Original Signature

NRC FORM 313
(1-84)
10 CFR 30, 32, 33, 34, 35 and 40

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED BY OMB
3150-0120
Expires: 5-31-87

APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

FEDERAL AGENCIES FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIAL SECTION B
631 PARK AVENUE
KING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
MATERIAL RADIATION PROTECTION SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
MATERIAL RADIATION PROTECTION SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTION.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- [ ] A. NEW LICENSE
- [ ] B. AMENDMENT TO LICENSE NUMBER _____
- [X] C. RENEWAL OF LICENSE NUMBER BML 12-00722-09

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip Code)*

DEPARTMENT OF ARMY
HQ, ARMAMENT, MUNITIONS AND CHEMICAL COMMAND
ATTN: AMSMC-SF
ROCK ISLAND, IL 61299-6000

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED

THROUGHOUT THE UNITED STATES BY US ARMY AND US MARINE CORPS PERSONNEL

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION | TELEPHONE NUMBER

BYRON E. MORRIS, HEALTH PHYSICIST | AV 793-2964/COMM.(309) 794-2964

SUBMIT ITEMS 5 THROUGH 11 ON 8½ x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL — a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time. ANNEX I

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED. ANNEX II

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE ANNEX III

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS. ANNEX III

9. FACILITIES AND EQUIPMENT ANNEX IV

10. RADIATION SAFETY PROGRAM ANNEX V

11. WASTE MANAGEMENT. ANNEX VI

12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY EXEMPT | AMOUNT ENCLOSED $

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT, NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN, IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948, 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

SIGNATURE–CERTIFYING OFFICER	TYPED/PRINTED NAME	TITLE	DATE
J. R. Poole	JAMES R. POOLE	COLONEL, GS CHIEF OF STAFF	24 Oct 86

14. VOLUNTARY ECONOMIC DATA

a. ANNUAL RECEIPTS
- [ ] <$250K
- [ ] $250K–500K
- [ ] $500K–750K
- [ ] $750K–1M
- [ ] $1M–3.5M
- [ ] $3.5M–7M
- [ ] $7M–10M
- [ ] >$10M

b. NUMBER OF EMPLOYEES *(Total for entire facility excluding outside contractors)*

c. NUMBER OF BEDS

d. WOULD YOU BE WILLING TO FURNISH COST INFORMATION *(Dollar and/or staff hours)* ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? *(NRC regulations permit it to protect confidential commercial or financial–proprietary–information furnished to the agency in confidence)*
- [ ] YES
- [ ] NO

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY
		EXEMPT	FEE EXEMPT	
AMOUNT RECEIVED	CHECK NUMBER			DATE

PRIVACY ACT STATEMENT ON THE REVERSE

APPLICATION SUMMARY STATEMENT

1. Headquarters, US Army Armament, Munitions and Chemical Command (AMCCOM) located at Rock Island, Illinois 61299-6000, has the logistical responsibility to procure, deploy, and maintain the family of cannons currently being used with the Main Battle Tank. This application is a request for a renewal license to possess and deploy a tritium illumination device mounted on the cannon to provide an alignment capability at night. The tanks and the family of cannons equipped with the illumination device will be used by both the US Army and Marine Corps.

2. The complete illumination device will be replaced when broken or when its useful life is terminated. The source does not present an external hazard to the user, and bulk storage will be only at authorized depots in a controlled area. Tritium lamps will not be replaced, and maintenance will not involve removal of the tritium source. Defective lamps will be disposed as radioactive waste (Annex VI).

3. The renewal application contains essentially the same information as previously submitted with the exception of the following:

a. Maximum activity to be possessed at any time increased to 85,000 ci.

b. Update of resumes of License Manager, Radiation Protection Officer (RPO), and Alternate RPO.

c. Update of drawing and technical information.

Application for Renewal of
Byproduct Material License
12-00722-09

Application Package Contents

Annex	Subject	NRC Form 313 Block
I	Radioactive Material	5
II	Purpose for Which Licensed Material Will be Used	6
III	Training and Experience in Radiation	7 and 8
IV	Facilities and Equipment Involved in Fielding The Muzzle Reference Sensor	9
V	Radiation Safety Program	10
VI	Waste Management	11

ANNEX I - Radioactive Material

1. Reference NRC Form 313, block 5.

2. Headquarters, AMCCOM, has the logistical responsibility to obtain and administer NRC licenses required to deploy US Army/Marine Corps weapons and systems procured by AMCCOM. The Army and Marine Corps Tanks are fitted with a muzzle reference sensor (MRS) on the cannon. The MRS has a maximum activity per source of 10 curies of tritium (H-3) oxide with impurities not to exceed 6 percent. The maximum amount which will be possessed at any one time is 85,000 curies or 8,500 sources, whichever is reached first.

ANNEX II - Purpose for Which Licensed Material Will be Used

1. Reference NRC Form 313, block 6.

2. The Muzzle Reference Sensor (MRS) System measures and compensates for gun tube bend caused by the uneven heating and cooling effects of solar radiation, wind, rain, and main gun firing. The MRS System permits rapid main gun to gunner's primary sight bore sight correction whenever the gunner suspects tube movement and aligns the primary sight reticle with the muzzle-mounted MRS reticle and enters the change semiautomatically into the vehicle fire control ballistic computer.

3. The MRS System consists of the following components:

   a. A fixed collimator reticle bolted to the gun tube muzzle.

   b. The adjustable gunner's primary sight reticle (aiming reticle).

   c. Logic to input alignment changes to the ballistic computer.

4. The muzzle-mounted reticle is illuminated by ambient light for day viewing and by the tritium light source for night viewing.

5. The following figures are enclosed:

   a. Figure 1-1 shows the XM-1 vehicle with the muzzle reference sensor mounted on the cannon.

   b. Figure 1-2 is a close-up of the muzzle reference sensor mounted on the cannon.

   c. Figure 1-3 shows the collimator assembly.

   d. Figure 1-4 shows the cell assembly.

   e. Figure 1-5 shows the beam splitter assembly.

   f. Figure 1-6 shows the tritium light source.

6. Design of the cell assembly (figure 1-4) precludes breakage in the field due to rough handling. The tritium is contained in a sealed glass sphere under a pressure of 40 psi. The inside of the sphere is coated with a zinc sulfide phosphor that emits visible light. To prevent accidental breakage of tritium source during firing, the glass is encapsulated by a .050-inch thick layer of silicone rubber inslide a metal housing. Only a .125-inch diameter window is required in the rubber enclosure for MRS reticle night illumination.

7. The cell assembly (figure 1-4) is a complete sealed module in which the tritium source is housed. No part of the source is exposed to the user. A

defective cell assembly is defined as one which does not illuminate and will be replaced in the field as a complete module. No specific procedures are required for this operation. Organizational personnel will be authorized to requisition the cell from depot support and will be required to turn in a defective cell to obtain the replacement. No storage of this module will be authorized at any level other than depot. We are also requesting that complete muzzle reference sensors (figure 1-3) be authorized at user locations to support the tanks. It is not anticipated that these requirements will exceed 10 spare units per 100 vehicles.

