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SADARM ENVIRONMENTAL ASSESSMENT

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13. ABSTRACT (Maximum 200 words)

The SADARM environmental assessment (EA) report identifies and quantifies any hazardous materials inherent within the projectile and the chemical byproducts created in firing the projectile and the submunition. The data has been cataloged by system components and specific test series performed during the full scale development testing program.

This report uses the policies, procedures, and guidelines described in Army Regulation 200-2 (23 Jan 89) and the National Environmental Policy Act (NEPA) of 1969. The culmination of this report focused on the generation and submission of a formal document identified as the findings of no significant impact (FNSI) which contains rationale and conclusions why the 155-mm SADARM will not contibute to significant adverse impact to the environment.

The SADARM EA and FNSI are a matter of public record and are held for viewing a the Rockaway and Jefferson Township public libraries located in New Jersey.

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INTRODUCTION

The purpose of this report is to address the life cycle phases and data generated in the preparation of the environmental assessment (EA) for the 155-mm SADARM projectile XM898. The SADARM life cycle begins with the conceptual phase and continues through advanced development, full scale development (FSD), production, deployment, and finally the disposal phase. All hazardous materials and/or their byproducts that have been or will be used or formed during SADARM's life cycle have been addressed with respect to their impact on the environment.

The design, test, and manufacture tasks vary with each phase of the life cycle. SADARM is currently in the full scale development phase, and its configuration and design requirements form the basis of this report. Inputs for future phases (i.e., production and disposal) are also included. This life cycle environmental document (LCED) approach requires periodic updates as environmental impacts and emission standards become better known.

A list of project hardware test configurations, along with a description of each test to be conducted by the government, and the expected impact they will have upon the environment are included, as well as a comprehensive listing of current FSD configurations of 155-mm SADARM components, hazardous materials, emissions, and byproducts resulting from FSD testing.

NATIONAL ENVIRONMENTAL POLICY ACT

The National Environmental Policy Act (NEPA) was enacted by the Senate and House of Representatives in 1969. Revisions and amendments to this legislation followed in 1970, 1975, and 1986.

The purpose of NEPA was to establish a national policy which would not only protect the environment but promote methods by which to enhance it. The act established the policy, procedures, and regulations to which federal, state, and local governmental agencies must adhere to maintain and restore environmental quality. Furthermore, NEPA identifies the appropriate parties and organizations responsible for the enactment and enforcement of this legislation. One major purpose of NEPA was the establishment of the Council on Environmental Quality which is tasked with overall responsibility to formulate and recommend national policy to the president.

Title I, Section 101 identifies the six major environmental areas to be addressed. The one which concerns SADARM is as follows: "Provide to attain the widest range of beneficial uses of the environment without degradation, risk to health and safety, or other undesirable and unintended consequences." This requirement was the driver for preparing the environmental assessment for SADARM.

ENVIRONMENTAL ASSESSMENT RESPONSIBILITY

AR 200-2 specified that the materiel developer (program proponent) is the organization responsible for the preparation of any required environmental documentation. For the SADARM program, the program/project manager (PM) has been identified and tasked with this effort. The PM has delegated this mission to the Fire Support Armament Center's (FSAC) Precision Munitions Division for implementation. This effort was conducted in-house because of the technical expertise needed to assess areas such as propellants, explosives, and munitions development. The SADARM environmental personnel formulated the strategy for complying with federal, state, and local regulations. A concerted effort was made in the coordination and collection of data from those agencies, lab personnel, and contractor facilities as listed in the EA. These groups assisted in the preparation and review of the document to assure that proper environmental considerations were addressed. The EA was subsequently staffed and approved with all the appropriate signatures.

ENVIRONMENTAL ASSESSMENT POLICY SUMMARY

The prime purpose of an EA is to determine the need for an environmental impact statement (EIS). If the action being assessed has a significant environmental impact, then an EIS must be prepared.

- An EA must be made in order to determine the extent of environmental impacts of a project/program and ascertain whether or not the impacts are significant. The decision maker (FSAC), after review of the EA evidence, will determine whether a finding of no significant impact (FNSI) or an EIS should be prepared.

- Two major categories exist in the regulations which determine the necessity for providing an EA.

Category I: An EA is required when the proposed action has the potential for:

1. Cumulative impact on environmental quality when combining effects of other actions or when the proposed action is of lengthy duration

2. Release of harmful radiation or hazardous/toxic chemicals into the environment

NOTE: Of the four total conditions identified in category I of the regulations, only the above two conditions were identified as SADARM specific regarding the necessity for providing an EA.

Category II: Actions normally requiring an EA are new weapon systems development and acquisition, including the materiel acquisition, transition, and release processes.

NOTE: Of the 23 total possible actions identified in category II, only the above action was identified as SADARM specific regarding the necessity to provide an EA.

REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENTS

An EIS is required when any action or actions caused by either a public or private agency/organization is known to contribute adverse effects on the environment. The criteria which describe the necessity for an EIS are summarized as any action which would:

1. Violate existing pollution standards

2. Cause water, air, noise, soil, or underground pollution

3. Impair visibility for substantial periods of any day

4. Cause interference with the reasonable peaceful enjoyment of property or use of property

5. Create an interference with visual or auditory amenities

6. Limit multiple use management programs for an area

7. Cause danger to the health, safety, or welfare of human life

8. Cause irreparable harm to animal or plant life in an area

To ascertain any possible adverse environmental effects, SADARM environmental personnel investigated the above eight categories during the design, design, development, and testing phases of the program. After careful review and analysis, it was determined that no test conditions significantly affected any of the above criteria. This positive result therefore did not necessitate the submission of an EIS.

FINDINGS OF NO SIGNIFICANT IMPACT

Requirements

The FNSI is a formal document generated by the proponent agency which presents the methodology and conclusions why the program action or actions (i.e., SADARM Research and Development Technical Test Program) does not pose a significant impact to the environment (app). Included within the SADARM FNSI are:

1. Name of action

2. Brief description of the action

3. Discussion of anticipated environmental effects

4. Conclusions which led to the FNSI

The latter two items relating to anticipated environmental effects and conclusions comprise the bulk of the EA.

Considerable time and effort was expended in providing the tabulated analysis of munition element makeup and combustion byproducts. The format structure began with the tabular description of the prime submunition components (i.e., M577 fuze, propelling charges, the fuzing, safe and arming device, LX-14 explosive, etc.) and phased down to the subcomponent level. Each submunition item/level of contamination (elements and byproducts of combustion, noise, etc.) was subsequently compared to federal guidance levels of acceptance. The explosive gases and residues were shown to be minimal and confined to the immediate areas of test with no significant impact on the environment.

Regulations require that the Public Affairs Office provide a press release to inform the general public of any published environmental assessments. A public release was published in the Daily Record on 9-19-91. The deadline for any written comments was 30 days; no comments were received.

