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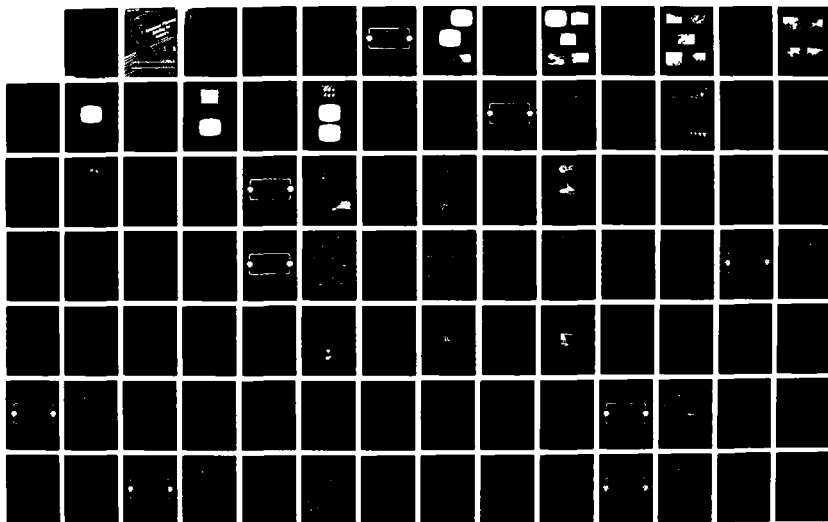
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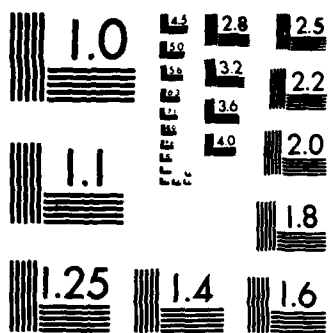
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Advanced Planning Briefing for Industry

Proceedings

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US Army Armament
Research, Development
and Engineering Center

Picatinny Arsenal
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Soviet Military Power



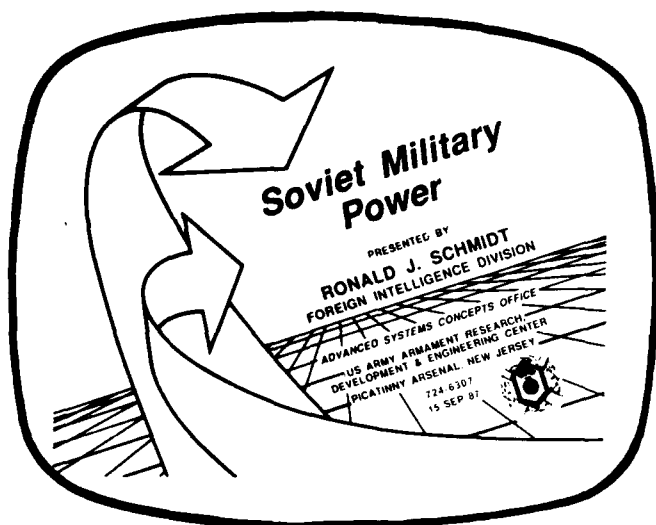
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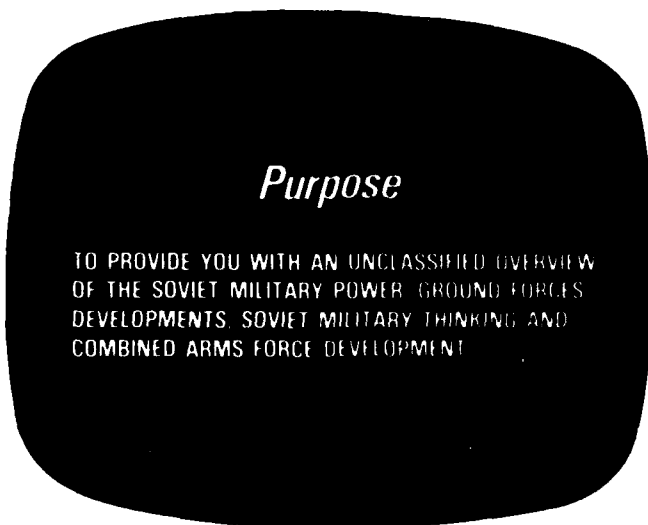


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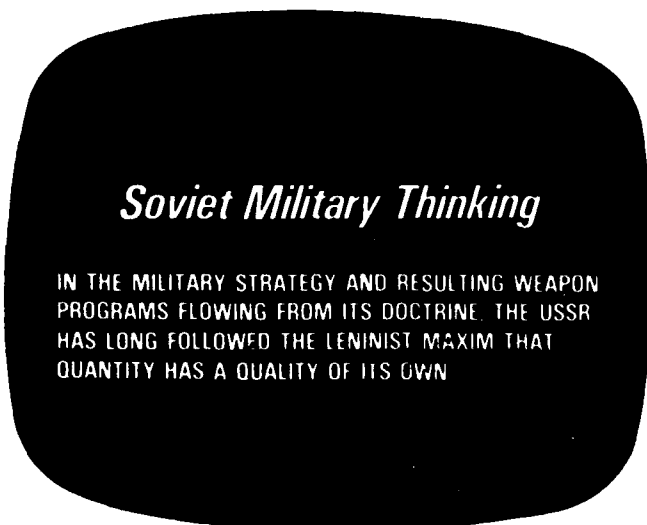
Mr. Ronald J. Schmidt



Slide #1



Slide #2



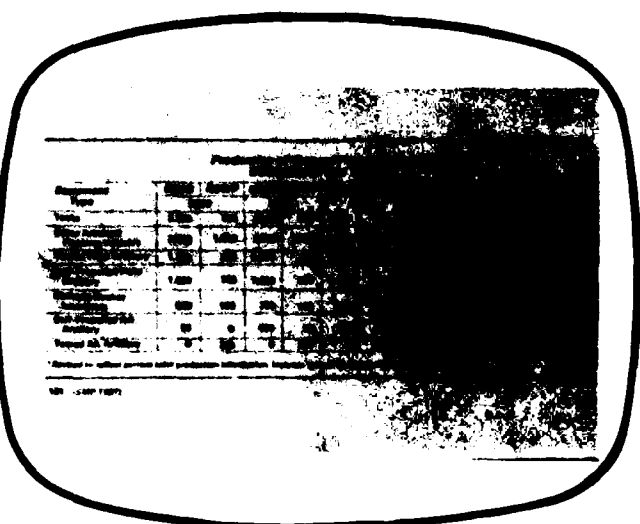
Slide #3

**US and Soviet Procurement
 of Major Weapon Systems 1977-1986**

	US	USSR
ICBMs and SLBMs	850	3 000
IRBMs and MRBMs	200	1 000
Surface-to-Air Missiles*	16 200	140 000
Long- and Intermediate- range Bombers	28	375
Fighters**	3 450	7 150
Military Helicopters	1 750	4 650
Submarines	43	90
Major Surface*** Combatants	89	81
Tanks	7 100	24 400
Artillery	2 750	28 200

* Includes naval SAMs
 ** Excludes ASW and combat trainers
 *** Excludes auxiliaries

Slide #4



Slide #5

Slide #1. The foreign threat is the key factor in the research and development (R&D) process. Without the threat to security or the well being of the free world, there would be no need for development and acquisition of weapon systems. I hope this briefing will provide you with an appreciation for the threat challenges that must be met by the U.S. and our allies.

Slide #2. Since the Soviets/NSWP represent the most probable threat to the free world. I will present you with an overview of the threat as we see it, that being the Soviet military power, military thinking, and combined arms force development. It is imperative that the Soviet military objectives and methods of achieving them be understood in order to develop systems which will defeat their weapons, and be effective deterrents.

Slide #3. In the military strategy and resulting programs flowing from its doctrine, the USSR has long followed the Leninist maxim that quantity has a quality all its own - sacrifice some quality for the fielding of more systems. They strive for a 6-1 ratio at the outset, settling for having a 3-0 ratio after the initial encounter.

To get an idea of this strategy, the following production/procurement figures are provided for the 1977-1986 time period:

Slide #4. As you can see from this comparison, the USSR procured 2,900 more military helicopters, 17,300 more tanks, and 25,450 more artillery systems than we did.

To give you a greater appreciation lets look at the ground forces materiel production figures for 1984-1986.

Slide #5. I draw your attention to the column for the USSR-1986 and all of NATO for the same year. The USSR has out produced all of NATO by:

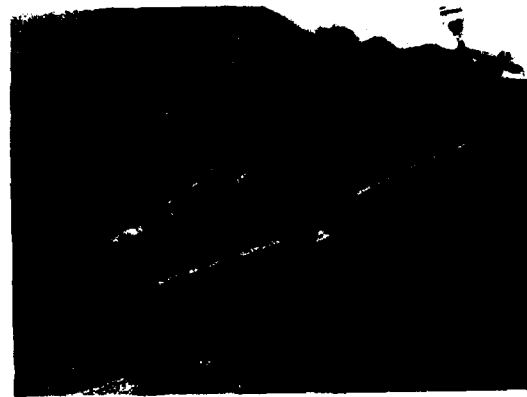
- o 2,000 tanks
- o 600 AFVs
- o 1,075 towed artillery systems
- o 775 self-propelled field artillery systems
- o 100 to 0 for self propelled anti-aircraft artillery systems

Because of the large Soviet advantage in numbers of weapons, The U.S./NATO has relied upon superior technology to ensure the continuance of an effective deterrent. U.S. technology, for various reasons, is now being challenged by the sophistication of the USSR's own growing scientific knowledge.

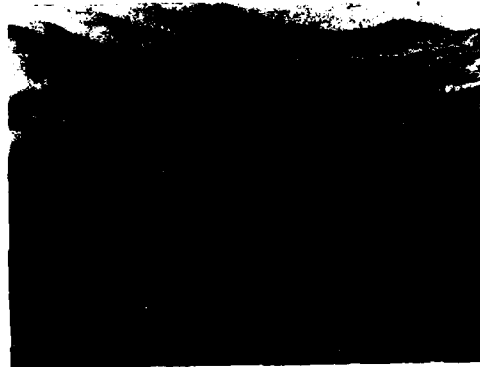
Technology Acquisition

EACH YEAR WE CONFRONT A MORE TECHNOLOGICALLY
ADVANCED SOVIET UNION, WHICH HAS BEEN AIDED BY
THEFT AND LEGAL ACQUISITION OF WESTERN TECHNOLOGY.

Slide #6



Slide #7



Slide #8



Slide #9



Slide #10

Slide #6. In their drive for technological dominance, the Soviets have established the largest national research (R&D) resource base in the world far outstripping those of the U.S. and NATO.

Slide #7. The Havoc, seen here, is similar to the U.S. Apache. Although still in prototype testing, it is expected to feature Apache type advances in performance, survivability, armament, and night/adverse weather capability.

- o Primary armament: 23-mm or 30-mm cannons
16 ATGMs (AT-1s)
- o Targets: Tanks and anti-tank helicopters

Slide #8. The Hokum, shown here, is a unique special purpose helicopter. It features a distinctive coaxial rotor system, a streamlined fuselage with a tapered nose, and retractable landing gear. It has a lightweight performance design with swept rotor tips, and:

- o Air speed - 350km per hour
- o Armament - Air-to-air missiles and rapid fire cannon

Its primary targets are low level aircraft and anti-tank helicopters.

Slide #9. Here we have the T-80 tank, a follow on to the T-64 and T-72. It is roughly the size of the T-72 but significantly faster, being powered by a 1,000 horsepower gas-turbine engine. It has:

- o A passive night vision system.
- o Collective CBR protection (overpressure, sensor/manual activated)
- o 125-mm main gun with auto loader
- o 12.7-mm machine gun
- o ATGM capable (AT-8)
- o Reactive armor
 - o Turret
 - o Frontal glacis
 - o Side skirts (tracks)

Slide #10. This next weapon is the 152-mm self-propelled howitzer. It is capable of firing the full range of munitions (HE, HE fragmentation, chemical munitions, etc.). Most significant is that it is capable of firing nuclear rounds.



Slide #11



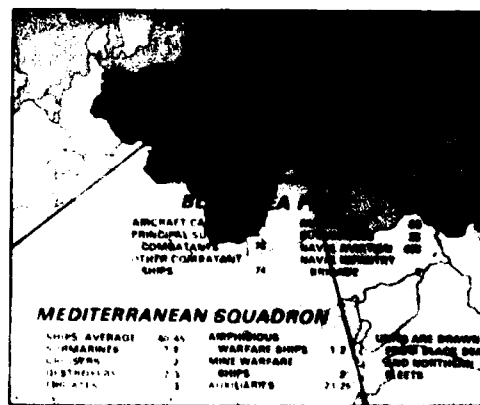
Slide #12



Slide #13



Slide #14



Slide #15

Slide #11. The final example is the BMP-2, which is a Bradley-type armored personnel carrier/infantry fighting vehicle. This BMP has:

- o An improved engine, drive train, and better off road performance than its predecessor.
- o A 30-mm rapid-fire gun in place of the 73-mm gun on earlier BMPs
- o The capability for carrying and firing the AT-5 anti-tank guided missile

Now then, having seen a few of their weapon systems, we will look at Soviet Theaters of Military Operations (TVD) and the number of weapon systems assigned.

Slide #12. The Soviet doctrine envisions that a war with the West would be wide in scope and waged over vast territories. Each TVD can extend a thousand kilometers or more in depth or width.

The military assets vary within a TVD and are usually determined by political objectives and enemy strength. For strategic actions, plans are formulated for the full spectrum of combat throughout the entire area. Soviet planning for the Western Theater (encompassing all of Europe) envisions three continental TVDs - Northwestern, Western, Southern - and two oceanic TVDs - Arctic, and Atlantic.

The next series of slides reflect the Soviet/NSWP military assets by TVD.

Slide #13. This organizational concept enables military planners to work out the strategy and tactics to achieve political objectives in a given geographic region, taking into consideration the capabilities of the ground forces, missiles, aircraft and ships at their disposal.

Slide #14. The same planning process is used in the Southern and Far Eastern TVDs.

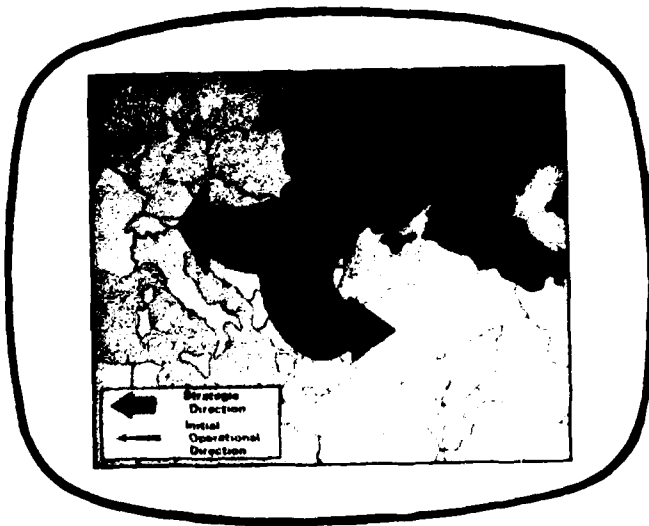
Slide #15. One thing to remember is that while a strategic operation within the TVDs may be conventional only, contingency nuclear strike planning is conducted at all levels.



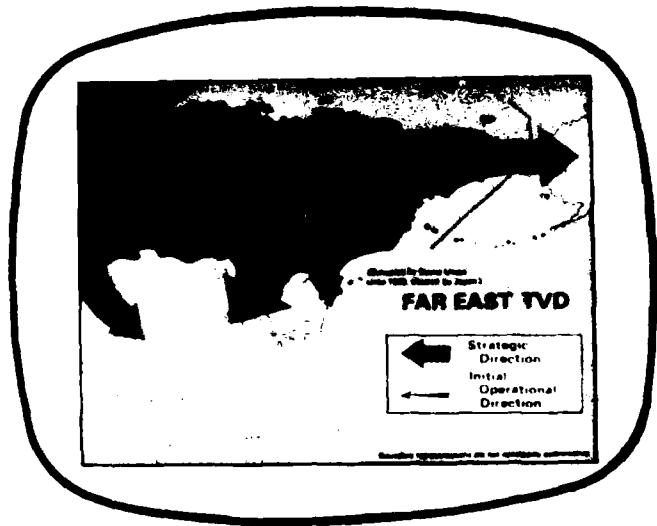
Slide # 16



Slide #17



Slide # 18



Slide #19

Slide #16. The contemporary Soviet concept of Theater Strategic Military Actions (TMA) has expanded in scope and complexity. They now plan for a TVD to consist of several fronts conducting dynamic, fast moving operations to seize strategic ground objectives located 600-800 kilometers away. Additionally, if war escalates to the nuclear level, Soviet doctrine calls for the massive use of nuclear weapons to preempt an imminent, large scale enemy attack.

The following series of slides reflects the direction of Soviet operations by TVD in a global war.

Slide #17. Specific Soviet aims in a global war would be to:

- o Defeat European NATO forces at any level of conflict, occupy NATO countries, and use Europe's surviving economic assets to assist Soviet recovery.

Slide #18. o Neutralize the US and its allies by disrupting and destroying their military forces.

Slide #19. o Deter China's entry against the USSR, and if that fails, neutralize their capability to interfere with the USSR, while avoiding land war in Asia.

- o Limit damage to vital Soviet political, military, and economic structures.
- o Dominate the postwar world in which socialism would become the basic political-economic system in all nations.

These are extremely high expectations, however, taking into account the R&D and production capabilities, the number of troops and weapons systems currently in the field/projected, and the fact that they will be fighting on their own continent. You must ask yourself, are their expectations too high?

Soviet Tactical Concerns

NATO'S TECHNOLOGICAL SOPHISTICATION

NATO'S DEEP ATTACK DOCTRINE

SURVIVABILITY OF NATO FORCES

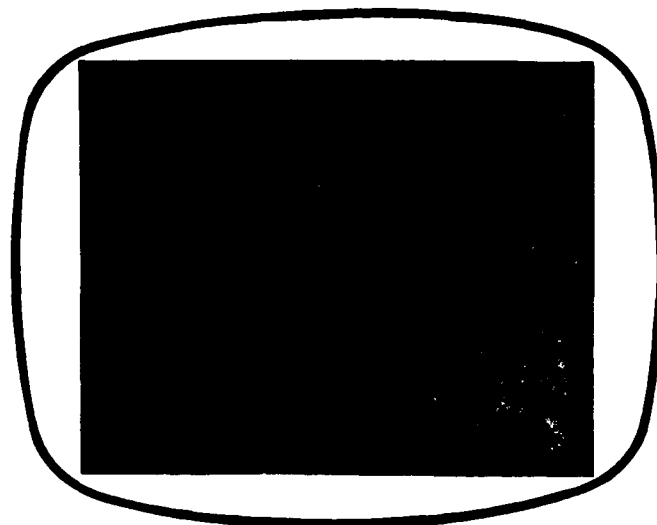
Slide #20

Slide #20. The Soviets have not developed their aims/goals without considering NATO capabilities. Despite their overwhelming superiority in numbers, the Soviets are concerned that fundamental changes in the nature of theater warfare, particularly in the crucial Western TVD opposite NATO's Central Region, may call into question their capability to obtain victory by rapid offensive operations. These changes include:

- o Growing technological sophistication and lethality of NATO's armor and anti-armor systems, artillery, close combat support, attack helicopters, electronic warfare, and command, control, communications and intelligence C3I systems.
- o NATO's development of deep attack doctrines such as the U.S. Airland Battle and NATO's follow-on forces attack concepts.
- o A shift in the traditional Soviet expectation that a theater or global conflict would be short in duration. They now believe that both sides possess enormous military capabilities that cannot be rapidly destroyed, even in nuclear conditions.

The desire to be able to conduct high speed, offensive operations despite NATO developments of deep-attack doctrines and supporting weapon systems is also influencing Warsaw Pact planning. Soviet planners now envision a combat environment with large-scale enemy ground offensives. They also realize that their key rear area facilities will be subjected to large scale attack by air forces, missiles, and reconnaissance-strike complexes.

Reflecting its position as a continental land power, the USSR has traditionally fielded large, well equipped ground forces. Current Soviet theater war-fighting concepts stress the need to expand and modernize these forces.



Slide #21

Soviet Ground Forces

● ACTIVE DIVISIONS	211
● ● MOTORIZED RIFLE DIVISIONS	150
● ● TANK DIVISIONS	52
● ● AIRBORNE DIVISIONS	7
● ● STATIC DEFENSE	2
● MOBILIZATION-BASE DIVISIONS	5
● UNIFIED ARMY CORPS	2

Slide #22

Slide #21. The typical Soviet tank division has raised its artillery and armored personnel carrier and infantry fighting vehicle holdings by 87 and 73 percent, respectively, since 1976.

- o Division personnel strength has grown 17 percent, while
- o Tank holdings remained constant at more than 300 with more than 200 IFVs.

In motorized rifle divisions APC/IFV and artillery holdings have increased 44 and 57 percent.

- o Personnel strength has grown 12 percent, while
- o Tank strength has held steady at approximately 250 with more than 400 IFV's.

In the 1980's, two more artillery divisions have been formed, and the number of non-divisional artillery brigades and regiments has increased 20 percent.

Many units are expanding from 54-gun regiments to 96-gun brigades.

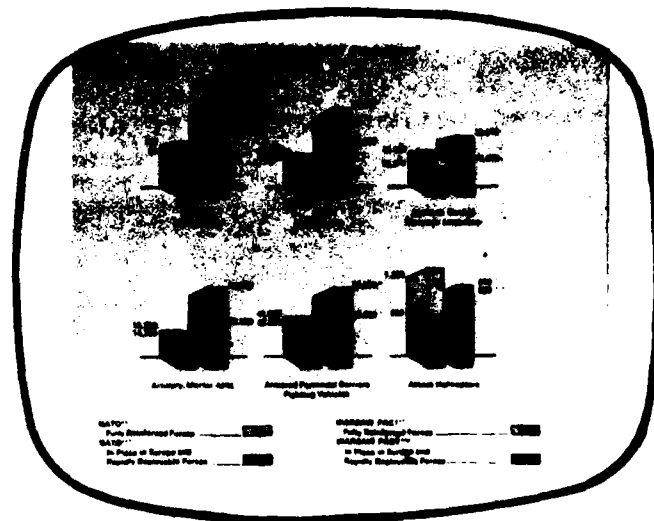
Additionally, seven air assault brigades were formed.

Slide #22. The Soviet ground forces are reflected on this slide. The Unified Army Corps are approximately twice the size of divisions (20,000 personnel) and are well suited to function as operational maneuver groups to execute deep operations into the enemy rear.

The Mobilization Base Divisions are at varying degrees of readiness, 40 percent being Cat I or 75% (plus) strength and able to activate/depart garrison within 24 hours of an emergency. The remaining divisions are less equipped/responsive.

Soviet ground forces also have an extensive array of non-divisional units assigned, including tactical surface-to-surface missiles, artillery, and air defense, making them true "combined arms" organizations.

The Soviet ground forces now consist of 211 active and 5 inactive mobilization-base divisions. Of the active divisions, 150 are motorized rifle, 52 are tank, 7 are airborne, and 2 are organized for static defense. Two additional formulations have been expanded into unified army corps. These corps are about twice the size of divisions and are well suited to function as operational maneuver groups to execute deep operations in the enemy rear area.



Slide #23

53,000 MAIN BATTLE TANKS
59,000 APC/IFVS
20,000 ARTILLERY SYSTEMS
11,000 MORTARS
7,000 MRLS
12,000 ANTI-AIRCRAFT ARTILLERY
1,000 SSMS
4,400 HELICOPTERS
- AND -
MORE THAN 2 MILLION PERSONNEL

Slide #24

Conclusion

NOVEL SOLUTIONS MUST BE SOUGHT TO GIVE OUR FORCES
EVERY PRACTICABLE ADVANTAGE IN THE AREAS OF
MANEUVER FIRE SUPPORT SUPPRESSION RECONNAISSANCE
ORGANIC DEFENSE AND COMBAT SUPPORT

Slide #25

Slide #23. Reflected on this slide is a NATO - Warsaw Pact comparison in Europe. As you can see, the only area in which we have a lead is in attack helicopters. These figures also only include modern equipment, late '70s and '80s. They do not reflect the older systems expected on the battlefield.

Slide #24. In summary, the Soviets present a formidable threat with an overall force containing the systems reflected here:

- o 53,000 main battle tanks
- o 59,000 APC/IFVs
- o 29,000 artillery systems
- o 11,000 mortars
- o 7,000 MLRS
- o 12,000 Anti-aircraft artillery
- o 1,600 SSMS
- o 4,400 helicopters
- and
- o more than 2 million personnel

In wartime they can field 27 combined arms and tank armies, and 10 army corps not including the unified army corps. At the outset of war, the Soviets and their pact allies can form at least 15 fronts while still maintaining a strategic reserve. (The front contains 2-5 armies.) Up to four first echelon fronts may be organized within a TVD, this most likely being in the Western TVD with 2-4 fronts being directed at the U.S. V and VII Corps.

Slide #25. It becomes apparent that novel solutions must be sought to give U.S. and NATO forces every practicable advantage in the areas of maneuver, fire support/suppression, reconnaissance, organic defense, and combat support. Greater numbers of personnel and weapons can be overcome by providing our fighting forces with superior weapon systems.

This is the challenge to both the combat and materiel developer communities. Working together you can, and must meet/defeat the threat.

Thank you.

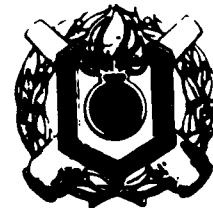
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Mission Area Material Plan (MAMP)



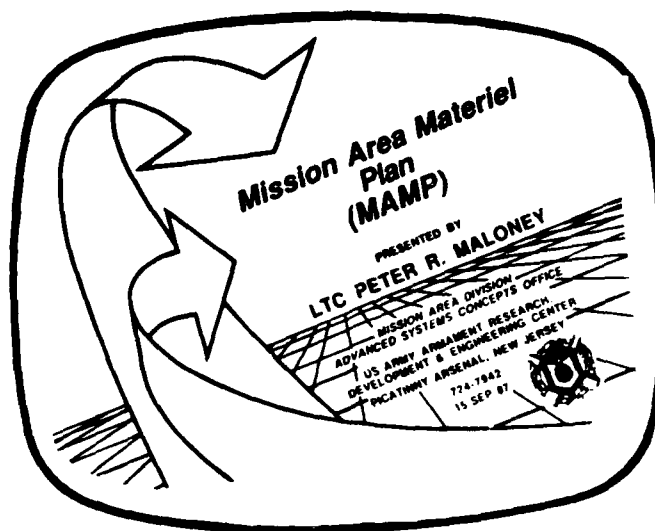
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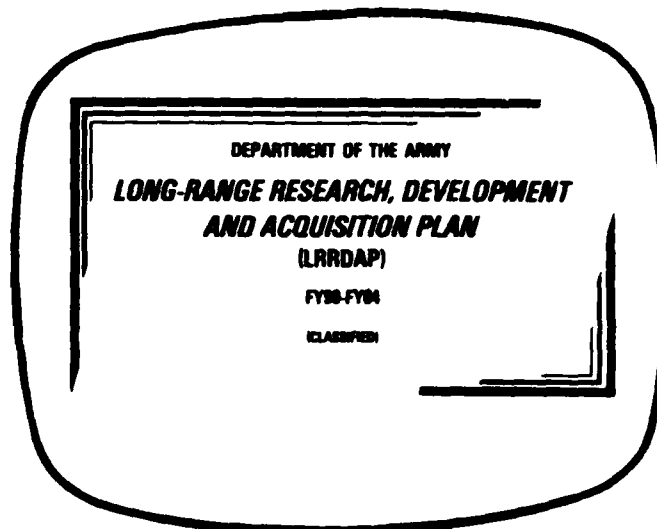


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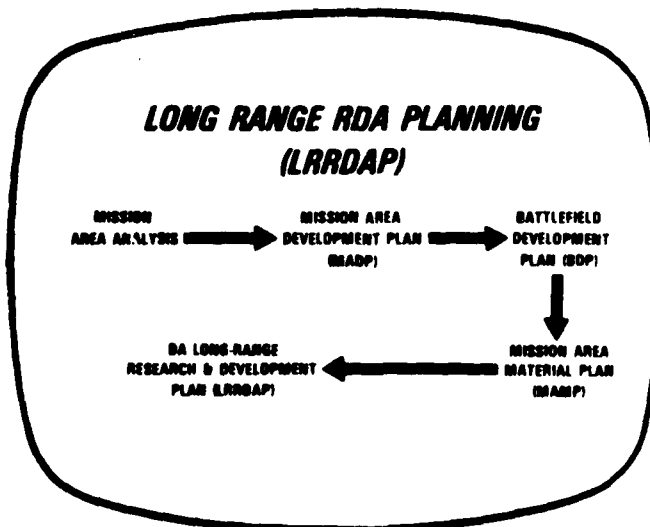
LTC Peter R. Maloney



Slide # 1



Slide # 2



Slide # 3

Slide #1. Good morning. I am LTC Peter R. Maloney, of the Mission Area Division of the Advanced Systems Concepts Office, U.S. Army Armament Research, Development and Engineering Center, Picatinny Arsenal, New Jersey.

The purpose of this briefing is to provide a broad-brush overview of a relatively new planning tool called the Mission Area Materiel Plan. We will discuss the process by which this plan is developed as well as how it interacts with the formulation of the Department of the Army Long Range Research Development and Acquisition Plan (LRRDAP).

Before we discuss the MAMP, let's first discuss the LRRDAP.

Slide #2. The LRRDAP is a classified, Department of the Army document for internal use which displays research, development, and procurement programs in terms of dollars and years that supports the overall Army materiel acquisition strategy.

The LRRDAP is organized into several volumes. Each volume represents a DA Mission Area (i.e. Fire Support, Close Combat) and is made up of Program Development Increment Packages (PDIPS). These PDIPS are written to:

- o Provide a narrative of what system or systems are contained in that package.

- o Prioritize programs in the Program Objective Memorandum (POM) Years, and,

- o Project program development and procurement profiles through the Extended Planning Annex (EPA) Years.

Thus, the LRRDAP covers a 15 year time frame, and provides the funding guidance from the Army leadership. The LRRDAP, currently being addressed, is for the years FY90 thru FY04.

Slide #3. The LRRDAP is actually the final planning document resulting from several efforts. Each TRADOC school, based upon the threat, conducts a Mission Area Analysis to determine in what areas they are deficient. Next they create a Mission Area Development Plan which lays out how they intend to overcome those deficiencies. The next step is a prioritization of deficiencies starting from most urgent needs which is titled the Battlefield Development Plan (BDP). The MAMP then adds materiel solutions and becomes the combined User (Combat Developer), and Materiel Developer input to the LRRDAP.

MAMP RESPONSIBILITIES

MANAGED AND IMPLEMENTED JOINTLY BY:



DCS FOR DEVELOPMENT ENGINEERING & ACQUISITION

• MATERIEL COORDINATION DIVISION

TRADOC



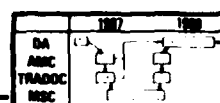
DCS FOR COMBAT DEVELOPMENT

• SYSTEMS MANAGEMENT DIRECTORATE

Slide # 4

MISSION AREA MATERIEL PLAN

IT'S A PROCESS THAT SYSTEMATICALLY FOCUSES



RDA PROGRAMS
AND
RESOURCES



On Solving Battlefield Deficiencies!

Slide # 5

MISSION AREA MATERIEL PLAN (MAMP)

- FOCUS RDA TO SOLVE DEFICIENCIES
- ADDRESS USER NEEDS
- PRIORITIZE RESOURCES TO PAYOFF'S
- ARTICULATE INVESTMENT STRATEGY TO HIGH LEVEL DECISION MAKERS

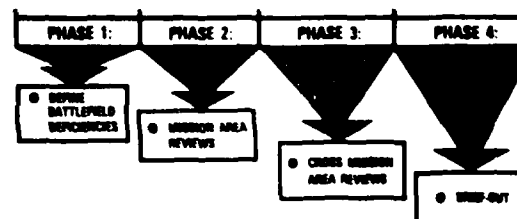
Slide # 6

MISSION AREAS

FIRE SUPPORT	NUCLEAR, BIOLOGICAL & CHEMICAL
CLOSE COMBAT, LIGHT	INTELLIGENCE/ELECTRONIC WARFARE
CLOSE COMBAT, HEAVY	COMMUNICATIONS
AVIATION	COMMAND AND CONTROL
AIR DEFENSE	COMBAT SERVICE SUPPORT
TRAINING	ENGINEERING & MINE WARFARE
ARMOR	SPECIAL OPERATIONS FORCES
BASE OPERATIONS	MATERIEL ACQUISITION BASE

Slide # 7

MAMP 4 PHASE PROCESS



Slide # 8

Slide #4. I must emphasize that the MAMP is a joint effort between TRADOC and AMC with the builder making every effort to provide the User with the equipment he needs in the timeframe he needs it, and with emphasis on his priorities.

Slide #5. Although AMC and TRADOC are the proponents of the MAMP, they are not the only players. This is a fully coordinated, multiappropriation process that includes key players from HQ DA, (ODCSOPS), Secretary of the Army (SARDA), MSCs, PEOs, PMs, TRADOC Schools, and all major directorates from HQ AMC and HQ TRADOC. The process systematically addresses the User's deficiencies and proposes system development and procurement strategies that will provide acceptable materiel solutions in a timely manner.

Slide #6. In bullet form, the objectives of the MAMP are :

- o To focus the Army's Research Development and Acquisition Program on solving critical battlefield deficiencies,
- o To address the User's needs in a priority driven sequence ,
- o To identify all resources available, and to place those resources into programs that provide the highest payoff, and,
- o To articulate an investment strategy which is executable, addresses the Army's needs and is defensible to the Department of the Army, the Department of Defense, and to Congress.

I've been talking about what the MAMP is and what it intends to do. Before we look at the process in more detail, let's look at what the Mission Areas are:

Slide #7. The Mission Areas are listed here. Their titles alone should give a pretty good indication of what they deal with. Those in red (Fire Support and Close Combat, Light) are the ones for which my office is Executive Agent, and we are responsible for putting them together. The areas in yellow are Mission Areas that ARDEC is involved with to varying degrees. Those in green we do not have much involvement with.

Slide #8. Each of the Mission Areas follow this 4 phase process in developing their MAMP. We will discuss each phase in more detail, but the major effort in each phase is as shown.

PHASE 1: DEFINE BATTLEFIELD DEFICIENCIES

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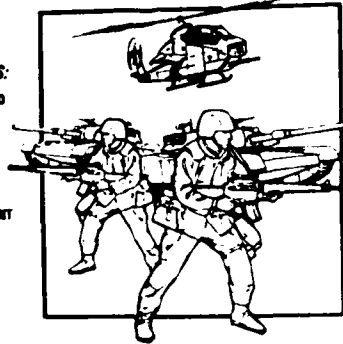
- THREAT ASSESSMENT

MISSION AREA ANALYSIS:

- DEFINE/RANK BATTLEFIELD DEFICIENCIES
- IDENTIFY INITIAL MATERIEL SOLUTIONS

OUTPUT:

- BATTLEFIELD DEVELOPMENT PLAN (BDP)



Slide # 9

PHASE 2: MISSION AREA REVIEW

INPUT:

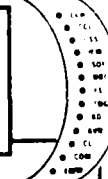
- BDP
- LOG 71
- DRAFT LOGRAP
- FISCAL FORCE STRUCTURE GUIDANCE

ANALYSIS:

- DEVELOP MIA STRATEGIES
- REVISE REALIZED RESOURCES
- ASSIGN CONTRIBUTION VALUES

OUTPUT:

- MISSION AREA PROGRAM
- BUDGET ISSUES



Slide # 10

PHASE 3: CROSS MISSION AREA REVIEW

INPUT:

- PROGRAM & BUDGET - EACH MISSION AREA (MA)
- UNRESOLVED ISSUES
- UNFUNDED

ANALYSIS:

- PRIORITIZE PROGRAMS
- RESOLVE ISSUES
- CROSS MA FUNDING

OUTPUT:

- CROSS MA PROGRAM & BUDGET/ISSUES



Slide # 11

Slide #9. In the first phase of the MAMP process, both the Combat Developer and the Materiel Developer do a comprehensive assessment of the Soviet threat (current and future) as it relates to each Mission Area. This assessment identifies specific threat capabilities which impact on our current and developmental programs and our ability to deal with the threat.

TRADOC then defines those Battlefield Deficiencies (or limitations in our capability to defeat the threat) and establishes a priority based upon criticality. At the same time, AMC and TRADOC along with the other principals identify deficiencies that can be resolved (in full or in part) by materiel solutions.. In the process of identifying these materiel or system solutions, technology barriers are identified which stand in the way of achieving or fielding the materiel solution. SO, at the end of phase 1, we have a priority listing of Battlefield Deficiencies in the form of the TRADOC BDP, along with proposed materiel solutions and tech barriers that must be overcome to realize those materiel solutions.

Slide #10. With the BDP in hand along with a similar plan that deals specifically with logistics deficiencies (Log 21 - a draft LRRDAP and other pertinent fiscal and force structure guidance) each Mission Area with all the players construct a set of programs which will contribute to the solution of Battlefield Deficiencies, and are executable under current funding guidance. To develop these strategies, the overriding thought is to apply the resources (time and money) to the highest priority programs which make the greatest contribution to resolving deficiencies.

Thus, the product of this phase is the Mission Area Manager's recommendation to HQs TRADOC and AMC on his Mission Area RDA strategy along with any internal resource moves and budget issues for systems that he needs but just cannot afford to do.

Slide #11. In the third phase, a Mission Area Integration Team composed of HQ Department of the Army, SARDA, Army Materiel Command, and Training and Doctrine Command members, with expertise in all Mission Areas, analyzes the program input from each Mission Area, prioritizes each of the programs, and attempts to resolve unfunded budget issues across Mission Areas. The Mission Area Integration Team further develops a set of unresolved budget issues which must be forwarded for review and resolution.

PHASE 4: BRIEF-OUT

BRIEFING TOPICS:

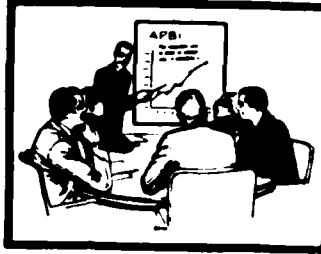
- PROGRAM (ARDBAP)
- BUDGET
- TECH BASE
- UNRESOLVED ISSUES

PRESENTED TO:

- HQ AMC/TRADOC
- 2304 *

OUTPUT TO DA:

- PROGRAM & BUDGET/ISSUES



Slide # 12

SUMMARY

- RBA PROGRAMS FOCUS ON MATERIEL SOLUTIONS TO BATTLEFIELD DEFICIENCIES
- SCARCE RESOURCES APPLIED TO MOST IMPORTANT/CRITICAL USER'S NEEDS
- PROCESS INTEGRATES BATTLEFIELD DEFICIENCIES, RBA PROGRAMS, TECH BASE, RESOURCES & SPECIAL INTEREST ITEMS
- RBA INVESTMENT STRATEGY DEFINES THE FUTURE

Slide # 13

ANTICIPATED PAYOFF

- COMMON TOOL FOR ALL PLAYERS
- DA STAFF USEABLE PRODUCT
- REDUCES UNFUNDED REQUIREMENTS
- REFLECTS STRATEGIES
- ASSISTS IN PLUS-UP/DECREMENT DRILLS

Slide # 14

• **Slide #12.** The final phase in the MAMP Process takes the integrated AMC and TRADOC combined Mission Area Materiel Plan through a series of General Officer reviews to obtain final approval for submission to the Department of the Army as input to the LRRDAP. The final product contains the Research, Development and Acquisition Strategies; Technology Base Requirements; Deficiency Resolution; and Resources and Unfunded Issues for all Mission Areas.

