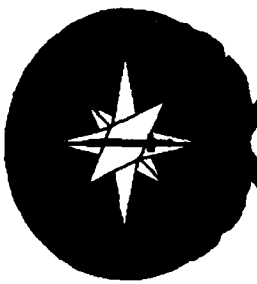
TOMORROW

- * REDUCED O&S COSTS**
- * DUAL USE**
- * REDUCED DISPOSAL COSTS**
- * INCREASED CAPACITY**
- * STATE OF CHARGE**

AMC

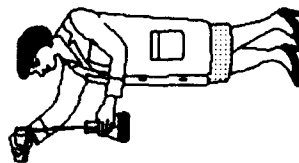


THE ROAD TO THE NEXT PRIMARY BATTERY PROCUREMENT



GOALS:

- ✓ DUAL USE
- ✓ STATE OF CHARGE
- ✓ 50% INCREASE IN CAPACITY

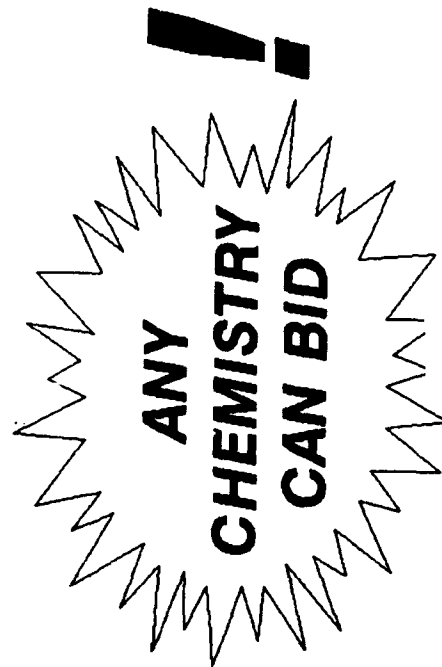


1994



SOLICITATION
* BEST VALUE
* BID SAMPLES
* RFP FORMAT

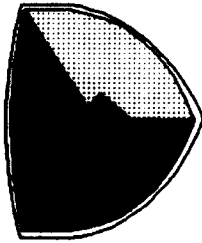
4Q96 - 1Q97
MULTIPLE YEAR
CONTRACT AWARD



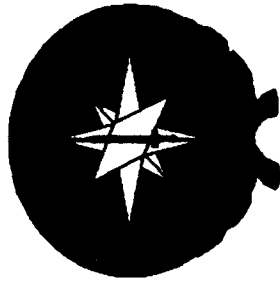
ANY
CHEMISTRY
CAN BID

NO NEW LITHIUM
PROCUREMENTS
PROJECTED UNTIL
4Q96-1Q97

AMC



THE ROAD TO THE NEXT RECHARGEABLE GENERATION



GOALS



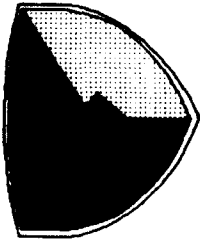
**NICKEL
CADMIUM**

**NICKEL
METAL
HYDRIDE**

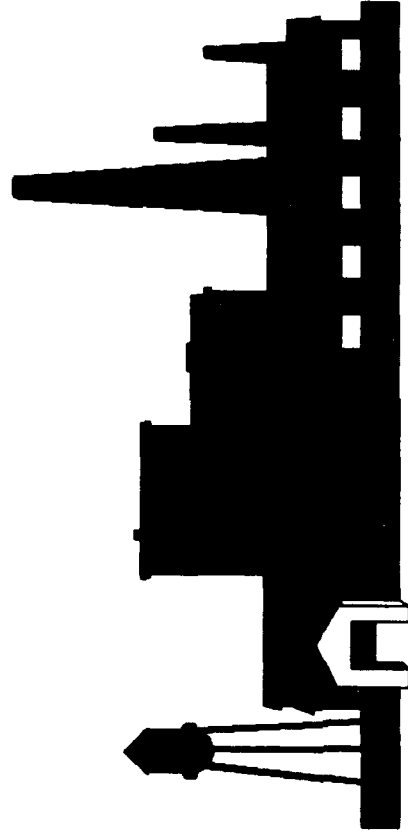
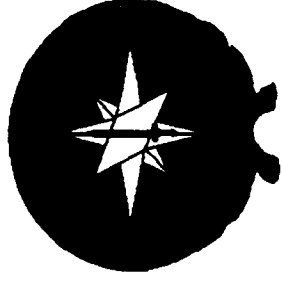
LITHIUM

**REDUCED WEIGHT
COST EFFECTIVE
IMPROVED PERFORMANCE
LOW COST, PORTABLE CHARGING SYSTEM**

AMC

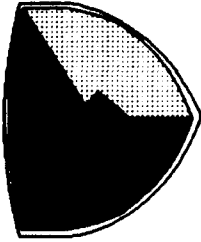


BUSINESS



OPPORTUNITIES

AMC



1993 APBI

BUSINESS OPPORTUNITIES

STATUS



AWARDED:

Li/SO2 BUY OUT

AIRCRAFT OMNIBUS

VARIOUS MERCURY

BA-5372

VALUE:

\$34.8M

\$ 5.0M

\$ 0.2M

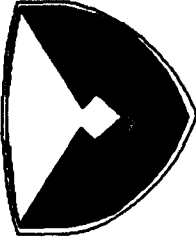
\$13.1M

IN PROCESS:

RECHARGEABLE OMNIBUS

BA-6516

AMC



BUSINESS OPPORTUNITY

***BB-590, BB-588, BB-503, BB-516, BB-X847
(INCLUDES CHARGER AND POWER SUPPLY)***

***CONTRACT METHOD: INDEFINITE DELIVERY/INDEFINITE
QUANTITY (BASIC & 4 OPTION YEARS) BID SAMPLES***

QUANTITIES: VARIES BY BATTERY

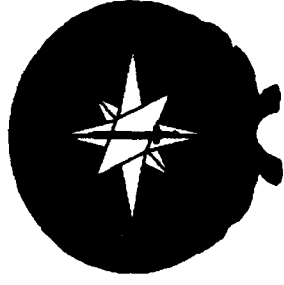
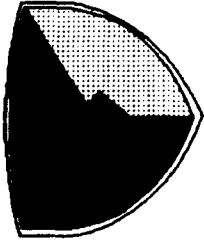
SCHEDULE: SOLICITATION DATE - 1QFY95

AWARD DATE: FY95

ESTIMATED VALUE: \$28,000,000

**POC: ROBERT REAGAN
C31 ACQUISITION CENTER
(908) 532-5645**

AMC



BUSINESS OPPORTUNITY

BB-542 (NiCd) REPAIR PROGRAM

CONTRACT METHOD: REQUEST FOR PROPOSAL

QUANTITIES: 346

SCHEDULE: SOLICITATION DATE - TBD

AWARD DATE: 2QFY95

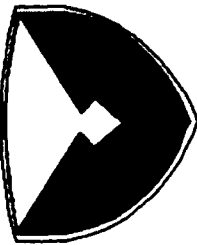
ESTIMATED VALUE: \$280,000

POC: ROBERT REAGAN

C31 ACQUISITION CENTER

(908) 532-5645

AMC



CECOM BATTERY PROGRAM MAJOR PROCUREMENTS



LI/SO2

NEXT GEN LITHIUM

----->

RECHARGEABLE OMNIBUS

----->

AIRCRAFT OMNIBUS

----->

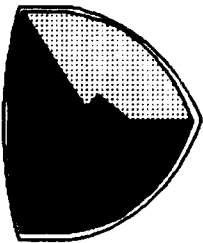
FY93 FY94 FY95 FY96 FY97 FY98 FY99 FY00

CONTRACT LENGTH

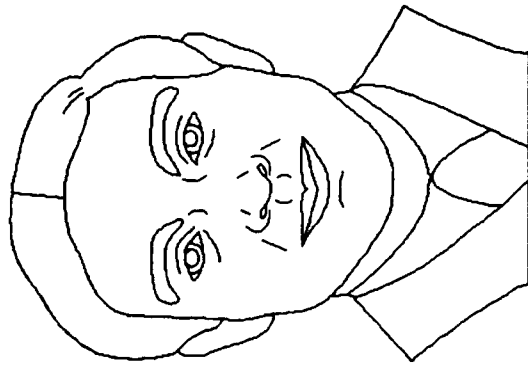
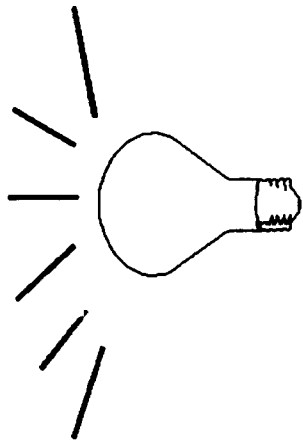
LEGEND: BASE YEAR

----- OPTION YEAR(S)

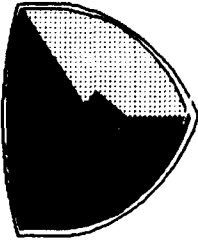
AMC



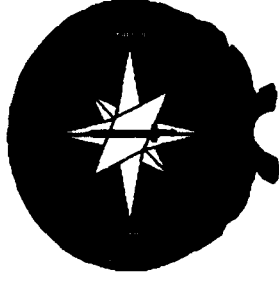
HAVE A GOOD IDEA?