Findings

Project No. 1M464631D644

1. Name of Action: Projectile, 155 mm, H.E. Counter Battery, XM898 Sense and Destroy Armor (SADARM)

2. Description of the Action: The SADARM system is currently in the full scale development phase (FSD) and managed by PM SADARM, resident at ARDEC. Two prime contractors, Aerojet ElectroSystems and Alliant Techsystems are responsible for the design, fabrication, and testing.

a. The 155 mm XM898 projectile consists of a steel shell body and base with a welded copper rotating band. Each projectile contains two SADARM submunitions which are dispensed over the target area. Each submunition contains multiple sensors (passive IR, passive MMW, and active MMW) for the detection of armored targets. A Ram air inflated device (RAID) and a Vortex ring parachute (VRP) are deployed after ejection from the projectile as a means of stabilizing and imparting spin to the submunition while controlling the rate of descent. The lethal mechanism, an explosively formed penetrator (EFP), consists of a dishshaped metal plate backed by LX-14 explosive.

b. When a target is detected by the sensors, the explosive is initiated, forming the metal plate into a penetrator which is projected at the target.

c. The existing method of neutralizing an artillery barrage is to fire a substantially large amount of explosive projectiles at the targets. This tactic is required because of the inherently lower probability of a direct hit. SADARM reduces the number of projectiles required to neutralize the threat by increasing the probability of hit/kill per projectile.

3. Discussion of Anticipated Environmental Effects: The attached environment assessment (EA) discusses the anticipated effects. In summary, minimal environmental impact will occur in the ballistic testing of the 155-mm projectile and the lethal mechanism. A comprehensive listing of hazardous materials is also contained in the EA along with descriptions of the manufacturing processes, transportation requirements, and method of disposal. Though activities and alternatives related to the production and disposal phases are anticipatory in nature, the EA has shown that these items will also have a minimal impact upon the environment. When drawing packages and other contract data requirement list (CDRL) items become available, these activities and alternatives will be completely defined and included in the next revision of the EA.

4. Conclusions Which Led to the FNSI: The environmental impacts have been reviewed for the life cycle of 155-mm SADARM which inlude development, testing, production, and demilitarization phases. These actions have or will be performed at established test ranges, contractor facilities, government ammunition plants, and government storage facilities. Each of these locations is required to comply with all federal, state, and local environmental regulations.

a. Environmental effects due to these actions include explosive gases released into the atmosphere, explosive residues deposited on the ground (including metal parts), and noise. Testing results have shown that gases/residues released into the atmosphere/ground are minimal and confined to the immediate areas designated for the intended actions. During the disposal phase, metal scrap and other parts will be recycled after dowloading and burning off of explosive materials.

b. The life cycle environmental assessment therefore concludes that the 155-mm SADARM will have no significant impact upon the environment.

5. Deadline: Deadline for receipt of public comment is 30 days after completion of the FNSI.

APPENDIX

LIFE CYCLE ENVIRONMENTAL ASSESSMENT FOR PROJECTILE, 155 mm, H.E. COUNTER BATTERY, XM898, SENSE AND DESTROY ARMOR (SADARM)

A. Purpose and Need for Proposed Action: The purpose of this document is to provide an environmental assessment of the materials and their byproducts that have been or will be used or formed in the life cycle of the SADARM projectile from its conceptual phase through its disposal phase. In general terms, the SADARM mission/need can be summarized as follows: It enhances the counter battery (our artillery) capability to neutralize an artillery barrage or threat by using Smart Submunitions; it operates in the fire and forget mode (i.e., no external inputs to the projectile or its submunitions after launch); it accomplishes its mission in the presence of countermeasures, inclement weather, degraded battlefield conditions, day or night operations and Nuclear, Biological and Chemical (NBC) environments.

B. General Description of the Proposed Action: This Environmental Assessment addresses the SADARM System which is currently in the Full Scale Development Phase (FSD) and managed by PM SADARM, resident at ARDEC, Picatinny Arsenal, NJ. Two prime contractors, Aerojet Electrosystems and Alliant Techsystems were responsible for the design, fabrication and testing of the complete projectile. During FY91 the acquisition strategy was changed to a leader follower concept and Aerojet's design was selected for development and production. Also covered in this assessment are the past design and development efforts completed in the Conceptual Phase and the Demonstration and Validation Phase, which are described in Sections D.1 and D.2. Future actions include the completion of the Full Scale Development Phase (Section D.3), the Production and Deployment Phase (Section D.4) and the Disposal Phase (Section D.5).

1. The 155mm XM898 Projectile (Photograph - Attachment 2) consists of a steel shell body and base, with a copper rotating band welded to the body. Each projectile contains two SADARM submunitions. Each submunition contains multiple sensors using infrared (IR) and millimeter wave (MMW) radar technologies for the detection of armored targets.

2. A Ram Air Inflated Device (RAID) and a Vortex Ring Parachute (VRP) are deployed from each submunition after ejection from the projectile as a means of stabilizing and imparting spin to the submunition while controlling the rate of descent. The lethal mechanism, an Explosively Formed Penetrator (EFP), consists of a dish shaped metal plate backed by LX-14 explosive. When a target is detected by the sensors, the explosive is initiated, forming the metal plate into a penetrator which is projected at the target. If no targets are detected, a self-destruct sequence is initiated at a predetermined altitude.

3. The characteristics of a single round and its components (FSD configuration), along with a list of all hazardous materials existing before and formed after deployment are described and listed in attachment 1. All actions, i.e. design, test and manufacture, vary with each phase of the Life Cycle. The attached characterizations are for the existing FSD design configuration. Earlier versions may be different and are discussed in each phase. Discussion of future phases, i.e., Production and Disposal Phases, uses the best existing information and will be updated as new information becomes available.

C. Alternatives Considered (to Satisfy Need): The existing method of neutralizing an artillery threat is to counterfire with a significantly large amount of conventional (dumb) explosive projectiles at the targets. The large number is required because of the inherently low probability of a direct hit. SADARM reduces the number of projectiles required to neutralize the threat by substantially increasing the probability of hit/kill per projectile.