Slide #13. In summary, what the Mission Area Manager is charged to do during the development of his Materiel Plan is to assure that his programs focus on the materiel solutions to the Battlefield Deficiencies. In so doing he must assure that:

- o Our critical programs are fully funded (in priority),

- o The Battlefield Deficiencies; RDA Programs; Tech Base, Resources and Special Interest Items are completely reviewed and integrated,

- o An executable Army RDA investment strategy is developed that correctly defines our future requirements, and lays out a logical plan on how to get from start to end.

Slide #14. The MAMP Process plays a vital role in developing a Mission Area Strategy for programs in the research, development and acquisition process. The joint involvement of the Materiel Developer and the Combat Developer in establishing an executable program based upon a logical and supportable strategy ensures that equipment in Research, Development and Acquisition Programs will solve the Battlefield Deficiencies projected for the future and give the soldier in the field a strong advantage over his enemy counterpart.

The payoff in bullet form is shown here, but the real bottom line is the last one.

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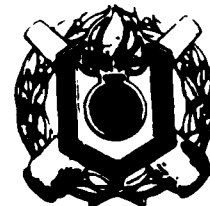
Technology Trends in Artillery Weapons



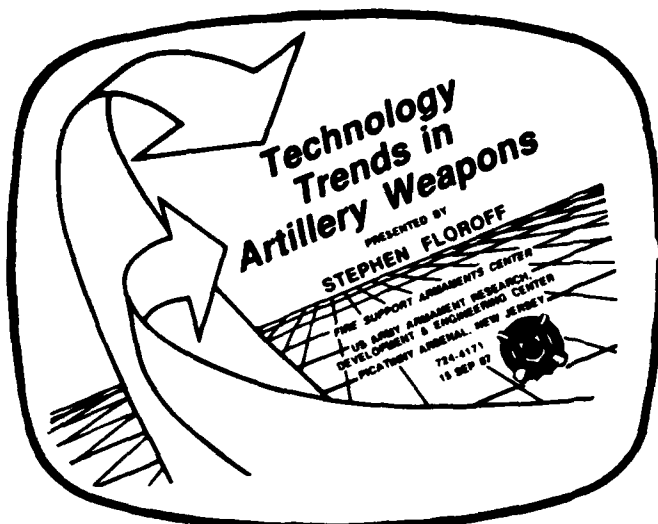
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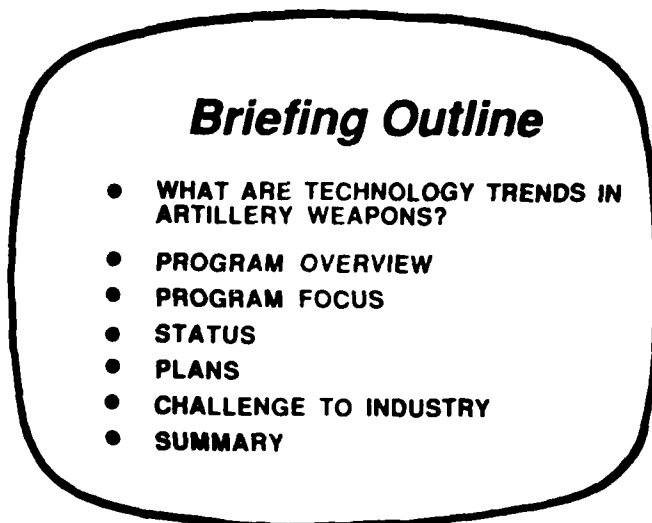
Mr. Stephen Floroff



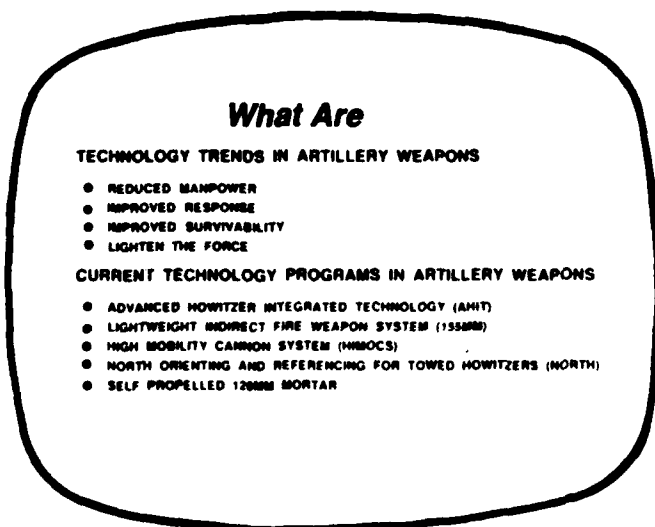
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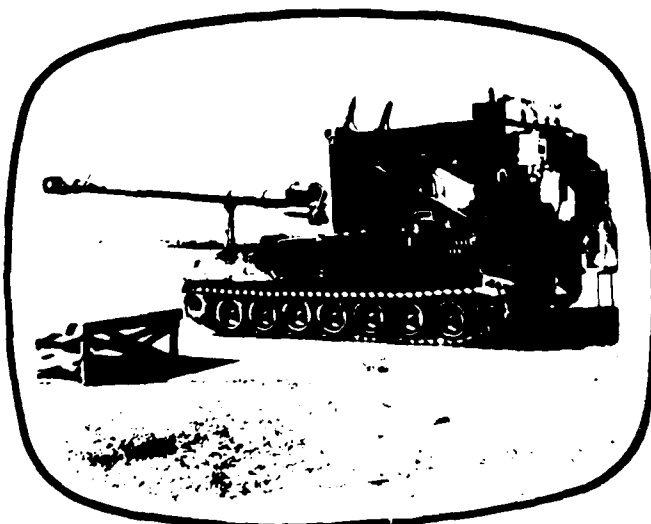
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Slide # 3



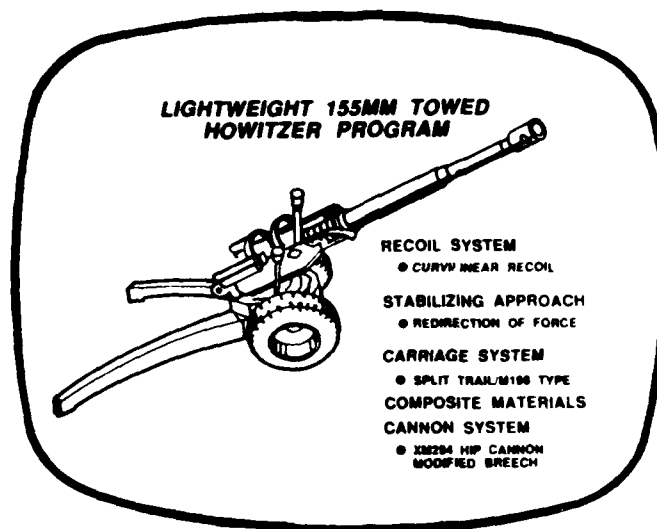
Slide # 4

Slide #1.- Good afternoon ladies and gentlemen. My name is Stephen Floroff. I'm with the Artillery Armaments Division of Fire Support Armaments Center here at ARDEC. I'll be discussing technology trends in artillery weapons.

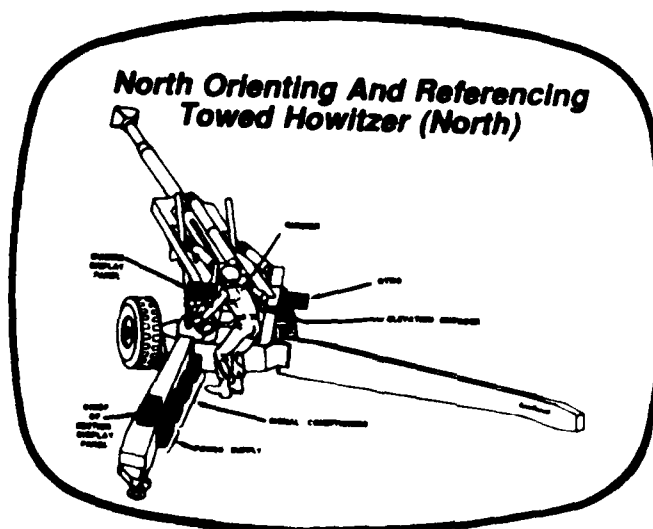
Slide #2.- The briefing outline is as follows... I'll be describing five programs that we are currently working on as an overview, what our primary focus is regarding these programs, current status, future plans, and the challenges to industry we feel should be brought to your attention.

Slide #3.- There are four technology trends we are pursuing for artillery... The first three I'm sure are very familiar to many of you. The fourth bullet reflects our increasing emphasis on lightweight design... and by this we mean investigating lightweight material applications for artillery weapons.... We currently have 5 programs which address these technology trends... The first and fifth bullets deal with self-propelled artillery... and the second and fourth involve towed weapons... the third bullet, indicated as the HIMOCs effort is quite frankly a little bit of both! I'll elaborate on each of these programs.

Slide #4.- The robotic howitzer test bed, now known as the Advanced Howitzer Integrated Technology effort or AHIT program is shown here being demonstrated at Ft. Sill, Oklahoma in August '86. This weapon proved for the first time the viability of robotics and artificial intelligence in an artillery environment. The weapon incorporated an autonomous fire control system, robotic ammunition handling mechanism, automated primer feeder, slide block breech, uni-charge combustible cased propellant as well as a remote driving capability. As I mentioned, this effort has evolved into the AHIT (Advanced Howitzer Integration Technology) program, addresses the trend toward reducing manpower, as well as improving system response and survivability. The potential now exists for 24 hour full performance capability from self-propelled artillery weapons. The robotic howitzer test bed demonstrated for the first time a truly autonomous artillery weapon to the user community and verified with real world hardware numerous artillery innovations. This test bed is only the beginning... we need industry to elaborate on these innovations we have demonstrated, and bring them to a practical, affordable reality, if I may note here... an excellent synopsis of the robotic test bed at Ft. Sill can be found in the April 87 edition of International Defense Review Magazine.



Slide # 5



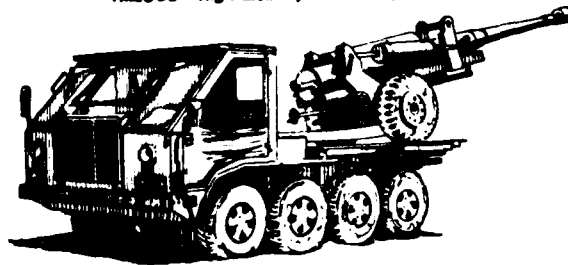
Slide # 6

Slide #5.- Our lightweight artillery program addresses the trend toward lightening the force. BMY, a division of HARSCO Corporation, York, PA. is currently developing a 9000 lb. towed artillery demonstrator with performance capabilities equivalent to the presently fielded M198 system. By performance I mean primarily range, in a weapon system that is 40% lighter than the M198. Significant innovations in the BMY approach include graphite epoxy composite for the trails, and to maintain firing stability, a unique curvilinear recoil path which effectively re-directs force downward during firing. This re-direction of force is possible due to the nature of the curvilinear approach, which essentially permits the recoiling parts to travel through an arc during weapon recoil.

Through the utilization of advanced composite materials, and a unique recoil mechanism design we believe BMY is on the right track towards a 9000 lb. system demonstrator. We feel our lightweight artillery effort just scratches the surface of potential applications for composite materials and unique energy absorption methods in an artillery environment, we are looking to industry for more ideas in these areas.

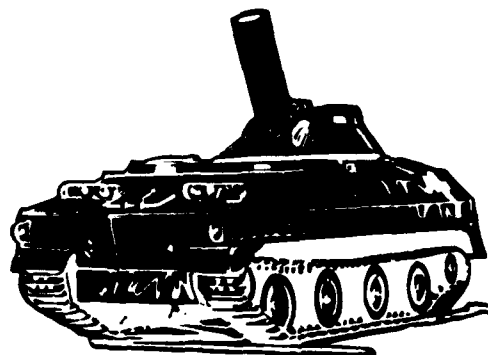
Slide #6.- The North Orienting and Referencing Towed Howitzer known as the North Demonstration, addresses the trends to reduce manpower, as well as improve response and survivability of towed weapons. What we've done is to mount an automated gun positioning system on-board a towed howitzer. The system is capable of maintaining a grid north reference at all times; effectively eliminating the need for traditional off carriage references. Since no off-carriage references are required, response time is significantly reduced. An additional advantage of incorporating an automated gun positioning system for towed weapons would be to bring towed artillery into the same operational scenario as the self-propelled HIP howitzer with its on-board Modular Azimuth Positioning System known as MAPS. We plan to demonstrate this system to the user in 1QTR FY88. This demonstration's purpose is to establish feasibility only. What remains to be done is to optimize the equipment by reducing weight, bulk and power requirements and of course to reduce per unit costs.

HMMCS - High Mobility Cannon System



Slide #7

120MM UNDER ARMOR MORTAR CONCEPT



Slide #8

Program Overview

SELF PROPELLED ARTILLERY WEAPONS

OBJECTIVE

EXPLOIT GAPS AND OVERSIGHTS
TECHNOLOGIES TO REDUCE BACKPOWER
IMPROVE RESPONSE IMPROVE SURVIVABILITY
IN SELF PROPELLED 120MM ARTILLERY AND
120MM MORTAR SYSTEMS

TECHNOLOGY BARRIERS

- COMPACT LIGHTWEIGHT ASSEMBLY LOADERS
- DIAGNOSTICS PROGNOSTICS
- ADVANCED GUN PROPULSION

NEEDED TECHNOLOGIES

- ADVANCED WEAPON AUTOMATION
- AMBUSH SYSTEMS
- UNCHARGE LP ST
- AUTOMATED RE-SUPPLY LOGISTICS

NEXT GENERATION MOTIONAL SYSTEMS

- AFAS
- SELF PROPELLED UNDER ARMOR
120MM MORTAR SYSTEM

Slide #9

Slide #7.- The High Mobility Cannon System (HIMOCS) consists of a M119 105-mm towed howitzer mounted on the bed of a unique truck chassis. The truck itself is being supplied by the Standard Manufacturing Company of Dallas, Texas. The suspension system on this vehicle is what makes it so unique; and affords us the opportunity to carry the M119 over very rough terrain. We will also be incorporating the Modular Azimuth Positioning System, or MAPS unit, on this system for autonomous navigation and gun position. We hope to verify that this unique adaptation of existing hardware will demonstrate improved response and survivability from the M119 system. The HIMOCS effort is one example of what we call... "Hybrid Artillery" that is, re-configuring existing hardware to satisfy one or all the technology trends previously mentioned. We look to you, industry, for other adaptations of existing hardware which will meet our technology trends.

Slide #8.- In addition to the preceding efforts the Fire Support Armaments Center is investigating concepts to place a 120-mm mortar inside a motorized armored vehicle. Conceptually we're showing the mortar mounted on a Sheridan chassis, but of course the mortar could be adapted to any of the Army's armored family of vehicles. The development of this technology has great potential to provide enhanced infantry fire support and to increase the capability to shoot and move rapidly to counter artillery and mortar fires. Technically, we're envisioning a turret mounted, automatically loaded, breech operated mortar system in a closed armored vehicle. The system addresses our previously described trends towards improving survivability and response times through rate of fire enhancements, and increased accuracy.

Slide #9.- An overview of our technology trends can be divided into self-propelled and towed artillery weapon systems. I'll discuss the self-propelled weapons first. Our goals are to reduce manpower and improve survivability and response of self-propelled and motorized mortar systems. The barriers we face are the need for compact, lightweight ammunition loaders, and increased emphasis on diagnostics/prognostics for the more complicated hardware we are introducing, and gun propulsion schemes to enhance firepower. Technologies we wish to investigate include advanced weapon automation with an increasing emphasis on artificial intelligence and expert control systems. Gun propulsion schemes of interest include electro-thermo and liquid propellant propulsion methods as well as the more near-term uni-charge propellant packaging schemes. Logistics and automated re-supply must also be increasing for the above technologies to be viable. We envision these technologies to play an increasing role in the emerging AFAS or advanced field artillery system and our concept studies involving the mortar.

Program Overview

TOWED ARTILLERY WEAPONS

OBJECTIVE:

PROVIDE THE LIGHT DIVISION WITH
HEAVY MOBILE, LIGHTWEIGHT TOWED
ARTILLERY SYSTEMS HAVING IMPROVED
RESPONSE, AND SURVIVABILITY

TECHNOLOGY BARRIERS:

- LOW COST COMPACT LAND NAVIGATION
- APPLICATION OF COMPOSITE MATERIALS
- RECON. ENERGY MANAGEMENT
- ELECTRICAL POWER SYSTEMS FOR TOWED ARTILLERY

NEEDED TECHNOLOGIES:

- LOW COST HIGH PERFORMANCE LIGHTWEIGHT MATERIALS
- LOW COST COMPACT LAND NAVIGATION
- HIGH PERFORMANCE, LIGHTWEIGHT RECON. SYSTEMS
- HIGH PERFORMANCE, COMPACT POWER GENERATION SYSTEMS

NEXT GENERATION/NOTIONAL SYSTEMS

- LIGHTWEIGHT 100MM HOWITZER
- HYBRID ARTILLERY SYSTEMS

Slide # 10

Program Focus

- APPLY ADVANCED AUTOMATION TECHNIQUES TO ARTILLERY WEAPONS
- ADVANCE THE STATE OF THE ART IN COMPOSITE MATERIAL APPLICATIONS
- ADVANCE THE STATE OF THE ART IN RECON. ENERGY MANAGEMENT
- CONDUCT PROOF OF PRINCIPLE DEMONSTRATIONS
- ENTER FULL SCALE ENGINEERING DEVELOPMENT WITH MATURE TECHNOLOGIES

Slide # 11

Slide #10.- As far as towed artillery is concerned, our objectives remain improved response and survivability, but with increased emphasis on lightweight systems to support our light division. Barriers to achieving our goals include the successful application of lightweight composite materials to the next generation of artillery weapons as well as novel approaches to recoil energy management. Improving towed artillery system response and survivability can be accomplished by introducing self-orienting electronic packages such as the previously mentioned NORTH system or even more sophisticated land navigation systems like MAPS. The driver here is cost and of course weight. Unfortunately any electronic system of this type will require power which somehow must be provided... so what we need to support our objectives are compact lightweight power generation systems for low cost land navigation packages. Our objectives for lightweight long-range artillery must also include continued investigation of new composite materials for potential application to the artillery weapon environment and recoil mechanisms which provide optimized energy dissipation. With respect to high performance recoil systems, FSAC is currently investigating the concept of actively controlling the recoil process through microprocessor controlled fluid throttling techniques. By this I mean incorporating a feedback controlled servo-valve in the recoil mechanism to consistently optimize recoil energy dissipation. Two contracts are currently on-going in this area... one with H.R. TEXTRON in Valencia, Ca. -and the other with Ares, Inc., Port Clinton, Ohio. The actively controlled recoil mechanism technology we are investigating shows promise, and we are looking for more industry interaction in this emerging field. All of the technologies I've just mentioned which will ultimately benefit from these needed technologies include the next generation lightweight howitzer and future hybrid artillery systems such as HIMOCs.

Slide #11.- Our program focus is to apply advanced automation techniques to artillery, and by that I mean automatic loading mechanisms, land navigation electronics, and artificial intelligence such that a diagnostic and prognostic capability will be possible. We intend to advance the state of the art in composite materials applications by investigating their use in artillery systems. We will continue to explore novel recoil energy management techniques because effective energy dissipation is paramount to effective, lightweight design. Of course, we will continue to conduct proof of principle demonstrations for all the emerging technologies we are exploring and ultimately enter full scale engineering development with mature technologies.

Status

ADVANCED HOWITZER INTEGRATED TECHNOLOGY (AHIT)

- AUTONOMOUS ARTILLERY DEMONSTRATION CONDUCTED IN AUG/SEP 86
- JOINT INDUSTRY/ARMY AUTOMATED ARTILLERY DEMONSTRATION PROGRAM INITIATED
- RESUPPLY MODULE SCOPE OF WORK BEING STAFFED
- UNCHARGE READY TO TRANSITION TO ADVANCED DEVELOPMENT

LIGHTWEIGHT INDIRECT FIRE WEAPON SYSTEM 155MM (LWIFWS)

- 8000LB 155MM DEMONSTRATOR FABRICATION UNDERWAY
- MICROPROCESSOR CONTROLLED RECON FEASIBILITY ESTABLISHED
- FULL SCALE 155MM MICROPROCESSOR CONTROLLED RECON MECHANISM IN FABRICATION

HIGH MOBILITY CANNON SYSTEM (HIMOCs)

- DESIGN OF M118 ON TRAILING ARM DRIVE VEHICLE COMPLETE
- VEHICLE BEING FABRICATED
- MAPS INTEGRATION INITIATED

Slide # 12

STATUS

NORTH ORIENTING AND REFERENCING FOR TOWED HOWITZERS (NORTH)

- NORTH REFERENCING, CREW DISPLAYS AND SENSOR PACKAGE MOUNTED ON M108
- PROOF OF PRINCIPLE DEMONSTRATION SCHEDULED FOR 1ST QTR 88

SELF-PROPELLED, UNDER ARMOR 120MM MORTAR

- CONCEPT INVESTIGATIONS INTO AUTOMATED TURRETED 120 MM BREECH LOADED MORTAR CONTINUING

Slide # 13

SELF - PROPELLED PLANS

PROGRAM	87	88	89	90	91	92	REMARKS
AHIT							
UNCHARGE							SUPPORTS
CAPITAL TECHNOLOGY							AT & S
RECONTE AUTO GUN/RESUPPLY							PROGRAM
TERMINAL DUTY							
RECON/TERMINAL DUTY							
HIMOCs							
DEVELOP FABRICATION							DEVELOP
TEST AT ALBA FWD							OF
SELF PROPELLED MORTAR							CAPITAL
CONCEPT STUDIES							DEVELOP
ANALYSIS							PROGRAM
AT ALBA FWD							UNDER
							RECON/TERMINAL DUTY

Slide # 14

TOWED WEAPONS PLANS

PROGRAM	87	88	89	90	91	92	REMARKS
LIGHTWEIGHT HOWITZER							
DETAIL DESIGN							DEVELOP/TEST/
FABRICATION							PROOF OF PRINCIPLE
TEST							
PROG							
PRODUCTION							PROG/TEST
NORTH							
DEMO							DEVELOP/TEST/
							PROOF OF PRINCIPLE
TOTAL (\$M)	6	8	7				

Slide # 15

Slide #12.- This is a snapshot of our program status as of today... As far as the AHIT program is concerned, this effort is considered an on going tech base activity, with our future work emphasizing the re-supply portion of the automated howitzer concept. The uni-charge combustible cased propellant was proven at our Ft. Sill demonstration and is continuing on in the development cycle... The lightweight indirect fire weapon system program has met some significant milestones... with a 9000 lb. full scale demonstrator presently being fabricated by BMV. As mentioned previously, this effort involves incorporating a feedback controlled servovalve which will effectively optimize energy dissipation. Computer simulations verify the viability of the approach, and we will be conducting live fire testing in October to verify the simulations. The October test will utilize a servovalve provided by H.R. TEXTRON. We also have a ground design microprocessor controlled recoil mechanism in fabrication by ARES, Inc. which we expect to be completed in 2QTR FY88... With regard to the HIMOCS program, the truck bed has been re-designed to accommodate the M199, and the HIP howitzer land navigation system is being incorporated into the HIMOCS vehicle.

Slide #13.- With respect to the NORTH demonstration, we hope to take the equipment down to Ft. Sill and conduct a firing exercise as soon as possible... The self-propelled mortar effort is still in the concept formulation phase... we hope to maintain user interest and continued input.

Slide #14.- Our plans through FY92 are as follows... for self-propelled weapons the AHIT program, including the re-supply effort, is an on-going technology demonstration program. The HIMOCS program is currently scheduled for test and evaluation in FY89/90 timeframe. A developmental decision will be made pending a successful demonstration. Self-propelled mortar studies will continue. Ultimately a program decision will be made pending a user requirement.

Slide #15.- For towed artillery, the lightweight howitzer program is laid out as follows; with an IPR decision scheduled for the late FY89 timeframe. After a development decision is made, FSED is estimated at 4 years....The NORTH demo is designed primarily to spark user interest in pursuing an on-board gun positioning system for towed artillery and as such is shown as a single event....Our funding profile through FY89 for both towed and self-propelled programs in millions of dollars is shown at the viewgraph, with 8 million in FY88 and 7 million in FY89.

Challenges To Industry

COMPACT/LIGHTWEIGHT AMMUNITION LOADERS

- PRESENT: 180FT WEIGHT/PAYLOAD = 15/1
- FUTURE: WEIGHT/PAYLOAD = 5/1

APPLICATION OF COMPOSITE MATERIALS TO ARTILLERY WEAPONS

- PRESENT: STRUCTURAL COMPONENTS FOR TOWED ARTILLERY
- FUTURE: SELF PROPELLED ARTILLERY

HYBRID ARTILLERY SYSTEMS

- PRESENT: HIMOCs
- FUTURE: UNDER ARMOR MORTARS

LOW COST LAND NAVIGATION SYSTEMS

- TODAY: \$5 - 100K
- FUTURE: 20 - 25K

Slide #16

Summary

I. PROJECT SUMMARY

- | | |
|-------------------------|---|
| • AMIT | • CONTINUED EVALUATION UNDERWAY |
| • LIGHTWEIGHT HOWITZER | • 3QFY88 DEMO PLANNED |
| • HIMOCs | • 4QFY88 DEMO PLANNED |
| • NORTH | • 1QFY89 DEMO PLANNED |
| • SELF PROPELLED MORTAR | • CONCEPTS VERIFY VIABILITY OF APPROACH |

Slide #17

Summary

II. INDUSTRY PARTICIPATION NEEDED IN THE FOLLOWING AREAS

• AUTOMATION/CREW REDUCTION

FY89-91.....

- FABRICATE SECOND GENERATION ROBOTIC AUTOLOADER
- DESIGN/MANUFACTURE NEXT GENERATION CONTROL SYSTEMS

• COMPOSITE MATERIALS APPLICATIONS

FY89-93.....

- PSD FOR NEXT GENERATION LIGHTWEIGHT HOWITZER
- NEW APPLICATIONS FOR COMPOSITE MATERIALS

• UNDER ARMOR MORTAR

FY89-93

- AUTOLOADER
- VEHICLE INTEGRATION

Slide #18

Slide #16.- We see many challenges to industry in the artillery area. The lightweight theme is becoming increasingly important, both in self-propelled and towed artillery, as sub-systems such as ammunition loaders are incorporated into the next generation self-propelled artillery. Weight impact will become increasingly important. We need to foster a lightweight design methodology for future systems and we see that coming about with more emphasis on composite materials application. We also feel the concept of "Hybrid Artillery" or the adaptation of existing hardware to meet our technology trends has great potential for industry participation. As far as land NAV systems are concerned I think it can be said this is a rapidly maturing technology for artillery systems: our NORTH demonstration will verify the viability of land NAV for towed artillery, but to successfully apply this technology to towed systems, the "per tube" costs must be reasonable. Reasonable in our view means a 75% reduction in per unit costs over what we have now. This is no easy feat, but can certainly be classified as a challenge! We look to industry for ways to reduce costs for future land NAV systems.

Slide #17.- As far as our 5 projects go, their schedules are shown here, with AHIT essentially an on-going tech base effort, 3 demos planned for FY88, and concept studies continuing on the under armor mortar concepts. We need your participation in pursuing innovative hybrid artillery systems, new composite material applications, integration of automated systems such as ammunition loaders and fire control systems to our under armor mortar concepts, and continued emphasis on automation and crew reduction in future self-propelled artillery systems. Thank you for your attention.

Slide #18.- As far as Industry's participation in our future work is concerned, we're planning to award contracts for fabrication of the next generation robotic autoloader and associated control systems in the FY89 to FY91 timeframe. Pending a user requirement for the self-propelled mortar, an autoloader and control system would be required for that program also. In the area of lightweight design, we feel composite material applications for artillery will increase, and we expect a contract award for the next generation 155-mm lightweight towed howitzer. We also may see contract activity relating to some as-of-yet unknown composite technology. The under armor mortar may also be a full fledged program in the FY89 to FY93 timeframe, and that will require a system level contractual effort. Ladies and gentlemen, what I've just described is where we see the technology trends in artillery heading for the next 5 years. I thank you for your attention.

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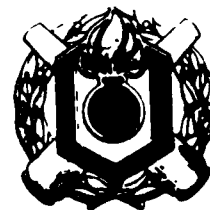
Electromagnetic Launch Technology



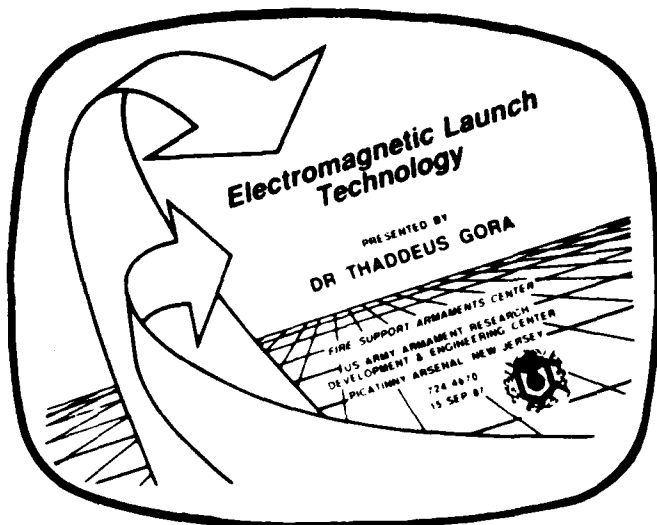
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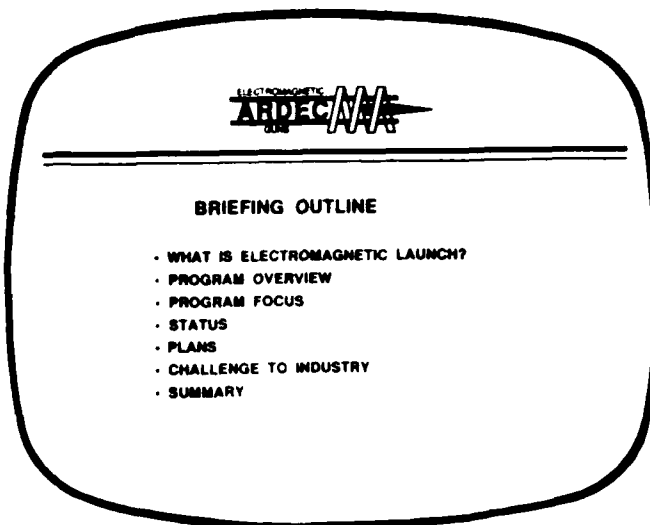
Dr. Thaddeus Gora



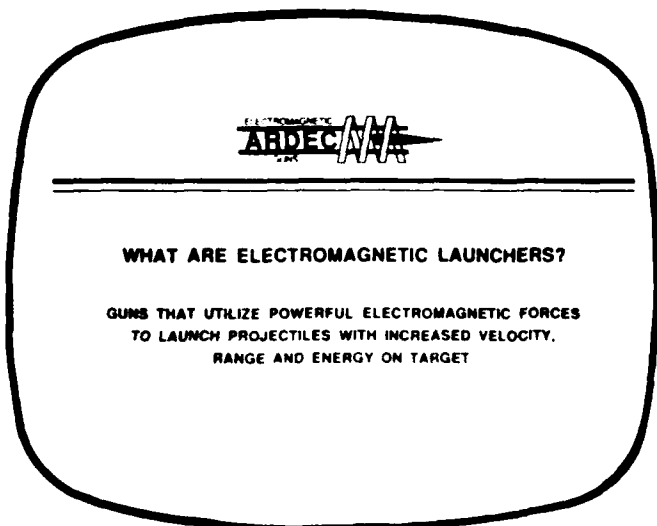
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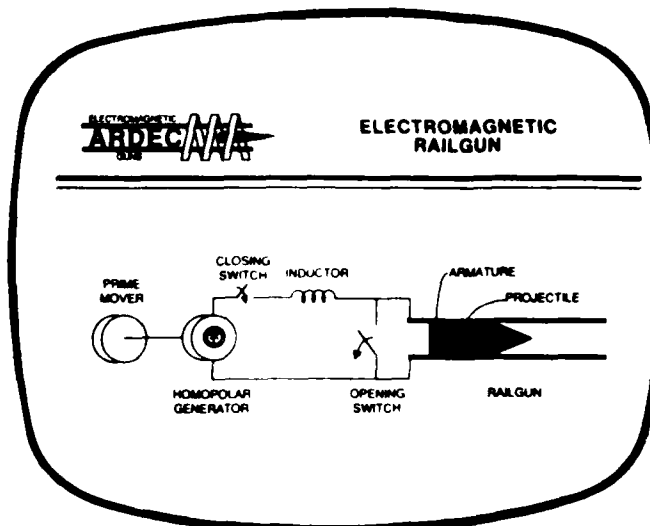
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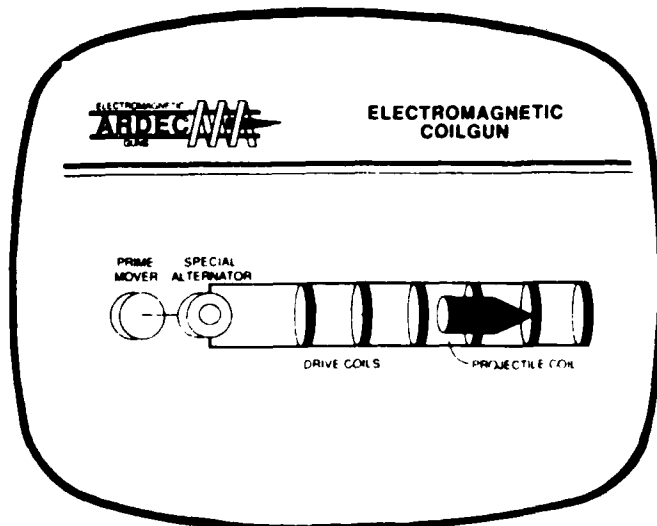
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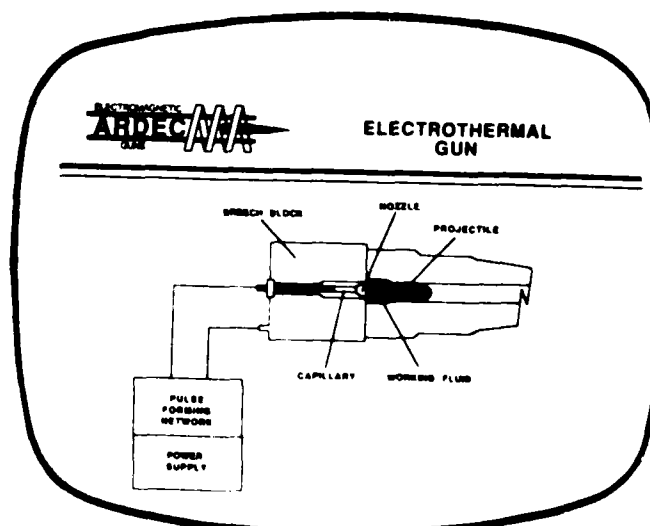
Slide # 3



Slide #4



Slide # 5



Slide # 6

Slide #1. Introduction by Dr. Thaddeus Gora, Chief of the Electromagnetic Armament Technology Branch. Briefing will focus on the Army's EM/ET Gun Program as related to Industry.

Slide #2. A Briefing Outline of six major areas of interest: (1) Theory of Electromagnetic Launch. (2) Program Overview outlining Program Objectives, Technology Barriers, The Need for New Technologies and Payoffs. (3) Program Focus from 1987 thru 1998. (4) Program Status. (5) Future Program Plans. (6) Challenge to Industry.

Slide #3. Defines Electromagnetic Launchers as guns that utilize powerful electromagnetic forces to launch projectiles with increased velocity, range and energy on target.

Slide #4. A diagram of the Electromagnetic Railgun showing the location and relationship of the major components; Prime Mover, Homopolar Generator, Closing Switch, Inductor, Opening Switch, Armature and Projectile. The forces are electromagnetic in a flux expansion mode, and involve the gradient of the system's inductance.

Slide #5. A diagram of the Electromagnetic Coilgun showing the location and relationship of the major components; Prime Mover, Special Alternator, Drive Coils and Projectile Coil. The forces are electromagnetic in nature, and involve gradients of mutual inductance.

Slide #6. A diagram of the Electrothermal Gun showing the location and relationship of the major components; Power Supply, Pulse Forming Network, Breech Block, Capillary, Nozzle, Working Fluid and Projectile. The forces are generated by the electrically heated working fluid.



PROGRAM OVERVIEW ELECTROMAGNETIC LAUNCH

- | | |
|--|--|
| OBJECTIVE:
• EXPLOIT THE BENEFITS OF ELECTROMAGNETIC LAUNCHERS FOR THE BATTLEFIELD | TECHNOLOGY BARRIERS:
• POWER SUPPLY WEIGHT & SIZE
• BARREL EROSION
• LAUNCHER EFFICIENCY |
| NEEDED TECHNOLOGIES:
• COMPACT POWER SUPPLIES
• IMPROVED THERMAL MANAGEMENT
• IMPROVED HIGH CURRENT SWITCHING
• HYPERVELOCITY PROJECTILE DESIGN
• INTEGRATION/MOBILE PLATFORMS
• FULL SOLUTION FIRE CONTROL | PAYOFFS:
• INCREASED VELOCITY
• RANGE
• ENERGY ON TARGET
• UNIFORM ACCELERATION
• REDUCED LOGISTICS COSTS
• REDUCED BLAST/SIGNATURE |

Slide # 7



PROGRAM FOCUS

- | | |
|---|---------|
| • 2 SINGLE SHOT 9 MJ LAB GUNS OPERATIONAL | 1987 |
| • 3 MULTI-SHOT 9 MJ DEMONSTRATORS | 1988 |
| • MOBILE, MULTI-SHOT 15 MJ GUN DEMONSTRATOR | 1991 |
| (Armored Family of Vehicles Candidates) | |
| • ANTI-TACTICAL MISSILE DEMONSTRATOR | 1994 |
| • ENGINEERING DEVELOPMENT | 1994-95 |

Slide # 8



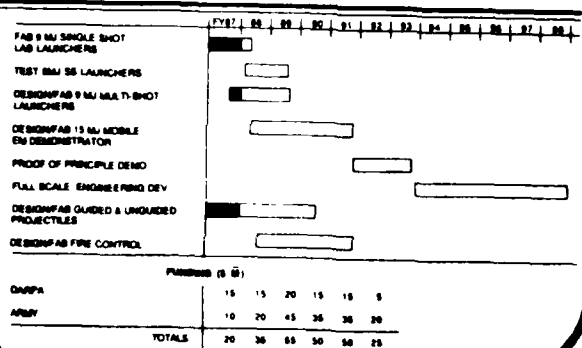
STATUS

- **TECHNOLOGY**
 - LAUNCHED: 2 grams (10 mm bore) to 6 km/sec
300 grams (50 mm bore) to 4 km/sec
700 grams (50 mm bore) to 2 km/sec
 - COMPACT PULSE POWER SUPPLIES: 2 KJ/kg
- **PLANS**
 - KEY DEMONSTRATIONS ARE PLANNED:
 - 9 MJ SINGLE SHOT
 - 9 MJ MULTI-SHOT
 - 15 MJ MOBILE
 - THE SINGLE SHOT AND MULTI-SHOT CONTRACTS HAVE BEEN AWARDED AND ARE ON TRACK

Slide # 9



TACTICAL DEMONSTRATOR PROGRAM PLAN



Slide # 10



9 MJ SINGLE-SHOT LAUNCHER SYSTEMS



AGENT	ARMY	DNA
CONTRACTOR	UTCOR DBB	MATWELL PBC
LOCATION	BALCONES (AUSTIN, TX)	GREEN FARM (SAN DIEGO, CA)
ACCELERATOR	RAIL	RAIL
PULSE POWER	95 MPO (INDUCTORS)	TRANSFORMER/RECTIFIER/CAPACITORS
LAUNCH MASS	1.25 kg	1.25 kg
LAUNCH VELOCITY	2.5-4.0 km/sec	2.5-4.0 km/sec

OPERATIONAL IN DEC 87

Slide # 11



9 MJ MULTI-SHOT LAUNCHER SYSTEMS



AGENT	ARMY	ARMY	DNA
CONTRACTOR	U of TEXAS/PRD	KABAN/EM	MATWELL/PBC
SYSTEM WEIGHT	18.3 tonnes	11.3 tonnes	18.3 tonnes
RATE OF FIRE	2-3 ROBS/SEC	2-3 ROBS/SEC	2-3 ROBS/SEC
TYPE ACCELERATOR	RAIL	COAXIAL	EY/EM
TYPE PULSE POWER	COMPULSATOR	PULSE ALTERNATOR	ALTERNATOR/TRANSFORMER/RECTIFIER/CAPACITORS
LAUNCH MASSES	1-2.5KG	1-2.5KG	1-2.5KG
LAUNCH VELOCITIES	2.5-4KM/SEC	2.5-4KM/SEC	2.5-4KM/SEC

DEMO IN FY88

Slide # 12

Slide #7. Program Overview of the Electromagnetic Launch outlining (1) Program Objective to exploit the benefits of Electromagnetic Launchers for the battlefield. (2) Needed Technologies such as Compact Power Supplies, Improved Thermal Management, Improved High Current Switching, Hypervelocity Projectile Design, Integration/Mobile Platform and Full Solution Fire Control. (3) Technology Barriers - Power Supply Weight & Size, Barrel Erosion and Launcher Efficiency. (4) Payoffs - Increased Velocity, Range and Energy on Target. Uniform Acceleration, Reduced Logistics Costs and Reduced Blast/Signature.