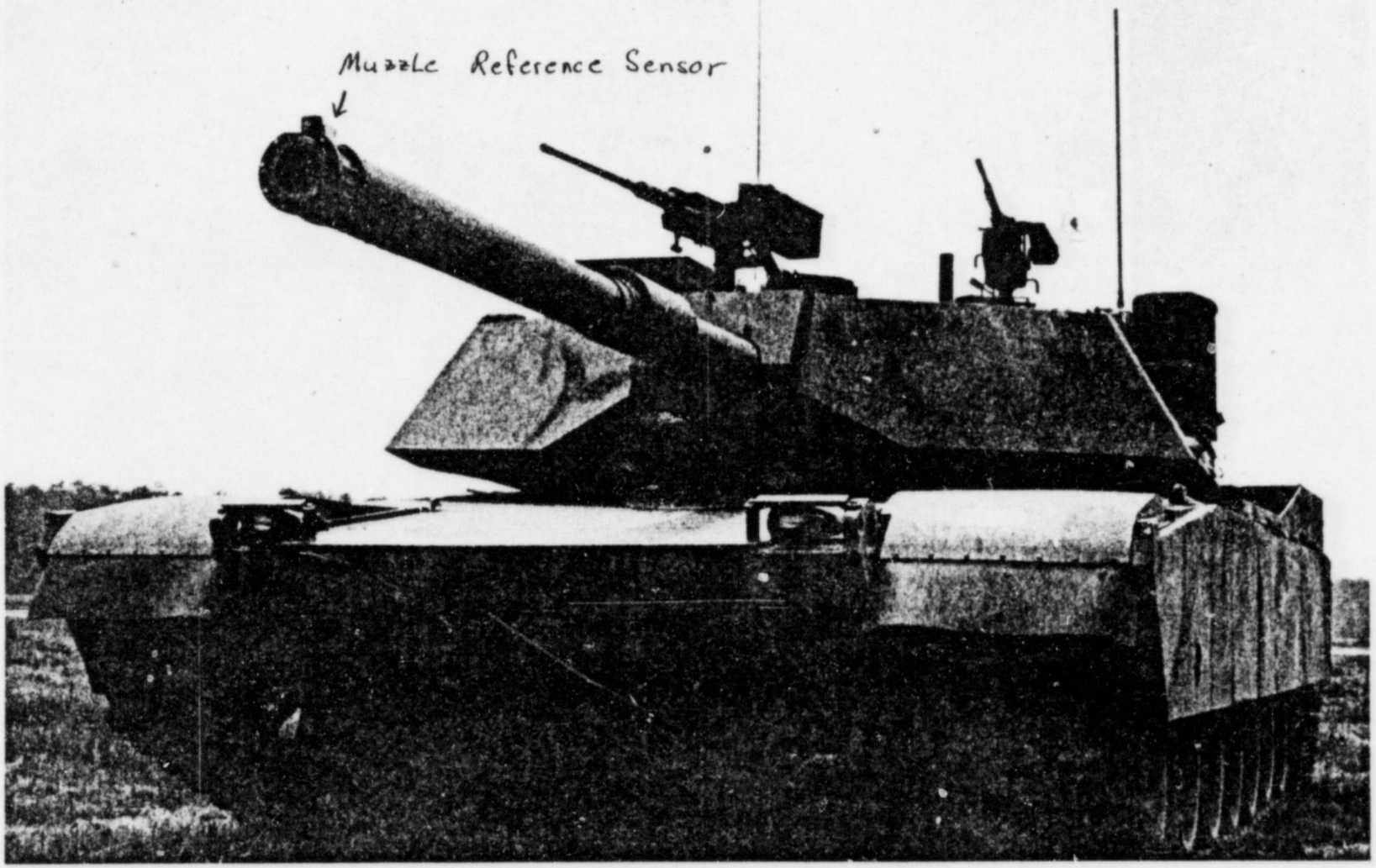


FIGURE 1-1 .... XM1 VEHICLE WITH MUZZLE REFERENCE SENSOR MOUNTED ON M68 CANNON

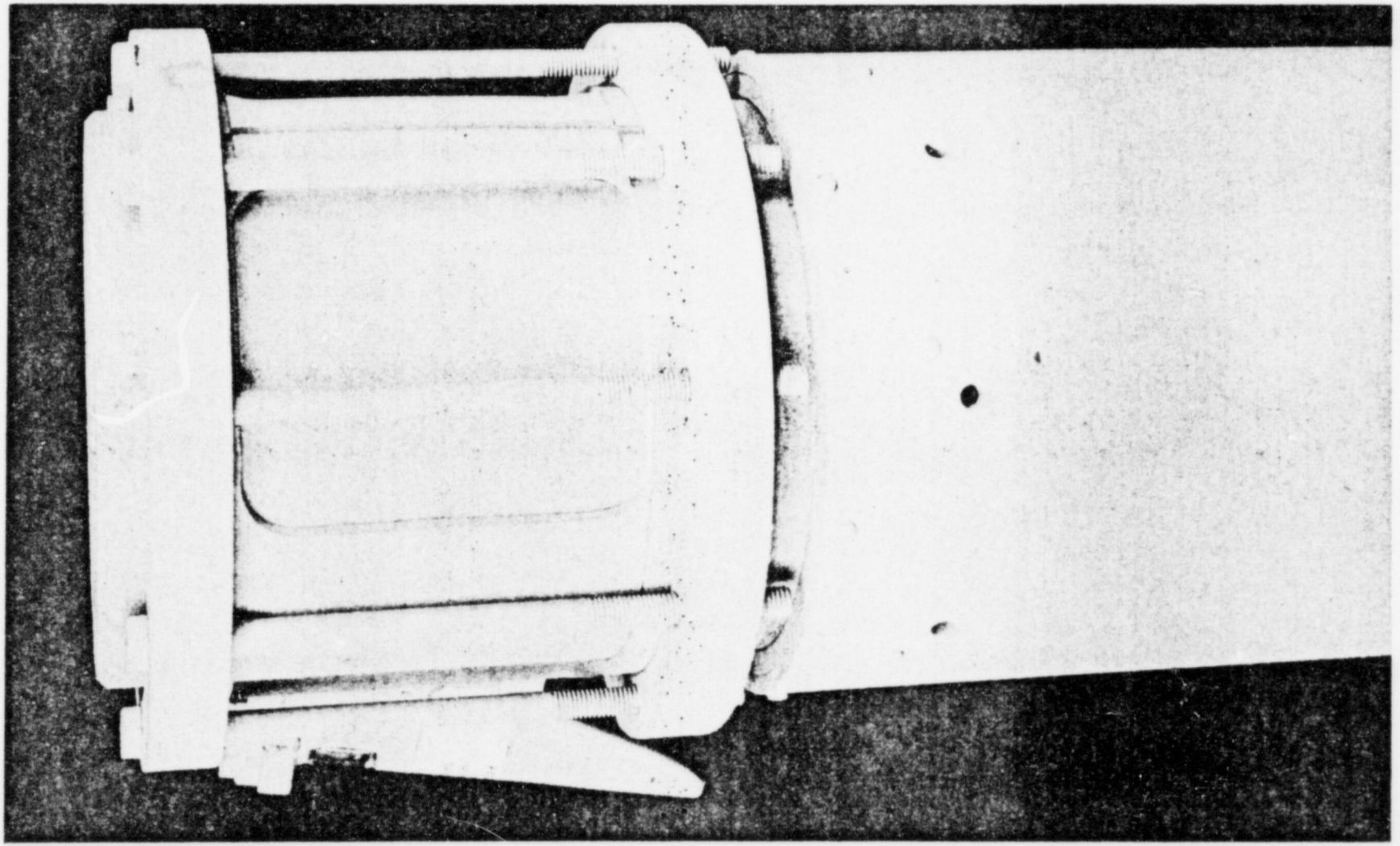


FIGURE 1-2 .... CLOSE-UP OF MUZZLE REFERENCE SENSOR MOUNTED ON M68 CANNON

NOTES

1. DRAWING TO BE INTERPRETED IN ACCORDANCE WITH STANDARDS PRESCRIBED BY DOD-STD-100C
2. FOR PROCESS INFORMATION SEE DRAWING NO. 12274277
3. FOCUS CELL ASSEMBLY - 12304713 SO THAT RETICLE IMAGE APPEARS AT INFINITY WITHIN 3 MILLIDIOPTERS
4. TAG OR BAG AND TAG IDENTIFICATION MARKING IN ACCORDANCE WITH REQUIREMENTS PRESCRIBED BY MIL-STD-130:
   19200-12321679
   MFR (CODE IDENT OR LOGO)
5. SHIP DESICCANT LOOSE IN AIR/WATER TIGHT SEALED PACKAGE

PRODUCTION RELEASE FOR MILSPEC

PLATE-12304711
ACTIVATE ADHESIVE WITH MFR SPEC TT-M-261
POSITION PLATE ON CENTER OF COLLIMATOR WITH DIRECTIONAL ORIENTATION OF WORDING OPTIONAL

DESICCANT-12285860 (SEE NOTE 5)

2-SCREW-12311124 [1]

SECTION A-A

STRAP ASSY-12321670

2-PIN-MS20392-5021
2-PIN-MS24665-300

4-SCREW-MS24674-15 [2]
4-LK WASH-MS35338-138

PIN-MS16554-(28 REF)

COTTER PIN-MS24665-162

KEY-12278750
2-SCREW-MS51959-17 [3]

COTTER PIN-MS24665-1013

CELL ASSY-12304713

PACKING-MS9021-027

HOUSING-12304712

WINDOW-12285867
SEALING COMPOUND SPEC NO. S-803A (SEE NOTE 2)

PACKING-MS9021-030

RETICLE HOUSING ASSY-12304720

PACKING-MS9021-025

CELL ASSY-12304725

NUT-MS51943-39
TO BE SHIPPED LOOSE

SECTION B-B

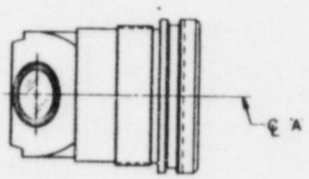
CURRENT		PART NO 12321679	
19200			
	DRAFT DOC DATE	U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48090	
	GENERAL DYNAMICS Land Systems Division	COLLIMATOR ASSY	
		K 19207	12321679

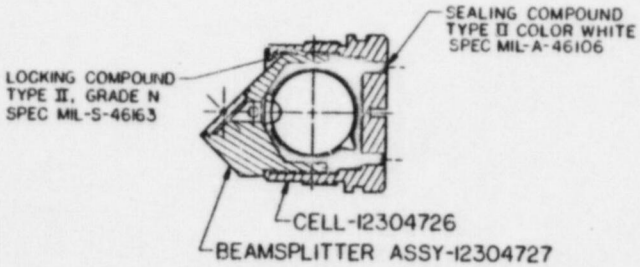
12321679 | REV | SH

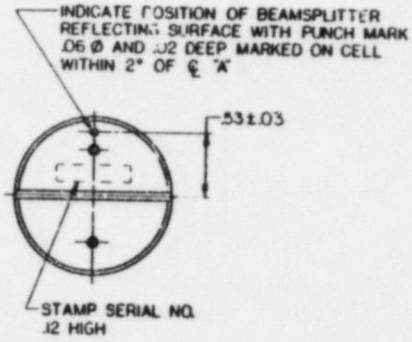
Figure 1-3

18548.