D. Environmental Impacts of the Proposed Action:

1. Conceptual Phase: Completed 1976-1979

a. Description of Activities and Alternatives: In the early stages of SADARM development, only passive sensor designs (i.e., non-active or non-radiating) were considered. All sensor tests were performed at contractor sites. During this same period several warhead (lethal mechanism) approaches were considered to develop an Explosively Formed Penetrator (EFP). Materials considered for the EFP were iron, which was found to lack sufficient ductility, and copper, which proved to lack the required density to meet performance requirements. Explosives considered for the warhead included Octol (which was later ruled out because of technical problems associated with fabrication) and LX-14.

b. Environmental Impacts of Activities: All testing was performed at Camp Edwards, MA and Eglin Air Force Base, FL, where state and local environmental codes were in effect. Explosive residues were emitted into the air and ground within confined areas and did not significantly affect the environment. These emissions are listed in attachment 1 (pages 10 and 11) for combustion products of LX-14 and Octol. Nontoxic metal debris, i.e. iron, copper and steel, was scattered about the immediate test areas, and attended to by the individual contractors (Aerojet and Honeywell). This included cleaning up the immediate test area, recycling and disposing of materials in accordance with applicable environmental codes. The total number of warhead tests for both the conceptual phase and the demonstration and validation phase is estimated to be 150. Noise levels for this phase were not recorded but would be similar to levels for FSD firings (D.3.C(1)(e)).

2. Demonstration and Validation Phase: Completed 1980-1985

a. Description of Activities and Alternatives: During this phase two contractor configurations (Aerojet and Honeywell) were considered. Sensor designs for both contractors included passive IR and active MMW (Ka band) low power radar. Both contractors continued to develop EFP designs using technologies similar to those of the conceptual phase. Materials considered were copper and the heavier metal tantalum. The only primary explosive considered was LX-14 because of its homogeneity, machinability and its high energy content.

During this phase, live submunition and live 8" projectile tests were conducted at Yuma Proving Ground (YPG). Twelve 8" rounds were fired, six by each contractor. Each of these rounds contained one live submunition, which was ejected over a target area. Two out of the twelve exploded while the other ten submunitions did not function and were recovered intact.

b. Affected Environments: The sensors were tested at Government Test Sites: Aberdeen Proving Ground, YPG, Sandia Test Range and Camp Grayling, Michigan. All warhead development tests were conducted at contractor sites of Socorro, New Mexico and Chino, California (Aerojet), and Honeywell Ordinance Proving Ground (HOPG), Minnesota. Live firing tests from an 8" gun were all conducted at YPG whose mission includes testing of munitions and weapon systems. Affected environments from these tests are covered in each test site's particular Environment Assessment. The SADARM Test Mission is matched to a particular test site's mission (e.g. 155mm Gun Firing at YPG). Each test site has its own specific Environmental Assessment Document, which is evaluated relative to each particular mission such as SADARM. Affected environments addressed in these documents include: climate, air quality, geology and soils, hydrology and water quality, biological resources, cultural resources, etc. Noise levels for this phase were not recorded but would be similar to levels for FSD firings (D.3.C(1)(e).

c. Direct and Indirect Environmental Impacts of Actions and Alternatives:

(1) Direct Impact:

(a) Sensor: Active MMW radiation was emitted in the KA band with less than 100 milliwatts of radiated power. This is less than the amount of power radiated by a cordless telephone. During testing, the average duration of MMW radiation is 1-2 minutes per test. The energy dissipates immediately leaving no residual effects or radiation. This will have less than minimal impact upon the environment.

(b) Warhead: Explosive residues were emitted into the air and ground within confined areas. Type and amount of byproducts from LX-14 explosive are indicated in the materials/byproducts list (attachment 1, page 10). Tantalum is biologically inert and poses no threat to the environment. Other non-toxic metal debris, i.e., steel, was scattered about the immediate test areas and was attended to by the individual contractors (Aerojet and Honeywell). This included cleaning up the immediate test and recycling and disposing of materials in accordance with applicable environmental codes.

(c) Propelling Charge: The products of combustion (emissions) of gun firings are listed in attachment 1 under "Propelling Charges".

(2) Indirect Impact: All major components and prototypes for testing were manufactured at contractor sites in Azusa, California (Aerojet) and Minnetonka, Minnesota (Honeywell). Contractors were required to meet all federal, state and local environmental requirements. As indicated in paragraph D.2.a, only six prototypes were manufactured by each contractor.

d. Adverse Effects and/or Conflicts which Cannot be Avoided: There were no unavoidable adverse impacts in this phase of the project.

e. Recommended Mitigation: None

3. Full Scale Development (FSD) Phase: FY1987 - FY1994

a. Description of Activities and Alternatives: SADARM development contracts for this phase had been awarded to Aerojet Electrosystems and Alliant Techsystems (formerly Honeywell, Inc.). The following is a description of the contractor's activities planned or completed until the acquisition strategy was changed in FY91. Thereafter Aerojet's design was selected to complete the FSD phase. The basic configurations and designs are improved versions of the Demonstration and Validation Phase. Sensor designs for both contractors include passive IR and active MMW low power radar. Aerojet also uses passive MMW detection (no transmitter). Aerojet's warhead/lethal mechanism design uses a pure Tantalum liner, whereas Alliant's uses a Tantalum/Tungsten alloy. LX-14 is the explosive used for EFP formation by both contractors. Attachment 1 contains the current FSD configuration for components and hazardous materials. This includes emissions and byproducts resulting from the FSD testing.

Both Government and contractor test plans and reports are available from the SADARM Program Office (SMCAR-FSP-I, Picatinny Arsenal, NJ); all are designated competition sensitive, some reports are classified Secret. Below is a listing of projected hardware test configurations and quantities for government testing. Quantities listed (in parenthesis) may vary slightly throughout the duration of FSD due to schedule slippages, contract changes or funding requirements.

(1) Lethal Mechanism (LM) (122): Tests will consist of forming the LM using Tantalum liners and LX-14 explosives in the tactical submunition configuration. The LM 's will be fired at stationary targets. Results will determine repeatability of design and response to environmental stress (climate, transportation, storage, etc.). Environmental impacts are discussed in paragraph D.3.c.(1)c, below.

(2) Sensor Units (12): Tests will consist of Captive Flight Tests (CFT) (mounting of the sensor in a fixture attached to a helicopter, which is flown over a target array) and drop tests (in which submunitions with sensors are dropped over target arrays). Results will determine the adequacy of sensor performance in a variety of conditions. A data base will be established to evaluate system performance and reliability. Environmental impacts are discussed in section D.3.c(1)(a), below.

(3) Nuclear Survivability (2): Tests will be evaluated using the SADARM Nuclear Survivability Plan, which is tailored from TECOM Test Operating Procedure TOP 1-2-612. This plan is currently in its draft form and is available at the SADARM Program Office. The objective of this testing is to demonstrate that the submunition sensor system, when contained in the 155mm carrier, will function properly after exposure to the electromagnetic pulse (EMP), Total Dose, and Neutron Fluence environments. After exposure, proper functioning will be verified. Environmental impacts are discussed in section D.3c(1)(b), below.

(4) Electromagnetic Radiation (EMR) (12): Tests will be conducted in accordance with the Government Electromagnetic Environmental Effects Plan, tailored from MIL-STD-461C, available at the SADARM Program Office. These tests will include exposure to the following: Electromagnetic Radiation Hazards, Electromagnetic Radiation Operational, Special Electromagnetic Interface, Electrostatic Discharge, Lightning Effects and Electromagnetic Pulse. Environmental impacts are discussed in section D.3.c(1)(b), below.