Slide #8. Chronology of planned Program focus from 1987 thru 1998. - 2 Single Shot 9 MJ Lab Guns Operational in 1987, 3 Multi-shot 9 MJ Demonstrators by 1989, Mobile, Multi-shot 15 MJ Gun Demonstrator by 1991, Anti-tactical Missile Demonstrator by 1994. Engineering Development 1994-98, leading to potential new system fielding by the end of the twentieth century.

Slide #9. Status of projectile mass vs velocity experiments achieved in major US EM launch facilities. Power supply energy densities of 2 KJ/kg have been achieved in laboratory storage experiments. A challenge to the technology is to achieve that energy density for practical fielded systems as they apply to muzzle energy.

Demonstrations are planned in the existing Army/DARPA Tactical EM Program. Contracts have been awarded and are on track. Program structured so that 1990 is important decision date.

Slide #10. Lays out Tactical Demonstrator Program Milestones achieved/anticipated and associated Funding for FY87 thru FY98.

Slide #11. Two Single Shot 9 MJ Lab Guns are funded in the program. They will be operational in December of this year.

Slide #12. Three 9 MJ Multi-Shot Launcher Systems compete in the program. Demonstration is planned for late FY89.



Slide #13. Attacks on the technology barriers involve parallel tech base efforts. These efforts lead to a progression of increased performance levels for tomorrow's advanced gun systems.

Slide #14. Challenge to Industry is to demonstrate the maturity of EML for tactical application in 1991-92. This will include addressing program capabilities and potential within the following areas of consideration: (1) Weapon Level Performance. (2) Weapon Mobility. (3) Army Fighting Vehicle Program Compatibility. (4) Multiple Shot Capability. (5) Gun System Competition scheduled for 1988.

We anticipate subsequent Armor, Air Defense Artillery and Theater Defense Applications.

An Anti-Tactical Missile Capability is possible for 1994, we want your help in addressing these challenges.

Slide #15. I've described the existing Army interest in EML technology, and the programs to achieve advanced weapon systems. We recognize industry's competence in the requisite technologies, and ask your help in achieving our nation's goals.

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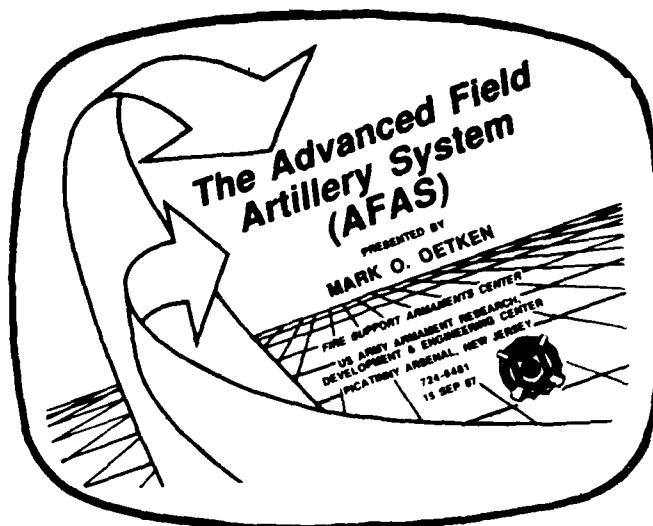
The Advanced Field Artillery System (AFAS)



Presented by



Mr. Mark O. Oetken



Slide #1

Briefing Outline

- WHAT IS AFAS?
- PROGRAM OVERVIEW
- PROGRAM FOCUS
- STATUS
- PLANS
- CHALLENGE TO INDUSTRY
- SUMMARY

Slide #2

What is AFAS?

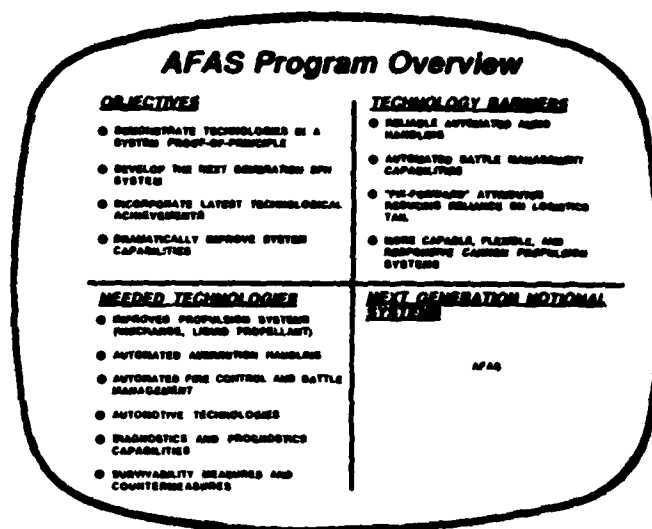
- NEXT GENERATION CANNON ARTILLERY WEAPON SYSTEM
- BLOCK MODIFICATIONS TO THE HOWITZER IMPROVEMENT PROGRAM (HIP)
- LEADING ARMORED FAMILY OF VEHICLES (AFV) VARIANT

Slide #3

Slide #1. Good morning, ladies and gentlemen. It's a pleasure to have this opportunity to talk to you about the Advanced Field Artillery System Program or AFAS as we call it.

Slide #2. This is an outline of my presentation this morning. At its conclusion, you will understand what our plans for the future look like, and what the needs and opportunities for Industry participation are.

Slide #3. Succinctly, AFAS is our next generation cannon artillery weapon system. It encompasses the self-propelled howitzer and a companion ammunition resupply vehicle. Our present acquisition strategy seeks to achieve the AFAS Program objectives by executing a series of block modifications to the Howitzer Improvement Program or HIP. These block mods are referred to as HIP MOD's I, II, and III. The Program Manager HIP is responsible for the development of the basic HIP and MOD I. The AFAS Program encompasses MOD's II and III. The program has also been structured to correspond with the Armored Family Vehicles Program. AFAS is, in fact, a leading variant within the AFV Program.



Slide # 4

Slide #4. As you can see in the lower right corner, AFAS is a next generation notional system. As such, it provides a template to guide and focus existing and planned artillery development efforts, both within the Army tech base and industry.

In the upper left corner, you can see the AFAS program objectives. In the near term, we plan to identify and demonstrate high pay-off technologies in component, and eventually, system demonstrations. By exploiting potentially leap-ahead technologies, we expect to provide the soldier a system that is substantially more lethal, survivable, responsive, and mobile, yet at the same time reduces the logistical burdens and operating costs associated with today's systems. Ultimately, our objective is to develop and field a system that can survive against and defeat the projected turn-of-the-century threat.

To accomplish this, a number of technology and engineering barriers must be overcome. I will briefly touch on some of the principal barriers listed here. Advanced propulsion systems offering improved performance and survivability characteristics are required to meet AFAS system requirements. The leading near-term contenders are presently Unicharge, an improved conventional propellant, and Liquid Propellant or LP. There are peculiar technology barriers associated with each, from the development of adequate seals and combustible case materials, to the control of the combustion process itself.

The need for automation is being driven by glaring battlefield exigencies as well as unfavorable demographic trends. The requisite technology is neither new or exotic; naval ammunition autoloaders have existed for years. However, the engineering barriers associated with integrating a reliable autoloader within the space and weight confines of a self-propelled howitzer are imposing, and as yet, undone.

Simulated wartime scenarios consistently demonstrate that currently fielded systems simply will not survive on tomorrow's battlefield in sufficient numbers to sustain a creditable deterrent. Clearly, AFAS must be a more survivable system, and therefore the focus on survivability measures and countermeasures. Here, we are faced with a demanding combination of technology and engineering barriers that require innovative approaches. Given willingness on the part of the User to accept a 70 ton system, the challenge diminishes. More practical alternatives are needed to meet the, at times, contradictory battlefield requirements.

Why the focus on technology and technology barriers? Quite simply, in a battle where neither side possesses a significant qualitative edge, numbers count. And where numbers count, we invariably lose.

Program Focus

PRESENT - 1990

- IDENTIFY, EVALUATE, AND EXPLOIT EMERGING TECHNOLOGIES
- ASSESS THE RELATIVE PAYOFFS/PENALTIES ASSOCIATED WITH THESE TECHNOLOGIES (TEST BEDS)
- MAKE DECISIONS REGARDING TECHNOLOGIES TO BE INCORPORATED INTO PROOF-OF-PRINCIPLE

1991-1992

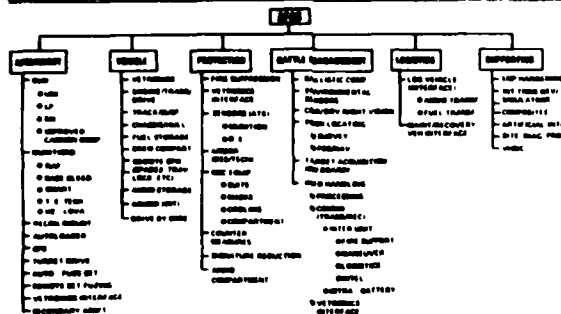
- DEVELOP ALTERNATIVE ENGINEERING, OPERATIONAL AND ORGANIZATIONAL CONCEPTS
- CONDUCT PROOF-OF-PRINCIPLE TO PROVEOUT THE SELECTED HARDWARE AND EMPLOYMENT CONCEPTS

1992-1996

- CONDUCT HIP MOD II FSD

Slide #5

ADVANCED FIELD ARTILLERY SYSTEM CANDIDATE COMPONENT TECHNOLOGIES



Slide #5. The program focus for now and through 1990 will be on the identification, demonstration, and evaluation of potentially high pay-off technologies and components. By 1990, we expect to have acquired sufficient technical know-how and technical data to make decisions regarding technologies to be incorporated into a follow-on system proof-of-principle. In 1991 and 1992, prototype systems will be designed, built, and provided to the User for evaluation within the context of the AFAS Operational and Organizational concept.

At the conclusion of the proof-of-principle, we will be prepared to proceed into Full Scale Development with confidence that our objectives will lead to an optimal system.

Slide #6. As previously indicated, our current efforts are focusing to a great extent on the technological opportunities that we feel exist. To consider the depth and breadth of the technical possibilities, we have prepared this template. Essentially, it is a hierarchy of the hardware and software which the eventual AFAS system might have. This template makes no decisions relative to what AFAS will have, only to what it could have. It is by no means an all inclusive list. Our recently initiated Broad Agency Announcement is a specific attempt to pulse Industry for other novel and innovative ideas that may exist.

Our immediate challenge is to ensure that all avenues are explored. This will permit us to formulate the optimal AFAS concept based upon the widest range of possibilities, with as complete as possible an understanding of what they will contribute to system capabilities.

Status

PROGRAM

- MOU SIGNED BY COMMANDING GENERALS OF USAFAC, AMCCOM, TACOM, AND LABCOM
- ARTILLERY TEST BED PROGRAM FORMULATED
- SYNCHRONIZED WITH THE AFV PROGRAM
- NATO COOPERATIVE DEVELOPMENT OPPORTUNITIES BEING EXPLORED (R&D)

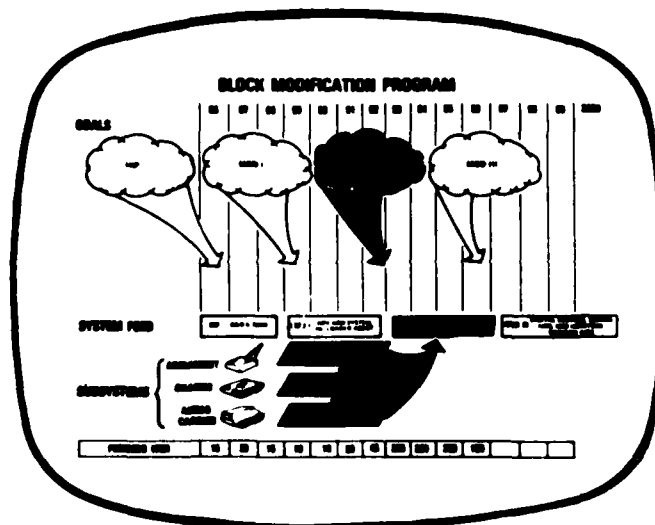
TECHNOLOGY

- TECHNOLOGY BARRIERS (PROPULSION)
- ENGINEERING BARRIERS (SYSTEM INTEGRATION/CONFIGURATION)

PLANS

- BROAD AGENCY ANNOUNCEMENTS/RFP's
- INITIATING CONCEPT FORMULATION EFFORT (SYSTEM STUDIES)
- FULL SCALE MOCK-UPS OF PROMISING CONCEPTS
- ARTILLERY MISSION MODULE DEVELOPMENT
- COMMUNITY EFFORT AMONG AMC - TRADOC - INDUSTRY

Slide # 7



Slide # 8

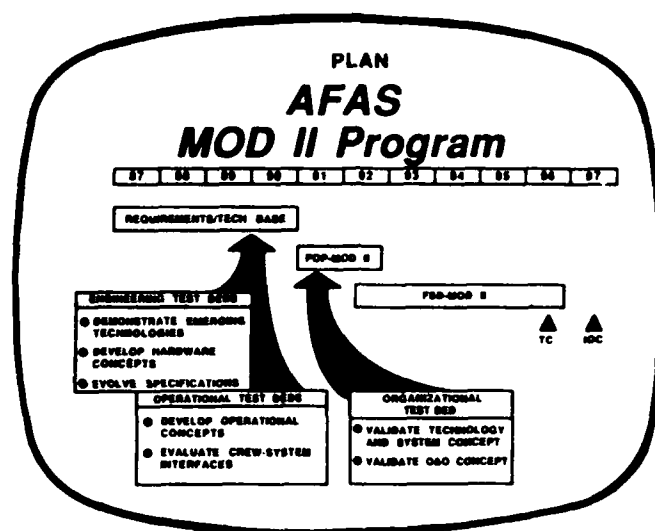
Slide #7. This chart summarizes where we presently stand. An Artillery Test Bed Program has been structured to coordinate previously independent development activities. The test bed program consists of four principal activities - the engineering, operational, and organizational test beds, tied to a supporting analytical effort. To implement the test bed program, a Memorandum of Understanding has been signed by the Commanding Generals of Ft Sill, AMCCOM, TACOM, and LABCOM.

As previously mentioned, the AFAS Program is in step with the Armored Family of Vehicles Program. In addition, discussions are underway with our NATO allies to determine what off-shore developments could contribute to AFAS, where cooperative development opportunities may exist, and in general, promote RSI.

As you saw earlier, a number of technology barriers exist, with one of the most significant being in the propulsion arena. At the same time, we are faced with considerable engineering barriers, particularly with respect to system integration and configuration. Solution of the primary technology barriers in itself does not guarantee success; component development must be carried on with an eye toward its eventual system application.

In general our plans include following up on the most recent Broad Agency Announcement with similar efforts oriented on conducting system studies and developing system concepts. We plan on building full scale mock-ups of the most promising concepts, and eventually designing and fabricating an artillery mission module for integration with either an AFV or TACOM chassis. We fully intend to sustain the community effort among AMC, TRADOC, and Industry that has characterized our recent activities.

Slide #8. This is the block modification program that now forms the basis of our advanced cannon artillery acquisition strategy. Along the top we have depicted the block mods. Our efforts are now focused on the near term AFAS objective Mod II. We have chosen to analyze hardware requirements with respect to the armament, chassis, and ammunition resupply subsystems that will comprise the AFAS system. Along the bottom of the slide are the funds currently in place to support the program. Funding through 1991 supports programs in the tech base that directly contribute to AFAS. Beginning in 1992, funding has been established to support AFAS full scale development.



Slide #9

Slide #9. Depicted here is the relationship between the development schedule for Mod II and the test bed program. We expect to accomplish our requirements and tech base activities within the framework of the engineering and operational test beds. The engineering test beds will be a mechanism for demonstrating technologies and components, developing hardware concepts, and evolving system specifications. The engineering test bed is not intended to be an all-encompassing system demo, but rather a series of brassboard and breadboard fixtures focused on specific technology or engineering barriers. The liquid propellant test fixtures under development are examples of engineering test beds. Other examples will undoubtedly include laboratory fixtures, hardstand fixtures, and integrated subsystems. The MOU that I discussed earlier calls for the engineering test bed activities to be chaired by the Commander, FSAC.

The operational test beds will allow us to develop novel operational concepts and evaluate crew-system interfaces of conceptual systems. Chaired by the Director of the Fire Support and Target Acquisition of the Human Engineering Laboratory, the operational test bed will use a variety of hardware and simulation tools to consider the impact of such things as the employment of command howitzers, artificial intelligence, and crew reduction. Examples of tools to be employed include the Artillery Control Experiment (ACE) facility, the Human Factors Howitzer Test Bed, and several other programs within the LABCOM Cooperative Development Program. In addition, hardware developed through the engineering test bed will be evaluated by the operational test bed to further assess crew interfaces and impacts.

The fruits of the engineering and operational test beds will be incorporated into an organizational test bed wherein the User will use prototype hardware to validate the technology, the system concept, and the operational and organizational concept. The test beds are interrelated to the extent that hardware and software will be exchanged to facilitate test and evaluation. ARDEC emphasis, as lead for the Engineering Test Bed will be on the development and demonstration of technologies, components, and system concepts.



Slide #10. The previous slide showed you a generic representation of how the Artillery Test Bed Program and the development of Mod II are related. This slide depicts some of the specifics. Again, emphasis is on activities pertinent to the engineering test bed. A Broad Agency Announcement was recently initiated with the objective of identifying new technologies or novel applications of existing technologies to support advanced cannon artillery development. Fifty-two proposals were received, and we expect to award multiple contracts in the near future. We have also let a contract to conduct a liquid propellant tech demo (155-mm) in 1990. We would also like to have a unicharge tech demo of relatively equal sophistication no later than 1990, although we feel it can be accomplished sooner. With respect to the ammunition resupply module, a draft RFP was released earlier this year to solicit comments from Industry. Under the stewardship of PM-Ammolog, we expect an RFP to be issued early in FY88.

The requisite chassis development is being pursued jointly by the AFV Task Force and TACOM, and we are working with both parties to ensure our efforts are mutually supportive. We are in the process of establishing an Integration Working Group with TACOM to facilitate this. A parallel concepting effort is underway at ARDEC to develop preliminary system concepts. When we have done the necessary homework, we plan to issue solicitations to Industry in order to develop alternative system concepts, and then build full-scale mock-ups of those that are most attractive. This work will form the basis for the artillery mission module RFP projected for FY89. In 1991 and 1992, components and subsystems generated by the engineering test bed will be integrated into a system proof-of-principle demonstration, with a Milestone I decision scheduled for 1993.

Throughout this process, the engineering and operational test beds and the analytical effort will continue to interactively support one another. This will be done with full cognizance of the AFV Program. Should the AFV Program proceed into hardware development, the integrated demo shown at the bottom will in essence become the AFAS proof-of-principle.

Challenge to Industry

- CONTRIBUTE TO THE FURTHER DEVELOPMENT OF AFAS AND HIP MOD II
- PARTICIPATE IN THE ARTILLERY TEST BED PROGRAM
 - ENGINEERING TEST BEDS
 - OPERATIONAL TEST BEDS
- ACCELERATE ELIMINATION OF TECHNOLOGY BARRIERS
- TALK TO US

Slide # 11

Summary

AFAS OPPORTUNITIES

- ENGINEERING TEST BEDS
 - COMPONENT DEMONSTRATIONS (TECHNOLOGY BARRIERS)
 - UNISCHARGE TECH DEMO
 - SYSTEM STUDIES/CONCEPT FORMULATION
 - ARTILLERY AND RESUPPLY MISSION MODULES
- OPERATIONAL AND ORGANIZATIONAL TEST BEDS
- SUPPORTING ANALYTICAL EFFORT

INDUSTRY PARTICIPATION

- FOCUS ON TECHNOLOGY BARRIERS
- BROAD AGENCY ANNOUNCEMENT - SYSTEM STUDIES/MOCK-UPS (2 QTR, FY88)
- RFP - AMMUNITION MISSION MODULE (1 QTR, FY 88)
- RFP - ARTILLERY MISSION MODULE (1 QTR, FY88)
- ARDEC WANTS INDUSTRY PARTICIPATION

Slide # 12

Slide #11. We are looking for firms interested in participating in the engineering and operational test beds, and in contributing to the supporting analytical effort. Participation is needed not only at the major subsystem or system levels, but at the technology and component level as well.

Of particular need are firms interested in tackling the technology and engineering barriers that exist in the areas of automated ammunition handling, automated fire control and battle management, survivability measures and countermeasures, diagnosis and prognosis capabilities, and advanced propulsion technologies. This can be accomplished at a number of levels, to include simulation, laboratory (breadboard) demos, hardstand fixtures, or full-up system demos. We are open for ideas and suggestions, and look forward to talking with you.

Slide #12. In summary, AFAS development continues to be vigorously pursued under the framework of the Artillery Test Bed Program. The activities I have just outlined are virtually independent of the route chosen, be it MOD II or AFV. Regardless of the name, the technology barriers must be overcome before further system development can occur. The engineering test bed will provide the tools for eliminating these barriers. Over the next three years, we hope to demonstrate the components that will solve these deficiencies. At the same time, we are beginning the system studies and analysis that will eventually tell us how to best configure the system to achieve our program goals. The organizational and operational test beds being led by the User and HEL will also play a key role in the process.

Specific areas needing Industry participation are shown in the lower half of the slide. Our first concern is developing and demonstrating components that will overcome the technology barriers. In addition, we expect to follow up on our most recent BAA by initiating concept formulation studies, and then constructing full-scale mock-ups. An RFP for the design and fabrication of an ammunition resupply mission module should be on the street in 10FY88. We expect to release an RFP for the design and fabrication of an artillery mission module in the 10FY89, contingent on the resolution of some funding issues. The participation of industry is crucial to the conduct of these and related efforts.

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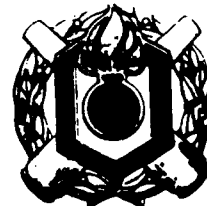
Manpower and Personnel Integration (MANPRINT) Applied to Future Artillery



US ARMY
ARMAMENT RDE CENTER

Presented by

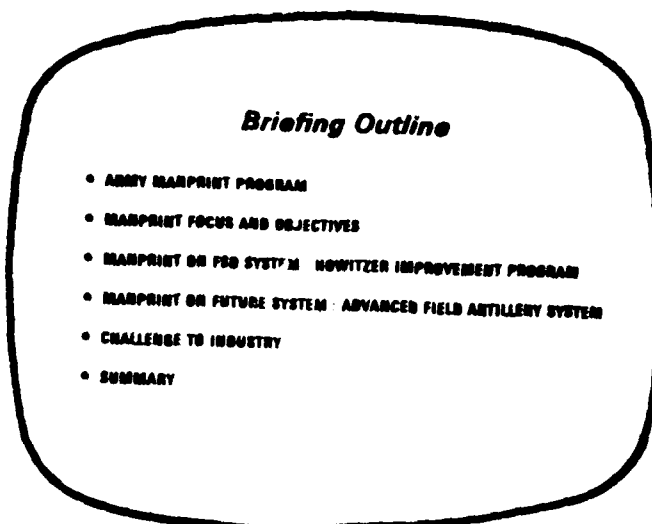
MAJ William E. Ehly



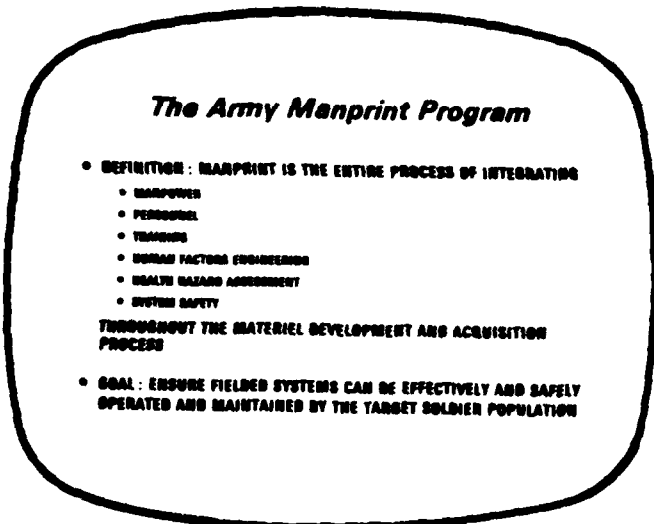
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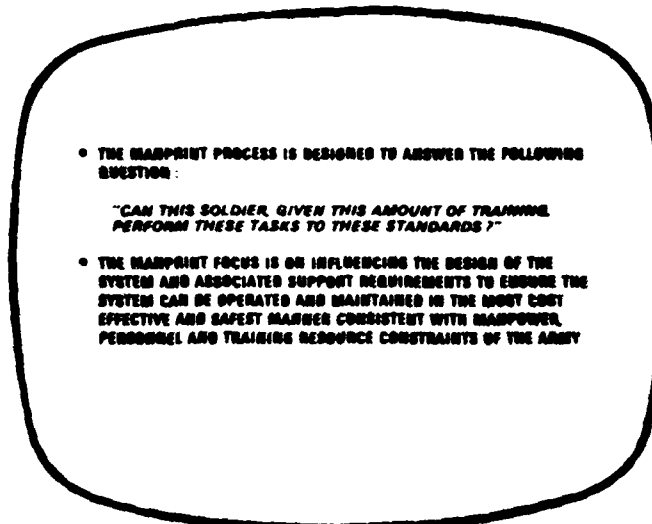
Slide # 1



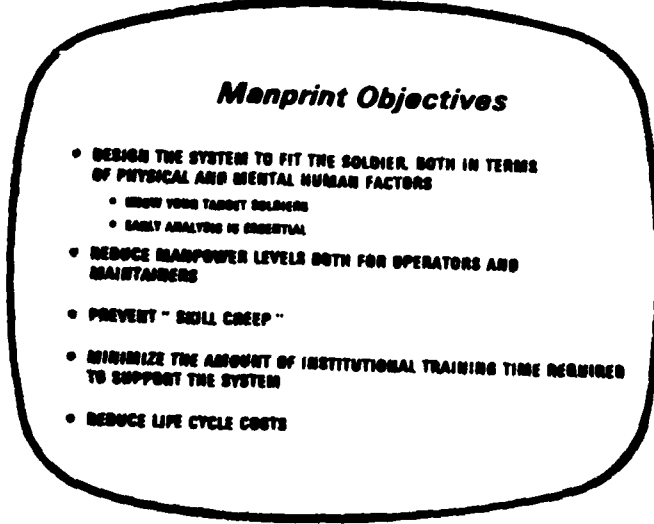
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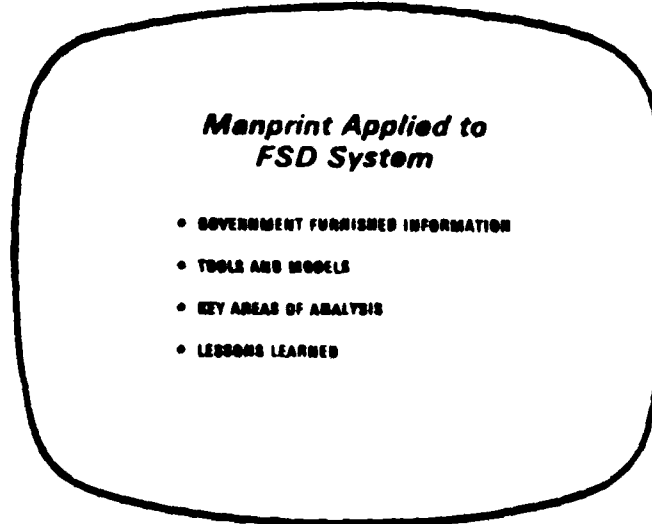
Slide #3



Slide #4



Slide # 5



Slide # 6

Slide #1. Good morning. I'm Major Ehly from the Project Manager's Office for Cannon Artillery Weapons Systems. The purpose of this briefing is to inform you about the Army's MANPRINT program and to give examples of how MANPRINT is being applied to a system under development, and a future system.

Slide #2. These are the topics I will discuss during my presentation. The systems I will use for examples are the Howitzer Improvement Program, or "HIP", and the Advanced Field Artillery System, or "AFAS".

Slide #3. MANPRINT is the entire process of integrating Manpower, Personnel, Training, Human Factors Engineering, Health Hazard Assessment, and System Safety into the materiel development and acquisition process. MANPRINT is iterative and multidisciplinary in nature. We refer to these 6 areas as the 6 domains of MANPRINT. Our goal is to ensure that new systems can be safely and effectively operated and maintained by soldiers in the field.

Slide #4. In pursuing our goal we want to be able to answer the following basic question: "Can this soldier, given this amount of training, perform these tasks to these standards?" We must focus on influencing the design of the system and its associated support items. We must also bear in mind the manpower, personnel, and training resource constraints of the Army.

Slide #5. These are the objectives of MANPRINT. The key to success is designing the system to fit the soldier, both physically and mentally. To do this we must know all about the soldiers who will operate and maintain the system and start our analysis early. We want to reduce the number of people it takes to operate and maintain the system. We want to prevent "skill creep" or the tendency of new systems to require smarter or higher grade personnel. And we want to minimize the time it takes to train personnel up to standards on the new system. If we are successful in these efforts then we will also be able to reduce life cycle costs.

Slide #6. I will now discuss the MANPRINT effort on the Howitzer Improvement Program, which is under full scale development, by focusing on these topics.

Government Furnished Information

- ENLISTED MASTER FILE DATA FROM PERSHOCOM
- PROGRAMS OF INSTRUCTION FROM TRADOC SCHOOLS ON TARGET ABSENCE SOLDIERS
- SOLDIERS MANUALS AND TRAINER GUIDES
- TECHNICAL MANUALS OF PREDECESSOR SYSTEM
- SAMPLE DATA COLLECTION INFORMATION ON PREDECESSOR SYSTEM
- GOVERNMENT STUDIES ON SOLDIER'S ABILITIES AND PERFORMANCE
 - ARMY RESEARCH INSTITUTE
 - HUMAN ENGINEERING LAB

Slide #7

Tools and Models

- DESAI CREW PERFORMANCE MODEL
 - IDENTIFY CRITICAL TASKS AND TIMES
- PERSONNEL LONG RANGE PLANNING MODEL
 - MATCH PROJECTED REQUIREMENTS WITH ASSETS
- JOB ASSESSMENT SOFTWARE SYSTEM
 - COMPUTERIZED SIMULATION TO IDENTIFY "HIGH DRIVER" TASKS IN TERMS OF COGNITIVE WORKLOAD
- OPERATIONAL SEQUENCE DIAGRAMS
 - FLOW CHARTS TO IDENTIFY KEY SOLDIER MACHINE INTERFACE POINTS
- TIME LINE ANALYSIS

Slide # 8

Key Areas of Analysis

- ON-BOARD CREW REDUCTION FROM FIVE TO FOUR
- IMPACT OF AUTOMATIC FIRE CONTROL AND SEMIAUTONOMOUS OPERATIONS
- ON-BOARD DIAGNOSTICS AND PROGNOSTICS
- COGNITIVE AND PHYSICAL WORKLOADING OF THE CREW

Slide # 9

Lessons Learned

- MANPRINT ORGANIZATION MUST BE ON A LEVEL EQUAL TO DESIGN
- MAINTAIN AN ENGINEERING FOCUS
- CONCENTRATE ON INFLUENCING DESIGN
- TOOLS AND MODELS ARE HELPFUL BUT PEOPLE ARE THE KEY TO ANALYSIS
- MANPRINT TRADE STUDIES MUST BE INITIATED EARLY
- IDENTIFY MANPRINT GFI REQUIREMENTS IN THE RFP AND SOW
- MAKE MANPRINT GFI AVAILABLE FOR CONTRACTOR INDEPENDENT RESEARCH AND DEVELOPMENT

Slide #10

Manprint Applied to the Advanced Field Artillery System (AFAS)

- WHAT IS AFAS ?
- MANPRINT OBJECTIVES FOR AFAS
- AFAS MANPRINT ISSUES
- MANPRINT ACTIONS

Slide #11

Slide #7. We found that it takes a tremendous amount of government furnished information to support the contractor's MANPRINT effort. From the Personnel Information Systems Command we acquired computer tapes of the Enlisted Master File to assist with our manpower and personnel analysis. For the maintainer analysis we provided technical manuals and information from sample data collection on the existing howitzer system. And to support our Human Factors, Hazard, and Safety Analysis we sought out studies conducted by Army Research Institute and the Army Human Engineering Lab.

Slide #8. This slide outlines the various analytical tools and models we're using to support our MANPRINT effort. The crew performance model helps identify critical tasks and times. The personnel long range planning model is a means of projecting future requirements versus future assets. The Job Assessment Software Program (JASS) simulation provides a way to measure cognitive workload and identify "high driver" tasks. Operational sequence diagrams identify the key soldier machine interface points. We have essentially been able to use existing models by tailoring them to the needs of the HIP program.

Slide #9. Here are the areas where we're concentrating our analysis. By automating certain functions we're able to reduce the size of the onboard crew, which results in a redistribution of tasks. We're using MANPRINT analysis to ensure all crew performance requirements can be met. The digital Automatic Fire Control System is a major improvement from the current optical fire control. This permits the howitzers to operate semiautonomously, which increases their survivability and effectiveness. Another area we're looking at closely is onboard diagnostics and prognostics. The diagnostics allows the crew to fault-isolate defective components, and the prognostics will provide a warning of impending failure. And we are analyzing the workload of the crew, particularly the Section Chief, to ensure no one is overloaded either physically or mentally.

Slide #10. We have learned a lot by doing MANPRINT on the HIP Program. For MANPRINT to be most effective it must maintain an engineering focus and be on an organizational level equal to design. While automated tools and models are helpful, it takes dedicated, innovative people to be successful. To ensure MANPRINT will influence design, trade studies and analysis must be done early. For systems under full scale development, Government Furnished Information must be identified and provided at the beginning of the contract. And GFI should be made available for contractors conducting independent research and development.

Slide #11. I'd now like to talk about MANPRINT as it is applied to a future system - AFAS. What is AFAS? and What are the MANPRINT objectives, issues and actions?

What Is AFAS ?

- NEXT GENERATION CANNON ARTILLERY WEAPON SYSTEM
- HOWITZER IMPROVEMENT PROGRAM (HIP) BLOCK MOD II
- INCORPORATION OF LEAP AHEAD TECHNOLOGIES INTO ARTILLERY SYSTEMS
- SCHEDULED FOR FIELDING - 1997

Slide #12

Manprint Objectives for the AFAS Program

- IDENTIFY MANPRINT CONCERNS DURING THE EXPLORATION OF LEAP AHEAD TECHNOLOGIES
- ESTABLISH RESPONSIBILITIES FOR ANALYSIS AND ACTIONS
- ESTABLISH MANPRINT POSITIONS ON CRITICAL CONCERNS/ISSUES
- ASSURE INTEGRATION OF MANPRINT WITH LOGISTIC SUPPORT ANALYSIS (LSA)
- ASSURE THE INCORPORATION OF THE MANPRINT CONCERNS AND DECISIONS INTO THE PROGRAM DECISION REVIEWS

Slide #13

AFAS Manprint Issues

- IMPACT FROM ADVANCE PROJECTILE PROPULSION SYSTEM
- OPERATION IN AN NBC AND OTHER HAZARDOUS ENVIRONMENTS
- IMPACT OF INCREASED RESPONSIBILITIES ON SECTION CHIEFS
- IMPACT OF ROBOTICS ON SOLDIER WORKLOADS AND SKILL LEVELS
- REDUCTIONS OF SYSTEM MANPOWER REQUIREMENTS
- SYSTEMS SAFETY ANALYSIS
- DEVELOPMENT OF THE TRAINING STRATEGY

Slide #14

Current Manprint Actions

- SYSTEM MANPRINT MANAGEMENT PLAN (SMPMP) DEVELOPED
- RESPONSIBLE AGENCIES AND REQUIRED FUNDING IDENTIFIED
- MANPRINT COORDINATING COMMITTEE ESTABLISHED
- STUDY OF LIQUID PROPELLANT MANPRINT ISSUES
- STUDY ON THE SECTION CHIEF'S ROLE CHANGES

Slide #15

Slide #12. AFAS will be the next generation cannon artillery weapon system. We are taking a "block modification" approach by building on the HIP technology and adding new technologies to arrive at the AFAS configuration. The "leap ahead" technologies we are developing include liquid propellant, auto loader, artificial intelligence, and robotics. These are designed to give us a qualitative advantage over the threat artillery systems since they hold a significant numerical advantage.

Slide #13. These are the MANPRINT objectives for the AFAS program. We want to identify the key areas of analysis, establish responsibilities, and develop positions on critical issues. To prevent duplication of effort we must ensure that the MANPRINT analysis is integrated with the Logistic Support Analysis. We want to ensure that MANPRINT issues and concerns are properly addressed at program decision reviews.

Slide #14. Here are the critical issues we will be addressing. We have to look at the impact of the liquid propellant, or other advanced propulsion system. We have to protect the crew and the howitzer from NBC and other hazardous environments such as blast, toxic effluents, vibration, and threat weapons. We must ensure that the Section Chief's tasks and responsibilities do not overload his capability. With the introduction of robotics to reduce the crew workload we must make sure that those savings are not offset by increasing the workload on maintainers. We are also looking at further manpower reductions. We are designing for safety and survivability. Since the AFAS will only be as good as the crews we have to operate it, we are starting early to develop an effective and comprehensive training strategy. As you can see, these issues encompass all of the 6 domains of MANPRINT.