AMC



CALL



UNSOLICITED PROPOSALS:

**NANETTE MULLENAX/
SANDY VERMONT
(908) 532-2671**

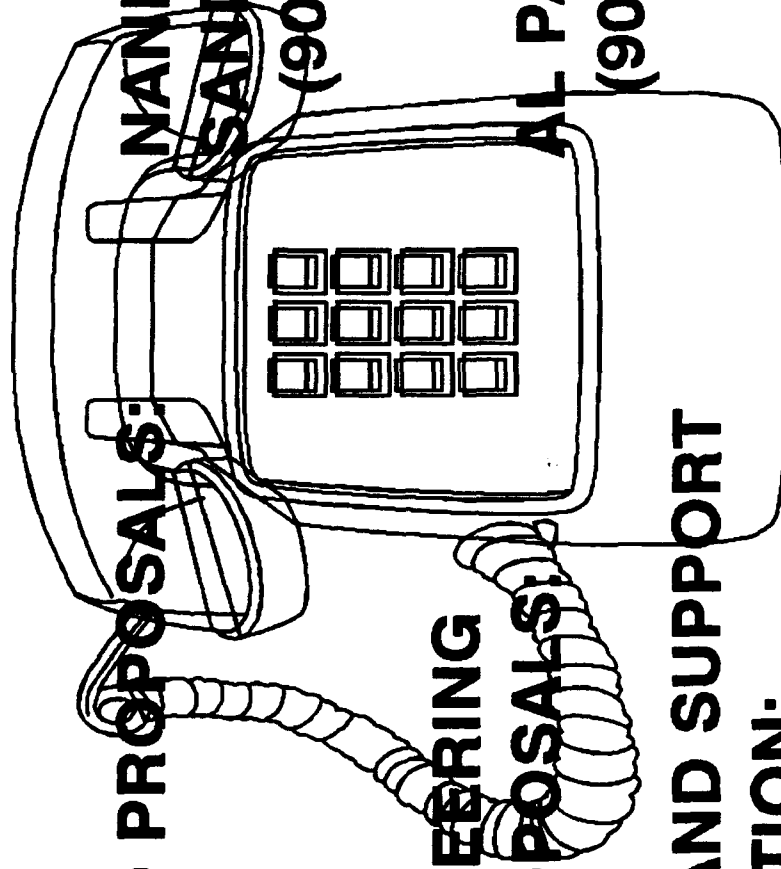
**VALUE ENGINEERING
CHANGE PROPOSALS:**

AL PALEY

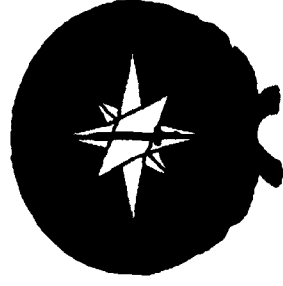
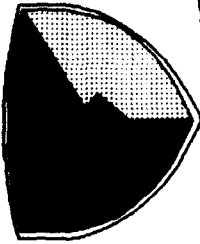
(908) 532-2318

OR

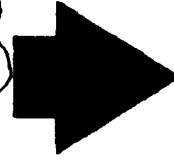
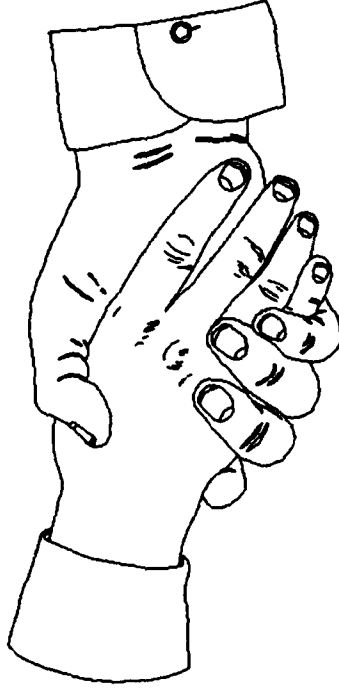
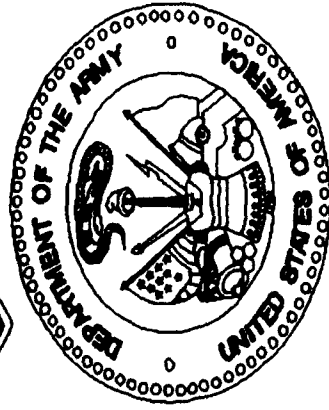
**OPERATING AND SUPPORT
COST REDUCTION:**



AMC

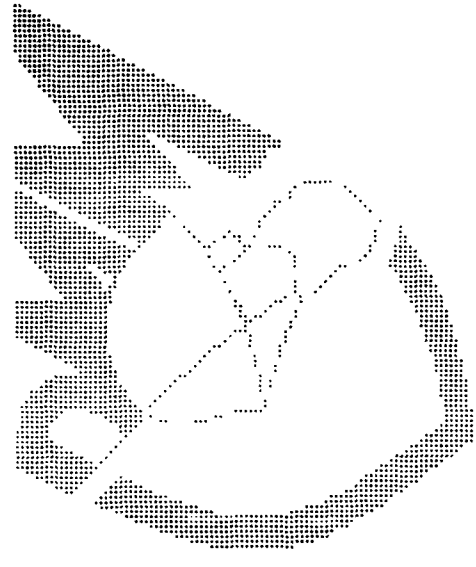
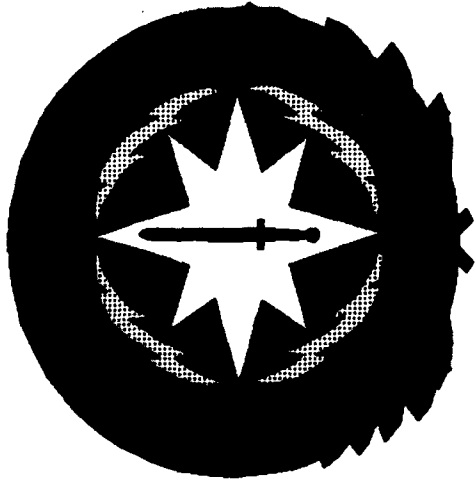


WORKING TOGETHER



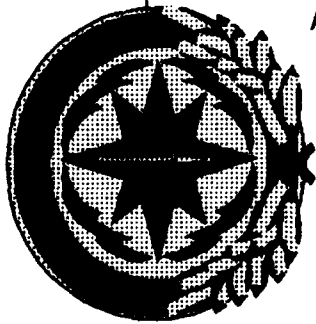
TO HELP *THE* SOLDIER

NOTES

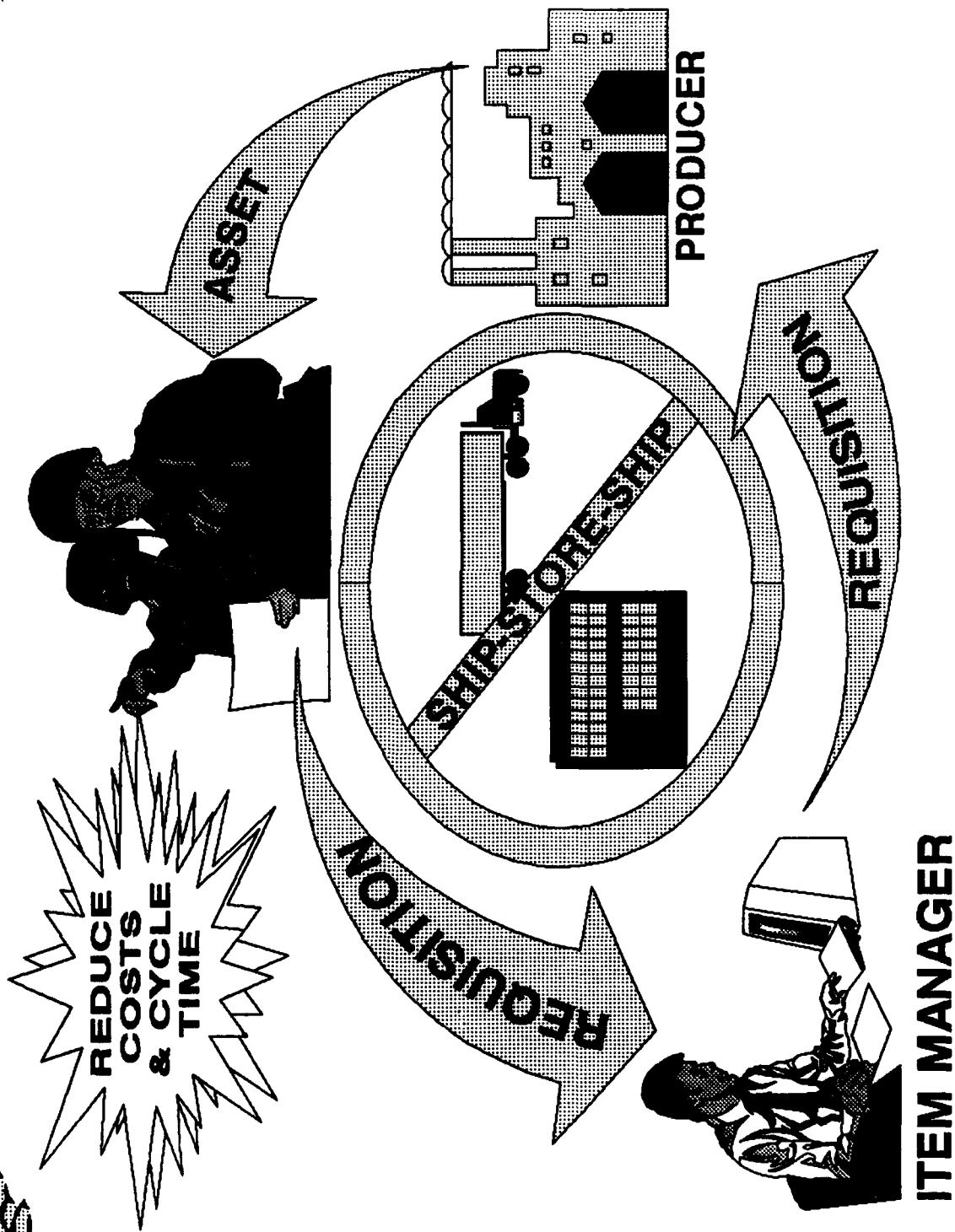
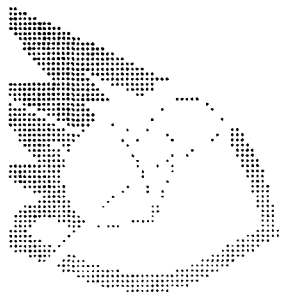


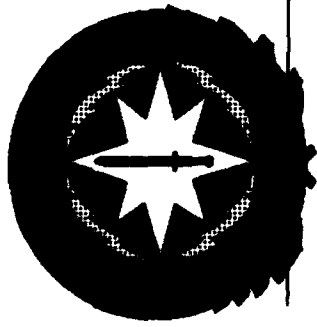
U.S. ARMY
COMMUNICATIONS-ELECTRONICS COMMAND
DIRECT VENDOR DELIVERY

Directorate of Materiel Management
Mr. Robert Pearson
U N C L A S S I F I E D
133