(5) 155mm Projectile System Tests.

(5.1) Demonstration Tests (78): Tests consist of 155mm gun firings, subsequent to environmental conditioning of the rounds. Four tactical configurations will be fired and seventy four inert (without the LM). Environmental conditioning of rounds consist of: temperature extremes, 7' drop, loose cargo, transportation, vibration and thermal shock. The test matrix is available at the SADARM Program Office. Results will determine projectile/submunition performance and reliability under the specified conditions. Environmental impacts are discussed in section D.3.c(1)(c), below.

(5.2) Technical Test (528): Tests consist of 155mm gun firings for safety, interoperability, firing table and performance phases. Safety tests include 12 meter drop, strength of design, worn gun tube test, sequential/environment and hazard classification. The test matrix is available at the SADARM Program Office. Results will verify that the design will meet the Required Operational Capability (ROC) performance and safety criteria. Environmental impacts are discussed in section D.3.c(1)(d), below.

(5.3) Firing Table Test (Ballistic Similitude (1188): Tests consist of 155mm gun firings. Results will be used to develop graphic and tabular firing tables along with software for current and future artillery systems. The test matrix is available from the SADARM Program Office. Environmental impacts are discussed in section D.3.c(1)(c).

(5.4) Performance Tests (104): Full-up 155mm munitions will be tested to determine the effect of temperature (hot, cold, ambient) and transportation/vibration at various charge/weapon/zone combinations. The firings will be conducted at Yuma in a desert environment with and without countermeasures. All rounds will be fired against targets. A target area instrumentation system will be used to gather performance data necessary to satisfy the developers objectives. Essential elements of the assessment include accuracy, range, terminal effects and human factors. The test matrix is available at the SADARM Program Office. Environmental impacts are discussed in section D.3.c(1)(a)-(d), below.

(5.5) User Tests (7): The user firing phases for 155mm SADARM munitions are planned to be conducted at sites representing a European-like summer and snow environment to complement firing which will be conducted in desert arid environments. Results will allow assessment of the submunition performance in these environments. Environmental impacts of gun firings are discussed in D.3.c(1)(a)-(d), below.

b. Affected Environments: Sensor tests were/will be performed at Government test sites: Camp Grayling, Michigan; Ft. Drum, New York, Ft. Greely, Alaska, YPG and Ft. Huachuca, Arizona. Electromagnetic Radiation (EMR) and Nuclear Survivability tests will be conducted at White Sands Missile Range, New Mexico and Picatinny Arsenal, New Jersey.

(1) Lethal Mechanisms (LM) firings were/will be performed at contractor sites of Socorro, New Mexico and HOPG, Minnesota. Some LM tests will also be performed at Aberdeen Proving Ground (APG), Maryland. All live firings will be conducted at YPG.

(2) For LM and live fire tests, the environments that would be affected include: air, ground and noise. Further insight into affected environments for each particular test site is included in their respective Environmental Assessments. The SADARM test mission is matched to a particular test site's mission and evaluated by the Test and Evaluation Command for environmental impacts to that site or its specific EA.

c. Direct and Indirect Environmental Impacts of Activities and Alternatives:

(1) Direct Impact:

(a) Sensor: Active MMW radiation emitted in the Ka band with less than 100 milliwatts of radiated power. This is less than the amount of power radiated by a cordless telephone. During testing, the average duration of MMW radiation is 1-2 minutes per test. The energy dissipates immediately leaving no residual effects or radiation. This will have less than minimal impact upon the environment.

(b) EMR and Nuclear Survivability tests are routinely conducted at WSMR whose effects on the environment are covered in their Environmental Assessment.

(c) Lethal Mechanism: Explosive residues were/will be emitted into the air and ground within confined areas. Type and amount of byproducts from LX-14 explosive are listed in the materials list (attachment 1). Tantalum is biologically inert and poses no threat to the environment. Other non-toxic metal debris will be scattered about the immediate area and cleaned up and recycled by test personnel per applicable environmental codes.

(d) 155mm Propelling Charges: Environmental impact of gun firings are covered in the attachment 1 where emissions are listed for combustion products and propelling charges for a typical 155mm round firing.

(e) Noise Levels for Firing Tests: At a 500 ft. distance, typical noise levels are 140 db. Per MIL-S-1474A no ear protection is required at this level. Noise levels significantly drop off as distance increases.

(2) Indirect Impact: All major components and prototypes will be manufactured by the two prime contractors and their subcontractors. Contractors will be required to meet all federal, state and local environmental codes.

d. Adverse Effects and/or Conflicts Which Cannot be Avoided: There are no unavoidable adverse impacts in this phase of the project.

e. Recommended Mitigation: None

4. Production and Deployment Phase: FY93 -

a. Description of Activities and Alternatives: The activities described within this phase are anticipatory in nature. Production quantities are subject to change and are designated FOR OFFICIAL USE ONLY. A preliminary production process list (high level block diagram) is available at the SADARM Program Office. The lists are designated Competition Sensitive and FOR OFFICIAL USE ONLY. The Aerojet configuration will be used in production.

Production is anticipated to start in FY93 and extend over a 10+ year duration.

b. Affected Environments: Production of SADARM will occur at the contractor's facilities. Hazardous operations have not yet been identified. Other contractor documents deliverable to the Government, will aid in the identification of processes potentially affecting the environment. Some of these documents include: Manufacturing Safety Check List, Program Parts Selection List, Production Plan and Engineering Drawings.

(1) Load, Assemble and Pack (LAP) operations of the high explosive, will take place at Government ammunition plants such as Iowa Army Ammunition Plant (IAAP). Environmental Assessment documents for these plants will be made available when locations are determined.

(2) Transportation procedures for submunitions and projectiles to and from production and storage facilities will be the same as those for standard 155mm projectiles and will not impose an environmental hazard. The fuze and the projectile are not assembled as a unit until they reach the field. Submunition fuze activation requires spin and setback forces imparted by gun launch, which will not be encountered during transportation.

(3) Storage of projectiles will occur at the same locations, i.e. Government depots, as standard 155mm projectiles. Environmental Assessment documents for these facilities will be made available when identified.

c. Direct and Indirect Environmental Impacts of Activities and Alternatives: Presently, production configurations and processes are still being defined. When drawing packages and other Contract Data Requirements List (CDRL) items become available, processes which may affect the environment will become identifiable.

d. Adverse Effects and/or Conflicts Which Cannot be Avoided: None at this time.

e. Recommended Mitigation: None

5. Disposal Phase:

a. Description of Activities and Alternatives: The activities described within this phase are anticipatory in nature. Alternatives for disposal are required to be submitted by the SADARM contractor and subsequently approved by the government. Currently only a draft disposal plan exists. This plan is available for review at the SADARM Program Office (classified Confidential). Activities are described to the extent of currently available information. The final SADARM configuration, including materials, production methods and quantities, is not fixed at this time. It will determine however, the actual byproducts, emissions and scrap resulting from demilitarization and disposal. The following methods (activities) are proposed as possible alternatives to disposal and are based upon the current configuration:

(1) Removal of the SADARM submunitions from the carrier projectile and remote downloading of the major submunition components.