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
A8 B5	A	III PROCESS NOTE REMOVED NOTES RENUMBERED (2)+(3) NOTE REVISED MIL-A-46106 TYPE II COLOR WHITE WAS MIL-S-11031 ECP X1301	5/10/81	H R MH
B5 C5	B	12304726 REVISED PER DETAIL ECP X1421	6/11/81	MH
	C	INITIAL RELEASE CODE IDENT AND COMMAND CHANGED ERR W2T2500-AK	82-05-19	MH







1. APPLY PER MIL-STD-130: 19200-12304725

NOTE

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-STD-100

SEE SEPARATE PARTS LIST 12304725

CAGE CODE NO	19200
PART NO.	12304725
CONTRACT NUMBER	DAAK-30-79-C-0096
CONTRACTOR	CHRYSLER CORP. DEFENSE OPN.
U.S. ARMY TANK-AUTOMOTIVE COMMAND WARREN, MICHIGAN 48090	
CELL ASSY	
SIZE	D
FSCM NO.	19207
DRAWING NO.	12304725
SCALE	2/1
SHEET	

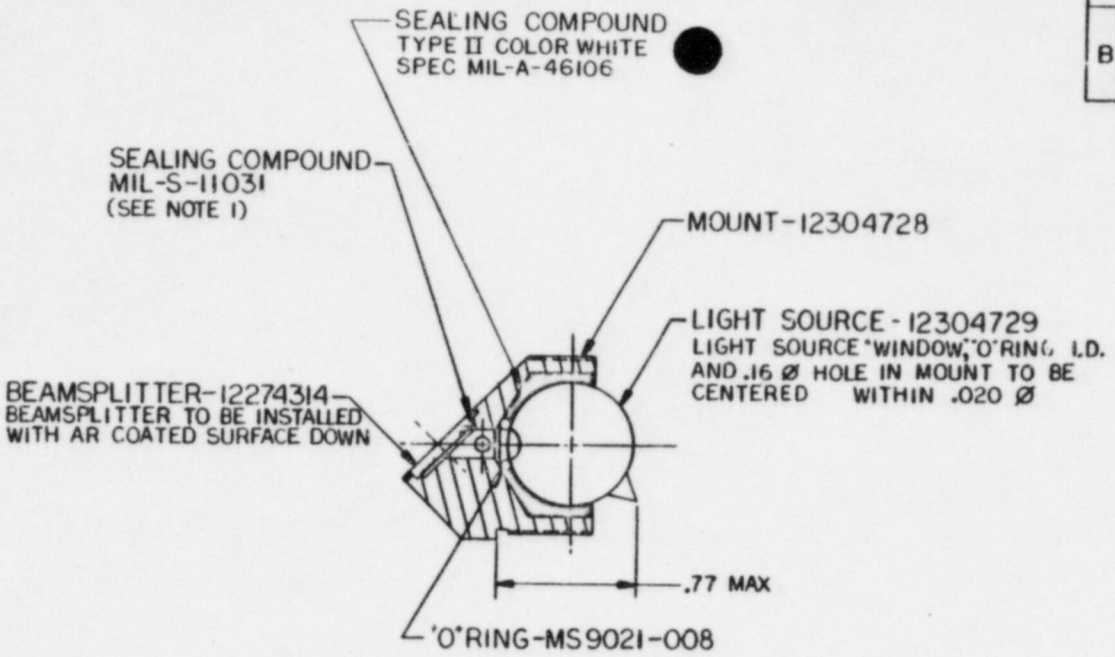
Figure 1-4

XM-ECP

W2T2500-AK

1

A	MIL-A-46106, TYPE II COLOR WHITE ADDED ECP-X1301	5/8/81	
B	INITIAL RELEASE CODE IDENT AND COMMAND CHANGED ERR W2T2500-AK	82-05-19	



2. APPLY PER MIL-STD-130:
19200-12304727

1. FOR PROCESS INFORMATION
SEE DRAWING 12274277

NOTES:

GEOMETRIC CHARACTERISTIC SYMBOLS
(AS PER ANSI Y14.5-1973)

— STRAIGHT ◎ CONCENTRICITY ⌭ CYLINDRICAL ⌖ TRUE POSITION
// PARALLEL ∠ ANGULARITY ○ ROUNDNESS Ø DIAMETER
▱ FLATNESS ⌯ SYMMETRICAL ⌓ SQUARENESS BASIC
↗CIRC CIRCULAR RUNOUT ↗↗TOTAL TOTAL RUNOUT
Ⓜ MAXIMUM MATERIAL CONDITION (MMC) ⌓ PROFILE OF A SURFACE
Ⓢ REGARDLESS OF FEATURE SIZE (RFS) ⌒ PROFILE OF A LINE
Ⓟ PROJECTED TOLERANCE ZONE

INTERPRET DRAWING IN ACCORDANCE WITH
STANDARDS PRESCRIBED BY MIL-STD-100

SEE SEPARATE PARTS LIST 12304727

12304725	M1
SEE ENGINEERING RECORDS	
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TOLERANCES ON:
2 PLACE ± ____ 3 PLACE ± ____ ANGLES ± ____

MATERIAL

MATL. ENGRG. 9/4/81

CONTRACT NUMBER DAAK-30-77-C-0006

CONTRACTOR CHRYSLER CORP. DEFENSE DIV.

DRAWN BY G. Bilanin DATE 4-23-80

CHECKER 6-2-80 ENGINEER

DRAWING APPROVAL

DESIGN APPROVAL R M Walsh

CODE IDENT NO. 19200

PART NO. 12304727

U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
DOVER, NEW JERSEY 07801

~~U.S. ARMY TANK AUTOMOTIVE COMMAND~~
~~WARREN, MICHIGAN 48090~~

BEAMSPLITTER ASSEMBLY

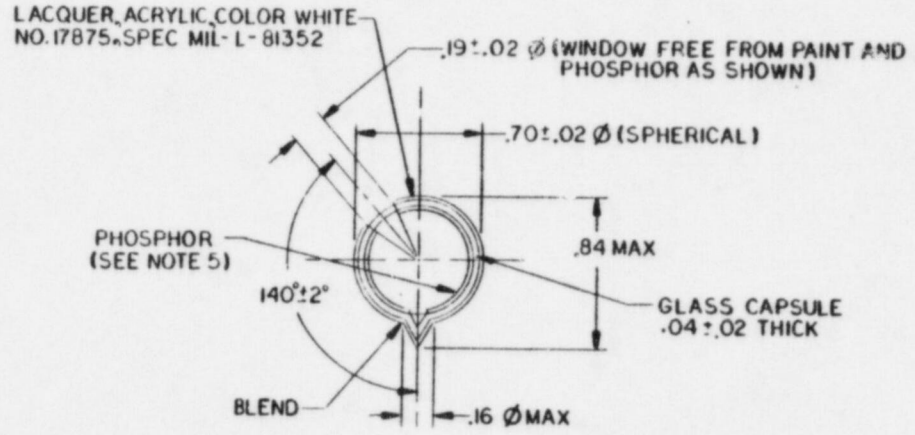
SIZE C | CODE IDENT. NO. ~~19207~~ | 12304727

SCALE 2/1 | UNIT WT. | SHEET

Figure 1-5

XM-ECP
W2T-2500-AK

LTR	DESCRIPTION	DATE	APPROVED
A	NOTE 3 REVISED ECP X1301	6/1/81	B.A. [illegible]
B	INITIAL RELEASE CODE IDENT AND COMMAND CHANGED ERR W2T2500-AK	82-05-19	[illegible]



7. QUALITY ASSURANCE REQUIREMENTS (QAR'S) APPLY TO THIS DRAWING (QAR NO. SAME AS PART NO.)
6. APPLY PER MIL-STD-130: 19200-12304729
5. PHOSPHOR COLOR-GREEN (5260±50 ANGSTROMS) BANDWIDTH AT 50 PERCENT INTENSITY LEVEL TO BE 75 MILLIMICRONS
4. MAXIMUM LEAKAGE RATE OF .05 MICROCURIES PER 24 HOURS MEASURE BY LIQUID SCINTILLATION TECHNIQUE IN ACCORDANCE WITH ANSI N540
3. TYPICAL TRITIUM CONTENT 10.0±.2 CURIES
2. SOURCE BRIGHTNESS SHALL NOT BE LESS THAN 5.0 FOOT LAMBERTS
1. MATERIAL: BOROSILICATE GLASS

NOTES:

GEOMETRIC CHARACTERISTIC SYMBOLS (AS PER ANSI Y14.5 1973)

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-STD-100

12304727	MI
SEE ENGINEERING RECORDS	
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: 2 PLACE ± —— 3 PLACE ± —— ANGLES ± —
MATERIAL: SEE NOTE
MATL. ENGR. [signature] 9/4/80

CONTRACT NUMBER: DAAK-30-77-C-0006
CONTRACTOR: CHRYSLER CORP. DEFENSE DIV.
DRAWN BY: K.K. DATE: 5-2-80
CHECKER: [signature] 6-2-80 ENGINEER W.J.S.
DRAWING APPROVAL: [signature]
DESIGN APPROVAL: [signature]

CODE IDENT NO. 19200
PART NO. 12304729
U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND DOVER, NEW JERSEY 07801
~~U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48090~~

LIGHT SOURCE
TRITIUM

SIZE C | CODE IDENT. NO. ~~19297~~ | 12304729
SCALE 2/1 | UNIT WT. | SHEET ——

Figure 1-6

XM-ECP
W2T2500-AK

ANNEX III - Training and Experience in Radiation

1. Reference: NRC Form 313, blocks 7 and 8.

2. Headquarters, AMCCOM - has the responsibility for the procurement and life-cycle management of the Muzzle Reference Sensor (MRS) System, including custodianship of the NRC license for possession and deployment. The HQ, AMCCOM, Radiation Protection Officer (RPO) provides health physics guidance and serves as the technical advisory point for the Command Staff. The HQ, AMCCOM, license manager acts for the Commander to provide management guidance and enforcement of NRC license conditions. Resumes for the License Manager, RPO, and Alternate RPOs are provided as encl 1.

3. Bulk Storage Locations - will be limited to depots (ANNEX IV) currently being utilized to store other NRC licensed tritium lamps or devices. The RPOs at these locations all have training and experience commensurate with their responsibilities. Personnel at these locations have received instructions and training and will not be authorized to perform any maintenance on the Muzzle Reference Sensor System. In addition, these installation RPOs will have, as a minimum, one of the following:

a. A Bachelors degree, or specialty, in Science, Engineering, Health Physics, or equivalent discipline.

b. 80 hours of formal training to include the following areas:

(1) Principles and practices of radiation protection.

(2) Radioactivity measurement standardization and monitoring techniques and instruments.

(3) Mathematics and calculations basic to the use and measurement of radioactivity.

(4) Biological effects of radiation.