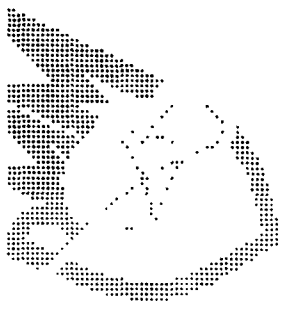


DIRECT VENDOR DELIVERY

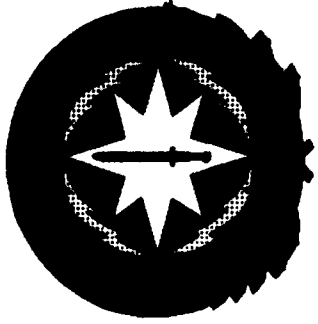




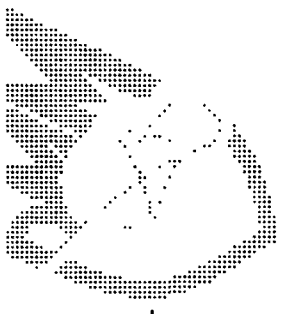
Direct Vendor Delivery (DVD)



- **Benefits**
 - Minimizes transportation costs
 - Reduces inventory at depots
 - Coupled with multiple year, packaged procurements
 - Moving towards use ANSI X.12 Electronic Data Interchange Standards
 - Requires joint effort (industry/government) to implement



DVD--Batteries

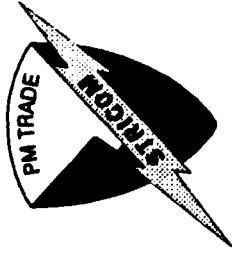


- Implemented DVD test with UNICOR (FPI)
- Looking at modifying agreements on existing contracts
- Developing "requirements"
 - ✓ EDI
 - ✓ Inventory levels/storage
 - ✓ Packaging
 - ✓ Inspection and acceptance, etc.

NOTES

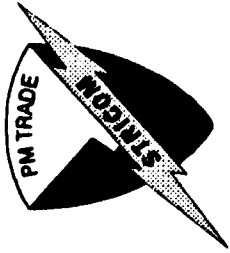
**U.S. ARMY SIMULATION,
TRAINING AND
INSTRUMENTATION COMMAND
(STRICOM)**

FUTURE EFFORTS



BATTERY POWER FOR MANWORN PERSONNEL DETECTION DEVICE TRAINING SYSTEM

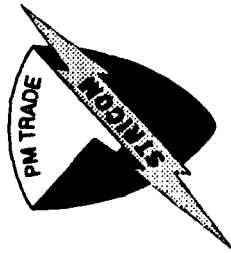
UNCLASSIFIED



STEVE MILBURN
DEPUTY PRODUCT
MANAGER
COMBAT SUPPORT
TRAINING SYSTEMS

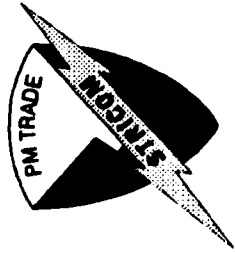
HQ STRICOM
ORLANDO, FL

UNCLASSIFIED

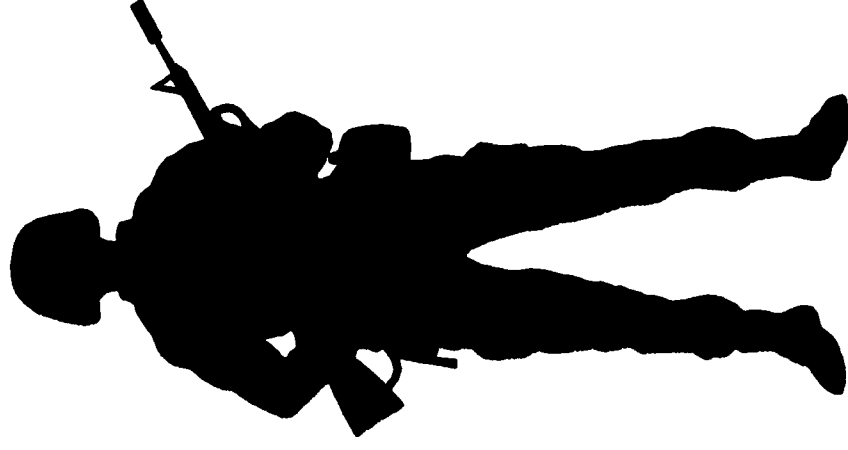


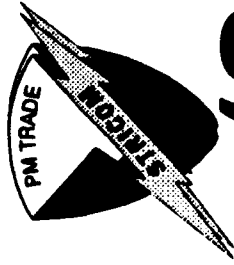
The Army has a Training Device System



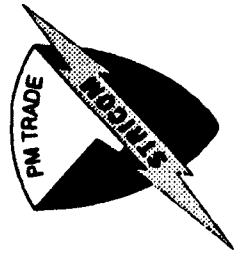


ITS NAME IS SAWE/MILES II

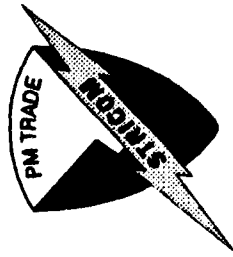




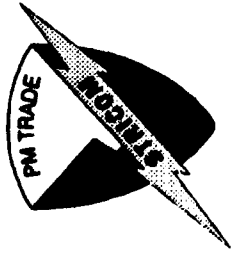
(SIMULATED AREA WEAPONS EFFECTS/MULTIPLE INTEGRATED LASER ENGAGEMENT SYSTEM)



THE SAWE/MILES II SYSTEM HAS A MANWORN COMPONENT

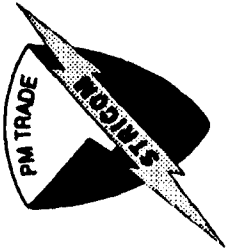


ITS NAME IS PDD (PLAYER DETECTION DEVICE)



**THE PDD HAS A
BATTERY**

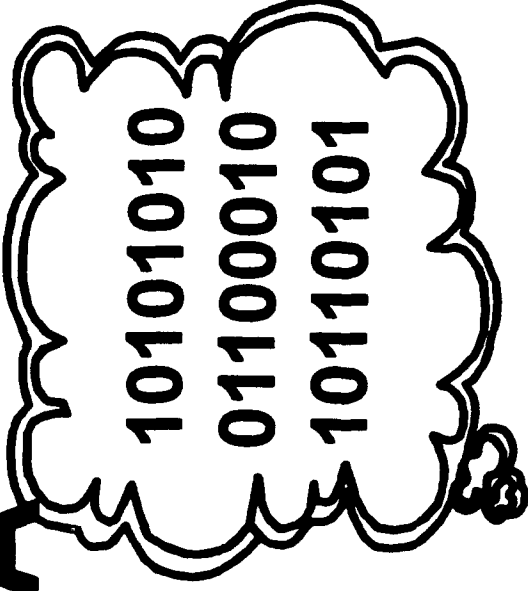
**ITS NAME IS
BA5590/U**

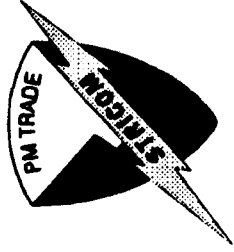


THE PDD DEALS

WITH DATA

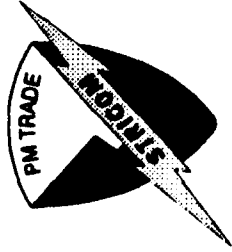
- Radio Frequency
- Transmissions
- Laser Reception
- Processing
- Digital Data Storage
- Position Location Polling
- Results/Timekeeping



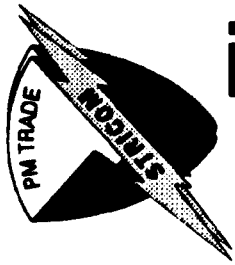


THE DATA IS ABOUT EVENTS AND SITUATIONS

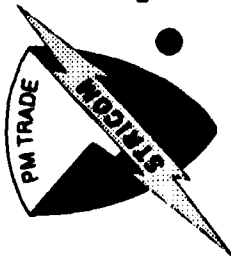
- **Position Location (Global Positioning System)**
- **Direct Weapon Engagement**
- **Hit/Kill Results (MILES)**
- **Indirect Weapons, Chemical, Biological and Nuclear Effects (SAWE)**



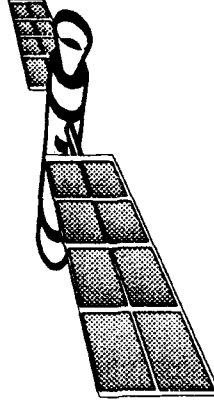
**THE SOLDIER WEARS
THE PDD IN ADDITION
TO ALL OTHER COMBAT
EQUIPMENT. THE
SOLDIER DOES HIS
JOB IN A REALISTIC
TACTICAL MANEUVER
ENVIRONMENT**

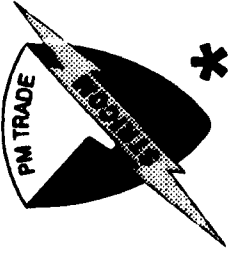


- **The PDD can "talk" to a CTC*
Data Collection and Analysis
Instrumentation System when a
DCI (Data Communication
Interface) Device (small
transceiver) is added.**
- **The PDD with a DCI makes an
"Instrumented Player."**

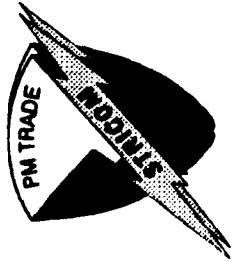


- The DCI gets its power from the PDD.
- The PDD components all draw on the same power source.
- The frequency of events, of position location reporting and event data reporting determine drain on the battery.