(2) Detonation of the submunition after removal from the carrier projectile or detonation of the submunitions within the carrier projectile.

(3) Open-pit burning of the submunitions after removal from carrier projectiles.

All scrap derived from demilitarization operations will be inspected for hazardous chemicals or explosives. All non-toxic scrap and materials will be either recycled or buried at an approved site. Toxic materials will either be recycled or retained in an approved manner. Exact methods for disposal of subassemblies/debris containing toxic, noxious or water soluble compounds must still be determined.

b. Affected Environments: Specific disposal sites have not been selected at this time. The site(s) selected will be a government site approved/suited for detonation, burning or burial of munitions.

c. Direct and Indirect Environmental Impacts of Activities and Alternatives:

(1) Direct Impact: Remote downloading of the major submunition components require methods for disposal of subassemblies containing toxic or water soluble compounds. Attachment 1 lists hazardous components. This procedure is not a likely or viable alternative because of safety and disposal hazards.

(a) Detonation entails dispersion of fragmented components, release of emissions into the air and ground, and noise levels comparable to the detonation of a round. Attachment 1 lists combustion products of the M-100 detonator, fuze, safe and arm device, and other hazardous components.

(b) Open pit burning of the submunitions entails release of emissions into the air and ground due to burning and possible high order detonation of LX-14. Byproducts of combustion are listed in attachment 1.

(2) Indirect Impact: All the above methods entail the recycling or burial of debris as discussed above. Noise levels for detonation for individual submunitions are anticipated to be similar to those measured in FSD (D.3.c(1)(e)).

d. Adverse Effects and/or Conflicts Which Cannot be Avoided: None

e. Recommended Mitigation: None

E. Persons/Agencies Consulted

1. Commander — Environmental Assessment
U.S. Army Yuma Proving Ground
ATTN: STEYP-LE-S/Jack Peters
Yuma, AZ 8536-9102

2. Commander — Environmental Assessment
White Sands Missile Range
ATTN: STEWS-TE-LD/Michael Courtney
White Sands, NM 88002

3. Sandia National Lab. DOE — Environmental Assessment
P.O. Box 5800
ATTN: Dave Bickel
Albuquerque, NM 87185

4. Commander — Environmental Assessment
U.S. Army Cold Regions Test Ctr
ATTN: STECR-TM/Jerry Reagan
Fort Greely, AK
APO Seattle, WA 97833-7850

5. Commander - TECOM — Environmental Assessment
U.S. Army Test & Evaluation Command
ATTN: AMSTE-TA-F/George Shandel
Aberdeen Proving Ground, MD 21005-5055

6. Commander
U.S. Army ARDEC
Picatinny Arsenal, NJ 07806-5000

a. P.D. Porotko Principal Contract Rep (612) 931-4822	Hazardous/Toxic Mtls in Alliant Submunition
b. Sidney Bernstein SMCAR-AEE-BP Bldg 382, Ext. 4776	Analysis of Products after Combustion in the Warhead
c. William Ng SMCAR-AEE-WW Bldg 3022, Ext. 2516	L/M Component Material List
d. William Felter SMCAR-AEF-F Bldg 61S, Ext. 5468	Initiated Lethal Mechanism After Products
e. W.L. Wong SMCAR-AEF-F Bldg 61S, Ext. 5639	FSA Explosive Quantity
f. R. Gentner SMCAR-EE-WE Bldg 3022, Ext. 4539	Analysis of Products After Combustion in the FSA
g. Theodore J. Malgeri SMCAR-FSP-E Bldg 1530, Ext. 3117	Sensor Part List

h. Rich Fong — L/M Material List
SMCAR-AEE-WW
Bldg 3022, Ext. 4859

i. Peter J. Burke — Integrated Front End Antenna Material List
SMCAR-FSP-I
Bldg 350S, Ext. 3613

j. Geoffrey Salathe — Information of Parts/Materials in the Sensor
SMCAR-FSP-I
Bldg 350S, Ext. 2490

k. Loctite Corporation — Chemical Components in Loctite Adhesive
TEL: (203) 278-1280
705 North Mountain Road
Newington, CT 06111

l. John Owens — Explosive Disposal Information
SMCAR-FSM-E (EOD)D
Bldg 281, Ext. 3868

m. David Chung — D/D/O&S Materials List
SMCAR-FSP-I
Bldg 350S, Ext. 2837

n. John Kostakis — Human Factors
SLCHE-AR, Ext. 5618

o. Mr. Studeny — 155mm Noise Levels
Paladin, Ext. 2927

F. Conclusions

1. The environmental impacts have been reviewed for the Life Cycle of 155mm SADARM which include development, testing, production and demilitarization phases. Presently, Activities and Alternatives related to the Production and Disposal Phases are anticipatory in nature. When Drawing Packages and other contract Data Requirement List (CDRL) items become available, these Activities and Alternatives will be completely defined and included in the next revision of the Life Cycle Environmental Assessment (LCEA). Actions taken during these phases were or will be performed at established test ranges, contractor facilities, Government ammunition plants and Government storage facilities. Each of these locations is required to comply with all federal, state and local environmental regulations.

2. Actions resulting in environmental impacts include explosive gases released into the atmosphere, explosive residues deposited on the ground (including metal parts) and noise. During testing, it has been shown that gases/residues released into the atmosphere/ground are minimal and confined to the immediate areas designated for the intended actions. During the disposal phase, metal scrap and other parts will be recycled after downloading and burning off of explosive materials.

3. The Life Cycle Environmental Assessment therefore concludes that the 155mm SADARM has been determined to have no significant impact upon the environment. A Finding of No Significant Impact (FNSI) is attached.