Slide #15. Although we are early in the AFAS life cycle, we have already developed the System MANPRINT Management Plan (SMMP) which will be updated as we progress. The SMMP identifies responsible agencies and funding requirements. We have established a MANPRINT Coordinating Committee and are conducting quarterly reviews in coordination with the ILS and LSA teams. We completed a study via contractor on the impact of handling and transporting liquid propellant. And we have initiated a study via RI on the roles and responsibilities of the AFAS Section Chief.

Challenge to Industry

- THINK MANPRINT - EARLY AND CONTINUOUS ANALYSIS
- ENSURE DESIGN ENGINEERS UNDERSTAND THE MANPRINT PROCESS
- DEVELOP MANPRINT DATA BASE COMPATIBLE WITH LOGISTIC SUPPORT ANALYSIS (LSA) DATA BASE (MIL-STD-1388-2A)
- DEVELOP INNOVATIVE TECHNIQUES AND MODELS
 - MEASURE COGNITIVE AND PHYSICAL WORKLOAD
 - PREDICT MANPOWER, PERSONNEL AND TRAINING REQUIREMENTS
 - DETERMINE SOLDIER PERFORMANCE
- BUILD THE SYSTEM TO FIT THE SOLDIER

Slide # 16

Summary

- MANPRINT OFFERS TREMENDOUS POTENTIAL FOR MANPOWER, PERSONNEL AND TRAINING SAVINGS
- DESIGN ARMY LEADERSHIP IS COMMITTED TO MANPRINT
- MANPRINT MUST INFLUENCE DESIGN
- MANPRINT ON TODAY'S SYSTEMS WILL PROVIDE PAYOFFS ON FUTURE SYSTEMS
- INDUSTRY COMMITMENT TO MANPRINT IS ESSENTIAL

Slide # 17

Slide #16. These are the major challenges to industry. Think MANPRINT and train design engineers in the MANPRINT process. Develop compatible MANPRINT and LSA data bases. This will be particularly beneficial in the area of operator and maintainer task analysis. We need improved analytical techniques and models. It is very difficult to look at the design of a complex weapon system on one hand, and a soldier/crew on the other hand, and predict how well that crew will perform with that weapon system in a combat environment. If we are successful in our MANPRINT efforts we'll be able to build the system to fit the soldier and give him the capability and survivability he needs on the modern battlefield.

Slide #17. In summary, MANPRINT offers tremendous potential for savings in manpower, personnel, and training. The Army is committed to the program and MANPRINT is here to stay. MANPRINT must influence design. What we do today will have payoffs on present and future systems. And lastly, industry commitment to MANPRINT, and effective government/industry coordination, is essential if we are to reap the benefits of MANPRINT and successfully develop and field new systems under the Army streamlined acquisition strategy.

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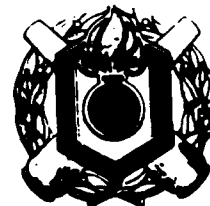
Regenerative Liquid Propellant Gun Technology



US ARMY
ARMAMENT RDE CENTER

Presented by

Mr. Cliff Daly



US ARMY
ARMAMENT RDE CENTER

Regenerative Liquid Propellant Gun Technology

PRESENTED BY
CLIFF DALY

FIRE SUPPORT ARMAMENT CENTER
US ARMY ARMAMENT RESEARCH
DEVELOPMENT & ENGINEERING CENTER
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724-3751
15 SEP 87



Slide # 1

Briefing Outline

- WHAT IS REGENERATIVE LIQUID PROPELLANT GUN (RLPG)?
- PROGRAM OVERVIEW
- PROGRAM FOCUS
- STATUS
- PLANS
- CHALLENGE TO INDUSTRY
- SUMMARY

Slide # 2

What is LP Gun?

- IT IS LIQUID CHEMICAL PROPULSION DEVICE CAPABLE OF GENERATING HIGH PRESSURE COMBUSTION GASES
- THERE ARE TWO BASIC CONCEPTS, BULK LOADED AND REGENERATIVE

BULK LOADED LIQUID PROPELLANT GUN

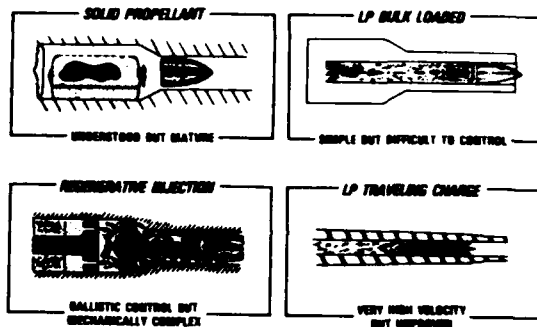
- MECHANICALLY SIMPLE
- BALLISTIC CONTROL NOT PRECISE

LIQUID PROPELLANT REGENERATIVE GUN

- MECHANICALLY COMPLEX
- CAPABLE OF MORE PRECISE BALLISTIC CONTROL

Slide # 3

Evolution of Propulsion Concepts

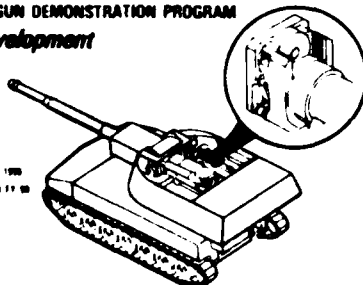


Slide # 4

LIQUID PROPELLANT GUN DEMONSTRATION PROGRAM 155MM Gun Development

LP GUN # 2

- GUN PROTOTYPE
- BULK DESIGN
- LP DESIGN
- CAPABLE OF BURST FIRE
- INTEGRATED INTO SPH MARCH 1988
- PORT S&L DEMONSTRATION NO 11 88



Slide # 5

Program Overview Regenerative Liquid Propellant Gun Program

OBJECTIVE ● DEMONSTRATE THE FEASIBILITY OF A 155MM REGENERATIVE LIQUID PROPELLANT GUN	TECHNOLOGY BARRIERS ● CHARACTERIZATION OF HYDRAULIC AMBIFORM UTRATE BASH BASED LP ● REDUCE HIGH FREQUENCY OSCILLATIONS ● LONG SEAL LIFE ● RELIABILITY, AVAILABILITY, MAINTAINABILITY AND DEPENDABILITY
NEEDED TECHNOLOGIES ● IMPROVED GAS FORMULATIONS ● ELIMINATE/CONTROL HIGH PRESSURE OSCILLATIONS ● ALTERNATE SEAL DESIGNS ● PACKAGING AND HANDLING TECHNIQUES	PHASES ● REDUCE LOGISTIC BURDEN ● REDUCE WEAPON AUTOMATION ● REDUCE MAINTENANCE ● REDUCE STOWAGE OF ON BOARD WEAPONS ● REDUCE PROPELLANT PROCESSMENT COSTS

Slide # 6

Slide #1. Self explanatory

Slide #2. Self explanatory

Slide #3. Self explanatory

Slide #4. Complements slide #3

The traveling charge effect we hope to confirm in our LP tank program presently is in the concept stage.

Slide #5. The General Electric Company under their IR&D program will be integrating the LP gun into a M109/A2 self propelled howitzer

Slide #6. We are asking you, the representatives of our industrial complex, to review the areas we see as our technology barriers, and to help us eliminate them. We want to remove these barriers in view of the benefits the Army will realize, especially in the logistic area.

Program Focus

- RLPG WILL FIRST BE ACCESSED IN ARTILLERY APPLICATION
- IDENTIFY AND RESOLVE TECHNOLOGY BARRIERS
- ACCESS THE LOGISTICAL IMPACTS OF INTRODUCING A NEW PROPULSION SYSTEM
- ARTILLERY SYSTEM DEMONSTRATOR IN 1988
- TANK APPLICATION TO FOLLOW ARTILLERY

Slide #7

Status

TECHNOLOGY

- REGENERATIVE LP 150MM CANNON
- FIRING IN 1988 ON
- 150MM FIRING SCHEDULED FOR FY88

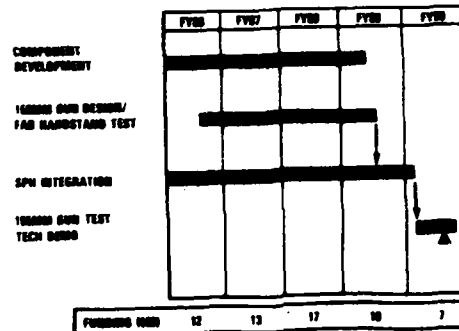
PLANS

- LIQUID PROPELLANT
 - STUDIES IN PROGRESS
 - LOGISTICS ON-GOING
 - VULNERABILITY ON-GOING
 - CHARACTERIZATION ON-GOING
- LP SELF PROPELLED HOWITZER
 - VEHICLE AT LETTERKENNY ARMY DEPOT
 - DESIGN, FABRICATION, AND INTEGRATION ACTIVITY UNDERWAY
- LP TANK GUN
 - RFP FOR SYSTEM STUDY LATE FY87

Slide #8

Liquid Propellant Gun Demonstration Program

ENHANCED LPG DEMO PROGRAM



Slide #9

Challenge to Industry

- OPTIMIZE REGENERATIVE GUN DESIGN
- DEVELOP HIGHER ENERGY MONO LIQUID PROPELLANTS
- DEVELOP ALTERNATE APPROACHES TO THE LP GUN
- PARTICIPATE IN FUTURE RFP

Slide #10

Summary

PROJECT SUMMARY

- ARTILLERY PROGRAM IS PROCEEDING AS PLANNED
- TECH DEMONSTRATOR FOR LP ARTILLERY GUN IS ANTICIPATED TO TAKE PLACE 1988

INDUSTRY PARTICIPATION NEEDED

- OPTIMIZE REGENERATIVE GUN DESIGN
- DEVELOP ALTERNATE APPROACHES TO THE LP GUN
- PARTICIPATE IN FUTURE RFP
 - DEVELOP CONCEPT STUDIES FOR LP GUNS AND PROPELLANTS DAA 1st QTR FY88
 - DRAFT RFP FOR HARDWARE DEVELOPMENT FOR LP TANK 1st QTR FY88
 - RFP FOR HARDWARE DEVELOPMENT FOR LP TANK 3rd QTR FY88
 - RFP FOR PROCESS DEVELOPMENT FOR DAA 1988 PHASE II 1st QTR FY88
 - RFP FOR PROCESS DEVELOPMENT FOR DAA 1988 PHASE III 4th QTR FY88

Slide 11

Slide #7. Our present program focus is to assess LP in an artillery application, solve the technology barriers, and assess the logistical impact.

Slide #8. As you can see the LP program is well underway. We are in constant communication with the various commands and agencies to make certain we meet the needs of the user community.

Slide #9. This is our program schedule for the LP artillery 155-mm gun. We do not reflect here that gun No.2 will continue to be fired for RAM-D data.

Slide #10. We are looking to optimize our gun design and evaluate alternate approaches to the LP gun. Therefore we would like to hear from industry.

Slide #11. Self explanatory.

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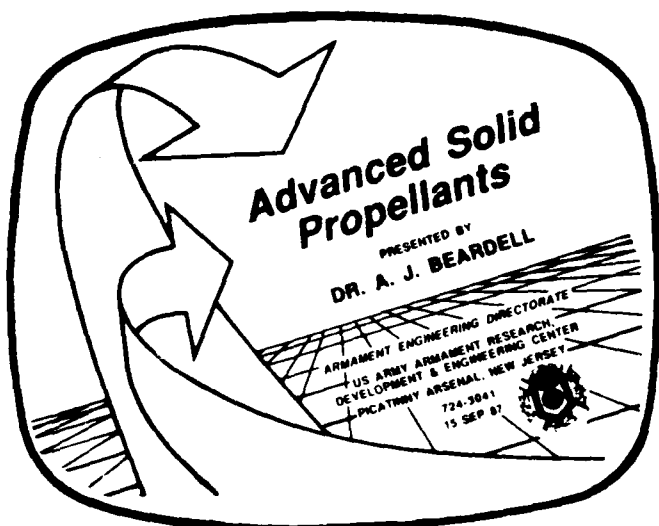
Advanced Solid Propellants



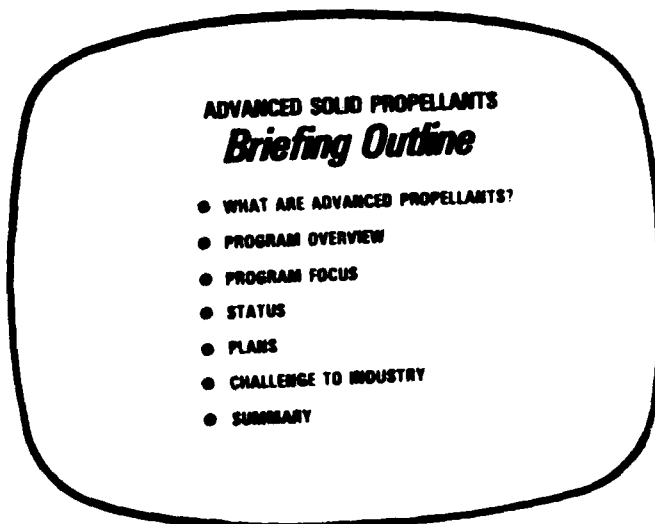
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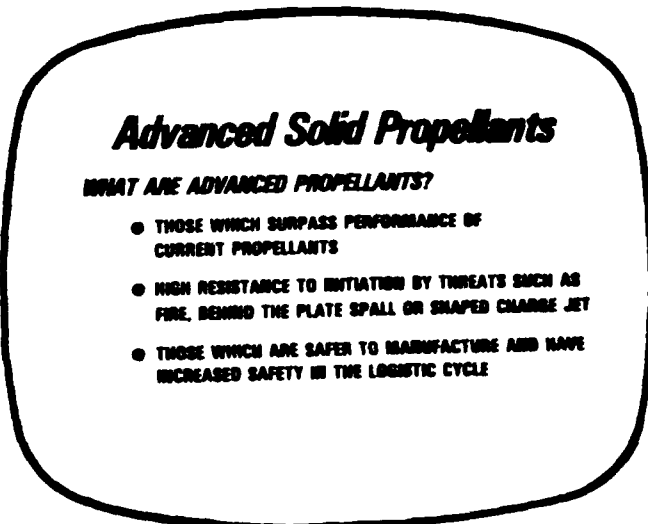
Dr. Anthony J. Beardell



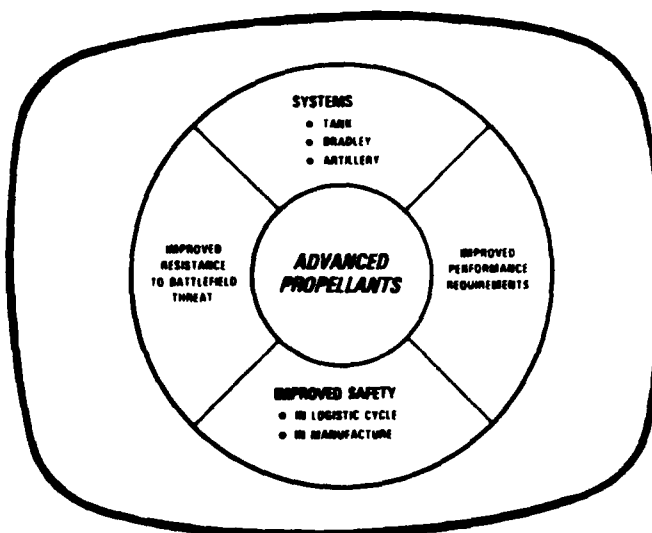
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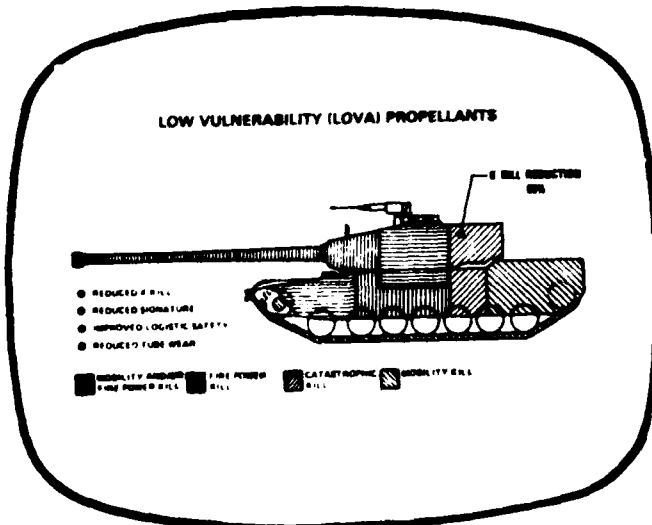
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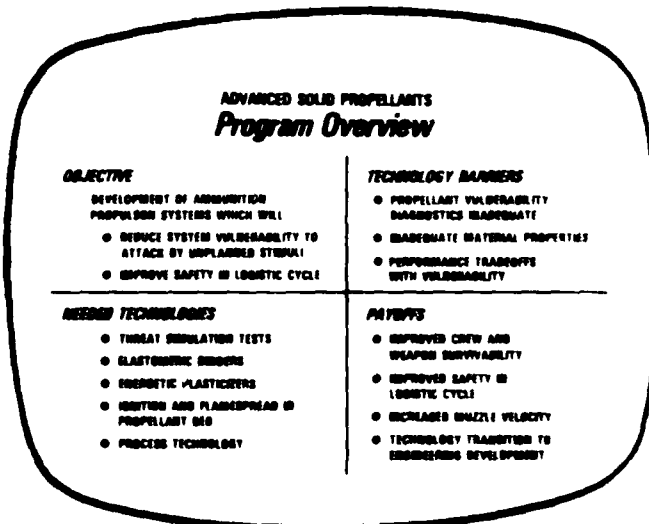
Slide #3



Slide #4



Slide #5



Slide #6

Slide #1. My name is Dr. Anthony Beardell. I am the Chief of the Research and Technology Section, Propulsion Branch, of the Armaments Engineering Directorate. I will be talking to you about the new developments in solid propellants for guns, which encompasses small arms, tank, and artillery systems.

Slide #2. The briefing outline.

Slide #3. The impetus for developing new solid propellants for guns is derived from experience in the battlefield and in storage dumps where the propellant is vulnerable to attack, and at the manufacturing plant where catastrophic explosions have resulted in the loss of life and property. The type of propellant that is being sought is designed to reduce vulnerability, and improve safety in manufacture while meeting or surpassing performance requirements.

Slide #4. Systems being addressed are tank, artillery, and the Bradley Fighting Vehicle.

Slide #5. Analysis has shown that there is a significant reduction in the K-Kill probability of the 105-mm tank if a low vulnerability propellant is used. Added benefits are improved gun tube wear and lower flash because the propellants being developed have a lower flame temperature than the currently used propellant (M30).

Slide #6. The program was focused originally on the 105-mm tank gun. Recently, with the advent of the insensitive munition policy by the Army, the effort has broadened to the M1 tank, artillery, and the 25-mm system. It is therefore necessary to analyze the threat for each system and design the propellant to meet these threats. The analysis shows that there are technology gaps which must be filled if the objectives are to be met.

Program Focus

- DEVELOP INSENSITIVE PROPELLANT FORMULATIONS
- DECREASE USE OF NITROGLYCERIN IN PROPELLANTS
- DEVELOPMENT OF THERMOPLASTIC ELASTOMERS
- PERFORMANCE DEMONSTRATION
- ENGINEERING DEVELOPMENT

Slide # 7

Advanced Solid Propellants

STATUS

- ARMY INSENSITIVE MUNITION POLICY A DRIVER FOR ADVANCED PROPELLANTS
- A LOVA PROPELLANT (XM30) DEVELOPED FOR 105MM HEAT ROUND
- TECHNOLOGY IS DIRECTED TO IMPROVED ENERGETICS AND PROPERTIES
- ENGINEERING EFFORTS ARE IN PROGRESS ON 105MM KE AND 253MM HEAT ROUND

Slide # 8

Advanced Solid Propellants

STATUS

- INSENSITIVE PROPELLANTS EFFORT FOR 155MM UNICHARGE BEGINS IN FY88
- DECISION ON UNICHARGE BASELINE OR LOVA-TYPE DESIGN OCCURS IN FY90
- ELASTOMERIC PROPELLANTS WILL BE DEVELOPED TO IMPROVE RESISTANCE TO SHOCK
- THERE IS INDUSTRIAL PARTICIPATION IN AREAS OF THERMOPLASTIC BINDERS, PROPELLANT FORMULATIONS AND IGNITION

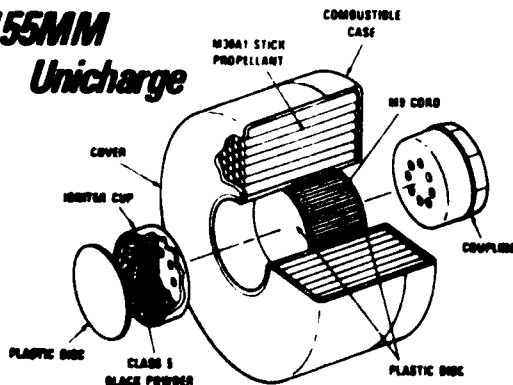
Slide # 9

Standard LOVA vs M30

COMPOUND	XM30	M30
CELLULOSE ACETATE BUTYRATE	12.0	-
NITROCELLULOSE (12.6%N)	4.0	28.0
ETHYL CENTRALITE	0.4	1.5
RDX	76.0	-
ACETYL TRIETHYL CITRATE	7.6	-
NITROGLYCERIN	-	22.5
NITROGUANIDINE	-	47.7
CRYOLITE	-	0.3
IMPETUS, J/g	1088	1081
FLAME TEMPERATURE, °C	2854	3010
SPALL INITIATION TEMPERATURE, °C	725	380

Slide # 10

155MM Unicharge



Slide # 11

ADVANCED SOLID PROPELLANTS Plans

ITEM	88	89	90	91	92	REMARKS
GENERIC R&D						
TANK						81 B & 7
105MM M809K1			TC		PRODUCTION	
105MM ALL SERVICE ROUNDS			TC		PRODUCTION	PP PLANS BEING DEVELOPED
105MM ARTILLERY						
M203A1						PLANS UNDERWAY
UNICHARGE				DECISION POINT		
BARRAGE						
INSENSITIVE						TC 83 OR 84

Slide # 12

Slide #7. The focus of the program is the design of propellants which will demonstrate the sought after reduced vulnerability and safety in manufacture. One of the focuses is the use of thermoplastic elastomers as binders. It is believed that this type of material will produce the kind of mechanical properties which improve shock resistance of the propellant.

Slide #8. Significant progress has been made in the development of an insensitive (LOVA) propellant for the 105-mm HEAT round. Much of this technology is being used to develop higher energy LOVA-type propellants for other ammunition. This slide shows the status of that activity.

Slide #9. An insensitive propellant is being sought for the new 155-mm propelling charge termed the "Unicharge". In FY87 industry was solicited by BRL to help. The development of a LOVA-type propellant for the Unicharge is a difficult problem in terms of burning characteristics and mechanical properties. There is a three year window in which to solve the problem (FY90). The slide shows the status of that activity and the role of industry.

Slide #10. The LOVA propellant is a drastic departure from the conventional nitrocellulose-nitroglycerin based gun propellants. The first generation LOVA propellant was designed to meet a hot fragment (spall) threat. Note the difference in the spall initiation temperature of XM39 LOVA vs M30.

Slide #11. Schematic of Unicharge is shown. It has a dual propellant system, one of which is a regressive burner, the centercore, and the second which is a progressive burner, the main charge. The Unicharge is designed for autoloading; the number of increments used will determine the velocity, and therefore the range of the projectile. Six increments will produce the M203A1 velocity.

Slide #12. The programs which will be conducted through FY92 are shown. There is a basic research program that is focusing on insensitive binder and solid filler synthesis, ignition and combustion problems and vulnerability diagnostics. There is a product improvement program in progress to type classify a 105-mm kinetic energy (KE) round using a LOVA-type propellant, and programs are planned but are as yet unfunded to address the ammunition for the 120-mm tank round. The insensitive propellant program for the Unicharge is a high risk effort and will run concurrently with a program using a more conventional approach. A decision point is projected for FY90 for full scale development.

TIME
BRADLEY, ZIMMER
STATE
RECORD
RECORDS SECTION
CASE 11-1-1000

REMARKS
PIP PLAN
BEING STAFFED
WERN-LONA. ACTION
PLAN SUBMITTED
ZINNO SYSTEMS

TECHNOLOGY OPPORTUNITIES

- PIP PLAN
BEING STAFFED
NON-LEAD. ACTIVE
PLAN SUBMITTED
ZIMM SYSTEMS

Advanced Solid Propellants

- SHORTFALL IN LOVA-TYPE PROPELLANT PRODUCTION FOR MRD-873
- NEW PROPELLANT INGREDIENT MANUFACTURING
- COMBUSTIBLE CASE MANUFACTURE
- CONTINUOUS LOVA PROPELLANT PROCESS TECHNOLOGY

ADVANCED SOLID PROPELLANTS

Summary

- THERE IS A MAJOR EFFORT BY THE ARMY TO IMPROVE SURVIVABILITY OF WEAPONS AND DEVELOP INSENSITIVE MUNITIONS
- INSENSITIVE LOVA TYPE PROPELLANTS ARE BEING DEVELOPED FOR 100MM AND 700MM TANK TUBES AND ARTILLERY SYSTEMS

- TECHNOLOGY CHALLENGES
 - HIGH ENERGY / LOW VULNERABILITY FORMULATIONS
 - NEW MATERIALS
 - VULNERABILITY DIAGNOSTICS
- PRODUCTION CHALLENGES
 - REAGENT MANUFACTURE
 - PROPELLANT MANUFACTURE
 - CONTINUOUS PROCESS DEVELOPMENT

86

Slide #13. There is a major effort underway to improve the survivability of the Bradley by the use of insensitive propellants and explosives. In FY87 a 6.2 program was conducted to develop an insensitive propellant for the new KI round and currently efforts are underway to extend the program to advanced and engineering development. As is noted in the chart, there is an Engineering Study underway on the XM792 heat round that will lead to a Product Improvement Program (PIP) in FY89.

Slide #14. Technology opportunities are directly relatable to the projected propellant characteristics that will be required for insensitive propellants, namely, improved resistance to shock, improved burning properties (especially for artillery charges), improved ignition at low temperature, and improved ballistic uniformity. Also there is concern that the currently used nitrocellulose-based cases used in the 120-mm and 155-mm charges may need modification to improve their resistance to ignition.

Slide #15. The projected production requirements for LOVA propellants and ingredients such as bis-dinitropropylacetal/formal and new binders or plasticizers are larger than the available resources and the Army is actively investigating the industrial possibilities.

Slide #16. In summary, the Army has a substantial program on the development of advanced solid propellants for guns. The effort is in line with the Army insensitive munition policy. We foresee both technology and production challenges and opportunities for industry.

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Shoot-to-Kill/Smart Munitions



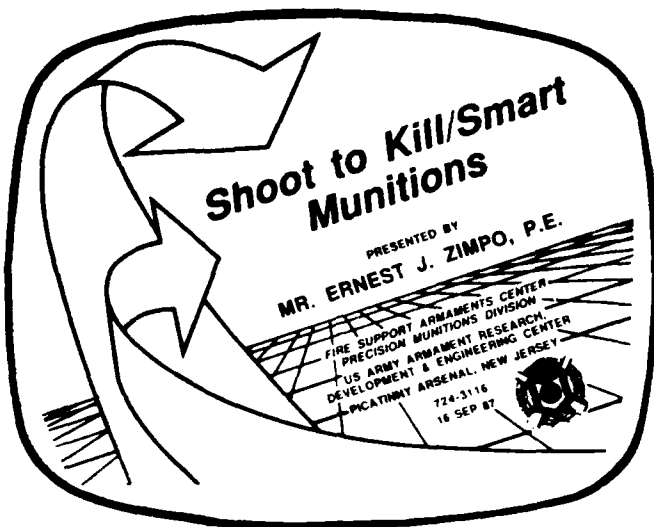
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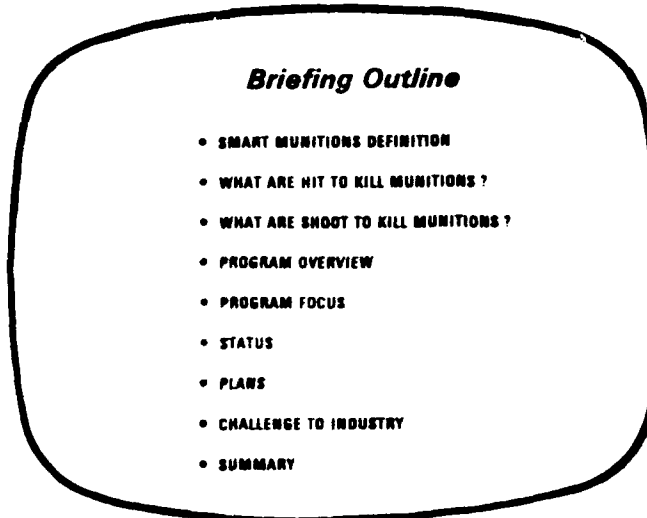
Mr. Ernest J. Zimpo, P.E.



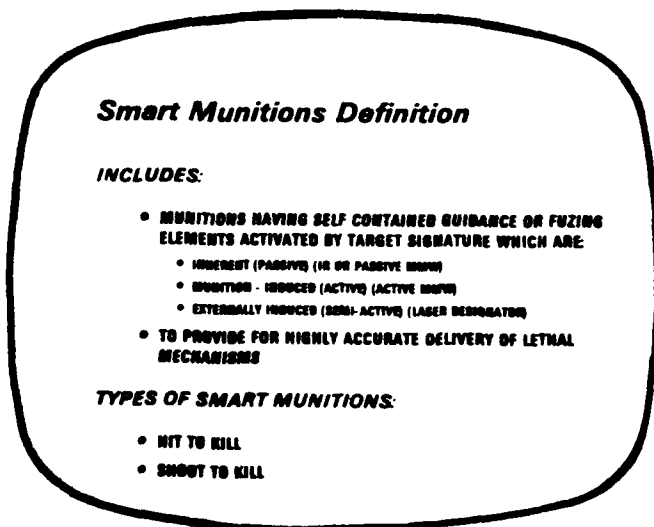
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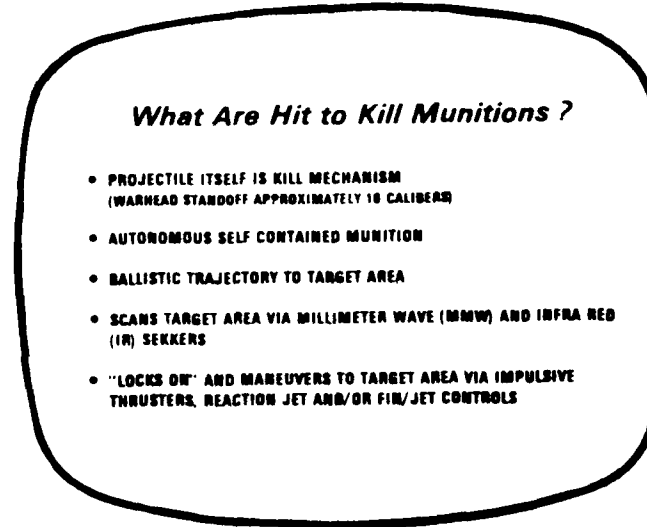
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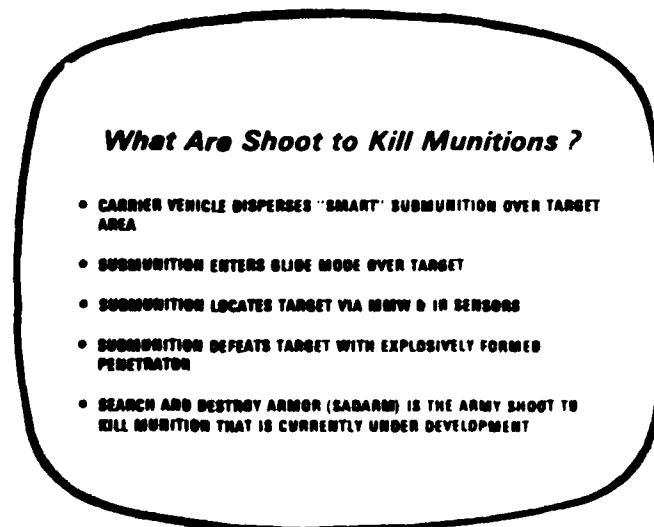
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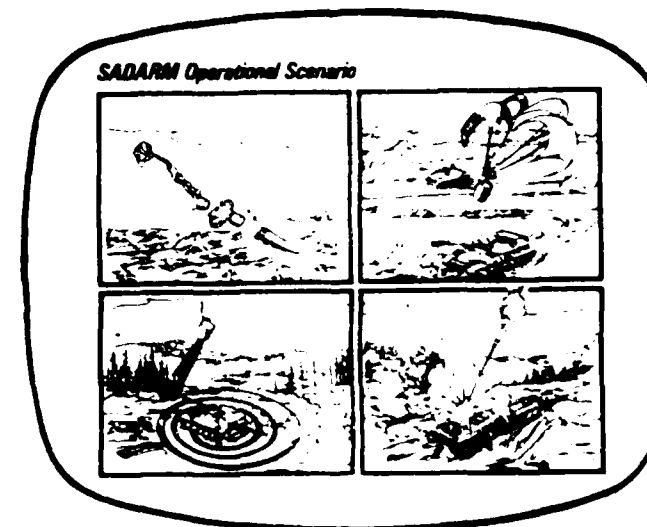
Slide #3



Slide # 4



Slide #5



Slide #

Slide #1.- During my portion of this presentation, I will be discussing shoot-to-kill, and the possibilities of how to improve the existing SADARM munition.

Slide #2.- This is an outline of the areas that I will be covering, making an emphasis on shoot-to-kill munitions and the role of industry in improving current munitions.

Slide #3.- What is a smart munition? It is any munition that can be guided to its intended target, either autonomously or externally, and/or detonated using a controlled fuzing scheme.

Slide #4.- The first type of smart munition is a "hit-to-kill" munition. In this type of munition, the kill mechanism is the fired/launched projectile, on a ballistic trajectory to the target area, with no release of submunitions involved. This requires that the projectile itself contain a seeker/sensor and some method of maneuvering to the target.

Slide #5.- The second type of smart munition is a "shoot-to-kill" munition. This involves some kind of carrier projectile that will disburse a smart submunition(s) over the intended target area. The submunition will contain all the necessary subsystems to assure a kill (seeker/sensor, maneuver mechanism, warhead).

Slide #6.- This slide describes the operation of the current Army shoot-to-kill munition, SADARM (Search and Destroy Armor).

- a. Submunitions are released from carrier vehicle.
- b. Submunition enters a glide mode over the target area.
- c. Target is located utilizing an on-board sensor (IR or MMW).
- d. Explosively formed warhead penetrator is fired at target when submunition has the proper orientation.

Program Overview

OBJECTIVE:

- DEVELOP A SUBMUNITION TO PERFORM THE FOLLOWING TASKS:
- AUTOMATICALLY SEARCH TARGET AREA
- DEFLAT CLOUDED ARMORED TARGET
- SEARCH TO HIT A VARIETY OF CARRIERS
- 100MM SUBMUNITION PROJECTILE
- 8 INCH PROJECTILE
- MULTIPLE LAUNCH ROCKET SYSTEM

TECHNOLOGY BARRIERS:

- SEARCHING TARGETS IN CLUTTERED BACKGROUND
- LIMITED SUBMUNITION SEARCH AREA
- DEFLAT OF IMPROVED ARMORS

NEEDED TECHNOLOGIES:

- DUAL MODE SEEKERS
- ENLARGED FOOTPRINT BLINDSPOTS
- HEAVY/IN METAL WARHEADS

FUTURE CAPABILITY:

- REDUCES LOGISTICS BURDEN
- ENHANCED TARGET ACQUISITION
- LARGER SEARCH AREA
- HIGH PRIORITY KILL

Slide # 7

Program Focus

- SHOOT TO KILL SUBMUNITION COMPATIBLE WITH 155MM, 8 INCH AND MLRS
- DEVELOP FOLLOW ON TECHNOLOGIES FOR ENHANCED SABARM PERFORMANCE VIA PRODUCT IMPROVEMENT PROGRAM (PIP)
 - ENHANCED FOOTPRINT LIFT/BLAS (L/B) SUSPENSION SYSTEM
 - IMPROVED WARHEAD AGAINST ARMORED THREAT
 - LOW COST EFFECTIVE SEEKERS

Slide # 8

Status

TECHNOLOGY

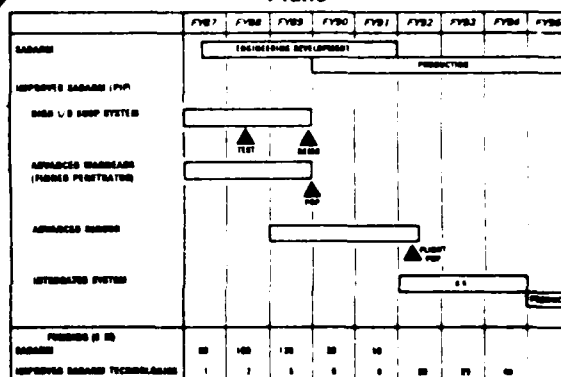
- ENGINEERING DEVELOPMENT EFFORT UNDER WAY FOR 155MM, 8 INCH AND MLRS
- ENTERED FULL SCALE DEVELOPMENT IN SEPT 86 FOR SUBMUNITIONS
- PIP EFFORT NOW UNDERWAY VIA BROAD AGENCY ANNOUNCEMENTS
 - HIGH L/B SUSPENSION SYSTEM
 - ADVANCED WARHEAD
 - LOW COST ADVANCED SEEKERS

PLANS

- SYSTEM ENGINEERING AND PERFORMANCE SCHEDULED FOR 1989, WITH DEVELOPMENT TESTING BEGINNING IN FY91
- FULL & OPEN COMPETITION FOR FULL RATE PRODUCTION BEGINS AT THE END OF 1993
- TECHNOLOGY PROGRAM FOR PIP, IN UNDERWAY

Slide # 9

Plans



Slide # 10

Challenge to Industry

- REDUCE COST BY IMPACT ON COST DRIVERS
- INCREASED EFFECTIVENESS/UTILITY - ABILITY TO PERFORM MISSIONS
 - ENHANCED FOOTPRINT
 - IMPROVED WARHEAD
 - ADVANCED SEEKER/SENSOR

Slide #

Summary

PROJECT SUMMARY

- OVERALL PROGRAM ON SCHEDULE
- PRE PLANNED PRODUCT IMPROVEMENT (PII) IS PLANNED TO INCREASE EFFECTIVENESS OF SABARM
- SABARM IS A MAJOR ARMY PROGRAM
 - CURRENTLY IN FULL SCALE ENGINEERING DEVELOPMENT PHASE

INDUSTRY PARTICIPATION NEEDED IN THE FOLLOWING AREA

- ENHANCED FOOTPRINT: BY IMPROVING TO INCREASE SEARCH AREA
- IMPROVED WARHEAD: BY IMPROVING FUTURE ARMORED THREAT
- ADVANCED SEEKER/SENSOR: BY INCREASING EFFECTIVENESS IN CLUTTERED BACKGROUND

Slide #

AD-A192 152

ADVANCED PLANNING BRIEFING FOR INDUSTRY PROCEEDINGS
15-16 SEPTEMBER 1987(U) ARMY ARMAMENT RESEARCH AND
DEVELOPMENT CENTER DOVER NJ REQUIR.. SEP 87

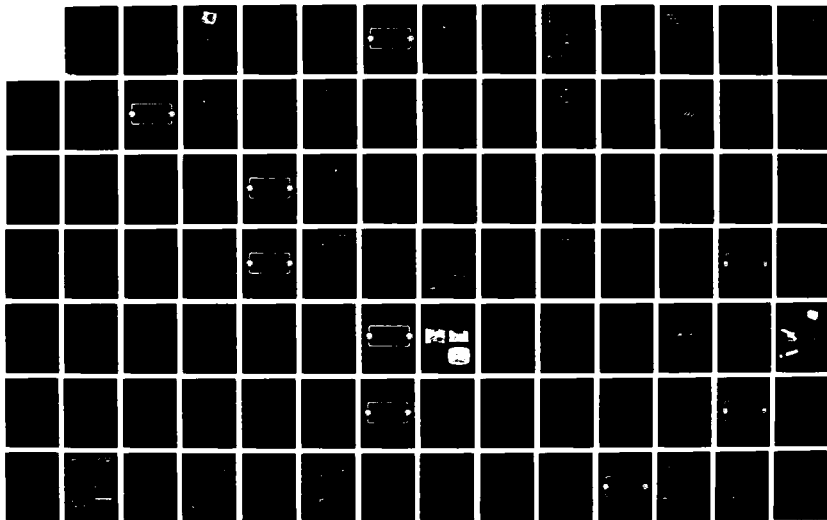
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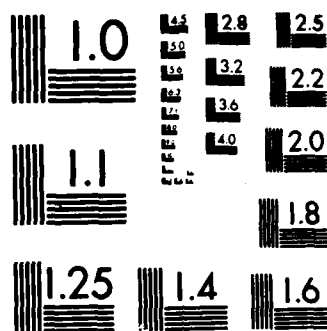
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Slide #7.- This slide highlights the technology barriers that face the shoot-to-kill munitions, and what technologies are needed for the munitions to accomplish their objectives.