(5) Applicable Federal and Army regulations.

c. Successful completion of US Army Radiological Safety Course (7K-F3) satisfies this requirement.

4. User Storage Locations - User storage locations will not be authorized more than 10 spare MRS at any one time and are required to have a military RPO or CBR officer. This RPO/CBR officer will provide control and responsibility for safe use and handling of the Muzzle Reference Sensor System. User storage locations will be at US Army or Marine Corps installations.

AMCCOM License Manager

Resume of Training and Experience of
David P. Skogman

1. Educational Background:

University of Minnesota - BSAE - Aeronautical Engineering 1962-1968
Texas A&M University - MEIE - Industrial Engineering 1970-1972

2. Formal Training in Radiation Protection Methods, Measurement and Effects:

a. Radiological Health (211 and 212) — 3 Weeks
Given by Eastern Environmental
Radiation Laboratory at Field
Safety Activity, Charlestown, IN (3/72)

b. Laser Safety — 1 Week
Field Safety Activity
Charlestown, IN (10/75)

3. Experience in Radiation Protection Methods, Measurement and Effects:

a. ARMCOM Alternate Radiation Protection Officer - 4/74 to 6/75.

b. ARMCOM Radiation Protection Officer - 6/75 to 11/76.

c. Member and Secretary of ARMCOM Ionizing Radiation Control Committee - 4/75 to 7/76.

d. ARMCOM NRC License Manager - 11/76 to Present.

e. Group Leader of Safety Office Division - 6/75 to Present. Responsible for ARRCOM Radiation Safety Program.

f. Chairman of ARRCOM Ionizing Radiation Control Committee - 7/76 to Present.

g. Acting Chief, Headquarters US Army ARRCOM Safety Office - 7/78 to 2/79.

h. Chairman of AMCCOM Ionizing Radiation Control Committee - 7/76 to Present.

RESUME OF TRAINING AND EXPERIENCE OF
BYRON MORRIS
AMCCOM RPO/HEALTH PHYSICIST

1. General Educational Background:

Hannibal LaGrange College	Undergraduate Work	Journalism	1948-49
St. Ambrose College	4 Years - BA	Physics/Math	1950-54
Texas Christian University	Graduate Work	Physics/Math	1957-59
Augustana College	Graduate Work	Physics/Math	1970-72
University of Illinois	Graduate Work	Physics	1974

2. Formal Training in Radiation Safety:

a. Principles and Practices of Radiation Protection.

Course	Duration of Training	Completion
Radiological Safety Fundamentals 133 Correspondence Course Aberdeen, MD	13 Credit Hours	September 1976
Radiological Safety Applications 134 Correspondence Course Aberdeen, MD	9 Credit Hours	October 1976
Introduction to Health Physics Oak Ridge Assoc. Univ. Oak Ridge, TN	100 Hours	December 1976
Depleted Uranium Safety Battelle PNL Department of Energy Richland, WA	40 Hours	April 1978
Laser Safety Field Safety Activity Charlestown, IN	24 Hours	October 1979
Depleted Uranium Safety in Processing Army Materiels and Mechanics Research Center Watertown, MA	40 Hours	October 1979

Course	Duration of Training	Completion
On-Scene Commanders Training Radiation Accident Course Defense Ammo Center & School Savanna, IL	8 Hours	October 1980
Radioactive Waste Disposal Workshop US Ecology, Inc. Rock Island, IL	16 Hours	March 1981
Radioactive Waste Packaging Transportation, and Disposal Chem-Nuclear Systems, Inc. Midlands Technical College Columbia, SC	27 Hours	October 1981

b. Radioactivity Measurement Standardization and Monitoring Techniques and Instruments.

Course	Duration of Training	Completion
Counting Room Operation and Analyses of Foil Detectors General Dynamics Ft. Worth, TX	1 Year (On-Job)	1957
Theory and Operation of Radiation Detection Instrumentation General Dynamics Ft. Worth, TX	3 Years (On-Job)	1960
Basic Radiation Monitor Foil Activation Analyses Course Nevada Test Site Mercury, NV	40 Hours	1962
Senior Officers Nuclear Accident Course Kirtland AFB Albuquerque, NM	28 Hours	September 1977

c. Mathematics and Calculations Basic to the Use and Measurement of Radioactivity.

Course	Duration of Training	Completion
Undergraduate Courses St. Ambrose College Davenport, IA	36 Semester Hours Credit	1954
Various Mathematics Courses Texas Christian University Ft. Worth, TX	18 Semester Hours Credit	1959
Advance Probability and Statistics Augustana College Rock Island, IL	27 Hours	1970

d. Biological Effects of Radiation.

Course	Duration of Training	Completion
Health Physics in Radiaton Accidents REAC Center, Oak Ridge Universities Oak Ridge, TN	40 Hours	January 1977
Laser/Microwave Hazards US Environmental Hygiene Agency Aberdeen, MD	40 Hours	April 1977

3. Experience with Radioisotopes:

Isotope	Maximum Activity	Duration of Experience	Type of Experience
Co-60	500 Curies	8 Years	Calibration, Leak Test, Inventory, Lab Analyses
Po-Be	10 Curies	8 Years	"
Pu-Be	10 Curies	8 Years	"
Cs-137	120 Curies	8 Years	"
Pm-147	Millicuries	4 Years	Survey, Inspection, Inventory, Lab Analysis
H-3	10 Curies	4 Years	"

4. Experience with Other Radiation Producing Machines:

Radiation Machine	Duration of Experience	Completion
Texas Nuclear Neutron Generator General Dynamics Ft. Worth, TX	2 Years	Operation for Various Shielding Experiments
Aerospace Shield Test Reactor (10 MW) General Dynamics Ft. Worth, TX	6 Years	Operation for Various Shielding Experiments
Tower Shielding Facility Reactor Oak Ridge National Lab Oak Ridge, TN	3 Months	Various Shielding Experiments
Linear Accelerator Nuclear Effect Lab White Sands Missile Range White Sands, NM	2 Weeks	Test Components of VADS for Vulnerability to Radiation

5. General Nuclear Background:

Was employed by General Dynamics at Ft. Worth, TX, from 1956-1970, and assigned to Nuclear Research and Development Division. Participated in all phases of nuclear experimental and analytical projects. Obtained experience in counting room with foil activation and analyses, becoming familiar with counting equipment and techniques. Spent considerable time in reactor area operating detection devices; such as, fast neutron detectors (FNDs), scintillation detectors (ASDs), and boron trifloride counters (BF_3s). Was responsible as crew chief for a variety of larger experiments involving radiation penetration and heating of candidate shield materials, with responsibilities involving safety and supervision of 3-6 nuclear engineers and support personnel in reactor area. Authored numerous technical reports from 1960-1970.

Was advisor and coordinator to ORNL scientists for General Dynamics' radiological detection devices used by Oak Ridge for several shielding experiments at the Tower Shield Facility.

Participated in the nuclear bomb test designated "SMALLBOY" at Nevada Test Site (NTS), and was designated Radiation Monitor for five-man team investigating shielding properties of US Army tanks. Received certification as "Basic Radiation Monitor" at NTS.

Appointed advisor to the US/Federal Republic of Germany Joint Design Team on matters pertaining to enhancement of nuclear radiation protection for Main Battle Tank 70. Provided analysis of family of F-111 Aircraft radiation protection for Air Force.

Was employed as Research Physicist for Rock Island Arsenal from 1970-1976. Was responsible for nuclear vulnerability/survivability (vs) analyses of US Army weapons systems as WECOM/ARMCOM VS Project Officer. Directed tests involving initial nuclear radiation, blast, and EMP threats directed at US Army systems.

Was responsible for development and operation of computer procedures to evaluate laser reflectivity from targets for several newly developed guided projectiles. Became familiar with the design and operation of US Army combat systems including the XM198, XM204, M109, and M110 Howitzers, the M551 Sheridan, and M60 Tank.

Am currently employed as Health Physicist for HQ, AMCCOM, Rock Island, IL. Major duties include serving as AMCCOM Radiological Protection Officer, advisor to the Commanding General on matters of radiological safety, and administrator of NRC licenses and DA permits held by the command for radioactive items of issue. Am listed as prime RPO on NRC licenses for byproduct, source, and special nuclear audits and provide advice for all radioactive waste generated and shipped in the Army system.

Resume of Training and Experience of
Elizabeth A. Peterson
Health Physicist/AMCCOM Alternate RPO

1. General Education Background.

Mary Washington College, 4 years, BS Chemistry/Math/Physics 1960-1964.
Oklahoma State University, Graduate work, Inorganic Chemistry 1964-1966.