ATTACHMENT 1

COMPONENTS , COMBUSTION PRODUCTS AND HAZARDOUS MATERIALS

CHARACTERISTICS OF SINGLE ROUND 155 mm PROJECTILE

PROJECTILE WEIGHT	103.5 Lbs.
No. OF S/M's* PER PROJECTILE	2
PROJECTILE LENGTH (W/FUZE)	35.4 IN.
PROJECTILE DIAMETER (MAX.)	6.094 IN.
FUZE	M577

* S/M : SUBMUNITION

CHARACTERISTICS OF FUZE M577

TYPE : MECHANICAL TIME AND SUPERQUICK
WEIGHT : 1.41 Lbs
PROJECTILE INTRUSION* : 1.507" MAX
ASSEMBLY DRAWING : 9352381-2
ARMING DATA :
METHOD : SETBACK AND SPIN FULL ARMED : 2-4 SECS BEFORE SET TIME
ROTATIONS : NON-ARM 16.7 RPS ARM 600 G
TIME SET 2-200 SECS

* MAX. SEATING DEPTH OF FUZE IN THE PROJECTILE

FUSE M577
MAJOR COMBUSTION PRODUCTS

EXPLOSIVE COMPONENTS

LEAD AZIDE ($Pb(N_3)_2$) .... 79 mg

RDX ($C_3H_6N_6O_6$) .... 354.2 mg

TOTAL EXPLOSIVE WEIGHT............ 433.2 mg

PRODUCTS	wt % *	GMS/CHARGE
N_2	35.54	.4066
CO	23.86	.2730
H_2O	21.03	.2406
H_2	8.39	.0959
CO_2	7.27	.0832
Pb	1.29	.0147

* 2.62% INERT MATERIALS

PROPELLING CHARGES
PRODUCTS OF COMBUSTION

		MIX	MOLES/Kg
M3A1			
TYPE: SEPARATE LOADED GREEN BAG (ZONE 1-5)		CH_4	0.2300
WEIGHT: 2812.27 gm		CO	18.592
LENGTH: .4064 m max.		CO_2	6.2430
		H_2	12.069
PROPELLANT: M1		H_2O	2.8060
CBI IGNITER		NH_3	0.0010
TOTAL MOLES/Kg	44.435	N_2	4.4940
M4A2			
TYPE: SEPARATE LOADED WHITE BAG (ZONE 3-7)		CH_4	0.2550
		CO	19.006
WEIGHT: 6350.29 gm		CO_2	6.0220
LENGTH: .5334 m max		H_2	12.281
PROPELLANT: M1		H_2O	2.6940
CBI IGNITER		NH_3	0.0010
TOTAL MOLES/Kg	44.729	N_2	4.4700
M119A2		CH_4	0.1800
WEIGHT: 10432.62 gm		CO	17.484
LENGTH: .6604 m.		COS	0.0030
PROPELLANT: M6		CO_2	6.6670
		H_2	11.468
CBI IGNITER +0.5 oz. BLACK POWDER		H_2O	3.0270
		H_2S	0.0530
		K_2CO_3 (S)	0.0580
		NH_3	0.0010
TOTAL MOLES/Kg	43.451	N_2	4.5100
M203A1		CH_4	0.0740
SEPARATE LOADING COMBUSTIBLE CASE CHARGE (ZONE 8)		CO	9.9350
WEIGHT: 13607.77 gm (UNPACKED NOMINAL)		COS	0.0020
PROPELLANT: M31A1		CO_2	5.6040
		H_2	12.382
CBI IGNITER + 0.75 oz BLACK POWDER		H_2O	4.8350
		H_2S	0.0620
		K_2CO_3 (S)	0.0640
		NH_3	0.0020
TOTAL MOLES/Kg	45.481	N_2	12.522

NOTE: ALL COMBUSTION PRODUCTS MEASURED AT THE FOLLOWING CONDITIONS PRESSURE - 1 ATMOSPHERE TEMPERATURE - 1000 DEG K. ADDITIONAL WHOSE MOLE FRACTION WERE LESS THAN 0.500 X 10^{-5} WERE NOT LISTED.

155 PROPELLANTS COMPOSITION

M1	COMPOSITION %
NITROCELLULOSE (C6 H7.678 N2.322 O9.645)	85
DINITROTOLUENE (C3 H5 N3 O9)	10
DIBUTYLPHTHALATE (C16 H22 O4)	5
DIPHENYLAMINE* (C12 H11 N)	1
POTASSIUM SULFATE* (K2S04)	1
TOTAL VOLATILES*	1.5

* ADDED

M6	COMPOSITION %
NITROCELLULOSE (C6 H7.678 N2.322 O9.645)	87.0
DINITROTOLUENE (C3 H5 N3 O9)	10.0
DIBUTYLPHTHALATE (C16 H22 O4)	3.0
DIPHENYLAMINE* (C12 H11 N)	1
POTASSIUM SULFATE* (K2S04)	1
TOTAL VOLATILES*	1.5

* ADDED

M31A1	COMPOSITION %
NITROCELLULOSE (C6 H7.678 N2.322 O9.645)	21.50
NITROGLYCERIN (C3 H5 N3 O9)	18.00
NITROGUANIDINE (C H4 N4 O2)	54.70
DIBUTYLPHTHALATE (C16 H22 O4)	3.00
CARBON BLACK (C)	.050
POTASSIUM SULFATE* (K2S04)	1.25
ETHYL CENTRALITE (C17 H20 N2 O)	1.50

CBI IGNITER MATERIAL

INGREDIENTS:	PERCENT
NITROCELLULOSE ($C_6H_{7.365}N_{2.67}O_{10.277}$)	98.5
DIPHENYLAMINE* ($C_{12}H_{11}N$)	1.5
GRAPHITE*	0.3

*ADDED

M100 ELECTRIC DETONATOR COMBUSTION PRODUCTS

EXPLOSIVE COMPONENTS	CO	H2O	NO	N2	PbO
1) LEAD STYPHNATE $PbC_6H_3N_3O_9$ .8mg	52% 2.856 mg	13.3% .0468 mg	4.1% .0240 mg	21.54% .1176 mg	8.7% .3800 mg
2) LEAD AZIDE PbN_6 206 mg	—	—	12.10% 1.443 mg	75.78% 8.430 mg	12.10% 10.73 mg
3) HMX $C_4H_8N_8O_8$ 16 mg	25% 6.06 mg	25% 3.900 mg	50% 13.00 mg	—	—

EXPLOSIVE COMPONENTS	TOXIC PRODUCT
1; LEAD AZIDE ($Pb(N_3)_2$)	NO, PbO
2) LEAD STYPHNATE ($C_6 H_3 N_3 0_9 Pb$)	CO, NO, PbO
3) HMX ($C_4 H_8 N_8 O_8$)	CO, NO

FUZING, SAFE AND ARM (FSA) COMBUSTION PRODUCTS

GAS PRODUCTS	GRAMS / EXPLOSIVE MIX
N_2	32.33762×10^{-3}
H_2O	10.95028×10^{-3}
CO_2	32.55103×10^{-3}
Pb	8.328000×10^{-6}
NH_3	1.146141×10^{-3}
CO	3.242715×10^{-3}
H_2	53.09100×10^{-6}
CH_4	2.095533×10^{-3}
CF_4	18.73800×10^{-6}
HF	2.018499×10^{-3}
H_2S	241.5120×10^{-6}
SO_2	1.041000×10^{-6}