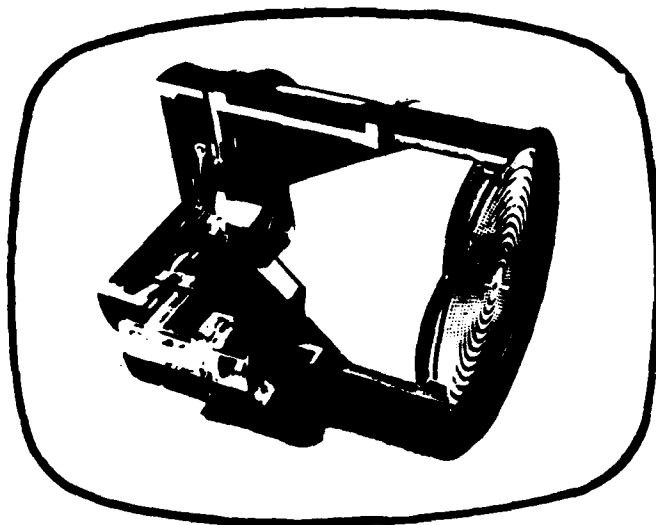
Slide #8.- The primary carriers for the SADARM type submunition will be 155-mm and 8" gun launched projectiles and the Multiple Launch Rocket System (MLRS). The emphasis of this program will be to produce an enhanced SADARM submunition with an enlarged "footprint", improved warhead to defeat future armored threats, and low cost seeker/sensor that will work under adverse conditions.

Slide #9.- The current status of this effort includes an ongoing engineering development program for the incorporation for the submunition in the 155-mm, 8" and the MLRS, and a product improvement program being put together utilizing Broad Agency Announcements. In the future we expect system engineering to take place in 1989, development testing in 1991 and open competition for full production in the late 1993 time frame.

Slide #10.- This slide shows how the proposed SADARM program will parallel the current SADARM program and how each of the subsystems will channel into a production phase around 1995. Also included are the proposed funding dollars for each program (not including production funding).

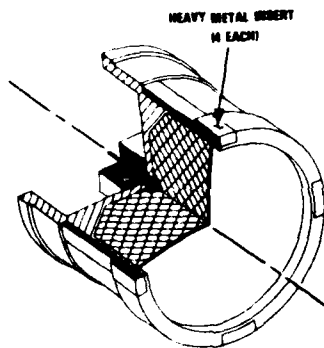
Slide #11.- The role of industry in this program is to reduce the cost of the submunition by producing subsystems that will increase the efficiency of the overall submunition, are easily upgradable and are highly simplistic from a production standpoint.

Slide #12.- Thus, the most logical and near-term method of increasing the role of shoot-to-kill munitions in the realm of smart munitions is to take the existing SADARM program and implement a product improvement program to increase the effectiveness of the round. The only way this offshoot program will succeed is if the Government can get a serious participation from industry in each of the vital SADARM subsystems.



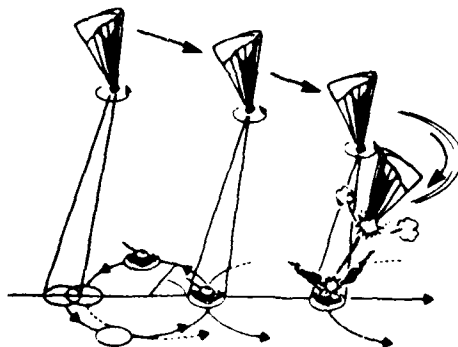
Slide # 13

SADARM Warhead Concept



Slide #14

**SCENARIO
*Steerable Axi-Symmetric 155MM SADARM***



Slide #15

Slide #13.- (Optional) - Current SADARM submunition configuration.

Slide #14.- (Optional) - Generic warhead configuration.

Slide #15.- (Optional) - Conceptual scenario for the Improved SADARM submunition.

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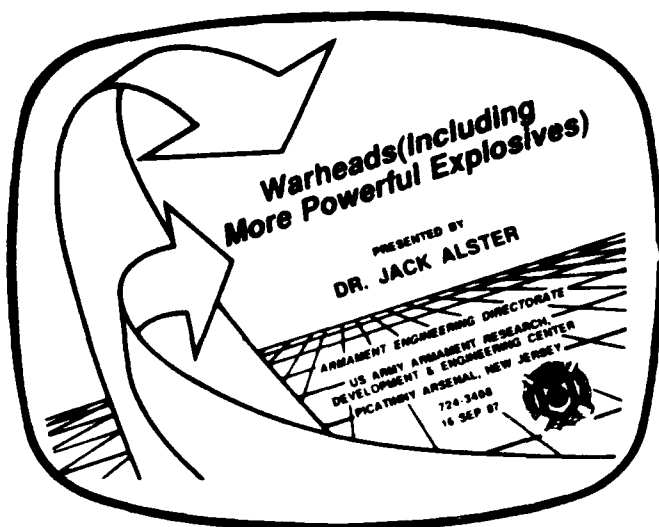
Warheads (Including more powerful explosives)



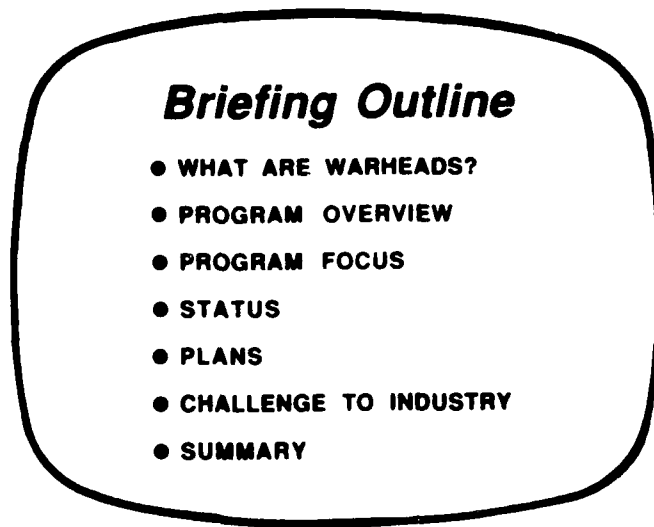
Presented by



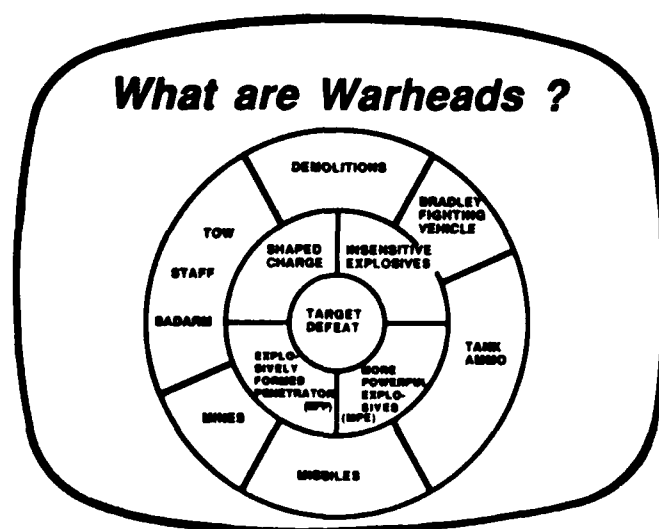
Dr. Jack Alster



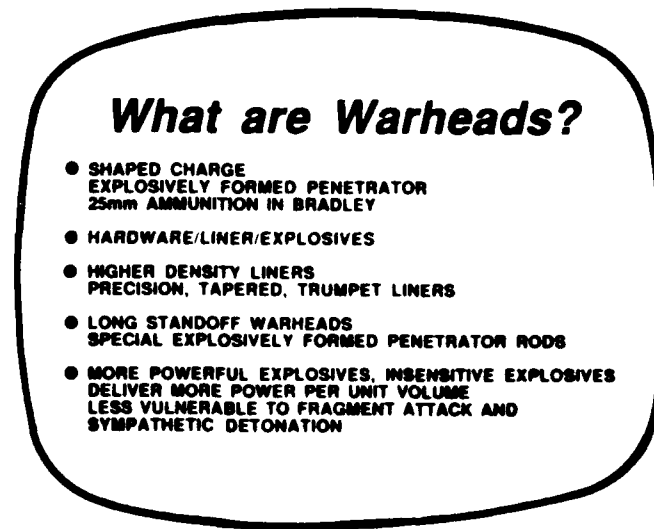
Slide # 1



Slide # 2



Slide # 3



Slide # 4

Slide #1. This presentation will be on the development of new warheads, including the development of new more powerful explosives.

Slide #2. The briefing will follow the outline shown.

Slide #3. The central aim of the warheads effort is to better defeat targets. There are a variety of warheads out there of which only two types are shown, that is the shaped charge (SC) and the explosively formed penetrator (EFP) types. Substantial progress has been made under the ARDEC program in improving these anti-armor warheads.

This year, ARDEC launched a crash program to develop a new insensitive explosive formulation which would greatly reduce the vulnerability of munitions to fragment attack.

In the area of more powerful conventional explosives (MPE), ARDEC last year triggered a remarkable revolution in the synthesis of high energy density compounds. In particular, theoretical calculations have highlighted, and experimental investigations have led to the synthesis of two entirely new classes of explosive compounds whose ultimate performers will be more powerful than current in-service explosives. Their molecular structures are of the compact, strained ring and cage type.

The outer ring in the viewgraph represents several applications for the emerging new warheads and explosives.

Slide #4. We shall in this briefing be primarily concerned with SC and EFP warheads as well as the 25-mm ammo rounds used in the Bradley Fighting Vehicle.

Three essential components in the SC and EFP warheads are hardware, a metal liner which carries the energy of the explosive to the target, and of course, the explosive.

There have been developments in conical liners for the SCs that are more dense than copper and have different shapes and dimensions. In the long standoff EFP warheads emphasis has been on explosive forming of penetrator rods of special geometry.

More powerful explosives are primarily intended for anti-armor munitions; and insensitive explosive formulations are designed for applications where the overriding concern is to reduce the risk of sympathetic detonation of munitions stored in close proximity without seriously compromising the performance of the munition.

Warheads

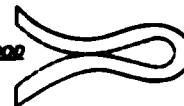


HE = HIGH EXPLOSIVE

Slide # 5

Objective

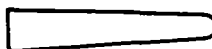
CURRENT EFP PENETRATOR ROD



GOAL

COMPACT ROD

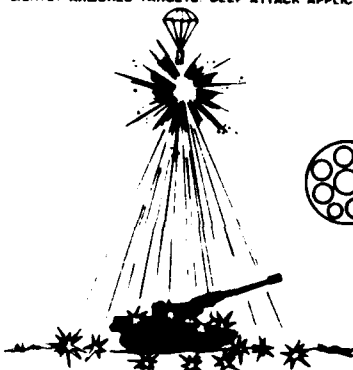
- MINIMAL MASS USED IN FLARE (OR FINE) RETAIN SAME AEROBALLISTIC ACCURACY
- MORE MASS AVAILABLE TO INCREASE LENGTH FOR MORE PERFORATION
- ELIMINATE VOIDS, INCREASING PENETRATOR RESISTANCE TO REACTIVE APPLIQUES
- REDUCED DRAG FOR INCREASED STRIKING VELOCITY AND PERFORMANCE



Slide # 6

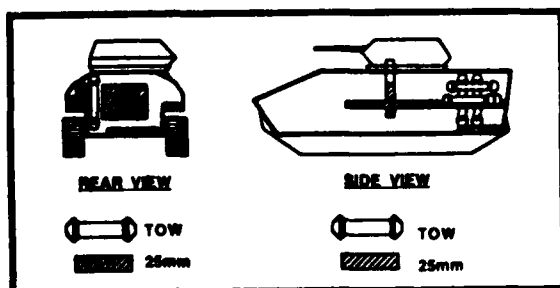
Multi Frag Submunition System

INCREASED LETHALITY THROUGH MULTI HIT CAPABILITY AGAINST LIGHTLY ARMORED TARGETS: DEEP ATTACK APPLICATION



Slide # 7

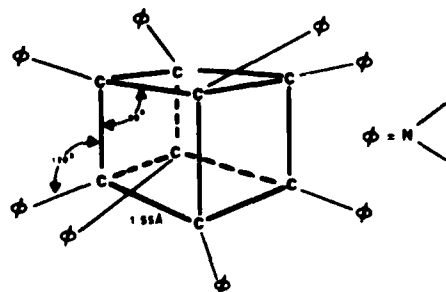
Infantry Fighting Vehicle



NEED FOR INSENSITIVE EXPLOSIVE

Slide # 8

Pernitrocubane (PNC)-High Energy Molecule



Slide # 9

Slide #5. Here we illustrate two different kinds of conical metal liners used in SCs, where precision means a tolerance in the thickness of the liner within 0.2 mil.

In the bottom diagram we show a bowl-shaped or dish-like metal liner used in an EFP warhead backed up by the explosive.

Slide #6. Upon detonation of the explosive, the dish is deformed into a rod, shaped as shown, and propelled forward at high speed toward the target. The shape is far from optimum for maximum penetration into the target.

To achieve the optimum shape shown at the bottom, it is necessary to:

- o minimize the flare
- o elongate the rod
- o eliminate the void, and
- o configure the rod so as to reduce air drag.

Slide #7. Here we show a sophisticated application of the EFP concept: top attack on a lightly armored target such as a self-propelled howitzer. Several penetrators simultaneously impact the target after they have been punched out by the explosive from a dish shown on the right. The circles represent dimples.

Slide #8. To demonstrate the need for developing new insensitive explosive formulations, let me refer to a side view of a Bradley Fighting Vehicle. We see that approximately 20% of the total area of the vehicle presented to enemy fire is subtended by 25-mm and TOW ammunition stored on board the vehicle. In the event of a direct hit on one munition, it is critical that the munition which was hit not cause sympathetic detonation of the remaining munitions. For this reason new insensitive formulations are being developed for use in insensitive munitions (IM).

Slide #9. As for more powerful explosives, we show an example of just one of many new more powerful cage molecules which have been highlighted by theoretical calculations and represent goals for synthesis, namely pernitro or octanitro cubane. It has eight carbon atoms bonded to one another in the shape of a cube, each carbon atom carrying a nitro group. There is enough oxygen to fully combust the carbon to carbon dioxide, yielding very high energy. The molecule is very compact thus leading to an appreciable increase in detonation performance relative to conventional in-service explosives.

Increase in EFP Penetration (CALCULATED)

LX-14

(BASELINE)



PERNITROGUANINE

34%



DINITRO DIAZA TETRAHEDRANE

48%



Slide # 10

Program Overview Warheads

OBJECTIVE

- INCREASE ANTI-ARMOR WARHEAD PERFORMANCE VIA
 - LINER DESIGN
 - USE OF MORE POWERFUL EXPLOSIVES
- INCREASE SURVIVABILITY OF MUNITIONS

TECHNOLOGY BARRIERS

- INADEQUATE PENETRATION OF SPECIFIC ARMORS, TARGETS
- LACK OF NEW CHEMISTRY FOR MORE POWERFUL EXPLOSIVES FOR WARHEADS TO DEFEAT HARD SENSITIVE ARMOR
- NOT ENOUGH INSENSITIVITY OF EXPLOSIVES IN BATTLEFIELD MUNITIONS

NEEDED TECHNOLOGIES

- PRODUCE SPECIAL JETS FOR SPECIFIC TARGETS
- PRODUCE IMPROVED EFP SHAPES, SIZES
- IMPROVED METALLURGICAL FABRICATION TECHNIQUES FOR BETTER JET DUCTILITY
- CHALLENGING NEW PROCEDURES FOR MAKING NEW IPE
- DEVELOPMENT OF NEW POWERFUL INSENSITIVE EXPLOSIVE FORMULATIONS

PAYOFFS

- IMPROVED SHAPED CHARGE PERFORMANCE AGAINST SPECIFIC ARMOR (REACTIVE, COMPOSITE, ROLLED HOMOGENEOUS)
- BETTER PROBABILITY OF KILL OF EXPLOSIVELY FORMED PENETRATORS
- UP TO 35% INCREASE IN PENETRATION BY WARHEAD FROM MORE POWERFUL EXPLOSIVE
- GREATLY INCREASED SURVIVABILITY OF MUNITIONS FROM INSENSITIVE EXPLOSIVES

Slide # 11

Program Focus

- DEVELOP LINERS TOWARD DESIRED JET SHAPES
- DEVELOP LINERS TOWARD DESIRED PENETRATOR RODS
- SYNTHESIZE NEW MORE POWERFUL CAGE EXPLOSIVES
- DEVELOP INSENSITIVE FORMULATIONS
- CONCEPT DEMO OF ABOVE
- ENGINEERING DEVELOPMENT OF MORE POWERFUL AND LESS SENSITIVE EXPLOSIVES IN PROTOTYPE WARHEADS

Slide # 12

Status of Warheads

TECHNOLOGY

- PRECISION COPPER LINER MACHINING REASONABLY PERFECTED
- PRECISION TRUMPETS IN PRODUCTION

PLANS

- COMPACT ROD EFFORT INITIATED
- THREE DIFFERENT WAYS TO DEFEAT REACTIVE ARMOR DEMONSTRATED, ONE BEING IMPLEMENTED
- EXPANDED WORK PLAN FOR MULTIFRAG PENETRATOR SYSTEM BEING DEVELOPED

Slide # 13

EFP Warhead In Support OF Shoot To Kill/Smart Munitions

	APPLICATIONS	PLANNED FY98 FUNDS (\$M)
ARMY/NAVY/AF/USMC		
1. LIGHT ROCKET WARHEAD (LR)	REACTIVE/SMART TARGETS	1.0
2. SMART ROCKET WARHEAD (SR)	REACTIVE/SMART TARGETS	0.1
3. SMART ROCKET WARHEAD (SR)	ALL OF ABOVE	1.0
NAVY/AF/USMC		
1. LIGHT ROCKET WARHEAD (LR)	REACTIVE/SMART TARGETS	0.5
2. SMART ROCKET WARHEAD (SR)	REACTIVE/SMART TARGETS	1.0
		TOTAL \$ 3.6M

Slide # 14

Slide #10. Translated into penetration of armor by an EFP warhead containing pernitrocubane in place of the baseline explosive LX-14 (which is 95% HMX), up to 34% improvement can be expected if the liner and hardware design is optimized to exploit the additional explosive power. In the case of the ultimate CNO explosive, diaza dinitro tetrahedrane, up to 49% increase in penetration can be expected. In particular, to achieve this increased performance, one would use more robust liners with the MPE, to produce longer more massive penetrators.

The theoretical shapes of the EFPs do not correspond to the optimally designed warhead; they are just a first approximation based on use of the same warhead configuration for all three explosives.

Slide #11. To integrate what has been said so far, the Warheads Program has a dual objective, namely to markedly increase the antiarmor warhead performance, and the survivability of munitions.

The most difficult of the three technological barriers to be overcome is the virgin nature of the new chemistry needed to synthesize high energy-density explosives. Clearly, new procedures must be developed to make these explosives. There is even a high probability that some of the new MPE will have low sensitivity.

In the area of warhead design, one needs to further develop technologies to produce special jets and EFP rod shapes for specific targets such as reactive armor. The anticipated payoffs follow readily from the full development in the near future of the needed technologies.

Slide #12. The Warheads Program focuses on the first four areas so that we will soon be able to demonstrate the validity of the new concepts in demo runs using new MPE and insensitive explosives in appropriate warheads.

Slide #13. Here is where we stand today with warheads technology and here is where we are going. In addition, I want to add that in EFP warheads the feasibility of long, aerodynamically stable rods has been demonstrated and further improvements are planned.

Slide #14. The new EFP warhead concepts will support the Shoot-to Kill/Smart Munitions effort in FY88 by carrying forward the tasks listed in the left column under the categories of axisymmetric and non-axisymmetric warheads for the given applications. A total expenditure of \$3.6M is planned for FY88.

Status of Explosives

TECHNOLOGY

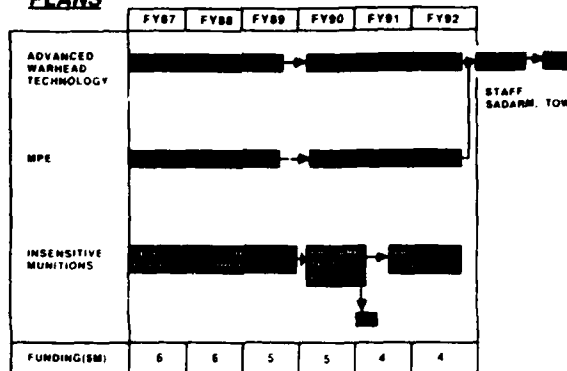
- TRINITROAZETIDINE - FIRST MPE SYNTHESIZED, TESTED
- FOUR NEW FORMULATIONS WITH LESS SENSITIVITY FOR BRADLEY

PLANS

- COMPREHENSIVE PLAN LAID OUT
- CONCERTED EFFORT TO SYNTHESIZE NEW MPE - IN-HOUSE, ACADEMIA-OGA-INDUSTRY
- NEW MPE DEMO IN PENETRATOR WARHEAD PLANNED

Slide # 15

PLANS



Slide # 16

Challenge to Industry

- IMPROVE PENETRATOR SHAPE, E.G. THE COMPACT ROD
- DEVELOP PENETRATOR WARHEADS WITH MULTIFRAG CAPABILITY
- DEVELOP SHAPED CHARGE WARHEAD FOR SPECIFIC TARGETS
- COMPUTER SIMULATION OF PENETRATOR/TARGET INTERACTION
- DEVELOP SCALED-UP PROCEDURES FOR MAKING NEW MPE/IE

Slide # 17

Summary

PROJECT SUMMARY

- MADE ACCOMPLISHMENTS IN SPECIAL WARHEAD TECHNOLOGY
- HAVE AGGRESSIVE PROGRAM IN MORE POWERFUL AND INSENSITIVE EXPLOSIVES
- THERE ARE TECH BARRIERS/CHALLENGES

INDUSTRY PARTICIPATION NEEDED IN FOLLOWING AREAS

- IN DESIGN OF SPECIAL WARHEADS
- LARGE SCALE PREPARATION OF NEW MORE POWERFUL EXPLOSIVES
- DEVELOPMENT OF INSENSITIVE EXPLOSIVE FORMULATIONS

Slide # 18

Planned BAA/RFP

- DESIGN/FAB/LOAD/TEST S.C. WARHEAD SECTION FOR SMART ARTILLERY PROGRAM FY90, 1st QTR
- DESIGN/FAB/LOAD/TEST EFP WARHEADS FY90, 1st QTR
- PILOT PLANT PRODUCTION OF MORE POWERFUL EXPLOSIVES FY90, 1st QTR
- FABRICATE/LOAD INSENSITIVE EXPLOSIVE FILLS FOR ARTILLERY ROUNDS FY90, 2nd QTR

Slide # 19

Slide #15. Where do we stand with the development of new explosives today?

Well at the outset of the talk I mentioned that theoretical calculations have highlighted two new classes of explosive molecules, namely, strained ring structures and cage structures. Pernitrocubane was described as an example of a cage structure. It is one of several target more powerful cage molecules in an intensive synthesis research program. Here, I wish to point to trinitro azetidine (TNAZ) as an example of a strained ring structure which contains three carbon atoms and one nitrogen atom in a strained, four-membered ring. It can now be prepared in half-pound batches. As it is a castable explosive compound we compare it with 70/30 Octol which is the Army's most powerful castable in-service explosive formulation and we calculate TNAZ to be significantly more powerful than Octol. Extensive testing of this new explosive is now in progress.

I must say that the rapid development of synthetic strategies and theoretical support has been and still is the result of a concerted effort by federal and contractor scientists at the ARDEC site working in close cooperation with world leaders of synthetic organic chemistry in academia, other government agencies, and private industry.

Slide #16. Here, we show plans for the development of advanced warhead technology, MPE and IM. Demo runs using MPE in STAFF and SADARM warhead configurations as test vehicles are planned for the FY90-92 time frame. Type classification of IMs is planned for FY91. The anticipated total funding which includes the EFP warhead effort in support of the SMART Munitions program is given at the bottom of this viewgraph.

Slide #17. Our challenge to you folks in industry is to help us achieve the following specific goals.

Slide #18. In summary, much has been accomplished, much more needs to be done to overcome technological barriers and to meet strong technical challenges. So, we invite you to help us achieve the specific goals set forth below.

Slide #19. We are planning to move forward with requests for proposals in the areas and timeframes indicated.

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Mine Warfare - A Significant Combat Multiplier



US ARMY
ARMAMENT RDE CENTER

Presented by

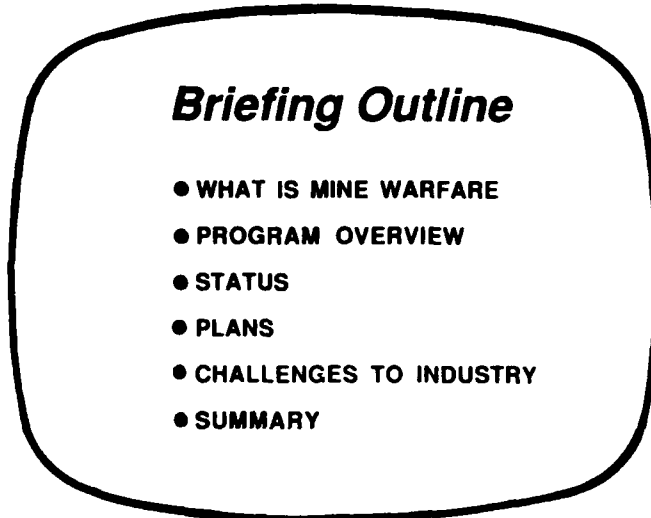


US ARMY
ARMAMENT RDE CENTER

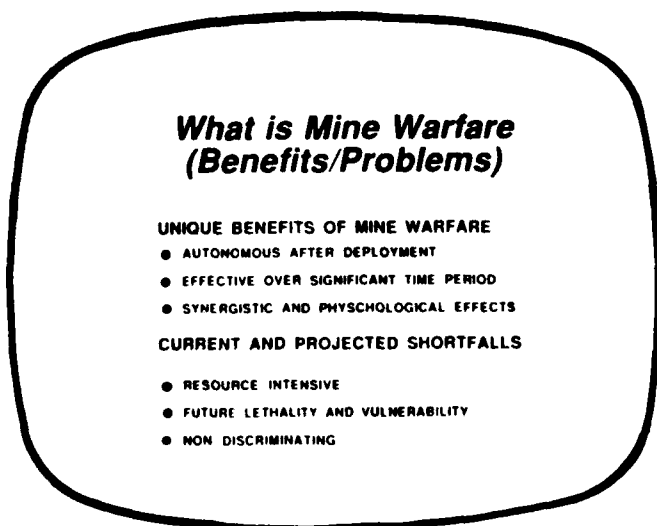
Mr. George E. Lutz



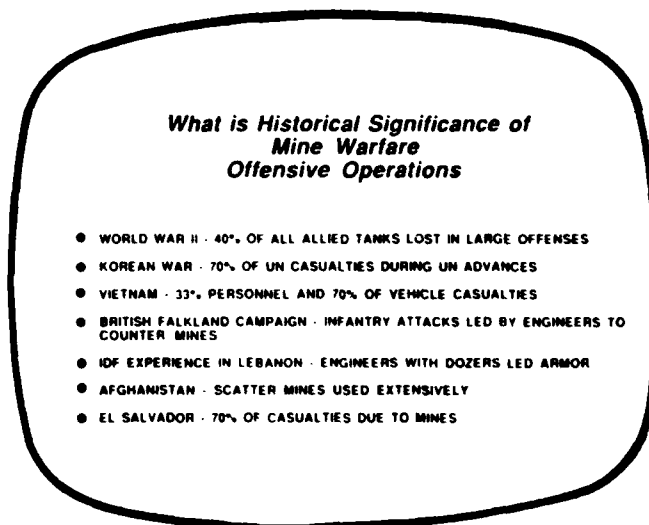
Slide # 1



Slide # 2



Slide # 3



Slide #4

Slide #1. Good morning, I am George Lutz of the Scatterable Mine Branch within the Fire Support and Armaments Center. I will be presenting an information brief today on Landmine Warfare and its future development.

Slide #2. I will first discuss what mine warfare is, why mines are an important factor in warfare, and some of the unique benefits of mine warfare as well as some of its particular problems.

Then I will present an overview of mine warfare, its focus, status and future plans.

I will conclude with technology challenges to industry to meet this plan, and summarize the presentation.

Slide #3. This chart depicts the recent historical significance of mine warfare. It is oriented to losses occurring in offensive operations which will be the primary application of mines today, i.e., as a defense against large scale conventional aggression.

The primary benefits of mine warfare are to delay, disrupt, and channelize (area denial) with significant attrition if breaching is attempted.

As you can see mines have been effective in these areas including the most recent combat situations.

Slide #4. Why is mine warfare a significant combat factor?

- o Mines are autonomous, that is they do not need an active crew after they are deployed, they are all weather, day/night systems without human factor constraints.

- o They can remain effective for long periods of time without additional resources required.

- o They are the only system where mobility of target increases hazard, but lack of mobility also increases hazard from other weapons (synergism of systems).

- o They are difficult to detect and difficult to clear. Threat of unknown and conflict of need to move and not move cause significant psychological stress.

What are the problems with current mine systems?

- o Require significant resources in manpower, time, equipment and number of munitions deployed.

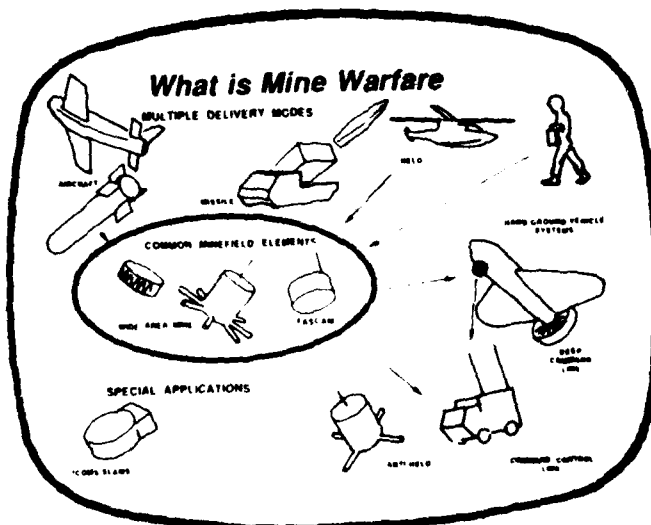
- o Threat targets continue to grow in hardness and countermeasure sophistication. Mine systems need to stay ahead.

- o Basic benefits of mine warfare are two edged since they can cause the same problems for friendly forces. Current systems do not discriminate and are controlled only with extensive documentation and reporting and by limiting their active life.

What is Mine Warfare (TODAY/TOMORROW)

- VARIETY OF DELIVERY SYSTEMS
- COMMON MINE ELEMENTS
 - FAMILY OF SCATTERABLE MINES
 - WIDE AREA MINE
- COMMAND AND CONTROL SYSTEMS
- SPECIAL APPLICATION MINES
- MANY DIFFERENT TECHNOLOGY APPLICATIONS

Slide # 5



Slide # 6

Slide #5. Mine systems of today and the near future for the US Army have the following characteristics:

- o They exploit available platforms with add on dispenser systems. All of the scatterable mines have common components and this theme will be continued with various applications of the wide area mine.

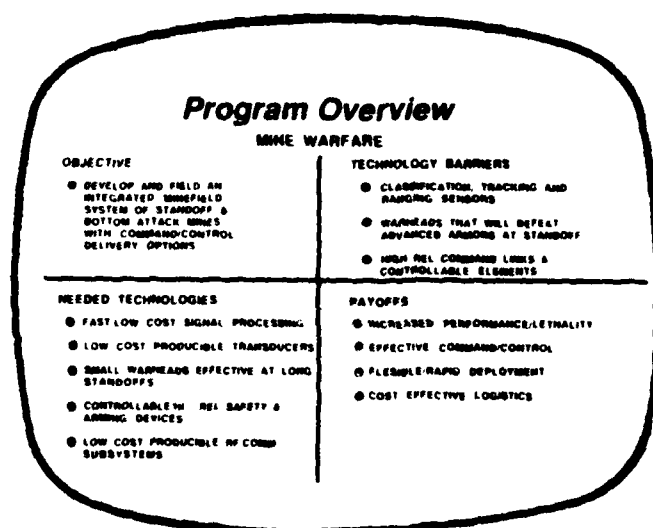
- o The capability of remotely activating/clearing friendly mine fields is strongly desired by the user. Settable and relatively short self destruct times provide limited control now. Modular Pack Mine System (MOPMS) adds flexibility with a remote RF link. Full real time on/off control is a goal.

- o There is a need for some special purpose mines, particularly small systems for special operating forces and for urban applications. Also mines with unique targets such as anti helicopter.

- o Modern mines include a broad range of technologies from electronics, aeroballistics, structures, warhead modeling etc., etc.

Slide #6. This is a graphic overview of mine warfare illustrating multiple delivery systems, hi-speed aircraft, missiles such as Tactical Missile System (TACMS) or Multiple Launch Rocket System (MLRS), helos, trucks, towed systems and hand carried. The common elements of a wide area mine and bottom attack scatterable mine would be dispensed from those platforms and be monitored and controlled via a network that may include local repeater units, RPV relays and display stations.

Specialty mines include long life systems such as Improved Conventional Mine System (ICOMS), small mines such as Selectable, Lightweight, Attack Munition (SLAMS), and anti-helo mines. Future systems will develop mobility such as a roving RPV, self mobility and increased flexibility, meaning top attack, bottom attack, airburst capability with adaptable warheads/sensors to exploit each mode.



Slide # 7

Slide #7. Primary objective of the program is to develop and field first a wide area standoff mine in the deep attack role and then build an integrated system of stand off and bottom attack mines with command control capability that will interface to multiple delivery platforms. Such mixed mine fields under either local or remote control greatly improve countermine resistance.

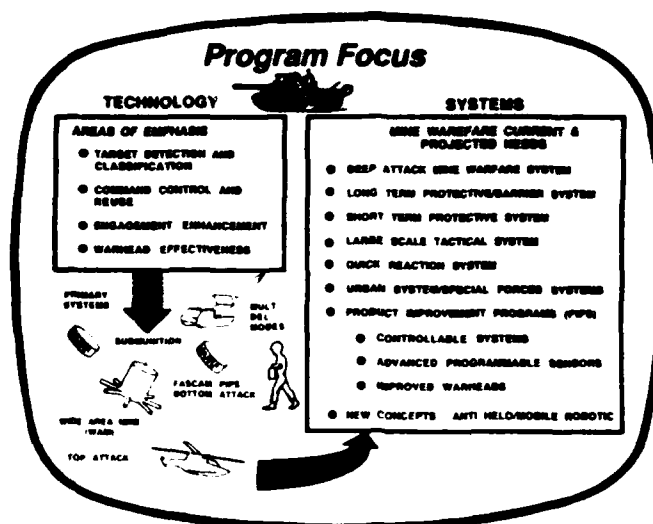
Technology barriers and needed advancement include intelligent sensors that can identify target classes, determine bearing, and the particularly difficult problem of accurate ranging while using low power, small size, and low cost.

There is the need for small, producible warheads that remain lethal as the threat continues to harden, and for very reliable, secure, low cost command links.

The payoffs are increased effectiveness per mine and increased effectiveness as a barrier. Command/control including inter-mine communication will allow the barrier to adapt to the threat and maximize use of resources by controlling expenditure, ignoring CM, and reuse of mine elements.

Flexible/rapid deployment options will give the commander greater control over application of resources.

All of this adds up to more effective logistics, delivering more firepower with fewer resources.



Slide # 8

Program Status

MINE WARFARE CURRENT & PROJECTED NEEDS	NOW	FUTURE
• DEEP ATTACK MINE WARFARE SYSTEM	GATOR	ATACBS/WAM
• LONG TERM PROTECTIVE BARRIER SYSTEM	CONVENTIONAL	ICOMB/WAM
• SHORT TERM PROTECTIVE SYSTEM	MOBMS	MOBMS PP
• LARGE SCALE TACTICAL SYSTEM	VOLCANO GEMSS	VOLCANO PIP/WAM
• QUICK REACTION SYSTEM	ADAM/RAAM	BLRS/WAM/PASCAM
• MOUT SYSTEM/SOF SYSTEMS	PDM	WASPW SLAMS
• PRODUCT IMPROVEMENT PROGRAMS (PIPS)		GARPA ARDEC JOINT PROGRAM
• NEW CONCEPTS		

Slide # 9

Slide #8. This chart represents the focus of future mine development.

These four areas of technology application will be emphasized leading to two primary mine systems.

Engagement enhancement covers standoff mines, flexible delivery systems, and integrated minefields.

Mine systems include the wide area mine currently in the proof of principle phase, and the other is the continuing evolution of the family of scatterable mines.

These basic systems modified for a particular application and enhanced through product improvement programs will provide the elements for the systems needs identified in the mine master plan.

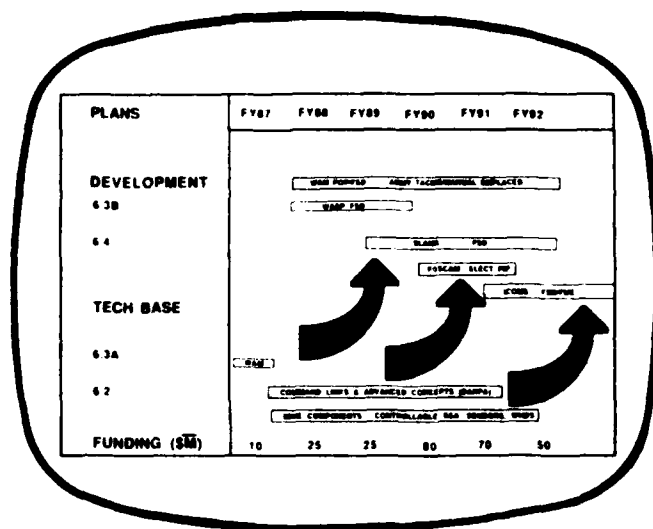
- o DEEP - Aircraft or missile 100km from the flot to disrupt/delay.
- o LONG - 6 months or greater as a barrier.
- o SHORT - Hours/days for temporary security.
- o LARGE SCALE - Few kms wide.
- o QUICK - Artillery emplaced response within minutes.
- o MOUT- Urban systems.
- o SOF - Special forces systems/light weight versatile munitions.