2. Formal Training in Radiation Safety:

a. Principles and Practices of Radiation Protection:

Course	Duration of Training	Completion
Radiological Safety Fundamentals 133 Correspondence Course Aberdeen, MD	13 credit hours	September 1975
Radiological Safety 7K-F3 Aberdeen, MD	120 hours	October 1975
Laser Safety Field Safety Activity Charlestown, IN	24 hours	October 1980
Nuclear Accident/Incident Control Operations and Planning Defense Ammo Center & School Savanna, IL	80 hours	December 1980
Radioactive Waste Disposal Work Shop US Ecology Inc. Rock Island, IL	16 hours	March 1981
Applied Health Physics Oak Ridge Assoc U. Oak Ridge, TN	200 hours	June 1983
Depleted Uranium Safety Course Battelle PNL US Army Belvoir Research and Development Center Fort Belvoir, VA	40 hours	March 1984

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b. Radioactive Measurement Standardization and Monitoring Techniques and Instruments:

Course	Duration of Training	Completion
Alpha, Beta, Gamma, and Liquid Scintillation Counting Rock Island Arsenal Rock Island, IL	1966-1977 (on the job)	1977
Applied Health Physics Oak Ridge Assoc U. Oak Ridge, TN	200 hours	June 1983

c. Mathematics and Calculations Basic to the Use and Measurement of Radioactivity:

Course	Duration of Training	Completion
Shielding, Decay Calculations	1966-1978 (on the job)	1978
Applied Health Physics	200 hours	June 1983

d. Biological Effects of Radiation:

Course	Duration of Training	Completion
Radiological Safety 7KF3	120 hours	October 1975
Applied Health Physics Oak Ridge Assoc U. Oak Ridge, TN	200 hours	June 1983
Radiation Emergency Response Radiation Management Corp. US Army Belvoir Research and Development Center Fort Belvoir, VA	40 hours	January 1984

3. Experience with Radioisotopes:

Isotope	Max. Activity	Duration of Experience	Type of Experience
Co60	120Ci	6 years	leak tests, irradiation experiments

Isotope	Max. Activity	Duration of Experience	Type of Experience
Pm147	1mCi	3 years	leak tests of sealed sources, tracer studies
Po210	180mCi	5 years	leak test of sealed sources
H_3	10Ci	10 years	leak test sealed sources, inventory, lab. analysis
S35	10mCi	4 years	tracer studies
Sr90	10mCi	4 years	tracer studies
Mo99	10mCi	4 years	tracer studies

4. Experience with Other Radiation Producing Machines:

Instrument	Duration of Experience	Completion
X-Ray Diffraction Spectrometer	10 years	1977
X-Ray Fluorescence Spectrometer	10 years	1977
Scanning Electron Microscope with energy and wave length dispersive spectrometers	5 years	1980

5. General Radiaction Work Background:

a. Was employed by Rock Island Arsenal at Rock Island, IL from 1966-1980 and assigned to the Materials Evaluation Branch of the Engineering Directorate. Conducted tracer analyses, leak tests, surveys, and calibrations of various types of radiation detection equipment.

b. Am currently employed as a Health Physicist for Headquarters, US Army Armament, Munitions and Chemical Command (HQ, AMCCOM) at Rock Island. Duties include working as alternate AMCCOM Radiological Protection Officer, advising the Commanding General on radiological safety matters, preparing NRC licenses and DA authorizations for radioactive items of issue managed by AMCCOM, conducting inspections of radiation safety programs at army ammunition plants, and conducting inspections of compliance to NRC license requirements at user and storage locations.

ANNEX IV - Facilities and Equipment Involved in Fielding the Muzzle Reference Sensor

1. Reference: NRC Form 313, item 9.

2. Storage operations will be conducted under the supervision of each installation RPO. The following facilities are requested to be designated as bulk storage facilities:

Anniston Army Depot, Anniston, AL
Letterkenny Army Depot, Chambersburg, PA
Lexington-Blue Grass Army Depot Activity, Lexington, KY
New Cumberland Army Depot, New Cumberland, PA
Red River Army Depot, Texarkana, TX
Sacramento Army Depot, Sacramento, CA
Sharpe Army Depot, Lathrop, CA
Tooele Army Depot, Tooele, UT

Individual storage areas of at least 1,000 cubic feet at these installations will be utilized to store a maximum of 500 Muzzle Reference Sensor Systems.

3. No radiation detection equipment is necessary at user level or temporary field storage sites. Storage of muzzle reference sensors in any quantity exceeding 10 sensors will not be authorized at temporary field sites. Replacement of a system will be by exchange at an authorized depot.

4. Installations authorized bulk storage of muzzle reference sensors will have the equipment listed below (or equivalent) available at all times.

Instrument	Radiation Detected	Sensitivity Range	Use
Liquid Scintillation System, Beckman Model LS-100 or Equivalent	Beta	0-10^6cpm	Measuring
Air Monitor, Johnson Model 955-B or Equivalent	Beta	0-10^4u Ci/m^3	Monitoring

5. Calibration of the liquid scintillation system is accomplished each time the system is use, with standards supplied by the manufacturer.

6. The air monitors are checked at least every 3 months according to methods supplied by the manufacturer.

7. The complete illumination device will be replaced when its useful life is terminated. Tritium lamps will not be replaced, and maintenance will not involve removal of the tritium source.

8. Independent testing agencies have been selected by the AMCCOM Product Assurance Directorate and are subject to the approval of the AMCCOM RPO. These agencies are used for testing, evaluation, and review of the products throughout the life cycle to assure that no health hazards exist. Surveillance tests on the Muzzle Reference Sensor System have shown no significant removable contamination. Copies of surveillance tests can be made available to the NRC upon request.

ANNEX V - Radiation Safety Program

1. Reference - NRC Form 313, block 10.

2. The license RPOs will be responsible for assuring compliance with licensing requirements and for monitoring the overall radiation protection program for effectiveness and adequacy. Specific duties of the HQ, AMCCOM, License RPOs and License Manager are detailed in the HQ, AMCCOM, Radiation Protection Program, encl 1 to this ANNEX. A copy of "Radiation Protection Special Study" and "Hazard Analysis and Storage Criteria" for the muzzle reference sensor are attached (encl 2-3). Copies of the following rules and regulations are maintained at HQ, AMCCOM, ATTN: AMSMC-SFS, Rock Island, IL 61299-6000. Copies may be requested, or information pertinent to these rules and regulations obtained, by contacting the HQ, AMCCOM, Radiological Protection Officer (RPO) AV 793-2964/2965;, commercial 309-794-2964/2965.

a. 10 CFR Part 19-Notices, Instructions, and Reports to Workers; Inspections.

b. 10 CFR Part 20-Standards for Protection Against Radiation.

c. 10 CFR Part 21-Reporting of Defects and Noncompliance.

d. NRC license, license conditions, and license application.

3. Field RPOs will implement radiation protection programs at their installations in accordance with license conditions and technical manuals. Technical manuals are provided to the field for all US Army equipment. These manuals provide safety as well as technical information. Personnel in the field will not be authorized to remove or replace any tritium lamps or perform any maintenance on the radioactive cell.

4. The following safety precautions will be complied with and will provide the basis for the radiation protection program at the user level:

a. The muzzle reference sensor on the end of the main gun tube contains a sealed tritium gas light to serve as an alignment aid. The sealed tritium sources are constructed of a borosilicate glass capsule which is internally coated with phosphorous, filled with high purity tritium gas under pressure of 40 to 50 psi. The phosphor (color green) is excited by the beta emissions of tritium. Every source is bedded in a shock absorbing material within a steel cell, which is assembled into the optical collimator. The low energy beta particles are too weak to penetrate the glass walls of the source. There is, therefore, no external radiation hazard, and consequently, no time limit for personnel handling this equipment. Breakage of a glass source would release the tritium gas, but dissipation into the atmosphere is immediate. The primary means for identifying a leaking H-3 source will be a loss of illumination.

b. Be aware that tritium lights are potentially hazardous when broken.

c. In case of source breakage, brightness decay, or loss of brightness during storage or field operations, inform the local Radiation Protection Officer, immediately.

d. Glass from broken sources must be handled as radioactive waste.

e. Broken sources will be disposed of as radioactive waste as stated in ANNEX VI of this application.

f. Tampering with this source in the field is prohibited by Federal law.

5. The following actions will be taken in regards to bulk storage of the muzzle reference sensors:

a. An inventory record of the radioactive source will be maintained IAW AR 700-64 at each storage depot. The following information will be considered for inclusion in the record: date of transaction, national stock number, radioisotope, activity per item (in curies, millicuries, or microcuries), storage location, number of items received or transferred, balance of items, and total radioactivity at the transaction. A copy of local inventory records will be furnished to key personnel who would be expected to respond to an emergency; e.g., security, safety, fire personnel.

b. A physical inventory count shall be made at least annually at bulk storage depots IAW AR 700-64. Containers will not be opened for this purpose.

c. In case of emergencies where assistance is required, the RPOs can be contacted as below:

Monday thru Friday, 0700-1600
Radiation Protection Officer
HQ, AMCCOM, ATTN: AMSMC-SFS, Rock Island, IL 61299-6000
AV 793-2964/2965
Commercial 309-794-2964/2965

All other times, including holidays, notify one of the license RPOs below:

Byron E. Morris (319) 391-9037 (home) or
Elizabeth A. Peterson (309) 762-8114 (home)

6. More stringent controls have been established for control of radioactive items than for other Army supplies, as distribution of these devices are limited to authorized activities. These controls include identifying and insuring that these systems are coded in the Commodity Command Standard System (CCSS) Automated Data Processing Program as radioactive in accordance with Appendix A of AR 708-1, cataloging and supply management data. These systems are coded with a special control item code (SCIC) of radioactive. Requisitions are processed initially by computers and, due to the radioactive SCIC designation, are then processed manually by the National Inventory Control Point (NICP) item manager to verify that the requisitions are authorized to receive the system.

Radiation Protection Program, HQ, US Army AMCCOM

Organizational Responsibilities

a. AMCCOM Ionizing Radiation Control Committee (IRCC)

(1) The AMCCOM IRCC was established by AMCCOM Regulation 10-1.

(2) The purpose of the AMCCOM IRCC is to serve as an advisory committee for the AMCCOM Commanding General in the supervision and control of the fielding and use of radioactive material. Specific functions of this committee include, but are not limited to the following:

a. Review and assist in the preparation of applications for NRC licenses for AMCCOM radioactive commodities. Provide concurrence for each of the directorates represented.

b. Review the NRC license application, the conditions imposed by the license and requirements covering procurement, acceptance from contractor, fielding, use, storage, and disposal of radioactive items of supply. Initiate any actions which may be necessary as a result of the review.

b. AMCCOM RPO

(1) A qualified person appointed by letter by the AMCCOM Command Staff. The present AMCCOM RPO is Mr. Byron Morris Health Physicist. The Alternate RPO is Mrs. Elizabeth Peterson. In the absence of the RPO, the Alternate RPO will perform all duties assigned to the RPO.