CONDENSED SPECIES

	GRAMS		GRAMS
C	2.67537×10^{-3}	BaO	654.789×10^{-6}
Pb	15.5296×10^{-3}	Sb	570.468×10^{-6}

FUZING, SAFE AND ARM (FSA)
HAZARDOUS COMPONENTS IN THE FSA

(1) M100 ELECTRIC DETONATOR	
HMX ($C_4H_8N_8O_8$)	16 mg
LEAD AZIDE ($Pb(N_3)_2$)	14 mg
LEAD STYPHNATE ($C_6H_3N_3O_9Pb$)	.8 mg
(2) ROTOR LEAD	
PBXN-5	60 mg
HMX ($C_4H_8N_8O_8$)	57.0 mg
VITON ($-CF_2-CH_2-CF_2-CF(CF_3)-$)	3.00 mg
(1) STAB PRIMER	
LEAD STYPHNATE ($C_6H_3N_3O_9Pb$)	8.0 mg
PRIMER MIX*	5.3 mg

* PRIMER MIX COMPOSITION:

LEAD STYPHNATE ($C_6H_3N_3O_9Pb$)
TETRACENE ($C_{18}H_{12}$)
ANTIMONY (Sb)
BARIUM NITRATE $Ba(NO_3)_2$
LEAD AZIDE ($Pb(N_3)_2$)

TOTAL EXPLOSIVE WEIGHT IN THE FSA 0.1041 gm

LX-14 EXPLOSIVE

MAJOR COMBUSTION PRODUCTS

LX-14 (C1.52 H2.92 N2.59 O2.66) .... 1530 grams

COMPONENTS

1) HMX (C4 H8 N8 O8) .... 1453.5 gm

2) ESTANE (C5.14 H7.50 N.19 O1.76) .... 46.5 gm

	MOLES/CHARGE
WATER (H2 O)	17.793
NITROGEN (N2)	17.430
CARBON DIOXIDE (C O2)	19.876
CARBON MONOXIDE (C O)	.413
HYDROGEN (H2)	.093
AMMONIA (N H3)	1.21
METHANE (C H4)	.0169
CARBON (SOLID) (C)	15.41

OCTOL EXPLOSIVE

MAJOR COMBUSTION PRODUCTS

(ADVANCED DEVOLOPMENT PHASE)

OCTOL (C1.78 H2.258 N2.36 02.69)

HMX (C4 H8 N8 O8) 75%
TNT (C7 H5 N3 O6) 25%

4 LB OCTOL

	MOLES/CHARGE
WATER	13.20
NITROGEN	12.50
CARBON DIOXIDE	11.96
CARBON MONOXIDE	0.36
HYDROGEN	0.11
AMMONIA	0.60
METHANE	0.02
CARBON (SOLID)	15.28

ALLIANT EXPLOSIVE/HAZARDOUS COMPONENTS

	WEIGHTS (mg)
STAB PRIMER	
LEAD STYPHNATE (P/N 9386497) (C6 H3 N3 09 Pb)	5 TO 9
PRIMER MIX :	
LEAD STYPHNATE (C6 H3 N3 09 Pb)	2.1
TETRACENE (C18 H12)	.3
ANTIMONY (Sb)	.8
BARIUM NITRATE (Ba(NO3)2)	1.1
LEAD AZIDE (Pb(N3)2)	1.1
M100 ELECTRIC DETONATOR (P/N12597293)	
LEAD STYPHNATE (C6 H3 N3 09 Pb)	.8
LEAD AZIDE (Pb(N3)2)	14
HMX, GRADE C, CLASS C (C4 H8 N8 O8)	16
ROTOR LEADS (2) (P/N9386515)	
INPUT LEAD (PbXN-5)	30 max
HMX (C4 H8 N8 O8)	28.5
VITON (-CF2-CH2-CF2-CF(CF3)-)	1.50
OUTPUT LEAD (PBXN-5)	30 max
HMX (C4 H8 N8 O8)	28.5
VITON (-CF2-CH2-CF2-CF(CF3)-)	1.50

ALLIANT EXPLOSIVE/HAZARDOUS COMPONENTS

	WEIGHTS (mg)
THERMAL BATTERY INITIATOR (P/N 12597574)	
TLX CORD	
HMX ($C_4H_8N_8O_8$)	10
ALUMINUM FLAKE (Al)	2.48
BOOSTER CHARGE	
DDNP ($(NO_2)_2C_6H_2ON_2$)	6.5

	WEIGHTS (gm)
POWER SOURCE	
IRON DISULFIDE (FeS_2)	8.62
LITHIUM SILICON (Li and Si)	4.54
LITHIUM CHLORIDE (LiCl)	3.22
POTASSIUM CHLORIDE (KCl)	3.93
POTASSIUM CHROMATE ($KCrO_4$)	6.8
POTASSIUM PERCHLORATE (K_2ClO_4)	2.32
BARIUM CHROMATE ($BaCrO_4$)	.03
IRON POWDER (Fe)	14.24
ZIRCONIUM (Zr)	.10

ALLIANT EXPLOSIVE/HAZARDOUS COMPONENTS

	WEIGHTS (gm)
POWER SOURCE CONT.	
POTASSIUM CHLORATE & LEAD (KClO4/Pb) SULFOCYANATE PRIMER MIX	.0023
LEAD STYPHNATE AND TETRACENE ((C6 H3 N3 09 Pb)/(C18H12))	.009
FIRING TRAIN (P/N 12597222)	
PBXN-301	1.0-1.3
PETN (C(CH2 ONO2)4)	.8-1.04
SILICONE RESIN	.2-.26
WIRED CUTTER	
KDNBF SALT OF DINITROBENZOFUROXAN (K C6 H2 N4 O6)	.025
IR SENSOR (P/N 12928512-1)	
BISMUTH TELLURIDE (Bi2Te3)	
LEAD SELENIDE (PbSe)	
POLYSTYRENE FOAM ENCAPSULANT (C6H5CHCH2)n	

ALLIANT EXPLOSIVE/HAZARDOUS COMPONENTS

	WEIGHTS (gm)
SIGNAL PROCESSOR (P/N 12909672)	557.9
POLYSTYRENE FOAM ENCAPSULANT $(C6H5CHCH2)n$	
MMW TRANSDUCER (P/N 12928292)	116.1
URETHANE FOAM ANTENNA SUPPORT (CO(NH2)OC2H5)	
GALLIUM ARSENIDE (IN DIODES) (GaAs)	
BERYLLIUM COPPER ALLOY (#25 C-172 Be-Cu, WITH 1.90% Be-Cu)	53
VRP (P/N 12909825-3)	68.1
POLYAMID NYLON WITH HEMAMETHYLENE DIAMINE AND ADIPIC , PER MIL-C-44378	
TYPES 1 AND 3 FINISHED CLOTH TREATED WITH FLUOROCARBON	
TYPES 2 TREATED WITH DOW SILICON ET 112A	