All these needs are supported in part with current fielded systems or systems in active development, but they have the problems previously mentioned. Logistics and control and the more effective systems are needed near term. Product improvement will have a priority on developing remote reporting and controllability capability. Advanced systems will include an anti-helicopter mine, and systems that are mobile either air or ground roving.

Slide #9. This chart relates actual and planned systems to the mine master plan needs.

Now means fielded or in initial production phase having been type classified.

Future means entering proof of principle or full scale development within the next several years.



Slide # 10

Slide #10. This is the planned time line for the next five years on new system and product improvement development. The major program is the wide area mine initially as a deep attack system and as a hand emplaced individual mine.

Wide Area Side Penetrating Mine (WASPM) is a side attack directional mine for defending confined areas such as roadways and urban areas.

SLAMS is a small multiple purpose munitions for SOF.

Electronic PIP is to upgrade scatterable mine sensors to new technology and provide processor based flexibility for multiple options or alternate algorithms and a link to future command/control systems.

ICOMS is a small conventional mine with modern sensors and warhead technology and capability for recovery and reuse.

DARPA is currently taking the lead in command/control communications for mines which will be a joint program with ARDEC.

ARDEC tech base will continue to support mine unique components with emphasis on elements that interface with the command/control technology.

Funding is approximate amounts and is development dollars only, does not include production dollars.

Challenges To Industry

REAL TIME CONTROL OF MINEFIELD

- T-VO WAY COMMUNICATION
- SAFE AND RELIABLE
- CLEAR EFFECTIVE INTERFACES

FLEXIBLE/COMMON HARDWARE

- UNIVERSAL SOLID STATE S&A
- PROGRAMMABLE SENSORS
- PROGRAMMABLE WARHEADS

RECOMMENDATION FOR INVESTMENT

- PRODUCTION IS THE GOAL BUT TAKES TIME TO GET THERE
- WORK ON DURABLE AREAS THAT WILL PAY OFF AND NOT DETAILS THAT MAY BECOME OBSOLETE FOR FUTURE PRODUCTION
- CONCEPTS MODELING
- TEST BEDS-HIGH LEVEL SOFTWARE/FIELD DEMOS
- MINE UNIQUE BASIC COMPONENTS

Slide # 11

Slide #11. The technical challenges to industry.

The user has repeatedly stressed a need for real time control/status of minefields.

It requires simple, effective, recyclable safety & arm (S&A) devices that are very reliable.

It requires clear interface to the user. This may range from indicators on the mine itself, to graphics display consoles in a rear area van, and all the systems in between.

Once communication links are developed smart minefields are possible, with mines sharing info with each other and taking coordinated action.

Modern technology should allow flexibility (multi-modes of operation from a set of common hardware).

Solid state S & A's under electronic control may allow a standard device for different deployment conditions.

Microprocessors and inexpensive memory will allow multiple modes of operation without changing hardware. Advanced warheads with multiple initiation points could result in various modes of attack (fragment size and direction) under electronic control. Again a versatile application without changing hardware.

The overall logistics burden needs to be reduced. The wide area mine (WAM) is a good first step. Reusable mines and reduction in basic types of mines that do not need to be refurbished can reduce stockpiles and transportation burdens.

Recommendation for industry investment.

It takes several years to field a system. Even with our current thrusts of accelerating programs, 6-8 years is likely.

Much of electronic component technology is volatile in terms of the market place, becoming obsolete very quickly. Detailing a design concept too early can result in a qualified system that can't be duplicated in a free market system.

Early investment should therefore concentrate on:

- o Modeling/analysis-needs/benefits/risks should be quantified before prototypes are built.

- o Software should be developed in ADA or other approved high order language, not machine dependant code so it remains useful and supportable.

- o Test beds using off-the-shelf hardware can be a useful development tool as well as a demonstrator of sensor and communication concepts in the field. Many of the design features can and should be hardware independent.

- o Unique basic components should be designed from the beginning for producibility, i.e. robotic assembly and test features.

Summary

PROJECTS

- WIDE AREA MINE PRIMARY VERSATILE SYSTEM
- WASP, SLAMS, ICOMS SPECIALTY MINES
- SENSOR/WARHEAD PRODUCT IMPROVEMENTS
- COMMAND/CONTROL CAPABILITY

INDUSTRY PARTICIPATION

- COMMAND/CONTROL CONCEPTS & COMPONENTS
- VERSATILE COMPONENTS SENSORS, WARHEADS, S&As
- CONCEPT DEVELOPMENT TESTS BEDS/FIELD DEMOS

Slide # 12

Slide #12. In summary, the major future projects in landmine warfare are the wide area mine with multiple modes of delivery, command and control capability, new components for product improvement insertion and special application mines.

In particular, we need industry participation in command/control (concepts and hardware), development of flexible components (sensors, S & A's) as product improvements adaptable to current systems and suitable for further improvement. We also need to demonstrate these new capabilities in a convincing manner for user acceptance.

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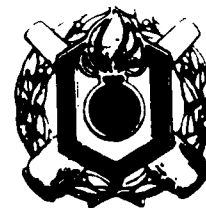
VHSIC Processor for Fire Control/ Battlefield Management Systems



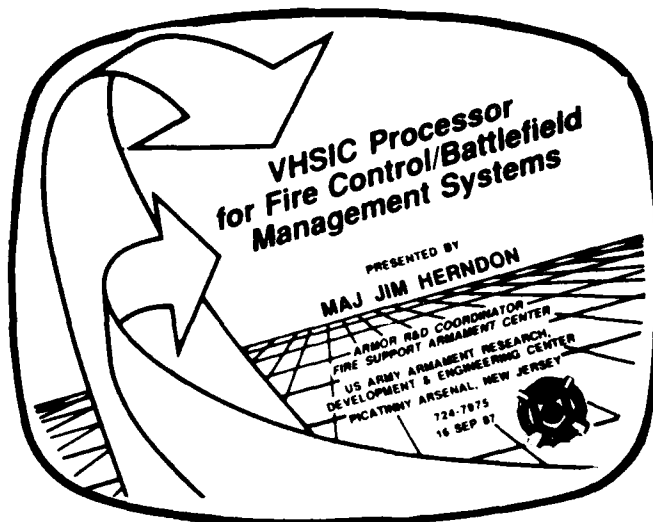
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Presented by

MAJ Jim Herndon



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Slide # 1

Briefing Outline

- **WHAT IS VHSIC ?**
- **PROGRAM OVERVIEW**
- **PROGRAM FOCUS**
- **PROGRAM STATUS**
- **PROGRAM PLANS**
- **CHALLENGE TO INDUSTRY**
- **SUMMARY**

Slide # 2

What Is VHSIC ?

- **VERY HIGH SPEED INTEGRATED CIRCUITS (VHSIC) - COMPLEX MICRO-CIRCUITS FROM 1.25 (PHASE I) TO 0.5 (PHASE II) MICRON FEATURE SIZE**
- **A BILLION DOLLAR DOD EFFORT TO EXPLOIT U.S. SUPREMACY IN MICRO-CIRCUITRY FABRICATION TECHNOLOGY**
- **THE GOALS OF THE DOD VHSIC EFFORT**
 - 10X INCREASE IN MICROCHIP OPERATIONAL RATE
 - 5X IMPROVED RELIABILITY
 - REDUCED SIZE AND POWER
 - IMPROVED LIFE CYCLE COSTS

Slide # 3

Slide #1. Good Morning ladies and gentlemen! My topic for this morning is entitled the VHSIC Processor for Fire Control/Battelfield Management Systems. My name is Major Jim Herndon, and I am currently serving as the armor R&D Coordinator for the Fire Support Armament Center in the Fire Control Division. The Fire Support Armament Center is one of the major centers within the Armament Research, Development and Engineering Center (ARDEC) located at Picatinny Arsenal.

Slide #2. Today's briefing will address what military requirements ARDEC believes VHSIC technology can satisfy, how this new technology is being pursued by ARDEC, and describe the current and future programs in this area at ARDEC. Once these topics are explained, I plan to challenge Industry to meet the Army's needs and show what role you can play in this emerging technology.

Slide #3. What is VHSIC? This acronym stands for very high speed integrated circuits and refers to micro-circuits that meet the DOD-established criteria. Phase I VHSIC requirements call for chips fabricated with 1.25 micrometer technology, chip clock rate of 25 MHz and functional throughput rate, a product of on-chip clock speed (Hz) and the gate

density (logic gates per square centimeter), of 5×10^{11} . The chips themselves are expected to perform over a temperature

range of -55° to $+85^{\circ}$ C in a radiation environment of 10^4 rads or greater. The Dept. of Defense has invested approximately a billion dollars in this technology to "leap ahead" of the threat and exploit U.S. supremacy in microcircuit. Overall performance goals for VHSIC beyond current technology are a tenfold increase in operating rates, a fivefold increase in reliability, reduced size and power. All of these factors should contribute to lower life cycle costs and greatly enhance performance for military weapon systems.

Present Day Fire Control

- ONE TANK vs ONE TARGET
- CREW INTENSIVE OPERATION
- TRADITIONAL VEHICLE CONFIGURATION
- LIMITED ON-THE-MOVE CAPABILITY
- LIMITED ALL-ENVIRONMENT ACQUISITION
- PRODUCT IMPROVEMENTS
 - HIGHER P_d
 - ENHANCED ACQUISITION

Slide #4

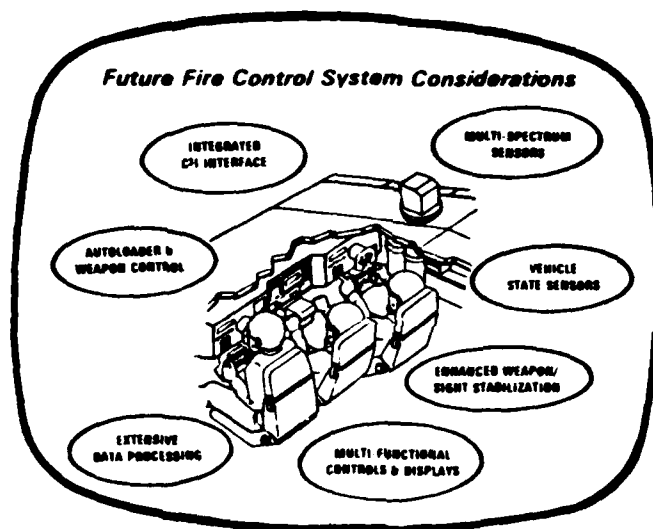
Slide #4. In order to explain how VHSIC Technology can meet evolving military requirements consider what present day Fire Control Systems offers. Current combat vehicles are essentially limited to a one tank vs one target type engagement and is operator intensive. In existing weapon systems, the majority of vehicle information and sensor data flows directly to the crew members who manually perform the majority of battlefield engagement decisions and functions. A well trained but highly burdened crew serves as the cohesive force necessary to integrate fire control hardware and functions. Operation of the vehicle in a battlefield environment is a full time job for the driver, loader, gunner and commander. Because of this traditional division of labor, there has been little change in the combat vehicles in terms of the shape, size, weight, and the location and functions of the crew in recent history.

The ability of the present day combat vehicle fleet to engage targets while on the move is limited by several factors such as:

- o sight stabilization only in the elevation axis for Abrams tanks,
- o only static gun tube bend is periodically compensated by the crew with an optical muzzle reference sensor, and
- o reliance primarily on the gunner's performance for accurate shooting.

Although the thermal imaging systems of the M60A3 and M1 vehicles provide the finest acquisition capability available today, their ability to penetrate all climate and battlefield obscurants is limited.

Product improvements in fire control have traditionally emphasized higher hit probability and enhanced acquisition. In the past, these have required extensive hardware modifications. Interface requirements of new technologies were not compatible with existing equipment and often required complete replacement of existing components. Costs associated with such improvements are high. The need to incorporate a particular capability within the constraints of an already overcrowded vehicle did not allow for human considerations and often compromised the man/machine interface of the system.



Slide # 5

Slide #5. Conditioning on the next battlefield will be extremely demanding for future combat vehicles. The combat vehicle must be capable of engaging targets day and night, through environmental conditions such as haze, fog, and rain, and through severe battlefield obscurants such as dust and smoke. Operation in a target-rich environment will require engagement of targets in rapid sequence, and the numerical superiority of the enemy will require acquisition and engagement at ranges in excess of the effective range of threat vehicles. The probable NBC contamination of the future battlefield will require operation in a closed hatch mode. Finally, the integrated operation of the combined arms team will require the vehicle to operate in a C³I network which will include an extensive amount of information from the chain of command as well as positional, navigational, and target information from battlefield management systems.

To meet these conditions, future fire control/battlefield management systems will be highly automated and software-intensive as opposed to the hardware-intensive, crew-dependent systems of today. Sustained operation will be possible through use of multiple sensors, each operating in different portions of the electromagnetic spectrum to allow for an all environment operation. Enhanced weapon and sight stabilization techniques along with dynamic vehicle state sensors will allow for acquisition and engagement of multiple, evasive targets while the vehicle is stationary or moving. Smaller crews will mandate autoloading for combat systems and the requirement to interface with the fire control system. Extensive data processing will be required to handle more sophisticated software algorithms. These algorithms are necessary to automate most of the target

engagement functions. A BMS (C³I) interface must be integrated into the fire control system in order to provide an effective two-way communication link between the vehicle and the balance of the information network.

In the area of man-machine interface, display technology such as flat screens and smaller size displays will assist in making scene and target information readily available to crew members, and programmable controls will allow for implementation of different functions with the same hardware. Other functions such as embedded training, Built-In-Test (BIT) and diagnostic functions will greatly enhance system capability.

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Slide #6

Modular Concept

- MODULAR CHASSIS ASSEMBLY
- STANDARDIZED INTERCONNECT BUS
- FAMILY OF ELECTRONIC MODULES DESIGNED AROUND PHASE I DEVICES
- LIBRARY OF SOFTWARE MODULES
- SOFTWARE DEVELOPMENT ENVIRONMENT

- **MODULAR CHASSIS ASSEMBLY**
- **STANDARDIZED INTERCONNECT BUS**
- **FAMILY OF ELECTRONIC MODULES DESIGNED AROUND PHASE I DEVICES**
- **LIBRARY OF SOFTWARE MODULES**
- **SOFTWARE DEVELOPMENT ENVIRONMENT**

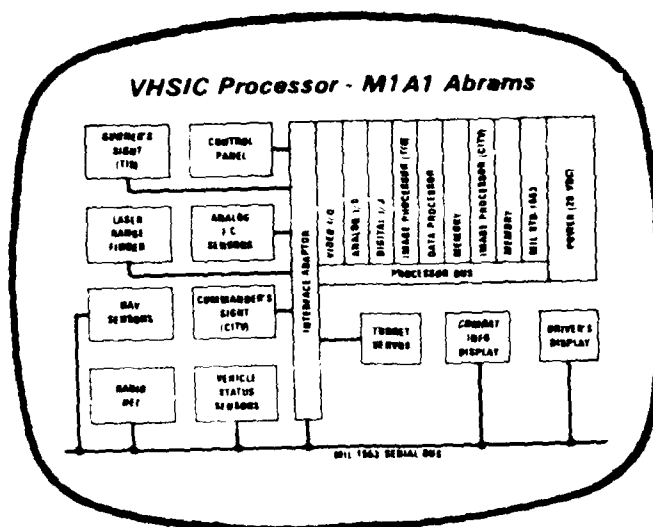
Slide #7

Slide #6. As shown by the previous slides, the evolving requirements for enhanced fire control techniques will surpass present fire control capabilities. The demands of future combat vehicles require automation of fire control functions to meet new requirements, through an integrated vetronics (short for vehicle electronics) architecture combined with VHSIC technology, future combat vehicles will be able to meet these demands.

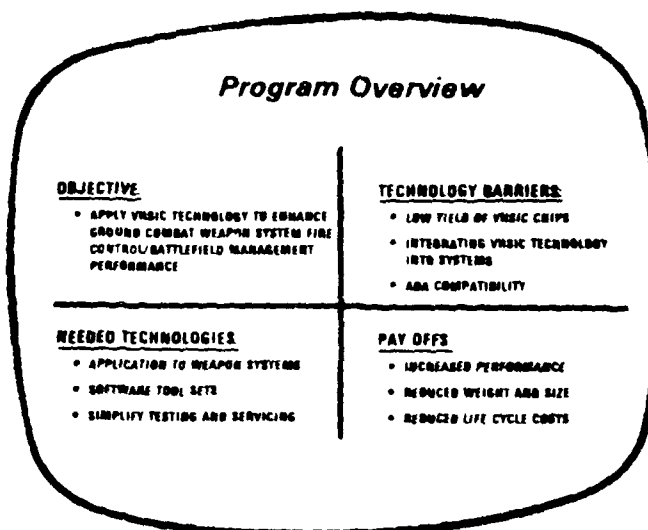
The level of sophistication of future combat vehicles will require embedded system control to manage the overall system operation and to control the data flow between the various subsystems. This command and control requires a high data flow rate and real time collection and correlation of data which a VHSIC processor will be capable of providing. The amount of data available through this system will easily overcome human sensory limitations. Data must therefore be manipulated in a manner which will be transparent to the crew, and only information requiring vehicle crew interaction should be presented.

Fire Control Automation does two things for the combat vehicle, first, it makes the armament system work better since a machine can do things faster and more accurately than a human. This capability translates into improved hit performance, reduced response time, and operational simplification. The second feature is that automation unburdens the crew from routine, repetitive tasks so that they have additional time to executive higher level functions such as fighting the battle!

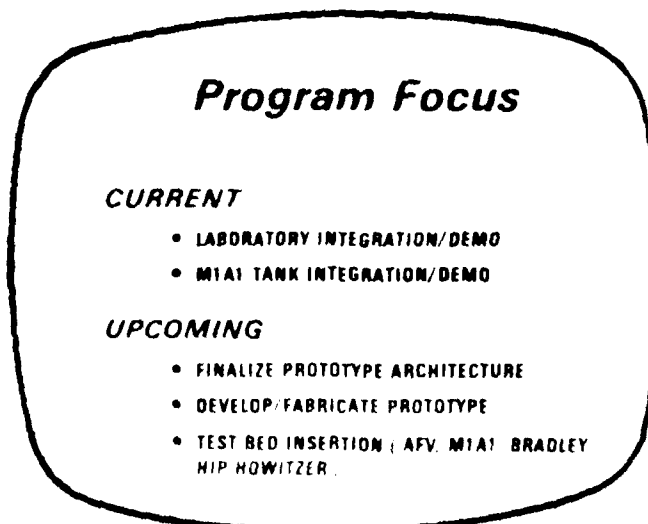
Slide #7. To implement VHSIC technology, ARDEC believes a standardized modular approach provides the most benefit. The chassis and interconnect bus would be standardized for form, fit, and function. A standard family of electronic modules must be designed for various functions such as data processing, array processing, digital and analog input/output. To accompany these hardware modules, software would be pre-packaged in modules for specific functions such as auto-cue, auto-track, and maneuvering target prediction. That way, a specific combat vehicle could readily accept new functions with previously developed software which could be tailored through a standard software development environment.



Slide #5



Slide #9



Slide #11

Slide #8. To illustrate this modular approach, an example using a schematic diagram of the M1A1 tank is shown.

In this diagram, the upper right corner shows a possible VHSIC Processor configuration interfaced with the tank fire control system and replacing the current computer electronics unit. Let's assume that a CITV (Commander's Independent Thermal Viewer) needed to be integrated into the tank system. Under the modular approach, the CITV sensor would be hooked up to the VHSIC processor through the interface adapter for operation.

Necessary processing would be accomplished through two plug-in modules dedicated to the CITV, the image processor and memory module. Further capability could be provided to the tank by connecting a 1553 serial data bus to the interface adapter and plugging in a MIL-STD-1553 module to handle processing. Through the 1553 data bus, battlefield management functions such as navigational information, vehicle status, and digital data displays could be added to the tank system.

Slide #9. ARDEC's objective in its VHSIC Program is to apply VHSIC technology so that critical Fire Control/Battlefield Management functions can be performed in an efficient and combat effective way. Payoffs are obviously based on the attributes of VHSIC technology; essentially you have more capability in less space with minimal power at a reduced life cycle cost. To achieve this goal the yield of VHSIC chips must increase to drive costs down, the technology must be packaged innovatively to fit in rugged combat vehicle environments, and ADA software must be developed to operate efficiently while performing real time functions. ARDEC is pursuing a program to crack these barriers and provide VHSIC benefits for ground combat vehicles.

Slide #10. Current program focus is to finalize the 6.2 effort. A lab demo of a VHSIC device performing autocue, identifying potential targets, and auto-track, tracking a designated target, was completed in June 1987 by ARDEC with Texas Instruments. This same system will be integrated by General Dynamics Land Systems into a M1A1 tank for a field test in October 1987.

A contract will be awarded shortly to follow up on this effort. A final prototype architecture will be defined in Phase I of this contract and on Phase I definition for vehicle insertion under this program. Candidates for vehicle testing are one of the versions of the Armor Family of Vehicles, the Abrams tank, or the Bradley Fighting Vehicle block improvement vehicles, or the HIP howitzer.

Development Plan

COMBAT VEHICLE VNSIC PROCESSOR	FY87	FY88	FY89	FY90	FY91
CURRENT PROGRAM (6.2)					
ADVANCED DEVELOPMENT (6.3)					
CONCEPTUAL DEVELOPMENT (6.4)					
PRODUCTION (FY92)					
5 MILLIONS	4	2	2	3	1

Slide # 11

Program Status

CURRENT 6.2 PROGRAM

- DEVELOP VNSIC BOARDS (DATA AND ARRAY PROCESSORS)
 - THESE BOARDS WILL PERFORM AUTO-ODI (IDENTIFY POTENTIAL TARGETS IN THE TANK SIGHT) AND AUTO-TRACK (SHOOT THE TARGET USING POTENTIAL TARGETS)
- LAB TECHNOLOGY DEMONSTRATION JUNE 1987
- FIELD TEST VNSIC DEVICE AUGUST 1987
- INTEGRATE INTO A M1A1 TANK SEPTEMBER - OCTOBER 1987
- COMPLETE TANK INTEGRATION TEST OCTOBER 1987

Slide # 12

Program Plans

- ESTABLISH FOLLOW ON R&D EFFORT TO INSERT VNSIC TECHNOLOGY IN GROUND COMBAT WEAPON SYSTEMS
- PRODUCE A "PROOF OF PRINCIPLE" VNSIC PROCESSOR FOR COMBAT VEHICLE TESTING BY 1988
- PRIME CANDIDATE: ARMOR FAMILY OF VEHICLES

Slide # 13

Challenge To Industry

- VNSIC IS A "MEANS" TO AN "END"
 - PROVIDES A TECHNOLOGICAL LEAP TO ACHIEVE A MORE EFFECTIVE FIRE CONTROL AND BATTLEFIELD MANAGEMENT SYSTEM IN THE NEAR FUTURE
- TECHNOLOGY BARRIERS THAT MUST BE BROKEN
 - INCREASING YIELDS TO LOWER PRODUCTION COSTS
 - INTEGRATING VNSIC MODULES INTO COMBAT SYSTEMS TO ENHANCE PERFORMANCE AND COMBAT EFFECTIVENESS
 - PROVIDE USEFUL SOFTWARE TOOL SETS TO MODIFY AND IMPROVE VNSIC MODULES
- INDUSTRY EXPERTISE AND ASSISTANCE NEEDED TO SUCCESSFULLY IMPLEMENT THIS STATE-OF-THE-ART PROGRAM

Slide # 14

Summary

- URGENT NEED TO INSERT VNSIC TECHNOLOGY INTO CURRENT AND NEAR-TERM COMBAT VEHICLES
- VNSIC PROVIDES OPTIMAL AND EFFICIENT USE OF ON-BOARD SENSORS AND ELECTRONICS
- ARDEC LEADING THE GOVERNMENT EFFORT IN GROUND COMBAT VEHICLES
- NEED INDUSTRY PARTICIPATION TO:
 - DEVELOP ELECTRONIC ARCHITECTURES
 - SEEK POSSIBLE MILITARY APPLICATIONS
 - DRIVE VNSIC COSTS DOWN

Slide # 15

Slide #11. The timeline shown illustrates the progression of the ARDEC VHSIC Program. The intent of this program is to have a viable VHSIC processor available to start full scale engineering development in 1989 and vehicle production in the early 1990's.

Slide #12. This slide describes specifics about the current 6.2 program which will conclude shortly. This effort produced a VHSIC device built by TI that performs the basic functions of autocue and auto-track through a M1 tank gunner's primary sight. Shortly this device will be integrated into a M1A1 tank by General Dynamic Land Systems for a tank demonstration. The purpose of this program is to demonstrate that VHSIC technology is viable, can perform vital functions for ground combat vehicles , and can accommodate a combat vehicle environment.

Slide #13. The current program plan is to pursue VHSIC through a 6.3 contract to take the technology a step further for vehicle application and build on the lessons learned in the 6.2 program. The goal of this program is to produce a VHSIC "Proof-of-Principle" system that can undergo vehicle testing by 1989 and perform comprehensive, integrated Fire Control/BMS functions. The prime candidate for vehicle insertion is the Armor Family of Vehicles.

Slide #14. Industry must recognize that VHSIC technology is not a goal in itself. Having or producing this technology does not provide the contractor with a worthwhile product for the government. This technology must be used in innovative applications, embedded in electronic devices, and extensive, parallel efforts must be made in developing useful software and software toolsets. VHSIC technology provides a technological leap for the government to achieve a more effective fire control and battlefield management system which will not be realized until support technologies are available and electronic architectures are developed that are combat effective and cost efficient. This is not an easy or inexpensive effort, but industry must meet this challenge to maintain the U.S. Army's fighting edge over its adversaries.

Slide #15. In summary, ARDEC believes there is an urgent need to capitalize on this state-of-the-art technology to satisfy current, near and long term requirements in Fire Control/Battlefield Management Systems. VHSIC technology can be applied to future systems, sensors and electronics can be optimized using this technology. ARDEC has the lead in the government to introduce VHSIC in ground combat vehicles, and we plan to pursue our program to provide the stated benefits. Industry participation is critical to drive VHSIC costs down, to develop new/innovative electronic architectures and to explore potential military applications. This concludes my presentation. Are there any questions?

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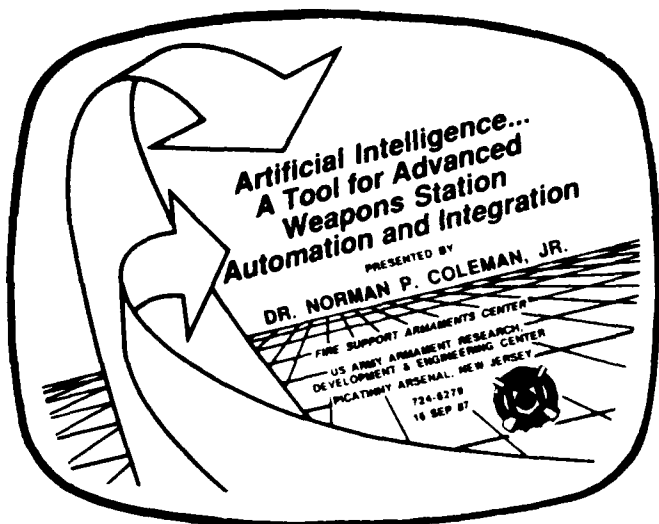
Artificial Intelligence...A Tool for Advanced Weapons Station Automation and Integration



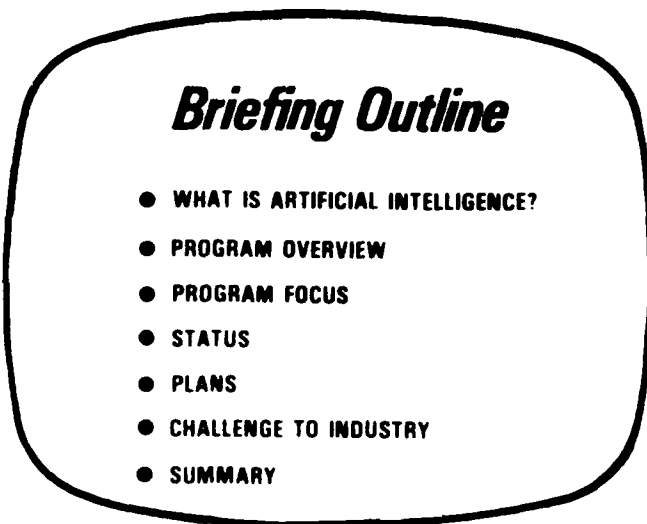
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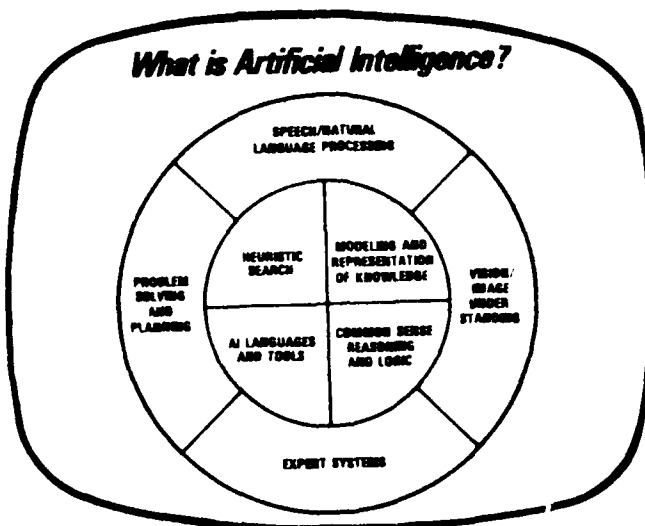
Dr. Norman P. Coleman, Jr.



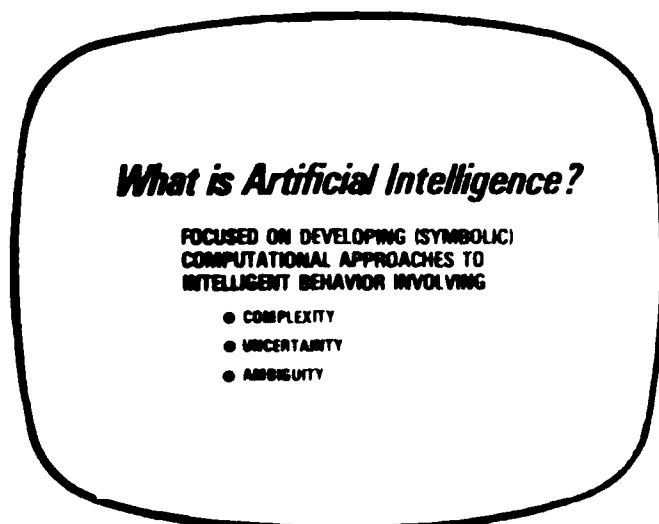
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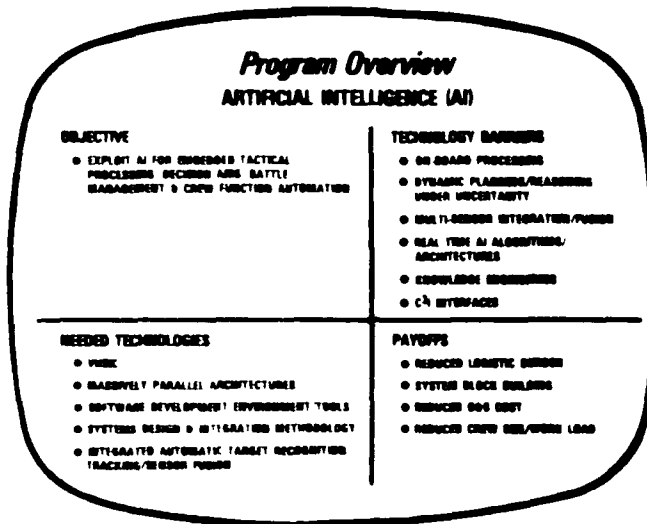
Slide # 2



Slide # 3



Slide # 4



Slide # 5

Slide #1. Artificial Intelligence (AI) has been widely recognized over the past decade as a potentially powerful, high leverage processing technology, capable of being applied to the automation of highly complex tactical information processing and decision making functions on the battlefield. In my presentation today I'll be discussing technology programs which will focus specifically on exploiting AI as an embedded software technology and tool for advanced weapon station automation/integration.

Slide #2. Briefly, my presentation will cover the following areas: (1) I'll begin by first defining what we mean by "AI", followed by a brief program overview describing our objectives, and the critical technology issues and barriers associated with achieving these objectives. I will then discuss, in more detail, the status of our current efforts, our plans, and the technical challenges which provide an opportunity for industry participation.

Slide #3. For the purpose of this presentation, we will define AI in terms of its eight component technologies. Four of these technologies focus on specific functions associated with human intelligence, i.e., natural language, expert systems, planning and image understanding. The remaining technology elements represent the basic technology building blocks common to every AI application domain.

Slide #4. The one very unique and powerful feature of AI which distinguishes it from all other disciplines is its focus on symbolic rather than numerical processing techniques as a means of emulating intelligent behavior and dealing with problems characterized by a high degree of complexity, uncertainty, and ambiguity. On the other hand, symbolic processing techniques have required the development of highly specialized computer architectures, languages and software development tools, which typically are not well suited for real time application.

Slide #5. The objective which we have set for ourselves, then, is to advance the state-of-the-art of AI technology and bring it to a level of maturity that will permit it to be effectively exploited as an embedded decision air/battle management aid and in the long term, to permit full automation of on-board crew functions. To achieve this objective, we will need to bridge a number of technical barriers, taking advantage of the state-of-the-art advances in microelectronics, high speed architectures, and software systems/integration technology. The payoff will be realized in terms of cost, logistics and performance benefits.

Program Focus

- EMBEDDED EXPERT SYSTEM ARCHITECTURES/ALGORITHMS
- RAPID PROTOTYPING TOOLS
- LABORATORY INTEGRATION/CONCEPT DEMO
- TEST BED INSERTION
- ENGINEERING DEVELOPMENT

Slide # 6

Status

TECHNOLOGY

- AUTOMATION ARCHITECTURE/DESIGN APPROACH DEVELOPED
- MULTIPLE EMBEDDED EXPERT SYSTEM MODULES
- INTERFACE TO SENSORS/ACTUATORS
- REAL TIME EXECUTION
- MULTIPLE PLATFORMS

- RAPID PROTOTYPING TOOL DEVELOPED
- LAB TECHNOLOGY DEMO INITIATED

PLANS

- COMPLETE TECHNOLOGY/COMPONENT MODULE DEVELOPMENT
- LAB INTEGRATION/TEST
- CONFIGURE FOR TEST BED INSERTION
- TEST BED INTEGRATION/FIELD EVALUATION

Slide # 7

Plans

1 COMPONENT TECH DEV

- DIAGNOSTICS/PROGNOSTICS
- VOICE/NATURAL LANGUAGE
- INTELLIGENT ROBOTIC CONTROL
- ATN/TRACKER MODULE
- SENSOR FUSION/TARGET ASSESSMENT
- BOMBING/ENGAGEMENT PLANNING MODULE
- LAB INTEGRATION/TEST DEMO

2 PROTOTYPE DEVELOPMENT DEMONSTRATION

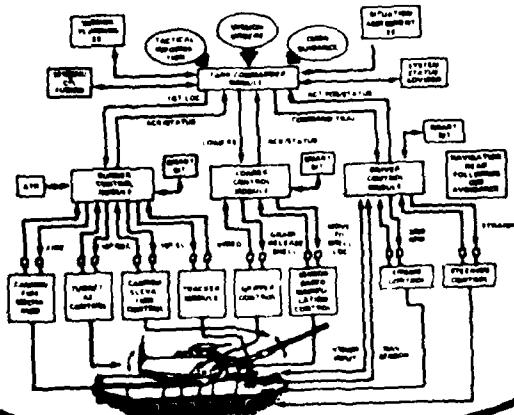
- EXPERT TANK BATTLES COMMANDER MODULE
- ARTILLERY FC DECISION AID

- POSITION LOCATION
- IDENTIFY/CLASSIFY WEAPONS
- DIAGNOSTICS/PROGNOSTICS
- SCHEDULE TRAINING

PERIODS 1001 2 2 3 3 4 5

Slide # 8

Weapon Station Automation/Integration



Slide # 9

Challenge to Industry

- ON-BOARD PROCESSOR
- DISPLAY/OPERATOR INTERFACES
- OPTIMIZE ARCHITECTURE/PROTOTYPING SOFTWARE ENVIRONMENT
- TACTICAL KNOWLEDGE BASES, TERRAIN DATA BASES AND C3I INTERFACES
- SOFTWARE ENGINEERING
- SOFTWARE MANAGEMENT

Slide #10

Slide #6. Our program focus, to date, has been primarily on the software and algorithm issues associated with real-time, embedded expert systems application, and laboratory implementation and validation of a prototype system. Over the next 3-5 years, the focus will shift more to hardware/software configuration for test bed insertion and engineering development.

Slide #7. Under our current technology program, we have been successful in demonstrating a prototype weapon station architecture which supports multiple embedded expert systems, interface to sensors and actuators, and real time execution with capability of extension to multiple platforms. In addition, software tools have been developed which support rapid prototyping and implementation of the system architecture and component software modules. Our plans call for completing the basic system technology and component module development including laboratory technology integration and evaluation, which will be followed by test bed insertion and field evaluation.

Slide #8. In terms of the time phasing of our program plan, we project completion of four prototype weapon station modules during FY88 followed by laboratory integration and test in FY89. The technology will be configured for test bed insertion starting in FY89 with field demonstration projected for FY92. A parallel prototype development leading to a field demonstration in FY92 is also planned for an embedded AI based artillery fire control decision aid with projected funding levels shown thru FY92.

Slide #9. To recap then, our program goal is to demonstrate a generic weapon station automation architecture consisting of the following components: (1) low level sensor processing and actuator control modules, (2) high level embedded AI modules and (3) hierarchical network of command, communication and control modules which provide the integration infrastructure for the automated crew station.

Slide #10. To achieve our objective we will need strong industry participation throughout each phase of our program. The major technical challenges, however, are expected to occur during the test bed configuration phase of the program with particular concern focused on the issues such as on-board processing, displays, system architecture and embedded software development. The areas of software engineering and software management will be especially critical in view of the extremely large volume and complexity of the embedded software.

SBIR/Artificial Intelligence Program

CURRENT PHASE II PROJECTS

- TANK COMMANDER DECISION AID
- ATR/TRACKER MODULE
- GENERIC ROBOTIC CONTROL MODULE
- SENSOR FUSION/SITUATION ANALYSIS

FUTURE TOPICS

- ADVANCED WEAPON STATION
AUTOMATION/INTEGRATION
- ADVANCED WEAPON CONTROL TECHNOLOGY
- EMBEDDED EXPERT SYSTEM DECISION AIDS
FOR FIELD ARTILLERY
- INTELLIGENT SENSOR BASED ROBOTICS

Slide # 11

Summary

PROJECT SUMMARY

- AI MUST BE EXPLOITED FOR EMBEDDED
MILITARY APPLICATIONS
- EFFORT IS PRIMARILY A TECHNOLOGY BASE PROGRAM
- LAB AND FIELD TESTS PLANNED

INDUSTRY PARTICIPATION NEEDED IN FOLLOWING AREAS

- ON-BOARD PROCESSOR DEVELOPMENT
- SYSTEM HARDWARE/SOFTWARE DEVELOPMENT
- LAB/TEST BED INTEGRATION/EVALUATION

Slide # 12

Slide #11. The Small Business Innovation Research (SBIR) program provides a particularly good mechanism for small business participation with four phase II projects currently being funded. Four additional topics which focus on embedded AI application will appear in the next SBIR program solicitation.