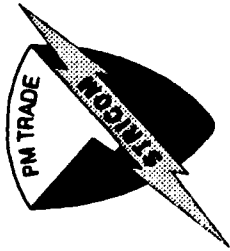




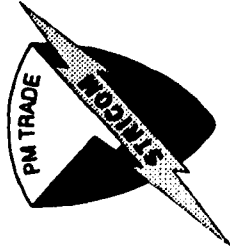
*** Three Combat Training
Centers (CTC):
Combat Maneuver
(Germany)
Joint Readiness
(FT Polk, LA)
National Training Center
(FT Irwin, CA)**



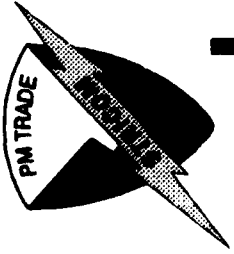
- **THE BA5590/U IS THE ONLY
TYPE CLASSIFIED
STANDARD BATTERY
CURRENTLY AVAILABLE
THAT SATISFIES ALL OF THE
MINIMUM ESSENTIAL
OPERATING AND COST
PARAMETERS**



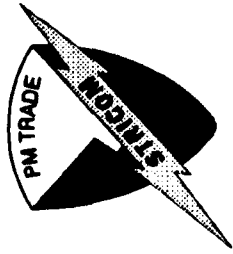
- **Power Output = 9.2w**
- **Size = Not as big as a brick**
- **Weight = Not heavier than 2.25 lbs**
- **Instrumented PDD Duty Cycle = 24 hrs minimum**
- **Cost = Under \$55 each**



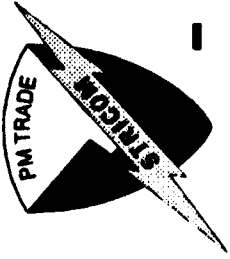
- **THE PDD IS BEING
MODIFIED TO BETTER
MEET SOLDIER
FUNCTIONAL NEEDS**



- **Lighter**
- **Better Component Layout,
Including Battery**
- **More User Friendly (e.g.,
set-up in MOP- 4)**



- **THE NEW DOWNSIZED
PDD'S BATTERY NEEDS
TO CHANGE ALSO**



- **Lighter Weight (high power to weight ratio)**
- **Longer Power Life (longer amp life in context of "average" demand)**
- **Lower Cost**
 - ▶ **Function of annual procurement expense, either or both**



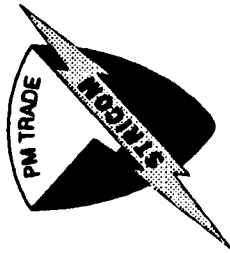
✓Lower price per battery
✓Longer life in operation

- Smaller Size and Smoother Configuration

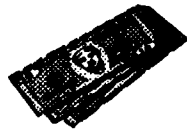
► Could be size and shape of common item soldier already carries (e.g. ammo magazine, first aid kit)



- ▶ **Human Engineering Factors (fits the training system)**
- **Easier to Handle, Connect, Carry and Dispose**

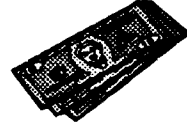


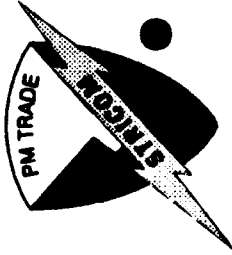
PDD BATTERY CONSIDERATIONS & CHALLENGES



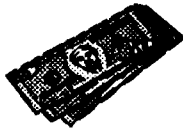
"OUR DESIREMENTS"

- Weight (lighter than 2.0 lbs each)

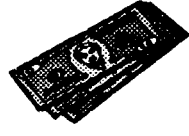




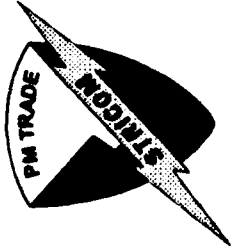
- Power (9.2w @ 12v/dc,
"standard instrumented use"
for MORE THAN 24 hrs)



- Cost (less than \$20 EACH)
- Configuration (example:
shaped as a 30 Rnd
"banana" magazine)



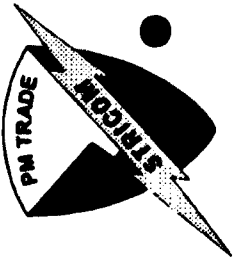
***Cost Impacts**



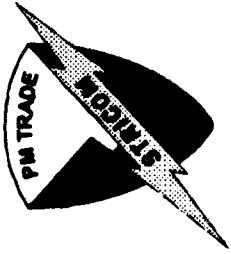
PDD BATTERY CONSIDERATIONS & CHALLENGES

"OUR DESIREMENTS" Cont'd

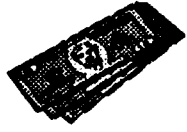
- **Environment Impact (low or no hazard - "drop and walk")**



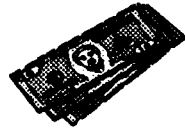
- **Ease of Use and Disposal**
 - **Connection access user friendly**
 - **Transportability (nothing special needed)**
 - **Durability (all weather/rough handling)**
 - **Disposal (simple/inexpensive, with no special handling)**



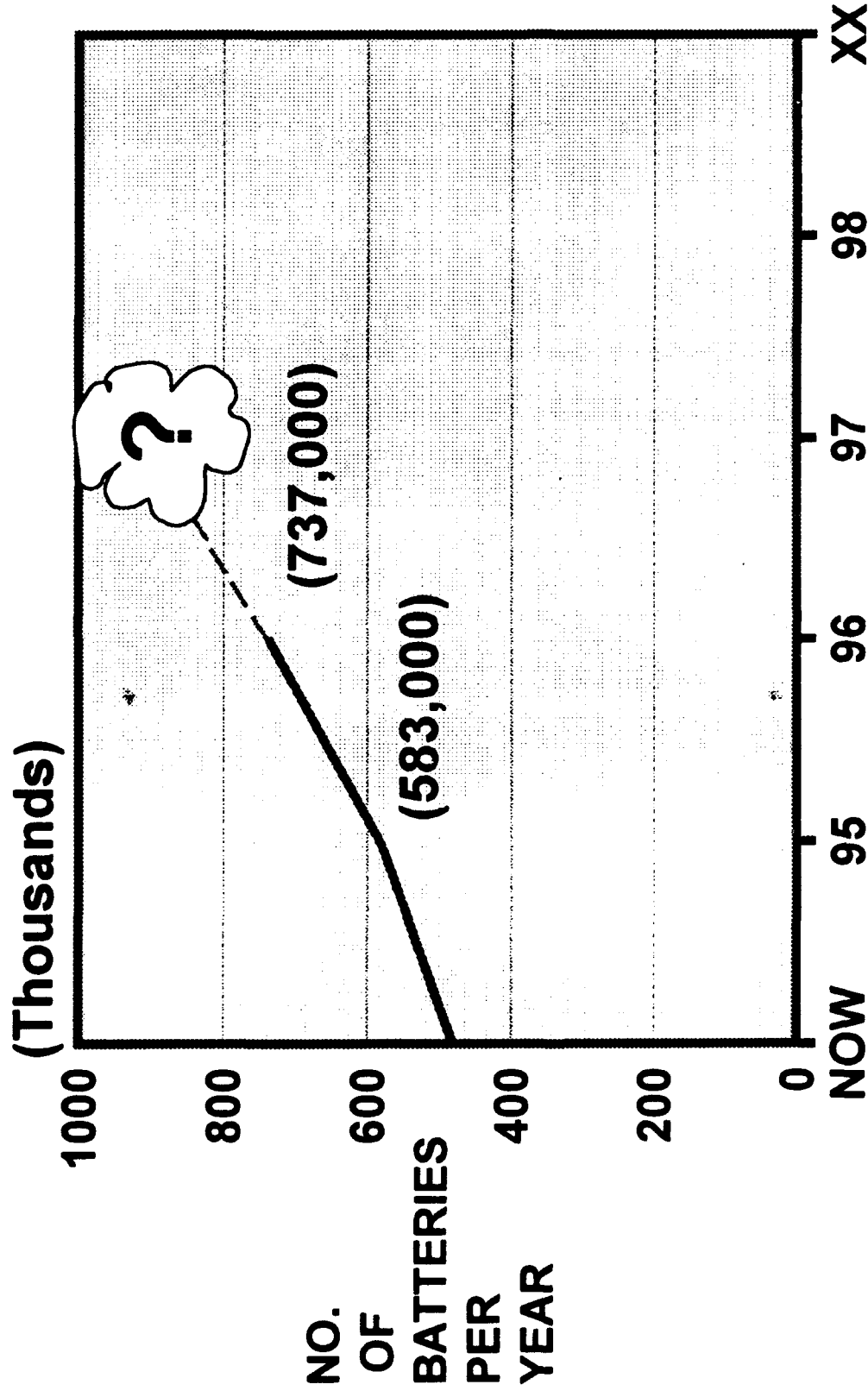
- **Safe (very!)**
- **Shelf Life (many months long and not heat/cold sensitive)**



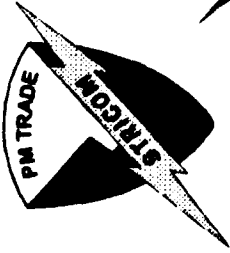
*** Cost Impacts**



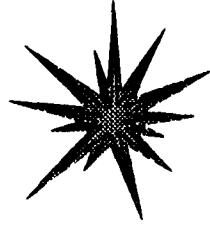
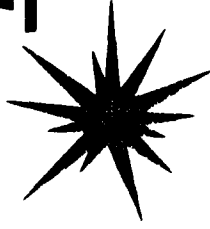
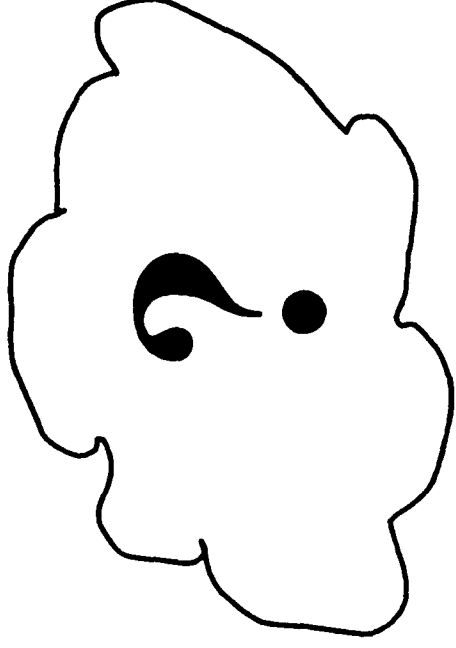
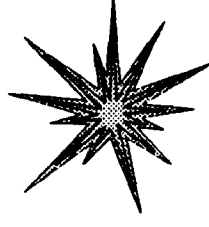
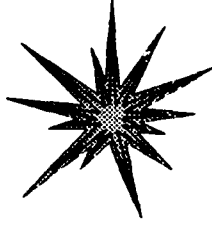
WHAT IS THE MARKET POTENTIAL?



* Figures are Rough Order of Magnitude (ROM) estimates based on planned equipment orders and usage experiences.