(2) Duties of the AMCCOM RPO include, but are not limited to the following:

a. Provide the AMCCOM Commander, the Ionizing Radiation Control Committee, and radiation users with advice and assistance on all matters pertaining to radiation safety.

b. Implement the radiation protection safety program for HQ, AMCCOM.

c. Review radiological operations utilizing radioactive material to determine compliance with regulations and approved procedures.

d. Review inspection and test reports on radioactive materials. Initiate any action which may be necessary as a result of the review.

e. Perform required radiation surveys or cause such surveys to be performed. The accuracy of tests and surveys if performed by others remains the responsibility of the AMCCOM Radiological Protection Officer.

f. Evaluate the hazard potential and adequacy of protective measures for existing and proposed operations involving AMCCOM radioactive commodities at US Army installations and activities.

g. Act as advisor on matters pertaining to any NRC license or DA authorization and respond to questions regarding radiation hazards.

h. Assure that incidents/accidents involving AMCCOM radioactive items are properly investigated and reported by the involved personnel.

i. Assist in the provision of radiation safety input into documentation relative to AMCCOM radioactive commodities.

j. Act as the point of contact for HQ, AMCCOM, on all matters pertaining to the NRC license, the conditions imposed by the NRC license, and license material.

k. Prepare input as necessary for the AMCCOM License Manager to obtain, amend, and maintain licenses and authorizations for radioactive commodities managed by AMCCOM.

c. AMCCOM License Manager

(1) A qualified individual appointed by the AMCCOM Commanding General. The present License Manager is the IRCC Chairman, Mr. Dave Skogman.

(2) Duties of the AMCCOM License Manager include the following:

a. Coordinate, administer, and review necessary licenses and authorizations for radioactive commodities managed by AMCCOM through the AMCCOM RPO.

b. Provide information and guidance to the AMCCOM Commandser with respect to limitations, constraints, and special data, conditions, or procedures which affect the responsibilities for each radioactive commodity.

c. Monitor the various elements of the life-cycle program of the radioactive commodities to assure compliance with conditions of the license or authorization.

d. Assure that licensed or authorized material is not transferred to unauthorized persons or organizations.

d. AMCCOM Safety Office, AMSMC-SF, is assigned the responsibility for the AMCCOM Radiological Safety Program.

e. Maintenance Directorate, AMSMC-MA.

(1) Prepare any special instructions required to the field and make necessary changes to technical publications on the radioactive material.

(2) Assure special instructions to the field contain safety and handling instructions.

(3) Provide or recommend training, as required, to other Army agencies or the Marine Corps for maintenance, rebuild, and rework of AMCCOM radioactive commodities.

(4) Obtain concurrence of AMCCOM RPO on above actions.

f. Materiel Management Directorate, AMSMC-MM.

(1) Maintain records of total quantities procured in the supply chain for worldwide assets.

(2) Maintain records of warehouse storage locations.

(3) Maintain records on total quantities disposed of.

(4) Make available above records as required to the AMCCOM RPO.

(5) Provide an annual inventory report to the AMCCOM RPO for review.

(6) Coordinate all transfers and disposal actions with the AMCCOM RPO.

g. Procurement Directorate, AMSMC-PC.

(1) Assure that the contract for purchase of any radioactive material or item of equipment containing radioactive sources is identified as a hazardous item contract. This will provide that a pre-award survey of the contractor will be performed. During the Radiation Protection Program pre-award survey, determination will be made that the contractor does have or will obtain an NRC license and the capability to perform the work involved safely.

(2) Assure the necessary safety clause identifying the hazardous item (radioactive material) is included in the solicitation and resultant contract.

(3) Assure information pertaining to the product assurance acceptance procedures are included in the solicitation and resultant contract.

(4) Assure the technical data package and the solicitation have been coordinated with the concurred in by AMCCOM RPO.

(5) Coordinate procurements and reporcurements with the AMCCOM RPO and Item Manager.

h. Product Assurance Directorate, AMSMC-QA.

(1) Coordinate and monitor broad overall command policy and procedures concerning AMCCOM quality assurance functions for production.

(2) Determine and apply requirements for contractual inspection and acceptance clauses/provisions which complement and/or ensure implementation of the quality assurance provisions in the design engineering activity's technical data package. Also, develop and maintain Storage Serviceability Standards for AMCCOM assigned radioactive items.

(3) AMSMC-QAF will provide the interface required between the Government agency designated inspection and acceptance functions and the AMCCOM RPO.

(4) During the acceptance inspection at the contractor's facility, the Government Inspector will reject the lot of material represented by the appropriate sample, when the sample fails to meet acceptance criteria. It will be the contractor's responsibility to screen the lot of rejected material and take necessary corrective action to preclude occurrence in future lots. Handling and disposal of defective radioactive source shall be by the contractor as specified in the contract. Additionally, quality audits by an independent testing laboratory (Government or industrial) shall be conducted by random sampling of production lots. The random samples selected from production are to be inspected to specified requirements to assure there are no health hazards with the product.

(5) Prepare and implement a Surveillance Program for item with light sources in storage and in use. This program will be coordinated with the NICP item manager and AMCCOM RPO.

a. An annual random sample shall be selected from items with light sources in storage and in use and forwarded to an independent testing laboratory. The sample size shall be in accordance with 10 CFR Part 32.110 for a lot tolerance percent defective 10 percent.

b. The NICP item manager shall determine location and quantity of items containing light sources to be selected for random samples in storage and in use.

c. Surveillance of materiel in storage is the responsibility of the depot/installation RPO to be conducted in accordance with the Storage Serviceability Standard, technical manuals, or special AMCCOM instructions.

(6) Assure all records of testing, inspection, and pertinent information are maintained and made available to the AMCCOM RPO and NICP item manager as appropriate and as required for their actions.

i. Engineering Support Directorate, SMCAR-ES, ARDC, and SMCCR-ES, CRDC.

(1) Shall be responsible for coordination of all R&D activities related to development and improvement of fire control containing H3 sources and licensed by the US Army AMCCOM.

(2) Shall be responsible for insuring that retrofits and product improvements connected with aforementioned items are in full compliance with the NRC license or DA permit.

(3) Provide current information, drawings, manuals. and technical input to the RPO for systems under their management. This input will be sufficient for inclusion in an NRC license application.

(4) Shall coordinate above activities with the AMCCOM RPO.

j. Weapons Systems Management Directorate, AMSMC-AS.

(1) Inform the RPO when a malfunction of AMCCOM supported equipment results in a release of radioactive material.

(2) Provide guidance and assistance to the RPO in matters of enforcement and inspection at depots, manufacturers, in the field, etc., to assure full compliance with conditions of the NRC license.

k. Surgeon General's Office, AMSMC-SG.

(1) Shall provide technical review of nonmedical radioactive material to determine possible existence of health hazards.

(2) Shall coordinate above reviews with the AMCCOM RPO.

l. Not used.

m. International Logistics, AMSMC-IL.

(1) Shall monitor all foreign military sales (FMS) of radioactive material. For sales involving radioactive material, shall provide AMSMC-SF with sufficient information to obtain an export license prior to mailing the letter of offer through channels to the FMS customer. This action will be accomplished by staffing all such offers through AMSMC-SF and by forwarding to AMSMC-SF, at the time of coordination, a separate sheet containing export license data.

(2) Shall keep history records of FMS shipments of Military Articles and Service List (MASL) items that contained radioactivity. These records will include the quantity of items shipped and the date they were shipped. Records will be made available to NRC inspectors upon request only.

n. Installations and Services Directorate, AMSMC-IS.

(1) Shall provide guidance in th development of environmental documentation necessary to obtain NRC licenses.

(2) Shall provide review of environmental data and assessments submitted by AMCCOM subordinate installations. Review will result in recommendations, if required, to improve submissions.

(3) Shall provide support required to maintain AMCCOM facilities and equipment as required by Federal regulations and NRC license conditions.

o. Office of Counsel, AMSMC-GC.

(1) Shall provide legal interpretations and guidance for all matters pertaining to radioactive licensing.

(2) Shall assist RPO in administering the Army wide radioactive waste disposal program wherever necessary.

p. Defense Ammunition Supply Directorate, AMSMC-DS.

(1) Shall provide administrative support and keep records involved with the operation of the Army radioactive waste disposal program.

(2) Shall provide concurrence of AMSMC-SF prior to shipment of all radioactive waste to a consolidation site, broker, or burial site.

q. Transportation, AMSMC-TM. Shall provide guidance on all matters concerning transport of radioactive items within CONUS and to/from OCONUS.

r. Public Affairs Office, AMSMC-IN.

(1) Shall coordinate and release all information to non-Government organizations as requested.

(2) Shall obtain concurrence of AMSMC-SF for matters pertaining to NRC license responsibilities and radiation safety.

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

Mr. Edge/lm/AUTOVON
584-3526

28 SEP 1979

HSE-RH/WP

SUBJECT: Radiation Protection Special Study No. 28-43-0923-79, XM1 Tank System Tritium Self-Luminous Light Source Used to Illuminate the Muzzle Reference Sensor Reticle for Night Viewing, 3 May 1979

Project Manager
XM1 Tank System
Warren, MI 48090

1. AUTHORITY.

a. AR 40-5, Health and Environment, 25 September 1974.

b. Message DRCPM-GCM-SW, Project Manager XM1, Tank System, 051535Z Jan 79, subject: XM1 Tank System, with indorsements thereto.

2. REFERENCES.

a. AR 70-1, Research and Development, Army Research, Development, and Acquisition, 1 May 1975.

b. AR 70-10, Research and Development, Test and Evaluation During Development and Acquisition of Materiel, 29 August 1975.

c. AR 700-64, Radioactive Commodities in the DoD Supply Systems, 18 November 1976.

d. Title 10, Code of Federal Regulation (CFR), 1979 ed., Part 32, Specific Domestic Licenses to Manufacture or Transfer Certain Items Containing Byproduct Material.

e. American National Standards Institute (ANSI) N540; Classification of Radioactive Self-Luminious Light Sources - 1975.