Slide #12. In summary, AI is a technology which can and must be exploited for the next generation armament systems if we are to provide the "leap ahead" capability required for the air-land-battle environment.

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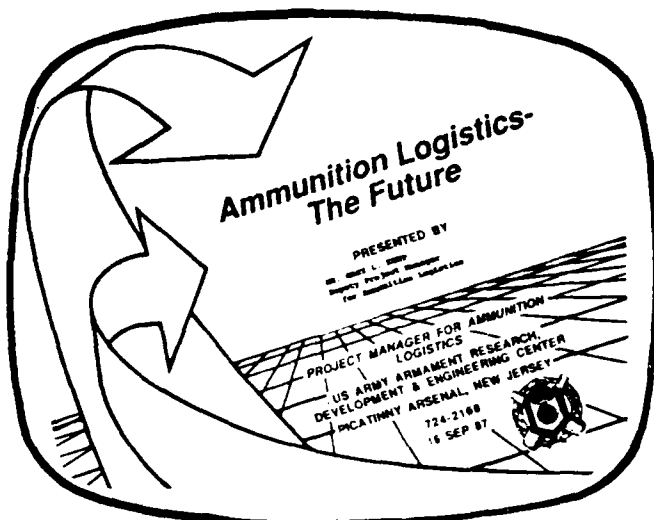
Ammunition Logistics - The Future



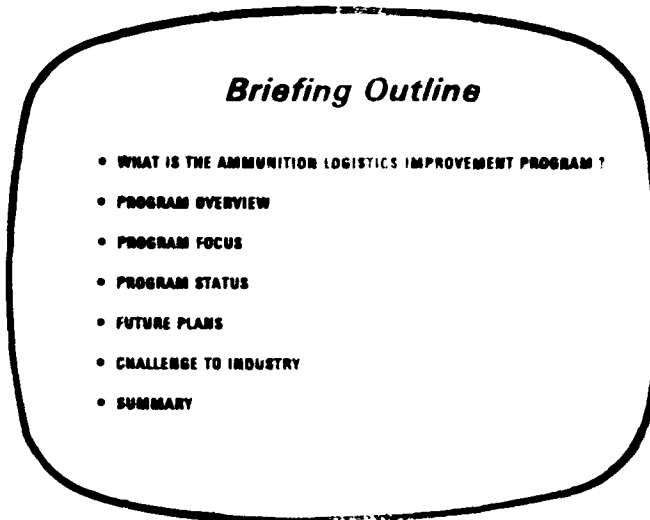
Presented by

Mr. Gary L. Kent





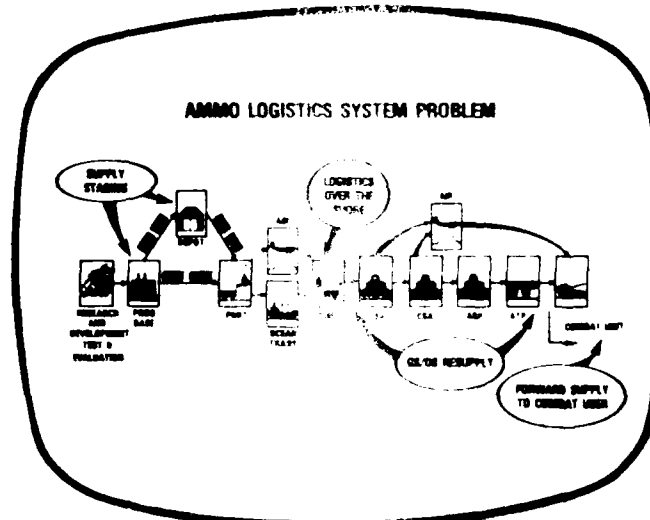
Slide # 1



Slide #



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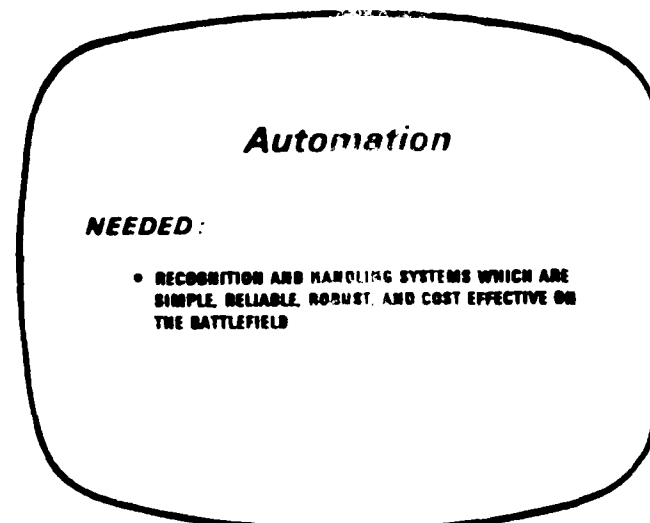


Slide #

**Program Overview
(FIRE SUPPORT)**

OBJECTIVE • SPEED REARS • REDUCE LABOR INTENSITY • LESSEN LOGISTIC BURDEN	TECHNOLOGY BARRIERS • RECOGNITION, HANDLING, FUSION OF SENSITORS • PERFORMANCE & COST OF MATERIALS • UNPREDICTABLE NATURE OF BATTLEFIELD
NEEDED TECHNOLOGIES • AUTOMATION • MATERIALS • ARTIFICIAL INTELLIGENCE	PAYOFFS • SHORTER REARS TIMES • REDUCED CREW LABOR AND FATIGUE • DECREASED LOGISTIC BURDEN (STRATEGIC/TACTICAL) • INCREASED COMBAT POWER AND SUSTAINABILITY • IMPROVED SURVIVABILITY

Slide #



Slide #

Slide #1. Good morning, I'm Mr. Gary L. Kent, the Deputy Project Manager for Ammunition Logistics.

Slide #2. I will tell you about improvements we are making to the Ammunition Logistics System, specifically, to Fire Support Programs. I'll review our programs, giving the focus of our efforts and plans for future programs.

Slide #3. Ammunition Logistics is more than a single hardware solution to an army need. It is a total system of resupply for ammunition. We're aimed at the entire system: domestic, strategic, and tactical. Our goal is total integration of the Weapon System with the Logistics System from the drawing board to the battlefield to improve sustainability and increase combat power.

Slide #4. This is the Ammunition Logistics System. Our mission is to improve the logistics for the full array of combat arms, but today, I will concentrate on the improvements we are planning for Fire Support Systems. We have been concentrating our initial efforts on near term improvements in packaging, handling, storage, and safety.

Slide #5. In rearm and resupply of Fire Support Systems the objective of our program is reduction of the labor intensive and time consuming tasks in artillery resupply.

To do this we need technologies in the areas of automated handling, materials, and artificial intelligence. These are not easy technologies to obtain and require engineering applications that are at the state of the art.

Some of the technology barriers are given in the upper right. These are the tasks that we are looking to do that present barriers to successful ammunition resupply.

Finally the payoffs we will obtain will improve the artillery crew's ability to continue the fight, and in the end translate to increased sustainability.

Slide #6. I'd like to talk more about our needs. In automation we must have the capability to identify and handle ammunition in combat without the human in the loop.

Materials

NEEDED:

- LIGHT, STRONG, SURVIVABLE, COST EFFECTIVE DESIGNS FOR EFFICIENT AND EFFECTIVE HANDLING, STORAGE, TRANSPORTATION OF MUNITIONS
- IMPROVED PERFORMANCE AND DECREASED COST OF PLASTICS, WOOD, STEEL, AND COMPOSITES

Slide # 7

Artificial Intelligence

NEEDED:

- EXPERT SYSTEMS WHICH REDUCE THE COMPLEXITY AND UNCERTAINTY OF BATTLEFIELD LOGISTICS

Slide # 8

Program Focus

- PROOF OF PRINCIPLE DEMO'S
- INTEGRATE INTO ENGINEERING/OPERATIONAL TESTBEDS
- STEPPING STONE APPROACH
- TRANSITION TECHNOLOGY

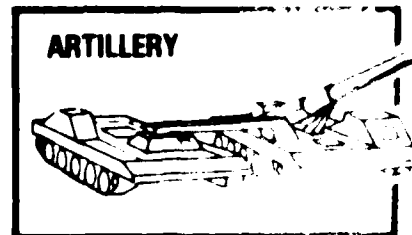
Slide # 9

Status

- AUTOMATION/HANDLING
 - ARTAIL
 - ARTY REARM MODULE
 - CONTAINERIZATION
- MATERIALS
 - ENHANCED WOOD
 - LOW ALLOY STEELS
 - PLASTICS
 - COMPOSITES
- ARTIFICIAL INTELLIGENCE
 - AUTOMATED EOD INFO RETRIEVAL AND EXPERT SYSTEM

Slide # 10

Future Integration



Slide # 11

Slide #7. We need improved materials that are better designed to survive the battlefield environment, offer increased performance and cost less than today's materials.

Slide #8. We also need systems that will assist the soldier in making complicated decisions on the battlefield.

Slide #9. Our program is based on several proof of principle demonstrations beginning in FY89. We're taking the burdensome task of artillery resupply a bite at a time. The results of our artillery resupply program will be demonstrated at the Advanced Field Artillery System (AFAS) demo in the FY89/90 timeframe. Finally, as with all of our programs, we will be transitioning the technologies resulting from the proof of principle process to the engineering development manager for fielding.

Slide #10. The status of the portions of the total program to improve the logistics of Fire Support is given here.

Two Israeli artillery trailers are being obtained this year for user evaluations at Ft. Sill and USAREUR. We expect to transition this technology to engineering development next year. This system will double the rounds available to the howitzer with a minimal cost in mobility.

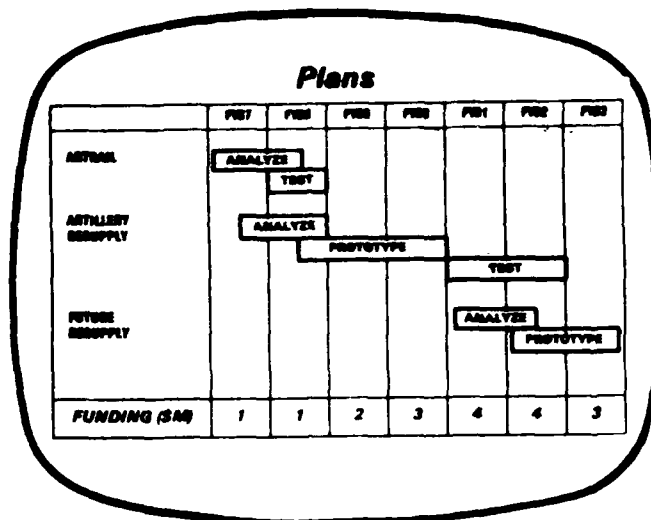
The artillery rearm module is leading to a proof of principle in FY89/90 and will demonstrate automated projectile transfer.

Our container program will demonstrate specialized and standard commercial containers in conjunction with an actual resupply mission in USAREUR later this year.

Wood has been the traditional packaging material because of its inherent shock resistance, abundance as a renewable natural resource, and cost. However, the environments of modern battlefields, which include NBC, have made wood less attractive, therefore we are investigating several approaches to the problem. Along with the National Wood Industry, we are investigating wood treatments and other wood products. We are taking advantage of the vast polymer data base available in this country and our allies. Immediate, but not necessarily the optimum solution, makes use of readily available high strength alloys.

Work to date in the area of artificial intelligence includes an information retrieval system that will assist the EOD folks in identifying munitions on the battlefield, and replace a truck full of classified documents.

Slide #11. Future plans are aimed at totally integrating all the components into a cohesive, efficient howitzer system.



Slide # 12

Challenge to Industry

- AUTOMATED HANDLING TECHNIQUES
- ARTIFICIAL INTELLIGENCE APPLICATIONS
- BATTLEFIELD RELIABILITY
- QUICK, INEXPENSIVE COMPONENT DEMO'S

Slide # 13

Summary

- PROJECT SUMMARY - PROGRAM TARGETED TO IMPROVE TOTAL SYSTEM EFFECTIVENESS
 - SPEED REARM
 - REDUCE LABOR
 - LESSEN LOGISTIC BURDEN
- INDUSTRY PARTICIPATION NEEDED IN THE FOLLOWING AREAS:
 - AUTOMATION
 - MATERIALS
 - ARTIFICIAL INTELLIGENCE

Slide # 14

Slide #12. The plans and funding are given here. Shown here are the two primary artillery programs: the artillery rearm module and the artillery trailer.

These two programs will demonstrate an important component of the total system for artillery resupply.

The lower program will look to the future and match tomorrow's capabilities in propellant with a future rearm vehicle.

Slide 13. The challenges we are issuing to industry are given here.

- o Improved methods of handling heavy artillery ammunition.
- o Systems to assist the soldier in making decisions on the battlefield.
- o Increased reliability on the battlefield, and
- o For industry, in the design of your proposals and development efforts, to structure your programs in terms of quick inexpensive component demos, not total system demos.

Slide #14. In summary, I have outlined for you a program that is dedicated to improving artillery resupply from factory to the front line by optimizing the resupply/rearm process for the artilleryman.

And finally, I have outlined areas where industry can participate in our efforts. Which, in total, will produce improved combat power and sustainability.

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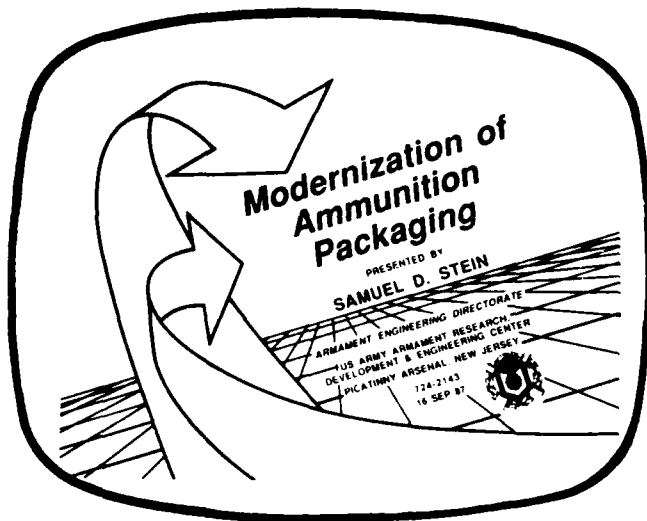
Modernization of Ammunition Packaging



Presented by

Mr. Samuel D. Stein





Slide # 1

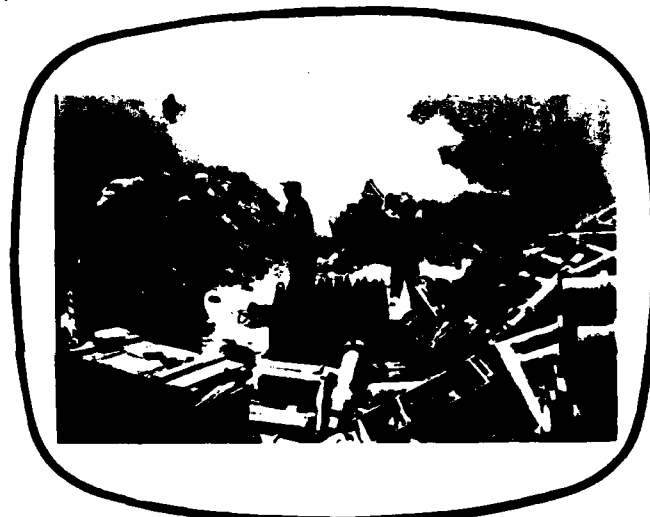
Briefing Outline

- WHAT IS MODERNIZATION OF AMMUNITION PACKAGING ?
- PROGRAM OVERVIEW
- PROGRAM FOCUS
- STATUS
- PLANS
- CHALLENGE TO INDUSTRY
- SUMMARY

Slide # 2



Slide #3

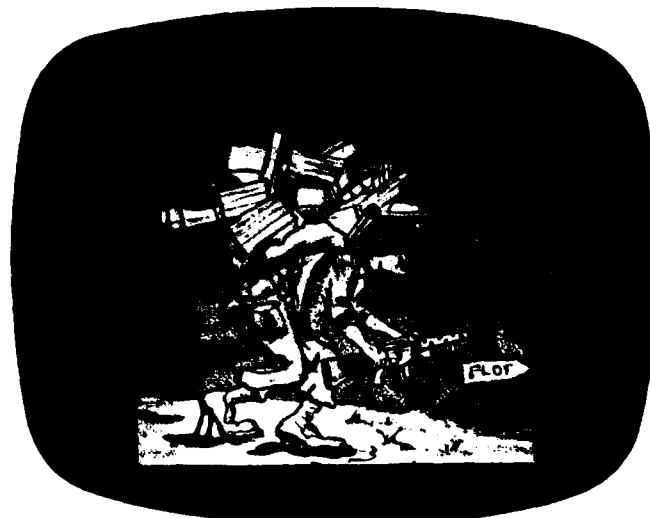


Slide #4

Why Modernize Ammunition Packaging?

- EXISTING PACKAGING IS NOT USER FRIENDLY !
- EXISTING PACKAGING IS LOGISTICALLY INEFFICIENT !
- EXISTING PACKAGING EXTENDS REARM TIME !

Slide # 5



Slide #6

Slide #1. - In this presentation I will provide an overview of the program in progress to modernize ammunition packaging.

Slide #2. - Briefly, I will cover the areas shown in this slide. I will describe what our objectives are in modernizing ammunition packaging, the extent of the program, the status of our current efforts along with our future plans, and the participation of and challenges to industry in the program.

Slide #3. - This slide shows an example of a tank resupply location. Note the size and amount of debris.

Slide #4. - This slide shows an artillery firing site. Here, too, note the debris. Maybe this is why they call them "dumps".

Slide #5. - This slide depicts the fact that in the past little attention was given to efficient packaging of ammunition to facilitate its carrying and handling by the soldier.

Slide #6. - The answer to the question "Why modernize ammunition packaging? is because:

- o Existing packaging is not user friendly; it is difficult to access the ammunition and takes a long time to do so.

- o Existing packaging is logistically inefficient; it is heavy and bulky, requiring excessive space in storage depots, aboard ships, and on trucks.

- o Existing packaging extends rearm times; the problems in handling and accessing the ammunition result in longer rearm times. From a tactical viewpoint, this is the most important negative aspect of existing packaging.

MODERNIZATION OF AMMUNITION PACKAGING *Identified Packaging Deficiencies*

- MOST CURRENT AMMUNITION PACKAGING MATERIALS AND METHODS
 - HEAVY
 - BULKY
 - PRESENT DIFFICULTIES IN ACCESSING AMMUNITION
 - ALLOW DETERIORATION FROM NATURAL ENVIRONMENTS
 - VULNERABLE TO RSC CONTAMINATION
 - GENERATE EXCESSIVE BATTLEFIELD DEBRIS
 - BURDENED ON THE LOGISTICAL SUPPORT SYSTEMS
 - CONTRIBUTE TO EXCESSIVE REARM TIME
- 1983 - VCSA DIRECTED IMPLEMENTATION OF PROGRAM TO CORRECT THESE DEFICIENCIES
- 1984 - PROGRAM INITIATED

Slide #7

MODERNIZATION OF AMMUNITION PACKAGING *Program Overview*

OBJECTIVE

- EXPLICIT TECHNOLOGICAL APPROACHES TO CORRECT THE TACTICAL AND LOGISTICAL DEFICIENCIES OF PACKAGING

TECHNOLOGICAL BARRIERS

- STABLE PLASTIC PERFORMANCE 80% + 100%
- NON/FLAMMABLE PLASTICS
- IMPROVED BARRETS AND CORROSION
- QUALITY CONTROL OF PLASTIC CONTAINER PRODUCTION
- COMPATIBILITY WITH BOM AND ROBOTICS

NEEDED TECHNOLOGIES

- INHERENTLY NONFLAMMABLE PLASTICS
- STABLE PLASTICS
- EFFICIENT INSULATION, CORROSION RESISTANCE
- MATERIALS/PROCESS CONTROLS TO ASSURE BOM OF QUALITY CONTAINERS

PAYOFFS

- REDUCED REARM TIME
- REDUCED LOGISTIC BURDEN
- ONE STEP EASY ACCESS
- ONE DECONTAMINABILITY
- LOWER COST
- REDUCED BATTLEFIELD DEBRIS

Slide #8

MODERNIZATION OF AMMUNITION PACKAGING PACKAGING PRODUCT IMPROVEMENT PROGRAM (PPPI) INITIATIVES *PROGRAM FOCUS*

ARTILLERY

- 85MM PROJECTILE
- 160MM PROJECTILE CHARGE
- 160MM HOWITZER
- ARTILLERY PRIMERS

ARMOR

- 120MM TANK CARTRIDGE
- 105MM TANK CARTRIDGE

AVIATION

- 7.62MM ROCKET
- 1.875MM ROCKET

SMALL CALIBER

- 5.56MM SOVIET AUTOMATIC WEAPONS (SAB)
- 7.62MM ARMS POOR
- M16A1 ARMS BOX
- M16A1 ARMS BOX
- 20MM CARTRIDGE (BRADLEY FIGHTING VEHICLE)
- 40MM GRENADE
- 40MM ECRC SIGNALS
- HAND GRENADE

MORTAR

- 120MM

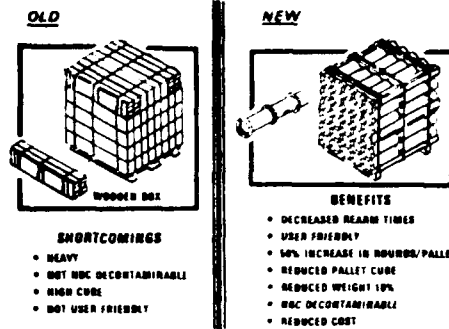
Slide #9

Slide #7. - The deficiencies associated with most current packaging are listed on this slide. Generally, the packaging is heavy and bulky, requiring excessive storage and shipping space. It also presents difficulties in accessing the ammunition resulting in excessive rearm times, allows moisture penetration resulting in propellant deterioration and metal parts corrosion, cannot be NBC decontaminated, and generates excessive battlefield debris (as you saw in the previous slides). As a result of these deficiencies, in 1983 the Vice Chief of Staff of the Army directed that a program be implemented to correct them. The program was initiated in 1984.

Slide #8. - The objective of our program, therefore, is to correct the tactical and logistical deficiencies of packaging by exploiting technological advancements in materials and design concepts. To accomplish this objective we need to overcome several technological barriers involving plastic materials, which are prime candidate packaging materials because of their lightweight, low cost and ruggedness. These involve stable performance over a broad temperature range, non-flammability or fire resistance/retardance, and electro-magnetic pulse resistance. We need efficient insulating and cushioning materials for improved gaskets and cushions. Poor quality control of plastic containers has led to disastrous fielding problems in the past. This has to be rectified if we are to achieve successful fielding of plastic containers. As equipment modernization increases, with the use of robotics, and the packaging becomes more integral to the weapon system, packaging design must be integrated into weapon system design. It can no longer exist as a separate entity. The payoffs to overcoming these barriers and developing the needed technologies are reduced rearm times, reduced logistic burdens (including manual labor) reduced battlefield debris, NBC decontaminability, and lower cost.

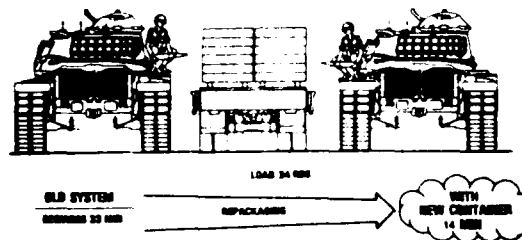
Slide #9. - The scope and focus of the modernization program are shown in this slide. We are involved with modernization packaging for artillery, armor, aviation, mortar and small caliber ammunition. The darkened bullets indicate the items I will use as examples of our efforts.

120MM, M829/830 Tank Cartridge Container



Slide # 10

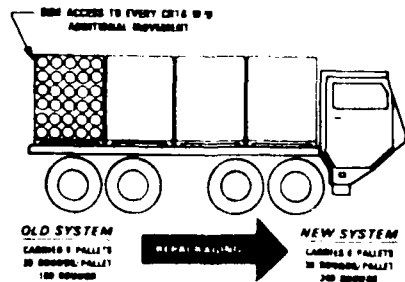
120MM Ammunition Tank Upload Concept, One Or Two Tanks At A Time



Slide # 11

Access to Ammunition from HEMTT * Resupply Vehicle

* HEAVY EXPANDED MOBILITY TACTICAL TRUCK



Slide # 12

Slide #10. - The first example will be the new container for 120-mm tank ammunition. The old method of packaging this ammunition was to put it in a heavy bulky, wooden box. The box was banded in three places. Twenty banded boxes were palletized and banded on a wooden pallet. Access to the ammunition required that the soldier break the pallet and individual box bandings, open the box, remove the round, and slide it out of a fiberboard tube.

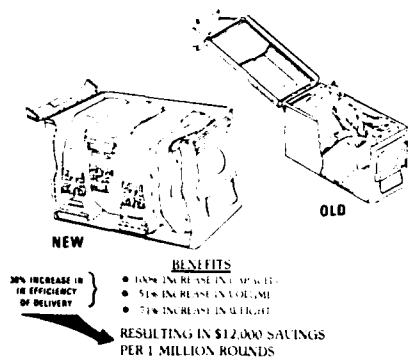
In the new packaging, the round slides into a metal container preassembled with a sleeve and support system. A cushion is placed over the end and a cover attached and closed with a single hand operated battlefly flap. Access to the ammunition is achieved by releasing the battlefly flap and a slight cover twist to release the cover from the container rim. A slight pull on the strap advances the round to where it can be grabbed with two hands and totally removed from the container. All of the containers (30) are permanently assembled in the palletized configuration and the ammunition is accessed without depalletization.

We have made the container user friendly and significantly reduced the rearm times. We have simultaneously increased the number of rounds per pallet while reducing overall pallet weight and cube. As you can visualize, this has a substantial logistical impact. We have made the entire palletized configuration NBC decontaminable and achieved all of these benefits at a reduced cost per container.

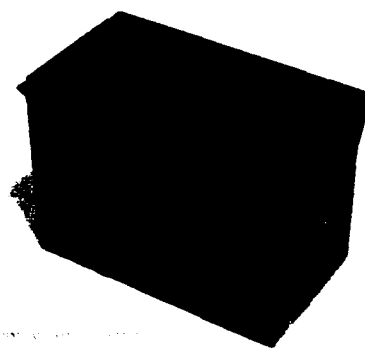
Slide #11. - Previously, it required 33 minutes to repack/rearm a tank. With the new packaging, two tanks can be simultaneously rearmed in 14 minutes. This represents a substantial enhancement of the ability to sustain tank engagements.

Slide #12. - Furthermore, the increase in rounds per pallet, with a concurrent reduction in pallet cube, now makes it possible to resupply the same amount of ammunition with two trucks where it previously required three trucks. This same logistical advantage is obtained at the storage depot, on railroad cars and ships, and throughout the logistics system.

**5.56MM SAW * Ammo Pack
* SQUAD AUTOMATIC WEAPON**

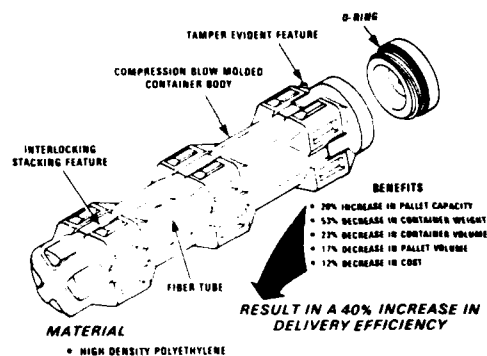


Slide # 13



Slide # 14

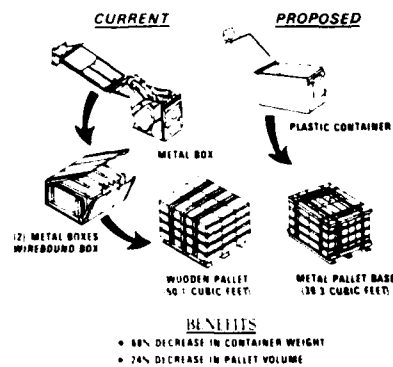
Plastic 155MM Propelling Charge Container



Slide #16

Slide #15

M2A1 Ammunition Container



Slide #18

Slide #17

Slide #13. - The next sample I will show you is a simple change which will yield significant savings. Previously, two SAW ammunition magazines were packaged in a metal M2A1 ammunition box. There was considerable empty space left which was fielded with dunnage. We were in effect transporting dunnage. A very inefficient arrangement.

By slightly expanding the height, length, and width of the container, we only increased the volume by 51%, but we increased the capacity by 100%. The new SAW ammo container carries four magazines. This results in a cost reduction of 12K for each 1M SAW rounds. Since the nominal yearly production rate is 100M rounds, the approximate yearly cost savings will be \$1.2M.

Slide #14. - An exterior view of the new SAW container.

Slide #15. - A picture of the new SAW container illustrating how four SAW ammo magazines are packaged.

Slide #16. - The new example involves one of the new propelling charge containers we are evaluating. Currently, propelling charges are packaged in heavy, bulky metal cans. With the new plastic container now undergoing safety certification testing, we have reduced the container volume by 23% and the weight by 53%. We have increased the pallet capacity by 20% (from 30 to 36 containers per pallet) while reducing the overall pallet volume by 17%. Here, too, we have increased the efficiency of the logistics system while providing a container which is user friendly (easier access to the ammunition), is NBC decontaminable, and has a lower cost.

Slide #17. - This is a picture of a propelling charge container.

Slide #18. - The final example is the new plastic M2A1 ammunition container. The existing metal box design does not provide adequate protection to its contents without an overpack. Therefore, two metal boxes are combined in a wooden wirebound without an overpack. Therefore, 2 metal boxes are combined in a wooden wirebound overpack, and 48 overpacks are combined on a pallet. The new plastic replacement, now undergoing final engineering tests prior to safety certification, has been designed to protect its contents without the need for the overpack. The same 96 containers can now be palletized with a 24% decrease in pallet volume with the attendant benefits to the logistics systems. Considering all the items that are packed in the M2A1 and the millions of containers manufactured each year, these benefits are substantial. They are obtained with a more user friendly, easier access container that is NBC decontaminable and costs less than the existing box.

Challenge to Industry

- GENERATE NEW/NOVEL CONCEPTS FOR IMPROVING TACTICAL AND LOGISTICAL UTILITY OF AMMO PACKAGING AS NEW MATERIALS AND PROCESSES EVOLVE
- PRODUCE QUALITY CONTAINERS AT AFFORDABLE PRICES
- DEVELOP INHERENTLY NONFLAMMABLE AFFORDABLE PLASTIC COMPOUNDS WHICH WILL MAINTAIN THEIR PERFORMANCE CHARACTERISTICS OVER -60°F TO +100°F TEMPERATURE RANGE

Slide # 19

Program Status

COMPLETED PROGRAMS

- 120MM CARTRIDGE CONTAINER
- 105MM TANK CARTRIDGE LIGHTWEIGHT CONTAINER
- SQUAD AUTOMATIC WEAPON AMMUNITION CONTAINER

ONGOING PROGRAMS COMPLETION SCHEDULE

- 48FY87 PYROTECHNIC SIGNALS CONTAINER
SMALL CALIBER AMMUNITION POUCH
- 28FY90 155MM PROPELLING CHARGE CONTAINER
PLASTIC HEAVY AMMUNITION BOX
- 48FY90 2 75 INCH ROCKET DRUM PACK
40MM GRENADE CONTAINER
- 18FY90 105MM HOWITZER AMMUNITION CONTAINER
25MM CARTRIDGE CONTAINER
- 48FY90 155MM FIELD ARTILLERY PROJECTILE PALLET
81MM MORTAR AMMUNITION CONTAINER

Slide # 20

Plans

	FY87	FY88	FY89	FY90	FY91	FY92
PROPELLING CHARGE CONTAINER						
SMALL CALIBER AMMUNITION POUCH						
155MM PROPELLING CHARGE CONTAINER						
PLASTIC HEAVY AMMUNITION BOX						
2 75 INCH ROCKET DRUM PACK						
40MM GRENADE CONTAINER						
105MM HOWITZER AMMUNITION CONTAINER						
25MM CARTRIDGE CONTAINER						
155MM FIELD ARTILLERY PROJECTILE PALLET						
81MM MORTAR AMMUNITION CONTAINER						
SMALL CALIBER AMMUNITION POUCH						
PROPELLING CHARGE CONTAINER						
PLASTIC HEAVY AMMUNITION BOX						
2 75 INCH ROCKET DRUM PACK						
40MM GRENADE CONTAINER						
105MM HOWITZER AMMUNITION CONTAINER						
25MM CARTRIDGE CONTAINER						
155MM FIELD ARTILLERY PROJECTILE PALLET						
81MM MORTAR AMMUNITION CONTAINER						
SMALL CALIBER AMMUNITION POUCH						
FUNDING \$'00	5	3	2	2	2	1

Slide # 21

Slide #19. - This slide lists the programs completed to date and the schedule for completion of on-going programs. All of the currently on-going programs are scheduled to be completed by the end of FY89.

Slide #20. - However, there are a number of additional programs which we intend to pursue and initiate as we complete several programs. These are indicated on the lower part of this slide. This will extend the modernization effort at least in FY92. The funding currently planned for the FY87-FY92 period is shown at the bottom of this slide. Prior to FY87 we had invested approximately \$25M on this effort. Thus, by the time the modernization program is complete we will have invested approximately \$40M. However, from the few examples I have shown, we anticipate that we will recover the total investment by the mid 1990's, but the tactical and logistical benefits will certainly outweigh the cost benefits.

Slide #21. - Each of the programs has, or will have, industrial participation. Several have had multiple industrial participants as we have evaluated multiple technologies in our design and material selections. The additional challenges to industry now are to:

- o Continue to generate new and novel concepts for improving the tactical and logistical utility of ammunition packaging. Reducing the cost is good. Shortening rearm time or reducing the logistic burden is significantly better.

- o Produce quality containers at affordable prices. On the few occasions in the past when an attempt was made to field plastic containers the result was failure. The quality of the containers produced was not consistent and the containers failed. Their performance was so bad that it has taken more than 20 years to overcome the resulting negative mind set. This time we must insist on stringent material and process controls. We must rely on you for these controls.

- o Develop stable, inherently nonflammable plastic materials. Naturally, we must have materials which maintain their performance characteristics over our storage and operating temperature range. Additionally, nonflammability, fire retardancy and, fire resistance are critical factors, especially to the Navy. All of our ammunition goes overseas aboard Navy ships. Much of our ammunition is used by the other services, especially the Marine Corps. The elimination/reduction of the fire hazard aboard ships is a major concern, objective, and challenge.

Summary

PROJECT SUMMARY

- MAJOR COMPREHENSIVE THROUST GROWING TO MODERNIZE AMMUNITION PACKAGING UTILIZING NEW CONCEPTS, MATERIALS AND PROCESSES
- MODERNIZED AMMUNITION PACKAGING ENHANCES TACTICAL AND LOGISTICAL SUPPORT SYSTEMS

INDUSTRY PARTICIPATION NEEDED IN FOLLOWING AREAS:

- DEVELOPMENT OF PLASTICS WITH RESOURCES ENHANCES PROPERTIES
- HIGH VOLUME PRODUCTION OF QUALITY CONTAINERS
- INTEGRATION OF PACKAGING DESIGN INTO WEAPON SYSTEM DESIGN

Slide # 22

Slide #22. - In summary, we have a major comprehensive thrust on-going to modernize ammunition packaging. By modernizing ammunition packaging we can significantly enhance tactical and logistical support systems while reducing the cost of packaging and transportation. The continued participation of industry is essential in the development of materials with the required enhanced properties and in the production of quality containers.

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Small Business Administration Activity



US ARMY
ARMAMENT RDE CENTER

Presented by

Mr. John Axiotakis



US ARMY
ARMAMENT RDE CENTER

I. Introduction

What is the U. S. Small Business Administration (SBA)? The SBA is an independent federal agency dedicated to aiding and assisting the small business community through several socio-economic programs, i.e. Finance and Investment, Business Development, Minority Small Business -Capital Ownership Development, and Procurement Assistance. Why aid and assist the small business community? The underlying philosophy of the Small Business Act is to preserve free competitive enterprise and strengthen the overall economy of the nation. By supporting small businesses, the nation is:

- o expanding the industrial base
- o providing jobs (approximately 60% of the nation's workforce is employed by small business, and approximately 90% of all businesses in the U.S. are small), and
- o encouraging new technology breakthroughs from a very and innovative national resource. For example, some important 20th century inventive contributions of independent inventors and small organizations are:

- xerography
- vacuum tube
- rocket engine
- titanium
- shell molding
- jet engine
- FM radio
- helicopter
- power steering
- air conditioning
- tungsten carbide

According to a National Science Foundation study, small firms are generally 2 to 2 1/2 times as innovative per employee as larger firms. A 1984 study conducted by Social and Scientific Systems, Inc. concluded that there are 154,000 small business firms in the U. S. involved in high-tech.

II. The role of SBA at ARDEC.

Why is the SBA stationed at ARDEC?

- a. to represent and facilitate the small business community, which has a great deal to offer in the areas of emergency technologies and developments;
- b. to monitor ARDEC procurements to ensure that small businesses receive their fair share of prime contracts and subcontracts;
- c. to be an active ombudsman for small business;
- d. to help provide a receptive climate for small business participation.

A relatively new SBA responsibility, which enforces the underlying theme of the agency, "to preserve free competitive enterprise," is to enhance competition for both small and large businesses in an effort to effect cost savings to the government. The introduction or expansion of competition is based upon technical and engineering considerations. One way we hope to enhance competition is to match the capabilities of small business and large business firms to the subcontracting needs of prime contractors likely to bid on major systems or subsystems.

In short, SBA is stationed at ARDEC to work with the Army to accomplish a successful Research, Development and Acquisition Program that is directed at exploiting new technologies and developments that will maximize the Army's fighting capability.

What specifically is SBA attempting to do at ARDEC? The SBA is endeavoring to:

- o identify appropriate small business to satisfy the Army's future needs, either as prime contractors to the government or as recommended subcontractor sources to prime contractors;
- o supply these sources to the ARDEC technical and contracting communities and to potential prime contractors;
- o notify small businesses about forthcoming requirements, at the appropriate time, to encourage them to seek out contracting opportunities at ARDEC, and thereby establish a small business track record; and,
- o work with Army Acquisition Managers to structure requirements in such a way as to enhance competition.

Why is SBA present at the APBI? The SBA is present to:

- o inform industry that SBA is stationed at ARDEC;
- o gear our efforts to finding sources involved in the technologies discussed at the APBI for future prime and subcontracting opportunities;
- o ask the SB firms present to make sure that the SBA office is aware of their capabilities, especially with regard to the technologies presented at the APBI;
- o request that small business and large business firms discuss with SBA where they think they can fit into the total scheme, i.e. a small business firm may not have the capability to perform a requirement in its entirety, but perhaps through a joint venture, or through subcontracting, some of ARDEC's missions could be accomplished.
- o inform large business that we would like to try to assist them by suggesting sources for their Subcontracting Plans. Based on the APBI presentations, you have a better understanding of how to plan for your future markets. Part of your decision making process will undoubtedly involve a make/buy plan. Please contact us and let us know what kind of firms and expertise you're seeking so we can target particular areas to research.