LINER

TANTALUM (Ta)	97.5%	WEIGHT CLASSIFIED CONFIDENTIAL
TUNGSTEN (Tu)	2.5%	

AEROJET EXPLOSIVE / HAZARDOUS COMPONENTS

	WEIGHTS (mg)
BAND CUTTER (P/N 234825)	
PBXN-301	19
PETN (C(CH2 ONO2)4)	15.2
SILICONE RESIN	3.8
LEAD AZIDE (Pb(NO3)2)	11
LEAD STYPHNATE (C6H(NO2)3(O2Pb)	12
AFT BAND CUTTER (P/N 234616)	
PBXN-301	260
PETN (C(CH2 ONO2)4)	208
SILICONE RESIN	52
THERMAL BATTERY (P/N 1324895)	
LEAD STYPHNATE /TETRACENE (C6H(NO2)3(O2Pb)/C18H12	21
LITHIUM/ ALUMINUM ALLOY (Li/Al)	3400
POTASSIUN PERCHLORATE (KClO4)	14000
IRON DISULFIDE (FeS2)	11000
ZIRCONIUM/ BARIUM CHROMATE (Zr/BaCrO4)	1000
FS&A 100 OHM (P/N 2595601)	
MINIATURE PISTON ACTUATOR	5.2
BARIUM STYPHNATE	2.6
POTASSIUM DINITROBENZOFUROXAN (KDNBF (K C6 H2 N4 O6))	2.6

AEROJET EXPLOSIVE / HAZARDOUS COMPONENTS

	WEIGHTS (mg)
TDU CARTRIDGE (P/N 234618-1-2)	
PERCUSSION PRIMER	
LEAD STYPHNATE TETRACENE MIX (C6 H (NO2)3 O2 Pb)	22
INITIATION MANIFOLD (P/N 234815-5-6)	
INITIATION MIX	
A1A per MIL-P-22264	60
ZIRCONIUM (Zr)	39.0
IRON OXIDE (Fe2 O3)	15.0
SILICON DIOXIDE (SiO2)	6.0
T2 DELAY CORD (P/N 222092-4)	
BORON/BARIUM CHROMATE (B/BaCrO4)	600
T2 CUP ASSEMBLY	
SEALER CHARGE	
SILICON/ RED LEAD (Si/Pb3 O4)	70
OUTPUT MIX	
TITANIUM/ POTASSIUM PERCHROMATE (Ti/KClO4)	50
T1 DELAY CORD (P/N 222092-1)	
BORON/BARIUM CHROMATE (B/BaCrO4)	400

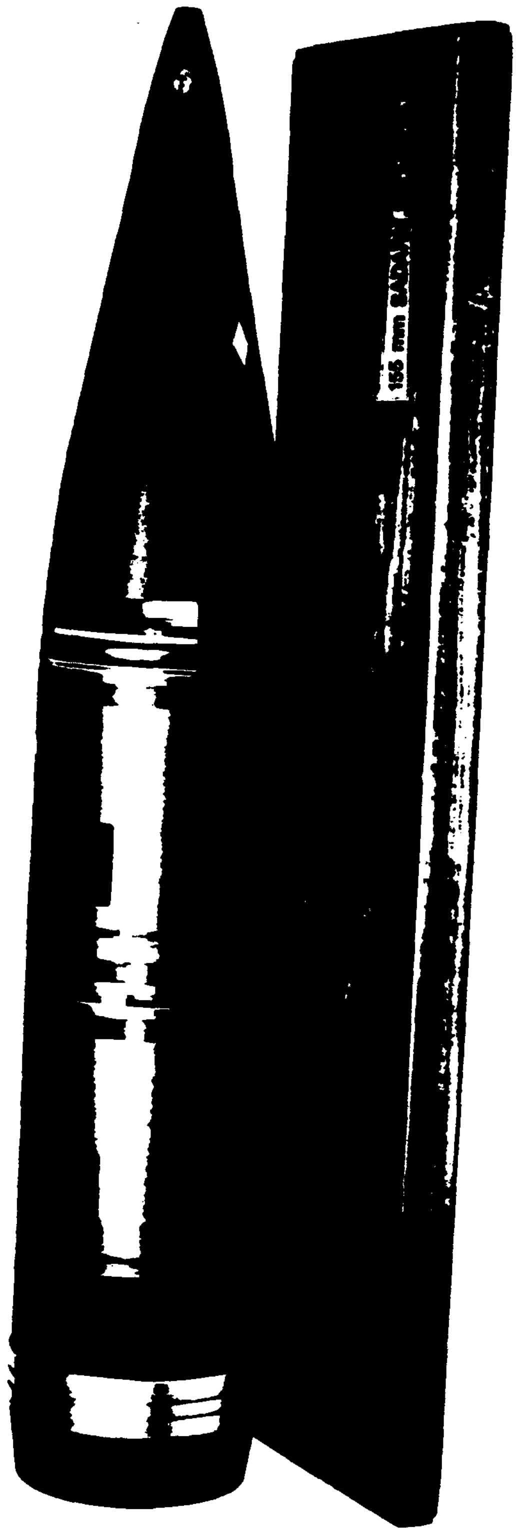
AEROJET EXPLOSIVE / HAZARDOUS COMPONENTS

	WEIGHTS (mg)
T1 CUP ASSEMBLY (P/N 234751-1)	
BOOSTER CHARGE	
LEAD AZIDE (Pb(N3)2)	35
OUTPUT CHARGE	
RDX (C3 H6 N6 O6)	35
PA500 MIL-48865 (ELECTRIC DETONATOR)	
LEAD AZIDE (Pb (N3)2)	13 mg
HMX-GRADE 2, CLASS C (C4 H8 N8 08)	15 mg
PIC	
PBXN-5	3000 mg
HMX (C4 H8 N8 O8)	2850
VITON ((-CF2-CH2-CF2-CF(CF3)-)	150
BOOSTER	
PBXN-5	(LESS THAN 100 gm)
HMX (C4 H8 N8 O8)	95%
VITON ((-CF2-CH2-CF2-CF(CF3)-)	5%

AEROJET EXPLOSIVE / HAZARDOUS COMPONENTS

LINER	WEIGHTS (grams)
PURE TANTALUM (Ta)	WEIGHT CLASSIFIED CONFIDENTIAL
EXPLOSIVE	
LX-14	1525
HMX (C4 H8 N8 O8)	1448.75
ESTANE (C5.14 H7.50 N0.19 O1.76)	76.25
FOIL	
COPPER (Cu)	(LESS THAN 100 gm)

ATTACHMENT 2



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