HSE-RH/WP
SUBJECT: Radiation Protection Special Study No. 28-43-0923-79, XM1 Tank System Tritium Self-Luminous Light Source Used to Illuminate the Muzzle Reference Sensor Reticle for Night Viewing, 3 May 1979

3. PURPOSE. This special study was performed to determine the presence and extent of any health hazards resulting from the use of tritium self-luminous light sources located on the muzzle reference sensor reticle for night viewing.

4. GENERAL.

a. The radiological health hazard evaluation to user personnel, from the tritium self-luminous light sources, was not initiated as early as possible in the field testing cycle. Therefore, pertinent data from each field test was not made available to this Agency to provide a basis for evaluating the radiological health hazard assessment.

b. This special study consisted of two parts: an onsite radiation protection survey of a tritium self-luminous light source mounted on a XM1 Tank which was located at Aberdeen Proving Ground (APG), Maryland; and laboratory testing of tritium self-luminous light sources after they had supposedly been subjected to appropriate field test operations.

5. FINDINGS.

a. Onsite Radiation Protection Survey.

(1) The onsite radiation protection survey was performed by 1LT John Sykes III, MSC, Health Physics Division, this Agency, on 3 May 1979.

(2) The study was conducted on XM1 Tank number PV-3, located at the Materiel Testing Directorate (MTD) Maintenance Facility, APG.

(3) The vehicle was equipped with the tritium muzzle reference source which contained approximately 7 curies of tritium gas. The source serial number was inaccessible.

(4) Approximately 3,000 rounds of ammunition had been fired through the muzzle with the reference source in place.

(5) The muzzle reference source and the distal end of the gun tube were surveyed using an Eberline RASCAL, ratemeter/scaler, serial number 222, calibrated 11 March 1979.

HSE-RH/WP
SUBJECT: Radiation Protection Special Study No. 28-43-0923-79, XM1 Tank System Tritium Self-Luminous Light Source Used to Illuminate the Muzzle Reference Sensor Reticle for Night Viewing, 3 May 1979

(6) Using the RASCAL with an Eberline HP-210, thin-end-window, Geiger Mueller detector, calibrated in milliroentgen per hour (mR/hr) to cesium-137, no readings were observed above 0.01 mR/hr (background was determined to be 0.01 mR/hr).

(7) Using the RASCAL with an Eberline PG-1, low-energy gamma scintillation detector, calibrated in gross counts per minute (CPM) which was equivalent to a 1200 volts bias setting, no readings were observed above 100 CPM (background was determined to be 100 CPM).

(8) Four wipe test samples, using membrane filter paper, were performed on the exterior of the muzzle reference source and its fitting on the gun tube. Each wipe test sample was placed in a liquid scintillation "cocktail solution" and returned to Radiological and Biological Chemistry Division (RBCD) for analysis. Results of wipe test samples are listed in Table 1 below.

Table 1. Results of Wipe Test Samples

Sample Identification	RBCD Lab Number	Microcurie Per Wipe Test Sample ±2 Standard Deviation
153	L614	$4.0 \times 10^{-5} \pm 7.1 \times 10^{-6}$
154	L615	$<9.8 \times 10^{-6}$
155	L616	$<9.8 \times 10^{-6}$
156	L617	$<9.8 \times 10^{-6}$
157 (control)	L618	$<9.8 \times 10^{-6}$

ALPHUS L. JONES
Chief, Radiological & Biological Chemistry Division

(9) The maximum removable radiological contamination measured was 40 picocuries per 50 square centimeters (cm^2) which was below applicable contamination limits established in Table 1, AR 700-64.

b. RBCD Laboratory Evaluation.

(1) Three tritium self-luminous light sources were received by RBCD on 14 May 1979 for the radiological laboratory evaluation.

(2) Each light source reportedly contained approximately 7 curies of tritium gas.

(3) Each light source was wipe tested with a moistened metrical filter. The wipe test samples were counted for beta activity using a liquid scintillation counter. The results were less than 24 disintegrations per minute per wipe test sample.

(4) Each light source was soak tested to determine the leakage of tritium gas. Each light source was submerged in distilled water for 24 hours. A ten (10) milliliter aliquot was collected and counted for beta activity using the liquid scintillation counter. The results are in Table 2.

TABLE 2. Results of Soak Tests

XM1 Collimator Identification	Picocurie Per 24 Hour Soak Test ±2 Standard Deviations
Serial Number 4	<214.7
Serial Number 9	217.0 ± 130.0
Serial Number 12	620.0 ± 140.0

ALPHUS L. JONES
Chief, Radiological & Biological Chemistry Division

(5) All observed leakage rates were less than the maximum leakage rate of .05 microcurie per 24 hours as specified in the current quality assurance requirements for the tritium source and which were in accordance with ANSI N540.

6. DISCUSSION. This special study was initially performed to determine the radiological health hazard to user personnel from the XM1 Tank tritium light source. The study consisted of an evluation of one tritium self-luminous source mounted on an XM1 Tank at APG, MD, and RBCD laboratory testing of

three tritium self-luminous sources. The three tritium self-luminous sources received from the XM1 System Project Manager's Office should have been field tested in typical user operations as outlined in AR 70-1, AR 700-64, and Title 10, CFR, Part 32. It could not be determined from the information received by this Agency if the tritium self-luminous sources had been subjected to any designed field tests. These designed field tests are required in order to establish and prove the radiological safety of the tritium sources during normal use, storage, and transportation. Consequently, a radiological health hazard evaluation to user personnel could not be determined from this special study. Previous radiological health hazard evaluations performed by this Agency were coordinated with the US Army Test and Evaluation Command which gave this Agency the opportunity to support materiel test and evaluation milestones prior to key decision points.

7. CONCLUSION. A review of the findings indicated that there were no radiological health hazards resulting from removable radiological contamination and the leakage of tritium gas from the tritium self-luminous sources evaluated. However, the potential radiological health hazard to user personnel could not be determined.

8. RECOMMENDATION. Radiological health hazard evaluation should be considered as early as possible in the test planning cycle and continue throughout the acquisition process as an element of the normal test program for evaluation at each decision review point. Additionally, pertinent data from all tests should be used to provide the basis for evaluating safety and health characteristics in accordance with paragraph 2-21, AR 70-10.

FOR THE COMMANDER:

Frank E McDermott

FRANK E. McDERMOTT
COL, MSC
Director, Radiation and
Environmental Sciences

CF:
HQDA (DASG-PSP)
Cdr, ARRCOM (DRSAR-SF)
Cdr, DARCOM (DRCSG) (10 cy)
Cdr, TECOM
Cdr, HSC (HSPA-P)
Supt, AHS (HSA-IPM)
C, USAEHA-Rgn Div North

HAZARD ANALYSIS AND STORAGE CRITERIA

1. HQ, AMCCOM, as the requesting authority for this license, is fully cognizant of the NRC concept of "As low as reasonably achieveable." This command will conduct operations relating to this license within the concept of ALARA. Our procedures are not based on the allowance of any exposures or releases of radioactivity. The numbers cited in the following hazard calculations as maxium requirements are so stated because of title 10, CFR. To date we know of no instances where any personnel have been exposed to as much as 10 percent of the permissible levels by tritium sources currently licensed to this headquarters. Nor have we released any effluents to unrestricted areas in excess of 1 percent of the MPC.

2. The calculations on the following pages are not intended to present situations which we feel are likely to occur. In fact, we have never experienced a problem as severe as these situations in connection with the tritium lamps currently used by the Army. These assessments are made only with the intent of demonstrating the relatively low degree of hazard associated with tritium-sealed sources in the amounts and size requested by this application.

Tritium Storage Limitations

1. Storage of Tritium Gas Souces

The procurement specifications (Govt. Drawings) permit a leak rate of a maximum of 0.050 uCi/day per source IAW American National Standard N540.

MPC (Maximum Permissible Concentration) for Tritium from 10 CFR 20:

unrestricted area: 2×10^{-7} uCi/ml air
restricted area: 5×10^{-6} uCi/ml air

Air changes taking place under average conditions, exclusive of air provided for ventilation, in a room with no windows or exterior doors*: 1/2 per hour (12 changes/day).

Allowed number of sources (storage) per 1000 cubic feet:

unrestricted area:
MPC x conversion factor ml/ft^3 x N air change/day
Permissible leak rate/source/day (from Procurement drawings)

$$= \frac{2 \times 10^{-7} \text{ uCi/Ml} \times 2.83 \times 10^{7} \text{ ml/1000 ft}^3 \times 12 \text{ air chg/day}}{0.05 \text{ uCi/source/day}}$$

$$= 1358 \text{ Sources/1000 ft}^3$$

Allowed number of sources (storage) per 1000 cubic feet

restricted area:

$$= \frac{5 \times 10^{-6} \text{ uCi/ml} \times 2.83 \times 10^{7} \text{ ml/1000 ft}^3 \times 12 \text{ air chg/day}}{0.05 \text{ uCi/Source/day}}$$

$$= 33{,}960 \text{ sources/1000 ft}^3$$

The above quantities exceed maximum storage of sources at any one installation due to physical restrictions.

*ASHRAE Guide and Data Book, Fundamentals and Equipment American Society of Heating, Refrigerating, and Air-Conditioning Engineers 1963, p432.