THE QUESTION

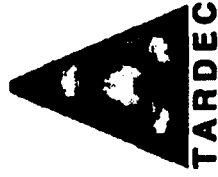


**How many of our Army
"desirements" can industry
fulfill, when and to what
extent?**

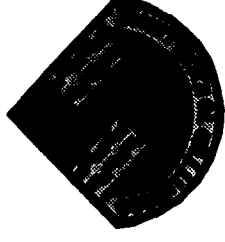
NOTES

**U.S. ARMY TANK-AUTOMOTIVE
AND ARMAMENTS COMMAND
(TACOM)**

BATTERY PROGRAM



TANK-AUTOMOTIVE RD&E TECHNOLOGY CENTER

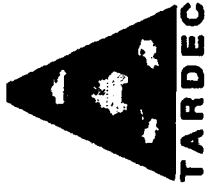


POWER & ENERGY STORAGE REQUIREMENTS FOR MILITARY VEHICLES

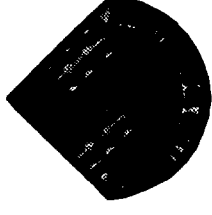
JOHN F. BUSH
APPLIED ENGR & ROBOTICS
DIVISION

(810) 574-5297
DSN 786-5297
FAX (810) 574-5008

UNCLASSIFIED

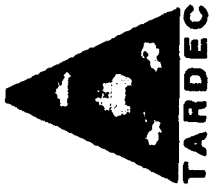


TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER

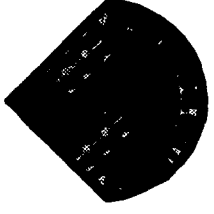


VISION

To become a world class leader for tank-automotive electrical systems and to provide the soldier with the most advanced electrical systems at the lowest cost.

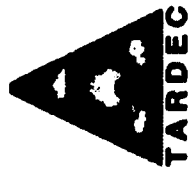


TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER

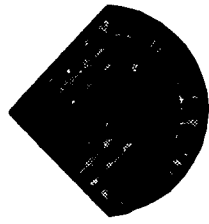


MISSION:

To provide the most reliable and cost effective **\$**
electrical systems and components. To **\$**
improve fleet readiness, and reduce operating **\$**
and support costs related to electrical power **\$**
generation, regulation, storage, and
distribution.



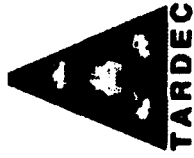
TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER



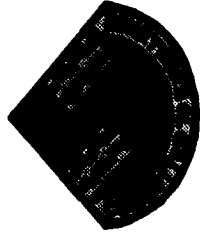
TEAM POWER

BATTERY TECHNOLOGY ORGANIZATION





TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER



ELECTRICAL POWER REQUIREMENTS FOR MILITARY VEHICLES



* 24 VOLT ELECTRICAL SYSTEMS

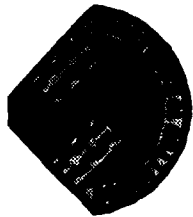
* HIGH POWER FOR ENGINE STARTING

* HIGH ENERGY DEMAND FOR SILENT
WATCH OPERATIONS

* OPERATE IN EXTREME TEMPERATURES (-40
TO 115 DEGREE F)

* INTERMITTENT OPERATION





TANK-AUTOMOTIVE BATTERY PROGRAM

OVERVIEW

THRUST

PAYOFF

6TL PROCUREMENT STRATEGY

DIRECT
VENDOR
DELIVERY

COMMERCIAL BATTERY USAGE

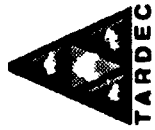
IMPROVE
AVAILABILITY &
DISPOSAL

CAPACITOR STARTING SYSTEMS

EXTEND
BATTERY
LIFE

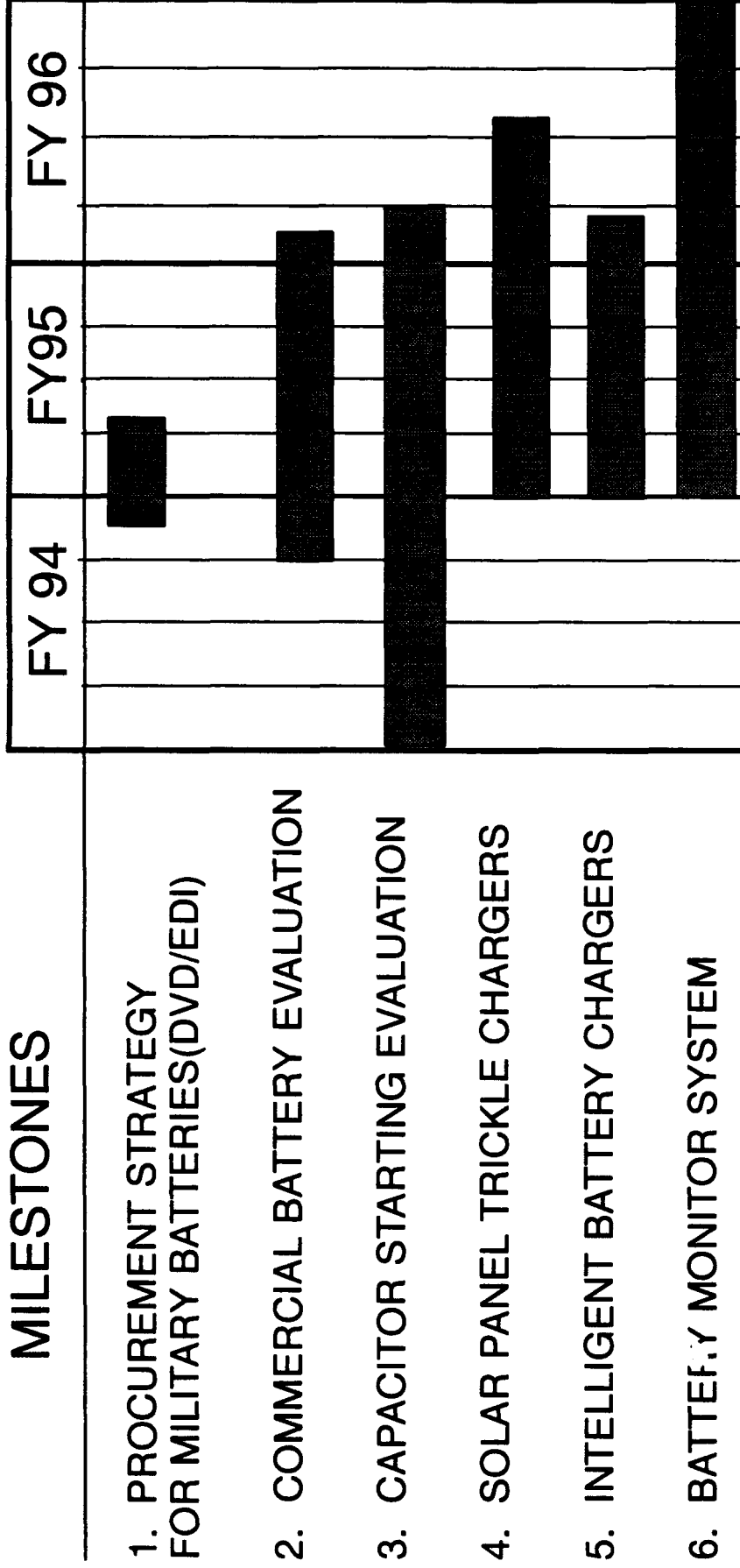
SOLAR POWERED TRICKLE CHARGERS

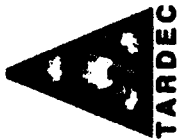
REDUCE
BATTERY
SULFATION



BATTERY MODERNIZATION PROJECTS

MILESTONES





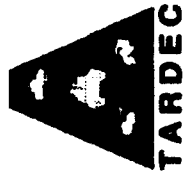
TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER



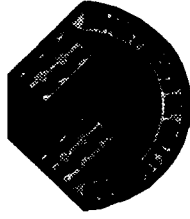
COMMERCIAL BATTERY PROCUREMENT FORECAST

VEHICLE	BATTERY TYPE	FY 95	FY 96	FY 97
TACTICAL	FLOODED	184,000	177,000	174,000
COMBAT	SEALED	58,000	56,000	55,000
		242,000	233,000	229,000

LEAD-ACID BATTERY TECHNOLOGY



TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER

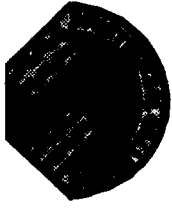


BUSINESS OPPORTUNITIES

FY95	FY96	FY97
* SEALED L-A BATTERIES	* ULTRA CAPACITORS	* ADVANCED BATTERIES
* COMMERCIAL BATTERIES		
* BATTERY DVD TACOM DLA	* BATTERY CHARGERS	* STATE OF CHARGE METERS
	* SOLAR CHARGERS	* EV COMPONENTS



TANK AUTOMOTIVE RD&E TECHNOLOGY CENTER

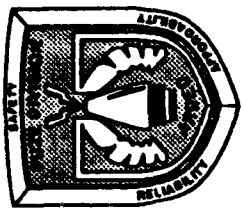


FUTURE REQUIREMENTS

- * HIGH POWER AND ENERGY DENSITY
- * EXTENDED BATTERY SERVICE LIFE
- * MAINTENANCE FREE
- * ENVIRONMENTALLY SAFE



NOTES



Fuze Power Supply Requirements

MR. ALAN C. REITER

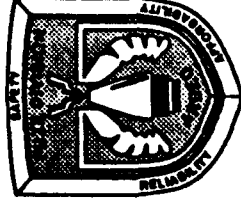
TACOM / ARDEC / FUZE DIVISION

ADELPHI MD

UNCLASSIFIED



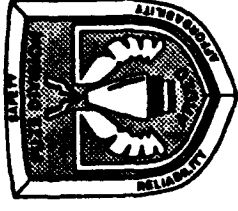
Outline



- **Fuze Environment**
- **Fuze Power Supply Requirements**
- **Reserve Power Supplies Descriptions**
- **Growth Technology Areas**
- **Business Opportunities**



Fuze Environment



GENERAL:

**One-shot after storage
@ -51°C to +71°C**

ARTILLERY:

**High spin rate & g-forces;
short mission time**

MINE:

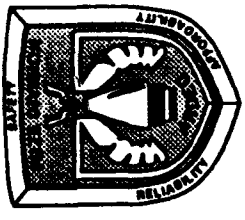
**No acceleration forces;
long mission time**

MISSILE:

**Low spin rate & g-forces;
moderate mission time**



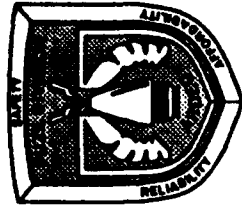
Fuze Power Supply Requirements



- Integral, Not Replaced
- 10 to 20+ Years Shelf Life
- Quick Response/Rise Time
Typically Milliseconds,
Depending on Application
- Typical Operational Range
-40°C to +60°C



Types of Reserve Batteries

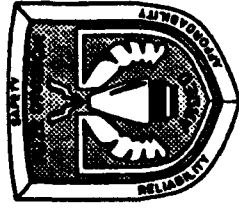


- Liquid Electrolyte
Artillery
Mines

- Thermal
Mortars
Rockets
Missiles (G&C, too)



Liquid Electrolyte Conventional Reserve Batteries



- **30+ Years Shelf-Life**
- **Pb/HBF₄/PbO₂ Electrochemistry**
- **Bipolar Plate Cells, Unique Material**
- **Electrolyte in Separate Ampule**
- **Setback and Spin Activated**

AMPULE ASSEMBLY

SUMP

AMPULE SEAL

2 STACKS
18 CELLS/STACK

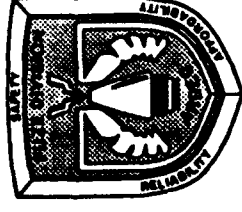
SEAL RING

BASE

MK 43 MOD X

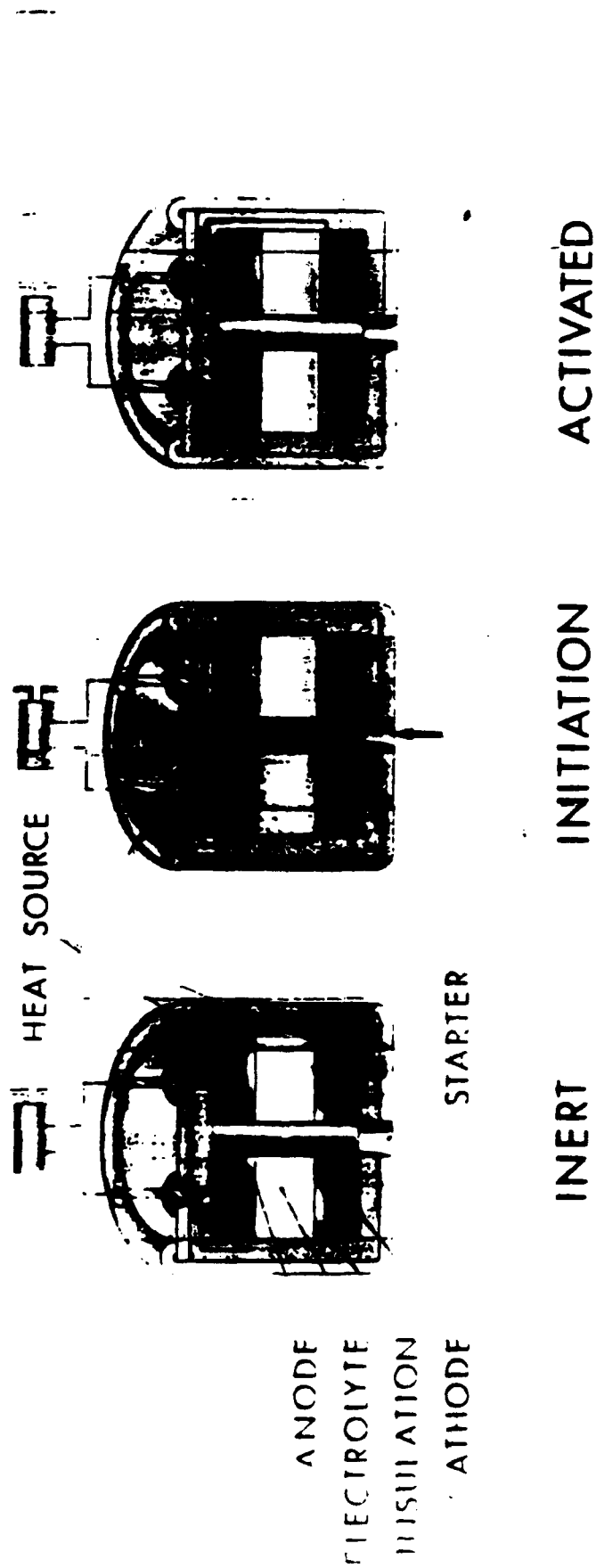


Thermal Reserve Batteries



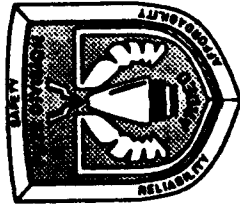
- 30+ Years Shelf-Life
- Solid Salt Electrolyte
LiCl-KCl or LiBr-LiCl-LiF Eutectic
Binder (Kaolin, SiO₂, MgO)
- Various Electrochemistries
- Activation by Inertial Starter, Electrical Match,
and/or Primer
- Heat Paper (28% Zn, 72% BaCrO₄ mixed with
glass and Fiberfrax fibers) or
Pellets (14-16% KClO₄, balance Fe powder)

SCHEMATIC THERMAL CELL





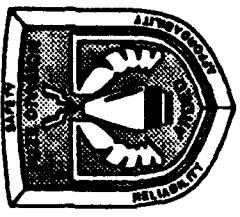
Growth Technology Areas for Fuze Applications



- **Lithium Liquid Reserve Batteries**
- **Family of Reserve Batteries**
- **Spin Thermal Batteries**
- **Active Batteries**
- **Alternate Energy Sources**



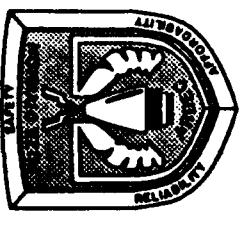
Lithium Liquid Reserve Batteries



- No Significant Mech. Design Changes
- Electrode Material Widely Available
- Variety of Applications:
Fuzing, Mines, Etc.
- Technical Challenges :
Passivation, Hazards, Etc



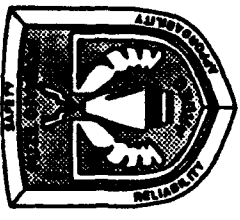
Family of Reserve Batteries



- **Family of Batteries Versus Unique Battery for Each Application (Follows British Model):**
 - **Standard Range of Power/Size Batteries**
 - **Fuzes Designed to the Standard Battery**
- **Challenges :**
 - **Unknown Purchase Quantities**
 - **Identifying Family Members:**
size, voltage, power, energy



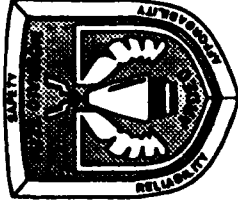
Spin Thermal Batteries



- **Started with Nuclear Artillery Fuze Program...**
 - **Current Application Ballistic Test in Fall '94**
- **Heat Management**
- **Cell Design**
- **Technical Challenges :**
 - **Heat Retention for Extended Range in Small Package**
 - **Mechanical Design to Contain Molten Salt at High Spin**



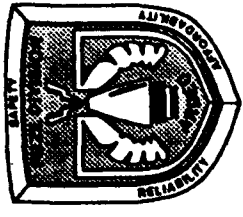
Active Batteries



- Existing Broad Manufacturing Base
- Use Active Cells for Short-Term Mobilization
 - Successful SBIR Air Gun Test
- Technical Challenges :
 - Shelf Life (10+ Years)
 - Passivation (response time)



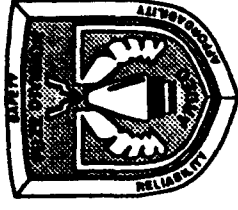
Alternate Energy Sources



- **Capacitors (charged prelaunch)**
- **Piezoelectric (launch shock excited)**
- **Air Breathing Generators**
- **Vibration Converters**
- **Technical Challenges :**
 - **Cost & Volume Restrictions**
 - **Power Requirements**



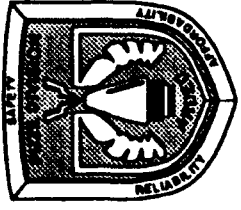
Conclusion



- **Niche Market:**
 - Dependent on Weapon Procurements**
 - potentially large quantities**
 - Fuze is Sub-Component**
 - Power Supply is Sub-Sub-Component**
- **Shrinking Manufacturing Base:**
 - 1 Liquid Electrolyte (from 8)**
 - 1 Thermal (from 9)**



Army Cooperative R&D Agreement Opportunities



ARMY RESEARCH LABORATORY POC:

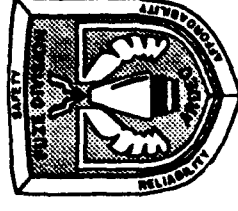
Mike Claffy (301) 394-3098

FUZE POWER SUPPLY TECHNICAL POC:

Allan Goldberg (301) 394-3114



ARL BAA Opportunities

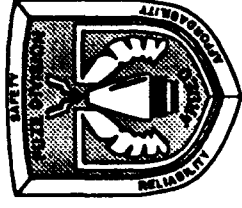


- **Solicitation #: DAAL01-95-R-ARL-BAA**
- **All Non-technical Questions:
Ms. K. Wishnow
(301) 394-3690**
- **All Technical Questions (on batteries):
Mr. A. Ballato
(908) 544-4308**



SBIR

Business Opportunities



- **DoD SBIR Solicitation:**
Defense Technical Information Center
ATTN: DTIC/SBIR
Building 5, Cameron Station
Alexandria, VA 22304-6415
(800) 225-3842
- **ARL SBIR Information:**
Dean Hudson
(301) 394-4808

NOTES

SMART MUNITIONS BATTERY REQUIREMENTS

MR. CLIFFORD D. SHOOK

**CHIEF, MINES AND DISPENSER ELECTRONICS SECTION
ARMAMENT RESEARCH, AND DEVELOPMENT CENTER
TANK AUTOMOTIVE AND ARMAMENTS COMMAND**