As a result of the briefing, SBA will endeavor to:

- o interact with ARDEC technical POCs on an ongoing basis to ascertain the types of resources they will be looking for to support the required effort;
- o perform market research in the particular technological areas;
- o contact sources to encourage them to think about gearing up in these areas, if they are interested in pursuing opportunities at ARDEC;
- o encourage ARDEC technical POCs to review capabilities of the firms we identify; and,
- o work with Army Acquisition Managers to structure these new concepts, which will become requirements, in such a way as to enhance competition downstream.

III. Conclusion

With proper planning for future requirements, coupled with the innovation and creativity inherent in the small business community, there's every reason to be optimistic that small business will, in some way, be able to supply technology for the Army's future needs. The SBA is at ARDEC to aid and assist in making it happen. Please visit our display and pick up information on other SBA and/or Procurement Assistance Programs. Also, if you have not already done so, please pick up and complete Sample Business Questionnaire.

The names and phone numbers of SBA representatives at ARDEC are:

-Marie Burke	724-6574
-Larry Mallory	724-6960
-Mike Cecere	724-6577
-Ugo Lancellotti	724-6565
-Brenda Fernandez	724-4967

E. Are there any questions?

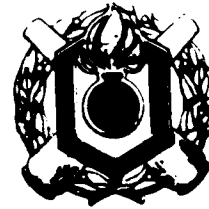
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1988 APBI Preview - CCAC Future Thrusts



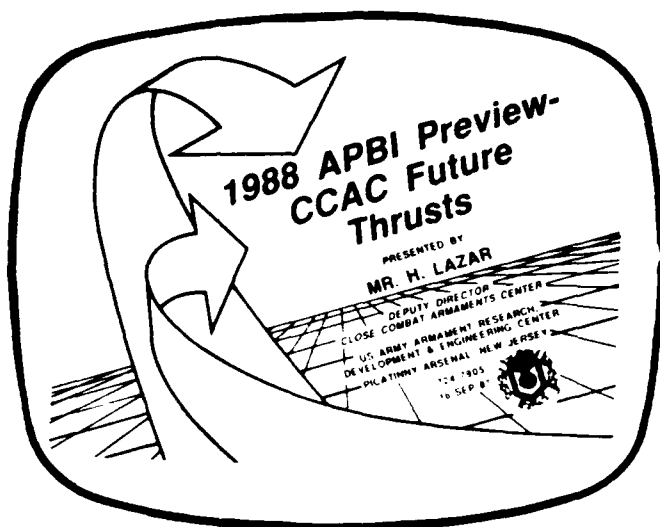
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ARMAMENT RDE CENTER

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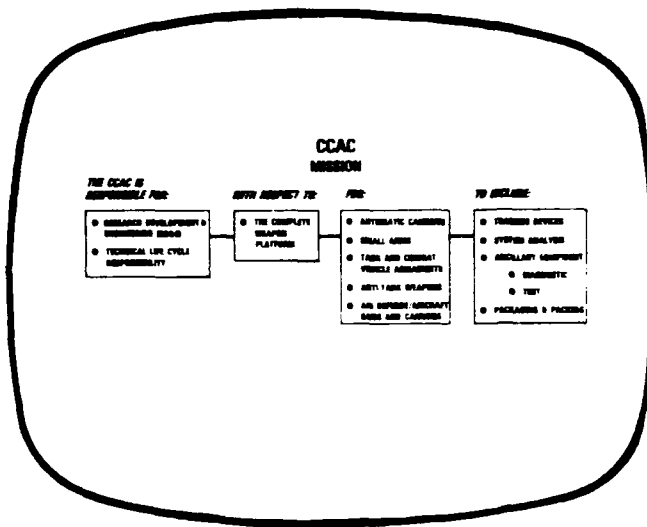


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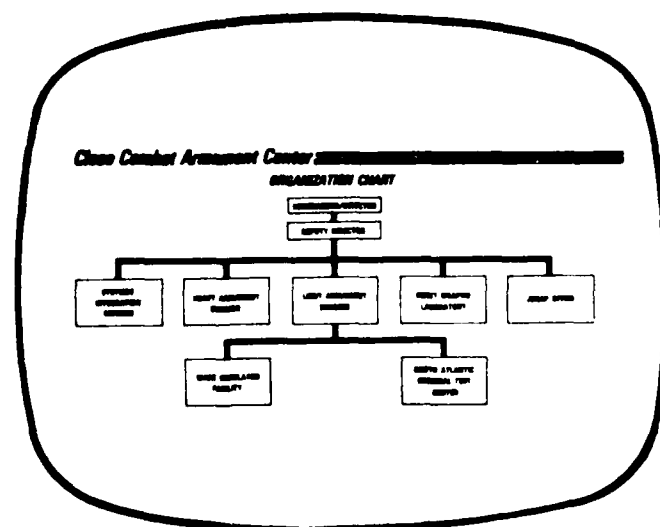
Mr. Hugh Lazar



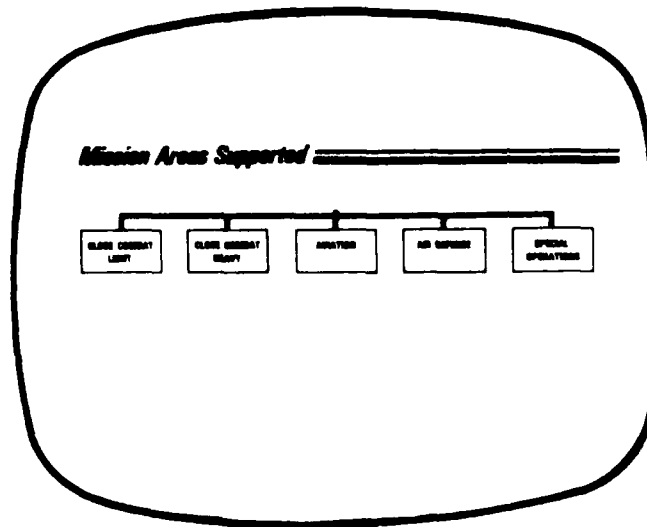
Slide # 1



Slide # 2



Slide # 3



Slide # 4

Slide #1. The Close Combat Armaments Center is the direct fire center with extensive responsibilities which extend from bayonets to 120-mm tank guns. The Close Combat Armaments Center has key subsystems responsibility except in individual soldier weapons where we have responsibility for the full system. We act as weapon developers with an increasing role as total armament subsystem integrator. We are the direct fire center.

Slide #2. The Close Combat Armaments Center's Mission involves us in the complete life cycle process of our commodities. This requires us to maintain knowledge and skills to support everything from 90-mm recoilless rifles to the latest in tank main armament systems. As the developer and integrator we acquire support from numerous other agencies to insure that all aspects of the hardware development and support are covered.

Slide #3. Our organization is structured similar to our sister center, Fire Support Armaments Center (FSAC), with the standard support organizations. A unique office which runs the DoD small arms program is the Joint Service Small Arms Program.

The Systems Integration Division can be thought of as the capstone division for subsystem development. It:

- o Uses products of other Divisions, ARDEC Agencies, and Army Labs and Centers.
- o Runs as mini PM's armament subsystem
- o Is a small division with large responsibilities.

The other three divisions have development and engineering support capabilities. The Heavy Armament Division is a complement to Benet Weapons Laboratory and:

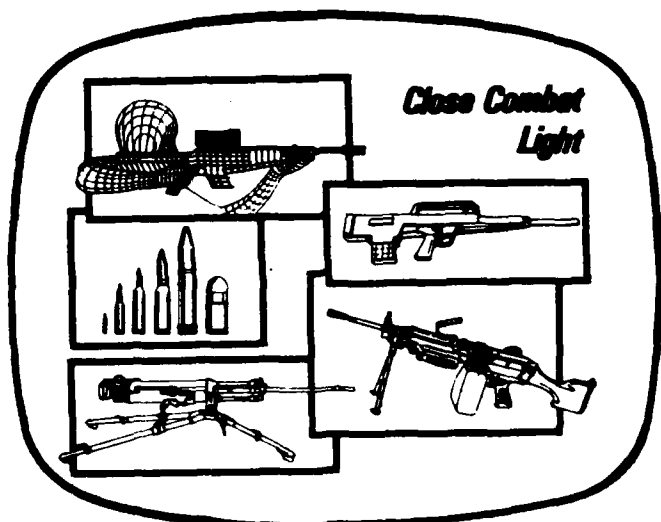
- o Is responsible for a wide range of direct fire munitions and support to artillery mortar munitions.
- o Assures ammo/weapon compatibility.
- o Works in advanced concepts to improve large caliber weapons systems capabilities.

The Light Armament Division has small arms and automatic cannon product areas and:

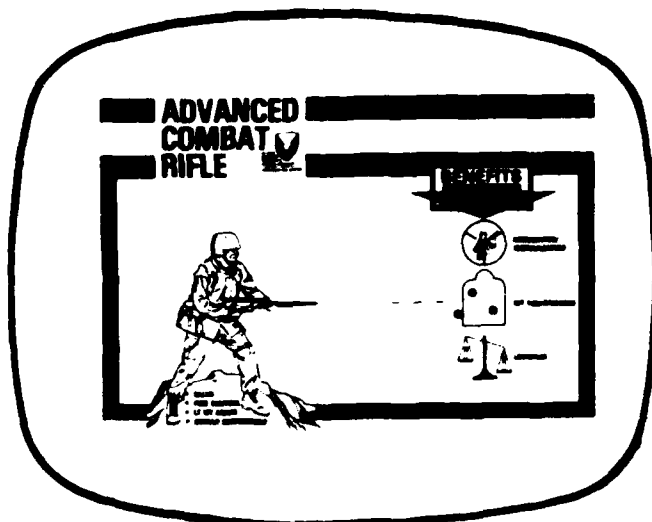
- o Can be thought of as having total responsibility for its product areas
- o Provides major matrix support to JSSAP and a number of PM's.

Benet Weapons Laboratory continues its long term role as center for cannon development and support as a full spectrum laboratory - research through engineering support. The co-location of Benet with Watervliet provides unique capability.

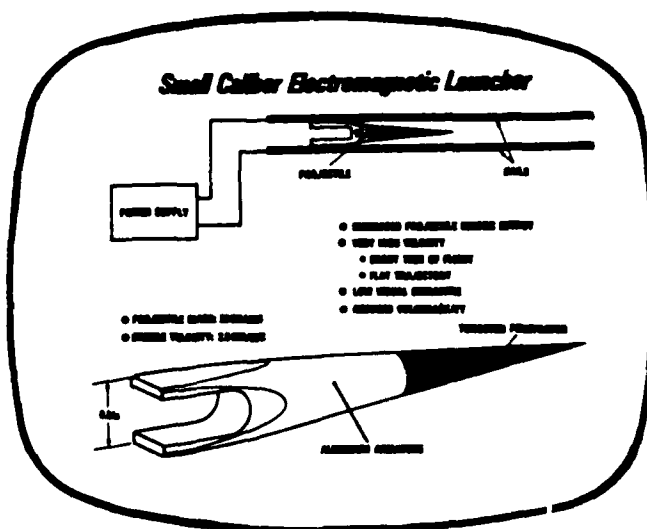
Slide #4. The Close Combat Armaments Center provides support to five mission areas. I will discuss selected systems under the first four of those areas. Special operations is currently supported by a single task in the joint service small arms program.



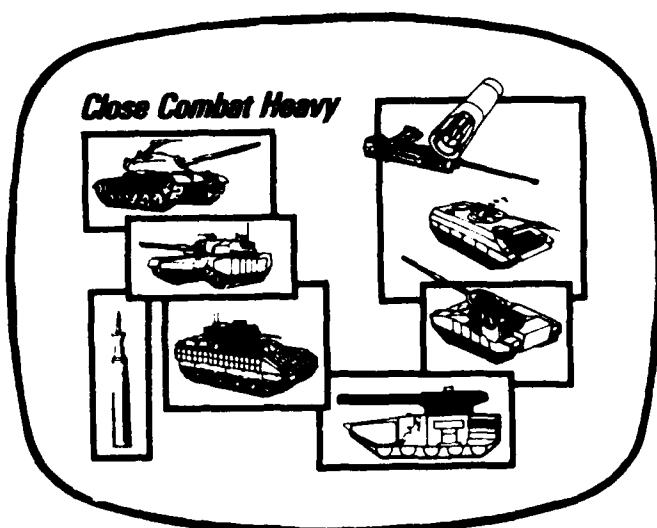
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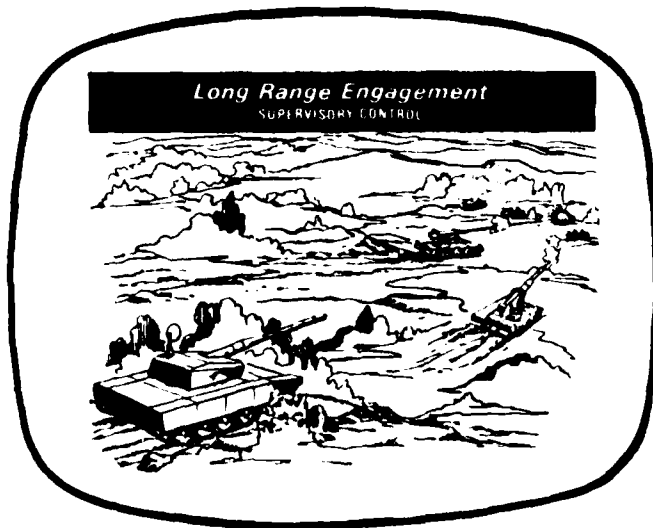
Slide # 6



Slide # 7



Slide # 8



Slide #9

Slide #5. The Close Combat Light Mission Area has a number of programs currently in progress. These include the Advanced Combat Rifle, the Squad Automatic Weapon, and the carbine. In addition, there are a number of small caliber ammo projects.

Slide #6. The Advanced Combat Rifle program is a technology base program designed to investigate and demonstrate a significant improvement in combat effectiveness. Under the stress of combat, aiming errors are large and hit performance is low. It is the goal of this program to investigate and demonstrate technologies to reduce and compensate for these large aiming errors. Technologies include multiple launch of projectiles in a controlled pattern, lightweight ammunition, and improved sighting techniques in a human engineered design. Industry has also been challenged to identify concepts of their own.

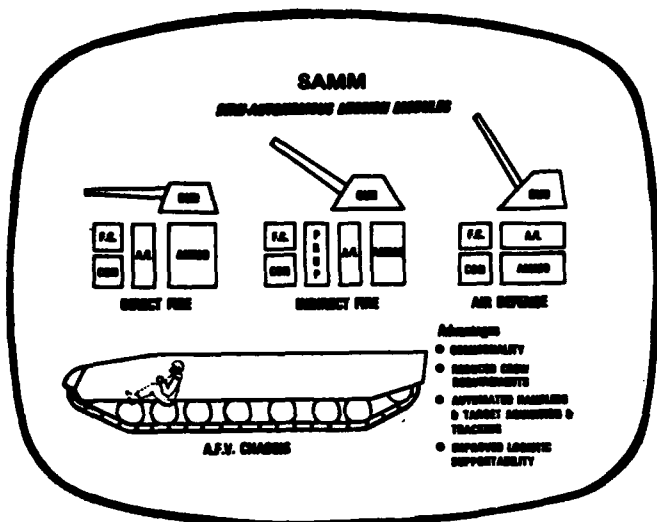
Slide #7. Another very exciting Close Combat Light effort is the small caliber EM launcher shown here. This effort is directed at firing a 20 gram projectile at velocities in the realm of 2.5 km/sec.

Slide #8. Many of our highest priority programs are in support of the Close Combat Heavy MAMP. They include cannons for tank main armaments, autoloaders, armor appliques for armored vehicles, and cannon caliber systems - from tech base to support to production.

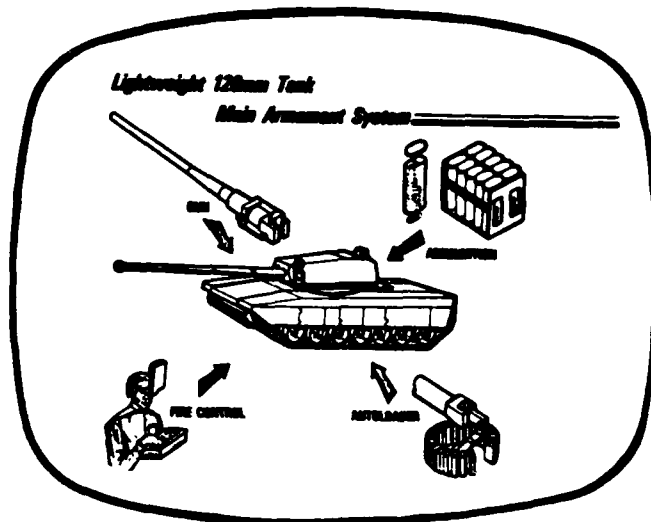
The Bradley Fighting Vehicle is at the limit of its effectiveness -including the latest kinetic energy ammo. COMVAT is a 30-mm system designed for maximum stored kills against the BMP-II. Follow-ons will include a new gun, cased telescoped ammo, linkless feeders, and full solution fire control. COMVAT will be oriented to Bradley improvement or AFV application so it meets the threat of the 1990+, and parts of the technology in MG Sunell's study. The program was initiated in FY86. The contractor team includes:

- o HONEYWELL - Prime and ammunition
- o ARES - Cannon
- o WESTERN DESIGN - Ammunition stowage and linkless feeders.

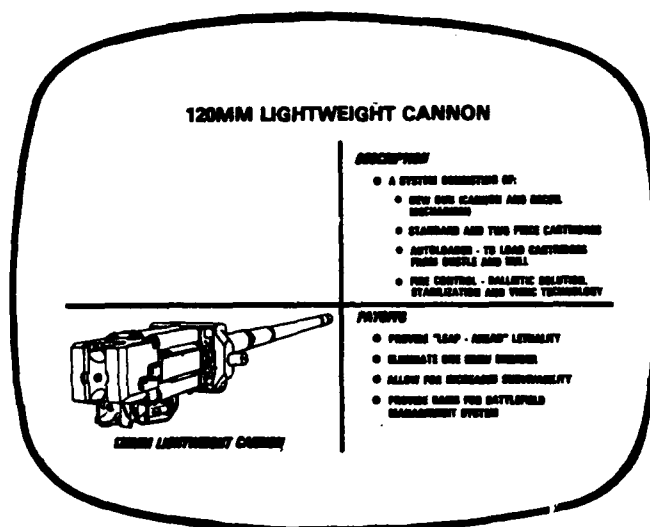
Slide #9. The SAMM program will support the Advanced Family of Vehicles (AFV) program through the creation and evaluation of armament turret modules for direct fire roles such as tanks and air defense systems, as well as the fire support role. The individual armament turret mission modules will be developed to maximize commonality across mission areas and will eliminate on-board dependency by the armament system for commanders, gunners, and ammunition loaders.



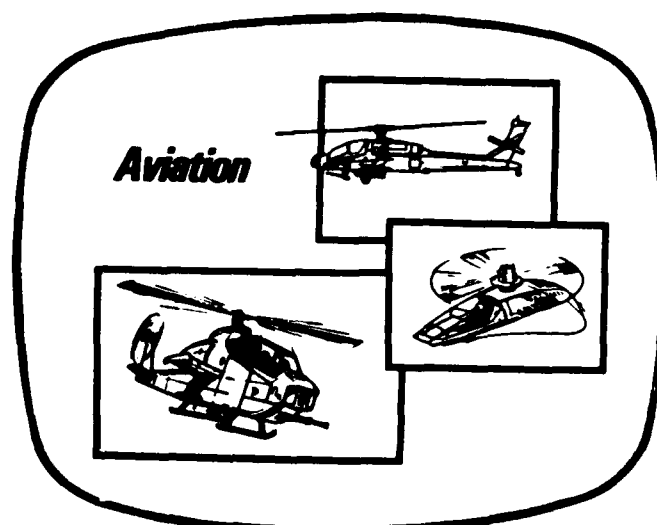
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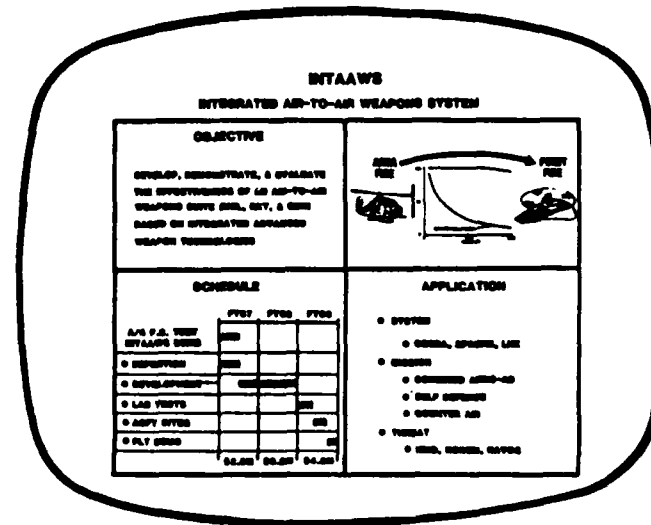
Slide #11



Slide #12



Slide #13



Slide #14

Slide #10. The program will pursue armament concepts that result in significant payoffs in system lethality, survivability, fightability, and ammunition logistics at an affordable cost. An in-house effort will pursue robotic principles to produce new concepts in turret design, ammunition handling, packaging, and re-supply by emphasizing commonality. Ultra-lightweight and lightweight prototypes of semi-autonomous large caliber direct fire armament systems for use with the future unmanned combat vehicles will be developed in-house with the family of modules developed under contract.

Slide #11. The lightweight 120-mm system includes:

- o the cannon
- o the ammunition in an advanced packaging/logistics concept
- o an autoloader which handles packaged ammunition
- o an advanced fire control incorporating VHSIC

The system applies to AFV heavy chassis or M1A1 block III.

The autoloading system has unique features which include:

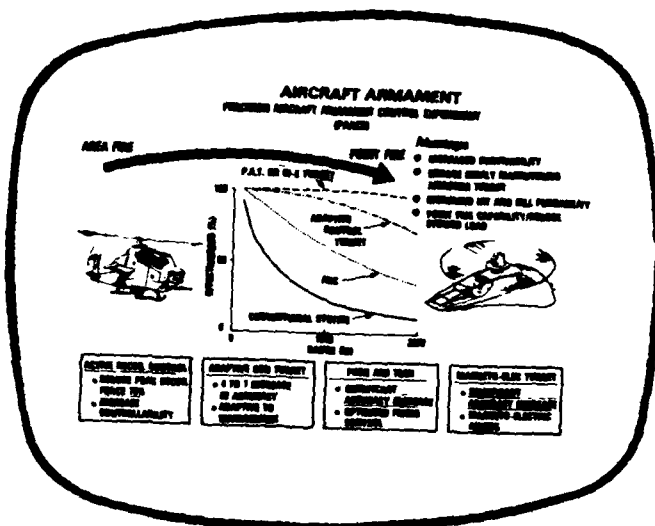
- o it is robotic
- o delivers packaged round
- o makes use of universal packaging - same pack for all rounds.

The autoloading system also has logistical advantages in that the round remains packed from ammo plant to breech; and it eases the problems of rearm in the field with modular "magazine" concept.

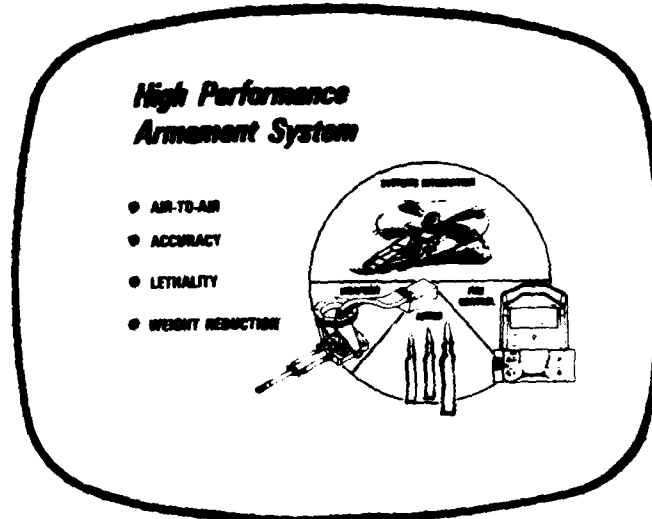
Slide 12. The cannon assembly includes interchangeable tubes, highly lightweight and efficient breech, and high impulse recoil mechanism.

Slide #13. We provide full spectrum support to aviation, and will concentrate on a new armament concept.

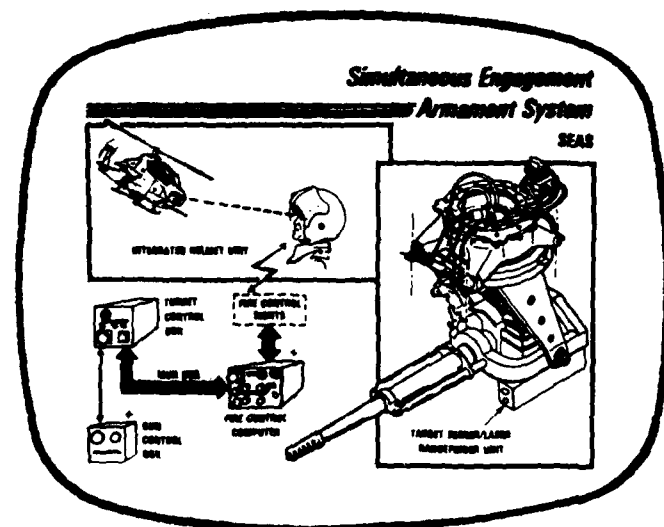
Slide #14. There is a new air-to-air threat materialization requiring changes to aircraft armament. Precision Aircraft Armament Control Experiment (PAACE) is jointly funded by ARDEC and AVSCOM. The major goal is precision pointing that gives point fire capability to what is usually an area fire weapon. PAACE permits air-to-air engagement, and is fully integrated into AVSCOM Integrated Aircraft Armament Weapon (INTAAW).



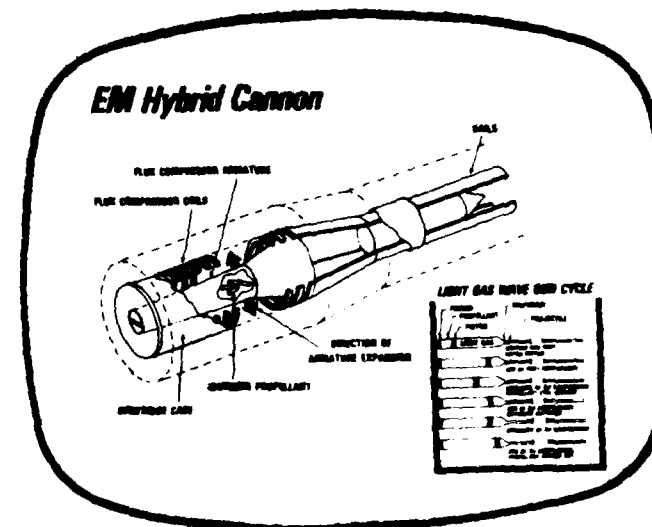
Slide # 15



Slide # 16



Slide # 17



Slide # 18

Slide #15. This slide shows the technologies which will be integrated into the PAACE programs, and the effectiveness gains (as a factor of range) which can be gained through their integration.

Slide #16. The High Performance Armament System (HIPAS) is a future effort which the Close Combat Armaments Center is pursuing in the area of "new/improved" armament systems for the future family of helicopters (LHX). The goals are improved air-to-air accuracy and lethality, overall weight reduction (caseless ammo), and fire control.

Slide #17. The simultaneous engagement armament system is a future effort which allows the turret gun to engage secondary threats while the helicopter's primary targeting system is being employed against primary mission targets. In essence, the helicopter pilot would be capable of engaging two targets thereby greatly enhancing his survivability.

Slide #18. In the EM Hybrid Cannon the conventional propellant performs three functions. They are:

- o Initial shot-start and early projectile acceleration
- o Closes circuit between rails and flux compressor
- o Powers compression of the magnetic field in the flux compressor which significantly increases the current which can be dumped into the rails and provide a substantial increase in launch velocity.

The EM propulsion uses a homopolar generator to provide initial power to the rails. The hybrid benefit is higher efficiency, reduced rail erosion, reduced weight and volume of electric power supply.

The Future

TECHNOLOGY CHALLENGES

- INCREASED RANGE, FL, PE AND SURVIVABILITY
- INCREASED ANTI-AIRBORNE CAPABILITIES
- IMPROVED TARGET ACQUISITION AND IDENTIFICATION CAPABILITY
- REDUCED LOGISTIC BURDEN
- LEAP AHEAD IN EFFECTIVENESS

TECHNOLOGY THRUSTS

- CASUALTY ASSURANCE
- HYPER-VELOCITY
- TELESCOPE ASSURANCE
- LINELESS FUSION
- MANEUVERING PROJECTILE
- ROBOTIC LOADS
- COMPOSITE MATERIALS

Slide # 19

Slide #19. Technology challenges include:

- o Increased range, PH, PK, and survivability
- o Increased anti-armor capabilities
- o Improved target acquisition and identification capability
- o Reduced logistic burden
- o Leap ahead in effectiveness

Technology thrusts are:

- o Caseless ammunition
- o Hyper-velocity
- o Telescoped ammunition
- o Linkless feeders
- o Robotic loader
- o Composite materials

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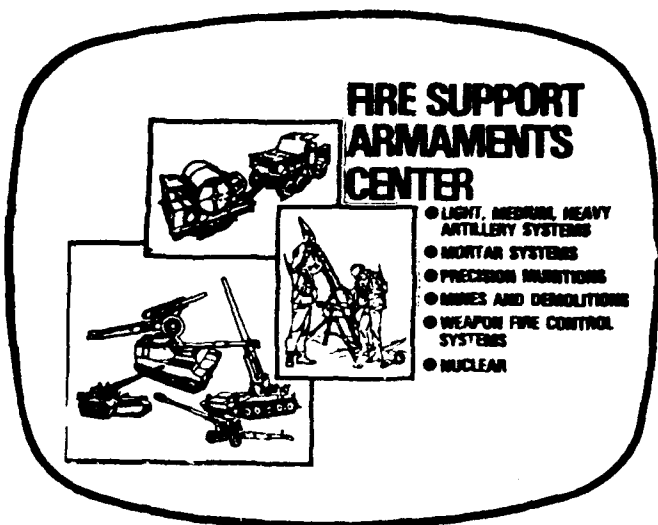
Closing Remarks



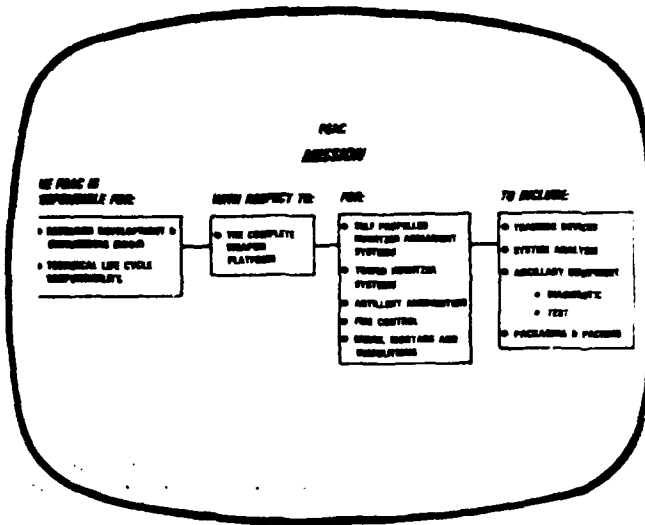
Presented by

COL Jean Reed
Commander FSAC

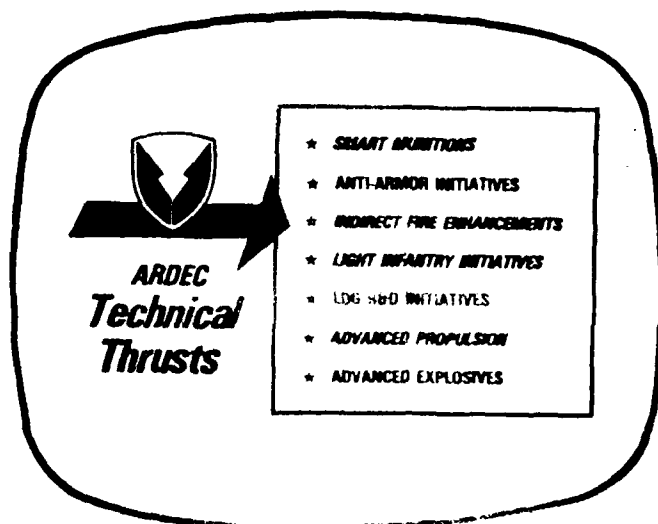




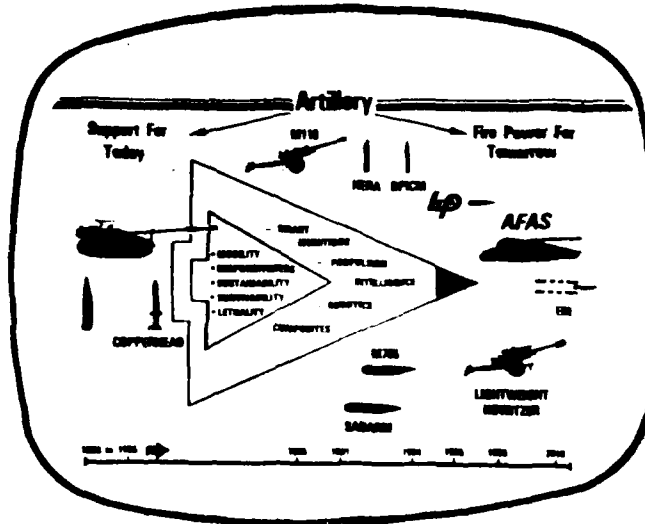
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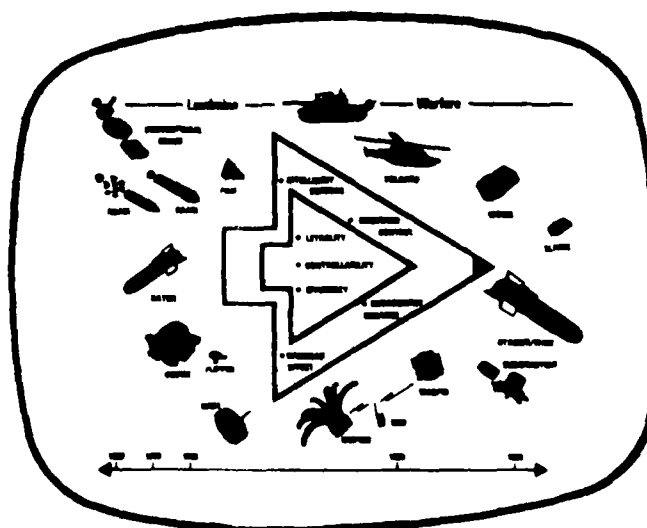
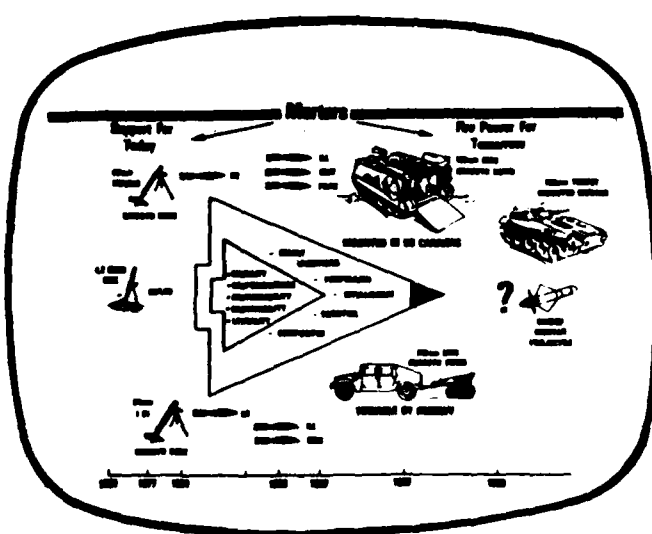
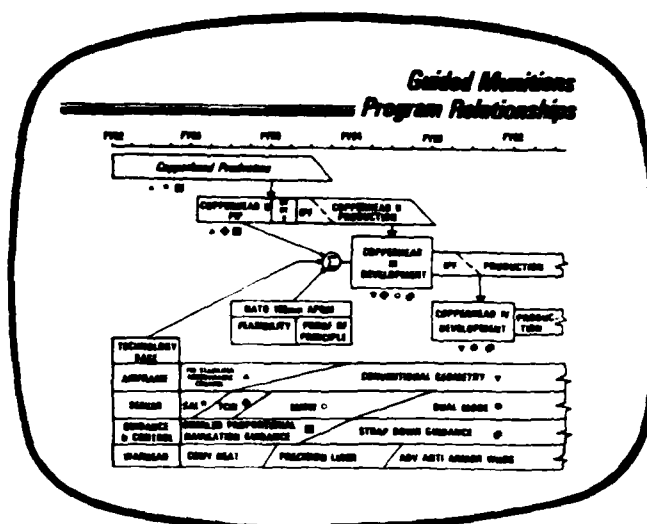
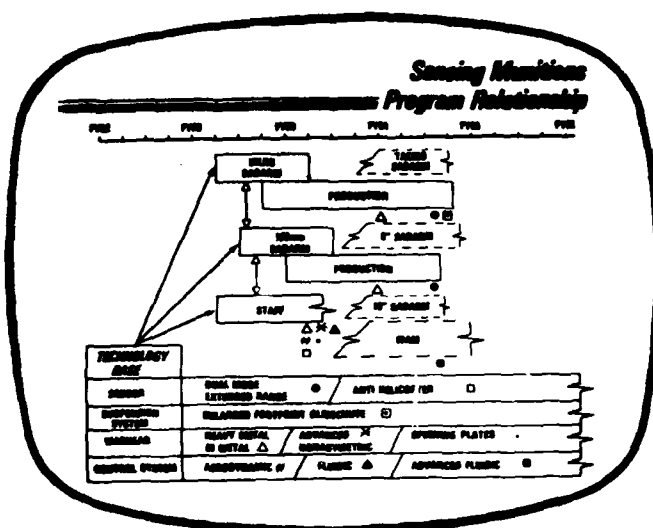
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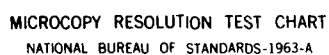
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ACRONYMS

FSACAM	Family of Scatterable Mines
WAM	Wide Area Mine
ICOMS	Improved Conventional Mine System
SLAMS	Selectable, Lightweight, Attack Munition
MOPMS	Modular Pack Mine System
GEMSS	Ground Emplaced Mine Scattering System
ADAM	Aerial Denial Anti-Personnel Mine
RAAM	Remotely Emplaced Anti-Armor Mine
PDM	Pursuit Deterrent Munition
MLRS	Multiple Launch Rocket System
WASPM	Wide Area Side Penetrating Mine
TACMS	Tactical Missile System
HIMOCS	High Mobility Integrated Technology
AHIT	Advanced Howitzer Integrated Technology
NORTH	North Orienting and Referencing Towed Howitzer
MAPS	Modular Azimuth Positioning System
HIPS	Howitzer Improvement Program
NSWP	Non-Soviet Warsaw Pact
ATGMS	Anti-Tank Guided Missile Systems
TVD	Theater of Military Operations
TMA	Theater of Strategic Military Actions
C3I	Command, Control, Communications, and Intelligence
APC	Armored Personnel Carrier
IFV	Infantry Fighting Vehicle

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