UNCLASSIFIED

SMART MUNITIONS BATTERY REQUIREMENTS

INTRODUCTION

**SMART MUNITIONS ARE GUIDED TO A TARGET
EITHER AUTONOMOUSLY OR WITH AN OPERATOR
OR THEY SENSE A TARGET AND FIRE A WARHEAD.**

SMART MUNITIONS BATTERY REQUIREMENTS

CONCERNS

- **PRESENT RESERVE AND THERMAL BATTERY PRODUCERS ARE VERY LIMITED IN NUMBER.**
- **ONE PRODUCER HAS MOVED OFF-SHORE.**

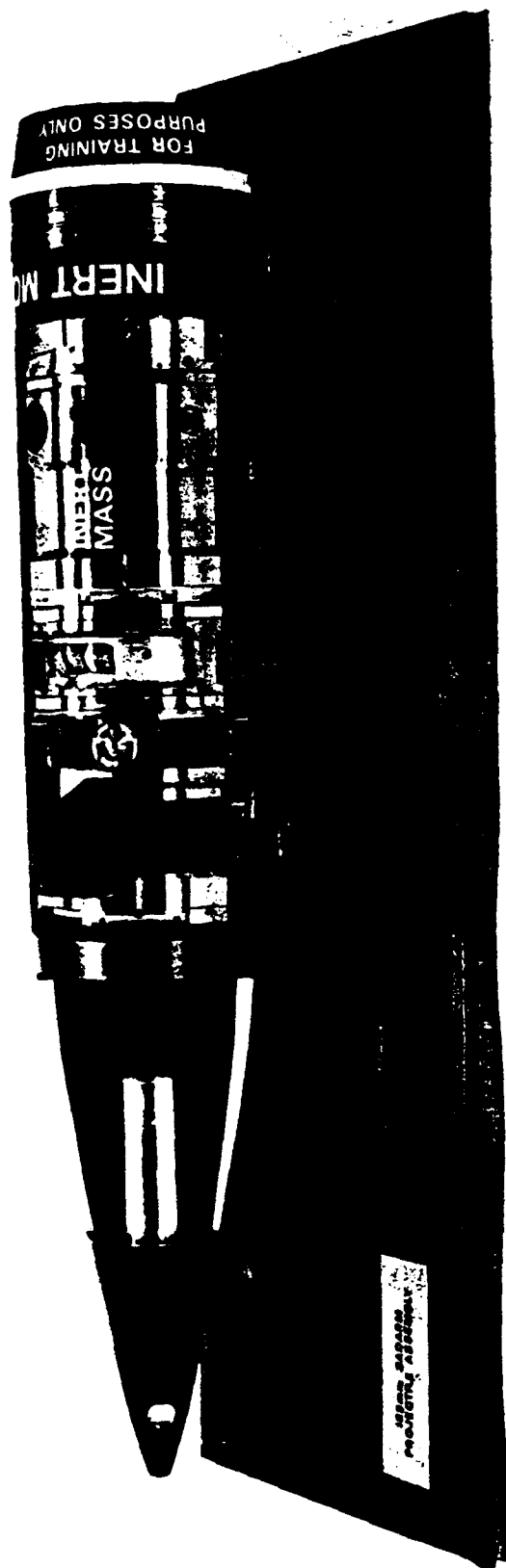
SMART MUNITIONS BATTERY REQUIREMENTS

UNIQUE REQUIREMENTS

- **WOODEN ROUND (NONREPLACEABLE / NONTESTABLE)**
- **STORAGE(UNPROTECTED) - 10 YEARS REQUIRED ; 20 YEARS DESIRED**
- **SURVIVE CANNON LAUNCH: 20K G's SETBACK, UP TO 240 RPS.**
- **HIGH RELIABILITY**
- **WORLD WIDE USE**
- **MINIMUM VOLUME**
- **HIGH POWER DENSITY**

SMART MUNITIONS BATTERY REQUIREMENTS

**SADARM
(SENSE AND DESTROY ARMOR)**



SMART MUNITIONS BATTERY REQUIREMENTS

SADARM

- **SENSE AND DESTROY ARMOR (SADARM)**
- **SADARM SUBMUNITIONS ARE DELIVERED TO AN AREA ABOVE THE TARGETS BY A VARIETY OF DELIVERY SYSTEMS. PRESENTLY, THESE DELIVERY SYSTEMS ARE THE 155 mm HOWITZER AND THE MULTIPLE LAUNCH ROCKET SYSTEM (MLRS).**

SMART MUNITIONS BATTERY REQUIREMENTS

SADARM

- **SADARM SUBMUNITIONS ARE DESIGNED TO AUTONOMOUSLY LOCATE AND DESTROY ENEMY STATIONARY ARMORED VEHICLES, PRINCIPALLY SELF PROPELLED HOWITZERS, FROM ALTITUDES OF 150 TO 300 METERS ABOVE THE TARGET AND AT RANGES OUT TO 30Km.**
- **SADARM SUBMUNITIONS ARE PRESENTLY IN THE FINAL STAGES OF ENGINEERING AND MANUFACTURING DEVELOPMENT.**

SMART MUNITIONS BATTERY REQUIREMENTS

SADARM BATTERY

- **THERMAL BATTERY (1.5 IN. D. X 1.25 IN. L)**
- **MINIMUM ACTIVE LIFE = 82 SECONDS**
- **VOLTAGE BETWEEN 7.5 VOLTS - 11.0 VOLTS**
- **CURRENT - 3.0 AMPERES FOR FIRST 47 SECONDS**
 - 6.0 AMPERES FOR REMAINING 35 SECONDS**
(3 AMPERE SURGE FOR 40 MILLISECONDS AT
TRANSITION POINT).
- **POC- MIKE SCHIKSNIS- COM: 201 - 724 - 4552.**

SMART MUNITIONS BATTERY REQUIREMENTS

SADARM CONTRACT OPPORTUNITY

- **LOW RATE INITIAL PRODUCTION IS SCHEDULED TO BEGIN IN FY95.**
- **SYSTEM FUNDING : TBD**
- **SYSTEM CONTRACT TO BE AWARDED.**
- **POC: HOWARD BRUNSVOLL, TELEPHONE: COM. 201-724-4044.**

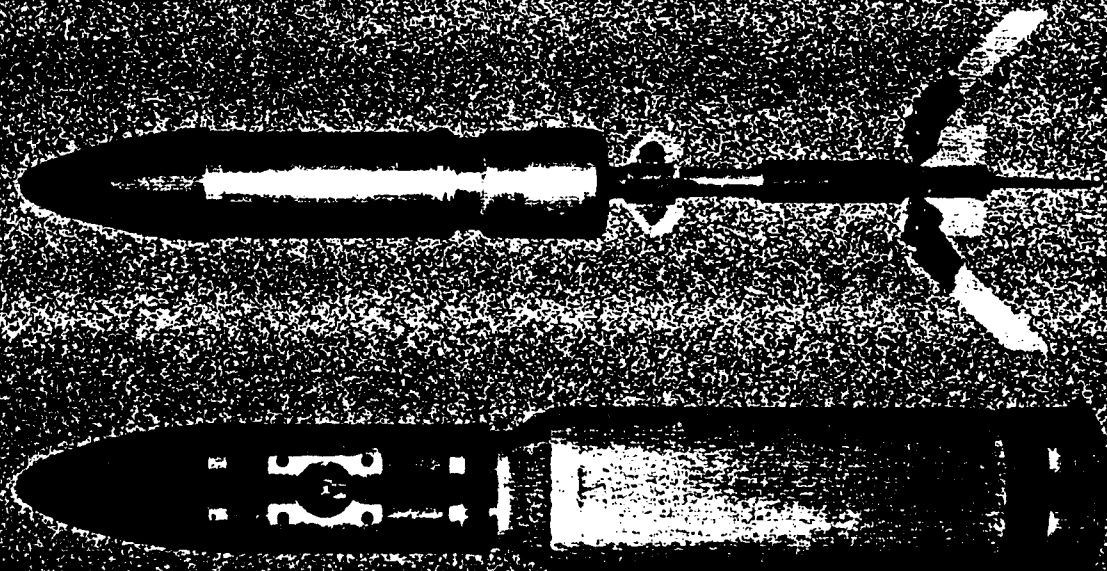
SMART MUNITIONS BATTERY REQUIREMENTS

STAFF

(SMART TARGET ACTIVATED FIRE & FORGET)

Tank STAFF—XM 943

Status Update



SMART MUNITIONS BATTERY REQUIREMENTS

STAFF

- **SMART TARGET ACTIVATED FIRE & FORGET (STAFF)**
- **STAFF IS A 120mm TANK FIRED SMART ANTIARMOR PROJECTILE.**
- **STAFF USES A FORWARD LOOKING MILLIMETER WAVE (MMW) RADAR TO DETECT ARMORED GROUND VEHICLES OR HELICOPTERS. AFTER A TARGET IS DETECTED AND VALIDATED, DOWNWARD LOOKING RADAR IS USED TO ROLL THE LETHAL MECHANISM UNTIL IT IS POINTED AT THE TARGET. AS THE PROJECTILE PASSES OVER THE TARGET, AN EXPLOSIVELY FORMED PENETRATOR IS FIRED INTO THE TARGET.**
- **STAFF IS PRESENTLY IN ENGINEERING AND MANUFACTURING DEVELOPMENT.**

SMART MUNITIONS BATTERY REQUIREMENTS

STAFF BATTERY

- **TWO(2) THERMAL BATTERIES: A= 1.63 IN.D. X 2.85 IN.L.
B= 1.44 IN.D. X 2.25 IN.L.**
- **MINIMUM ACTIVE LIFE = BATT. A = 15 SEC, INOPERABLE IN 30 MIN.
BATT. B = 11 SEC, INOPERABLE IN 30 MIN.**
- **VOLTAGE: BATT. A = 60 - 100 VOLTS.
BATT. B = DUAL OUTPUT OF 10-25 VOLTS & 15-36 VOLTS.**
- **CURRENT: BATT. A = 2.0 AMPS NOMINAL WITH SURGES TO 40 AMPS
BATT. B = UP TO 5 AMPS.(10-25V) & UP TO 7 AMPS.(15-36V).**
- **POC- GUS FLORIS- COM: 201 - 724 - 2829.**

SMART MUNITIONS BATTERY REQUIREMENTS

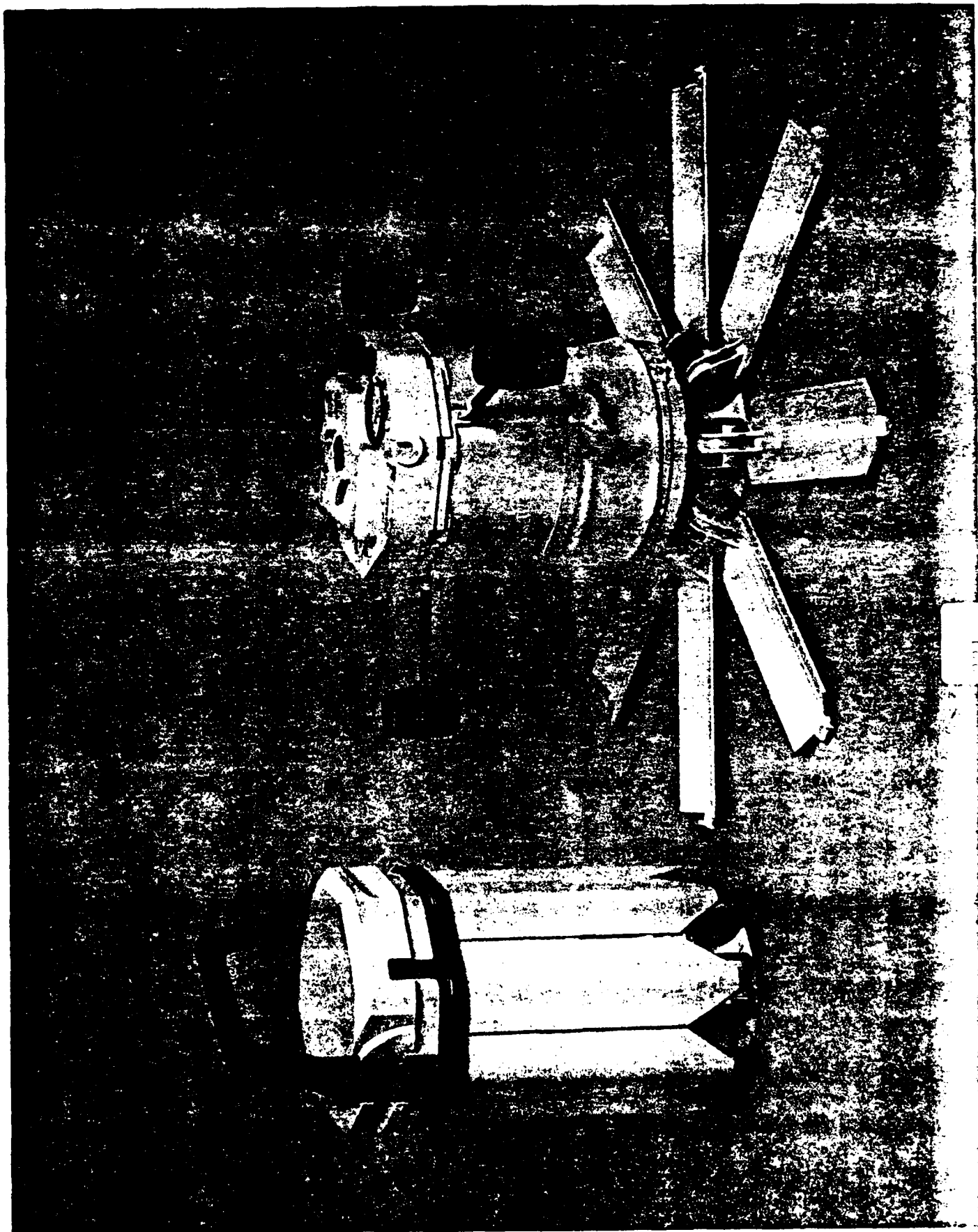
STAFF CONTRACT OPPORTUNITY

- **STAFF SCHEDULE : CLASSIFIED**
- **SYSTEM CONTRACT**
- **POC: DAVID PANHORST, TELEPHONE : 201-724-7258.**

SMART MUNITIONS BATTERY REQUIREMENTS

WAM

(WIDE AREA MINE)



SMART MUNITIONS BATTERY REQUIREMENTS

WAM

- **WIDE AREA MINE (WAM)**
- **WAM IS HAND EMPLACED ON THE GROUND AND AUTONOMOUSLY SEARCHES FOR THREAT VEHICLES USING ACOUSTIC AND SEISMIC SENSORS AT RANGES UP TO 100 METERS.**

SMART MUNITIONS BATTERY REQUIREMENTS

WAM

- **ONCE A TARGET IS LOCATED, A SMART SUBLET EQUIPPED WITH A SOPHISTICATED INFRARED SENSOR IS LAUNCHED OVER THE TARGET. THE TOP OF THE TARGET IS ATTACKED WITH A HIGHLY LETHAL EXPLOSIVELY FORMED PENETRATOR.**
- **THE WAM IS DEPLOYED BY A FOOT SOLDIER.**
- **WAM IS PRESENTLY IN ENGINEERING AND MANUFACTURING DEVELOPMENT.**

SMART MUNITIONS BATTERY REQUIREMENTS

PRESENT WAM BATTERY

- **LITHIUM THIONYL CHLORIDE RESERVE (3.95 IN. D. X 2.87 IN. L.)**
- **VOLTAGE: 8-15 VOLTS**
- **CAPACITY (400 ma DISCHARGE LOAD)**
 - 13 AMPERE-HOURS @ 145 F**
 - 14 AMPERE-HOURS @ 72 F**
 - 11 AMPERE-HOURS @ -25 F**
- **DEPASSIVATION PULSE REQUIRED.**
- **POC- ANGELO RUFRANO-COM: 201 - 724 - 6782.**

SMART MUNITIONS BATTERY REQUIREMENTS

NEAR TERM WAM BATTERY

- **LITHIUM COBALT DIOXIDE RESERVE (3.95 IN.D. X 2.87 IN.L.)**
- **RECHARGEABLE (10 CYCLES TO 80% INITIAL CAPACITY)**
- **VOLTAGE: 10 VOLTS MINIMUM**
- **CAPACITY: (400 ma DISCHARGE LOAD)
17 AMPERE-HOURS @ 145 F, 72 F, AND -25 F.**
- **DEPASSIVATION PULSE NOT REQUIRED.**
- **POC: ANGELO RUFRANO - COM: 201 - 724 - 6782.**

SMART MUNITIONS BATTERY REQUIREMENTS

FUTURE WAM BATTERY

- **UNKNOWN / TBD CHEMISTRY RESERVE (3.95 IN.D. X 2.87 IN.L.)**
- **RECHARGEABLE (10 CYCLES TO 95% INITIAL CAPACITY)**
- **VOLTAGE: 10 VOLTS MINIMUM**
- **CAPACITY (400 ma DISCHARGE LOAD)
25 AMPERE-HOURS @ 145 F,**
- **DEPASSIVATION PULSE NOT REQUIRED.**
- **POC- ANGELO RUFRANO-COM: 201 - 724 - 6782.**

SMART MUNITIONS BATTERY REQUIREMENTS

WAM CONTRACT OPPORTUNITY

- **WAM SCHEDULED FOR LRIP IN FY96**
 - **SYSTEM CONTRACT**
- **NEAR TERM BATTERY DEVELOPMENT EFFORT WILL BE ACCOMPLISHED THROUGH A GOVERNMENT CONTRACT OR THROUGH THE SYSTEM CONTRACTOR.**
 - **CONTACT AWARD TENTATIVELY SCHEDULED FOR FY95.**
- **FUTURE WAM BATTERY DEVELOPMENT TBD.**
- **POC: GEORGE LUTZ- TELEPHONE: COM. 201-724- 7848.**

SMART MUNITIONS BATTERY REQUIREMENTS

OTHER SMART MUNITIONS

- **PRECISION GUIDED MORTAR MUNITION (PGMM)**
 - DEMO PROGRAM USING GUIDED 81mm & 120mm MORTARS TO DEFEAT TARGETS.
- **X - ROD**
 - DEVELOP A 120 mm TANK FIRE & FORGET AUTONOMOUSLY GUIDED KINETIC ENERGY ROUND.
- **AUTONOMOUS INTELLIGENT SUBMUNITION (AIS)**
 - DEVELOP A TACTICAL SUBMUNITION WITH A WIDE SEARCH AREA AND CAPABLE OF MANEUVERING TO ATTACK TARGETS.
- **ARMICIDE - AIR DEFENSE WEAPON**
 - GUN LAUNCHED SMART MUNITION TO ATTACK ACTIVE RADARS.
- **BATTLEFIELD IMAGING PROJECTILE SYSTEMS (BIPS)**
 - CANNON LAUNCHED REAL TIME BATTLE ASSESSMENT SYSTEM.

SMART MUNITIONS BATTERY REQUIREMENTS

SUMMARY

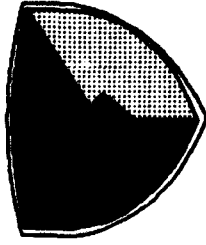
- **SMART MUNITIONS GIVE THE ARMED FORCES THE ABILITY TO MAKE SURGICAL STRIKES AGAINST STRATEGIC AND TACTICAL TARGETS.**
- **SMART MUNITIONS REQUIRE A BATTERY THAT IS CAPABLE OF BEING STORED UP TO 20 YEARS IN THE MUNITION AND THEN FUNCTION RELIABLY WHEN USED.**
- **THE NUMBER OF BATTERY MANUFACTURERS FOR SMART MUNITIONS NEEDS TO BE INCREASED TO PROVIDE A STABLE BASE.**
- **FUTURE SMART MUNITIONS WILL REQUIRE BATTERIES WITH HIGHER POWER DENSITIES.**

NOTES

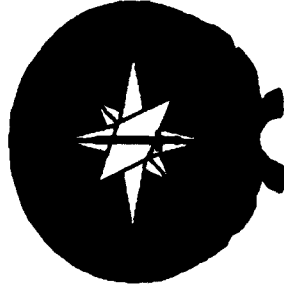
CLOSING REMARKS

**Mr. Kenneth M. Morgan
Director
Systems Management
CECOM**

AMC



SUMMARY



- ▶ **REDUCE O&S COSTS**
- ▶ **IMPROVE PERFORMANCE**
- ▶ **ENVIRONMENTALLY FRIENDLY**
- ▶ **ARMY-WIDE TEAMING**
- ▶ **ENHANCE THE ROLE OF
INDUSTRY**

NOTES

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