Maximum Hazard Assessment of a Fire Involving Breakage of Tritium Gas Souces

The maximum accident which could occur involving a storage area fire would result in the release of all of the tritium in a short period of time. An estimate of the hazard may be obtained using Sutton's equation:

$$\overline{X}(x,y) = \frac{2Qe^{\left[\left(\frac{1}{C^2x^{2-n}}\right)(y^2+h^2)\right]}}{(3.14)\ C^2ux^{2-n}}$$

where

$\overline{X}$ = volumetric concentration of the contaminant mCi per M3

Q = emmission rate, mCi/sec

x,y = coordinates of point of measurement from point of release, meters

u = mean wind speed, meters per second

C = virtual diffusion coefficients in lateral and vertical directions

n = dimensionless parameter determined by the atmospheric stability

h = effective chimney height, meters

At any distance from the point of release, the ground level concentration will be a maximum when the center line of the plume is at ground level, y=o. Assuming that the release occurs at ground level, and neglecting the effects of the heated air, the above equation becomes:

$$\overline{X}(x,0) = \frac{2Q}{(3.14)\ C^2ux^{2-n}}$$

Assume that 1,000 Ci of tritium gas is released in all directions during 1 hour. Thus Q = 1,000 Ci/60 min = 16.67 Ci/min = 277.8 mCi/sec.

From Smith and Singer* for a lapse metrological condition

n = 0.24 and C = 0.4.

*M.E. Smith and I.A. Singer. Am Ind Hyg. Assoc. Quart. 18, 319 (1957)

Assuming a mean wind speed of 10 meters per minute, the resulting concentration of tritium at ranges of 100, 500, and 1000 meters would be as follows:

Range (Meters)	Concentration of H-3 (mCi/M3)
100	2
500	0.12
1000	0.03

The maximum hazard to man would result only in the unlikely event of the fire converting all of the tritium to tritium oxide. The standard man, while performing light work, breathes 1200 liters (1.2 cubic meters) of air per hour, thus, the maximum tritium intake at the above ranges for a 10-minute stay time in the radioactive smoke would be as follows:

Range (Meters)	H-3 Intake for a Standard Man (mCi) (10-min Stay Time)
100	0.67
500	0.023
1000	0.007

Standard practices in SOP's used by all Army activities require evacuation of personnel to an upwind area in case of fire involving radioactive materials and should preclude any exposure.

However, the maximum quantity of material permitted in any field storage area will be 1,000 curies or 1,358 sources, whichever limit is reached first.

At bulk storage locations available instrumentation and safety equipment to detect tritium is sufficient to allow a maximum of 10,000 curies or 33,960 sources, whichever limit is reached first, to be stored in a storage area. These areas will have forced ventilation and tritium air monitors installed as well as be relatively fire-proof.

Hazard Assessment of Accidental Breakage of One or More Tritium Sources

1. Postulated accident: The accidental breakage of one of the H-3 sources by a user with the following input:

a. Less than 1 percent of H-3 is converted to tritiated H_2O; therefore, 0.10 curies tritiated H_2O released in 1 minute.

b. Standard man breathes 20 liters per minute.

c. Maximum permissible body burden = 2×10^3 uCi.

d. Ten minute exposure time.

2. Assumption: The concentration of tritium gas following the breakage is of the form of a time dependent gradient with respect to distance from source. Assume the average concentration a user is exposed to is equivalent to having the activity uniformly dispersed in a spherical volume of radius 10 feet, i.e.:

$$\text{Concentration} = \frac{10.0 \times 10^4 \text{ uCi}}{\frac{4\pi}{3}(10)^3(12)^3(2.54)^3(10^{-3}) \text{ liter}}$$

Concentration = 0.84 uCi/liter

3. Exposure: Assuming even an unlikely 10 minute exposure, a man would inhale and retain the following amounts of tritiated water:

$$\text{Intake} = 0.84 \text{ uCi/liter} \times 20 \frac{\text{liters}}{\text{min}} \times 10 \text{ min}$$

Intake = 168 uCi tritiated water.

Intake = 1/11 Maximum permissible body burden for continuous exposure

4. Breakage of a source in the open air should not constitute any radiological hazard to the user.

ANNEX VI- Waste Management

1. Reference: NRC Form 313, block 11.

2. Radioactive waste generated by Army users is disposed of in accordance with AR 385-11, and current NRC and DOT regulations. At the present time, HQ, AMCCOM, is the focal point and issues instructions to all Army users on proper packaging and marking of shipments of radioactive waste. This headquarters also conducts on-site audits of radioactive waste shipments. The shipments are audited for full compliance with DOT, NRC, and burial site criteria.

3. Radioactive waste disposal methods and procedures used by all organizations covered by this application will be in accordance with NRC regulations and multi-service regulation AR 700-64.

NRC FORM 313
(1-84)
10 CFR 30, 32, 33, 34, 35 and 40

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED BY OMB
3150-0120
Expires: 5-31-87

APPLICATION FOR MATERIAL LICENSE

INSTRUCTIONS: SEE THE APPROPRIATE LICENSE APPLICATION GUIDE FOR DETAILED INSTRUCTIONS FOR COMPLETING APPLICATION. SEND TWO COPIES OF THE ENTIRE COMPLETED APPLICATION TO THE NRC OFFICE SPECIFIED BELOW.

FEDERAL AGENCIES FILE APPLICATIONS WITH:

U.S. NUCLEAR REGULATORY COMMISSION
DIVISION OF FUEL CYCLE AND MATERIAL SAFETY, NMSS
WASHINGTON, DC 20555

ALL OTHER PERSONS FILE APPLICATIONS AS FOLLOWS, IF YOU ARE LOCATED IN:

CONNECTICUT, DELAWARE, DISTRICT OF COLUMBIA, MAINE, MARYLAND, MASSACHUSETTS, NEW JERSEY, NEW YORK, PENNSYLVANIA, RHODE ISLAND, OR VERMONT, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION I
NUCLEAR MATERIAL SECTION B
631 PARK AVENUE
KING OF PRUSSIA, PA 19406

ALABAMA, FLORIDA, GEORGIA, KENTUCKY, MISSISSIPPI, NORTH CAROLINA, PUERTO RICO, SOUTH CAROLINA, TENNESSEE, VIRGINIA, VIRGIN ISLANDS, OR WEST VIRGINIA, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION II
MATERIAL RADIATION PROTECTION SECTION
101 MARIETTA STREET, SUITE 2900
ATLANTA, GA 30323

IF YOU ARE LOCATED IN:

ILLINOIS, INDIANA, IOWA, MICHIGAN, MINNESOTA, MISSOURI, OHIO, OR WISCONSIN, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION III
MATERIALS LICENSING SECTION
799 ROOSEVELT ROAD
GLEN ELLYN, IL 60137

ARKANSAS, COLORADO, IDAHO, KANSAS, LOUISIANA, MONTANA, NEBRASKA, NEW MEXICO, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TEXAS, UTAH, OR WYOMING, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION IV
MATERIAL RADIATION PROTECTION SECTION
611 RYAN PLAZA DRIVE, SUITE 1000
ARLINGTON, TX 76011

ALASKA, ARIZONA, CALIFORNIA, HAWAII, NEVADA, OREGON, WASHINGTON, AND U.S. TERRITORIES AND POSSESSIONS IN THE PACIFIC, SEND APPLICATIONS TO:

U.S. NUCLEAR REGULATORY COMMISSION, REGION V
MATERIAL RADIATION PROTECTION SECTION
1450 MARIA LANE, SUITE 210
WALNUT CREEK, CA 94596

PERSONS LOCATED IN AGREEMENT STATES SEND APPLICATIONS TO THE U.S. NUCLEAR REGULATORY COMMISSION ONLY IF THEY WISH TO POSSESS AND USE LICENSED MATERIAL IN STATES SUBJECT TO U.S. NUCLEAR REGULATORY COMMISSION JURISDICTION.

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*

- [ ] A. NEW LICENSE
- [ ] B. AMENDMENT TO LICENSE NUMBER _____
- [X] C. RENEWAL OF LICENSE NUMBER BML 12-00722-09

2. NAME AND MAILING ADDRESS OF APPLICANT *(Include Zip Code)*

DEPARTMENT OF ARMY
HQ, ARMAMENT, MUNITIONS AND CHEMICAL COMMAND
ATTN: AMSMC-SF
ROCK ISLAND, IL 61299-6000

3. ADDRESS(ES) WHERE LICENSED MATERIAL WILL BE USED OR POSSESSED.

THROUGHOUT THE UNITED STATES BY US ARMY AND US MARINE CORPS PERSONNEL

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

BYRON E. MORRIS, HEALTH PHYSICIST

TELEPHONE NUMBER: AV 793-2964/COMM.(309) 794-2964

SUBMIT ITEMS 5 THROUGH 11 ON 8½ x 11" PAPER. THE TYPE AND SCOPE OF INFORMATION TO BE PROVIDED IS DESCRIBED IN THE LICENSE APPLICATION GUIDE.

5. RADIOACTIVE MATERIAL. a. Element and mass number, b. chemical and/or physical form, and c. maximum amount which will be possessed at any one time. ANNEX I

6. PURPOSE(S) FOR WHICH LICENSED MATERIAL WILL BE USED. ANNEX II

7. INDIVIDUAL(S) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE ANNEX III

8. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS. ANNEX III

9. FACILITIES AND EQUIPMENT. ANNEX IV

10. RADIATION SAFETY PROGRAM. ANNEX V

11. WASTE MANAGEMENT. ANNEX VI

12. LICENSEE FEES *(See 10 CFR 170 and Section 170.31)*
FEE CATEGORY EXEMPT
AMOUNT ENCLOSED $

13. CERTIFICATION. *(Must be completed by applicant)* THE APPLICANT UNDERSTANDS THAT ALL STATEMENTS AND REPRESENTATIONS MADE IN THIS APPLICATION ARE BINDING UPON THE APPLICANT.

THE APPLICANT AND ANY OFFICIAL EXECUTING THIS CERTIFICATION ON BEHALF OF THE APPLICANT NAMED IN ITEM 2, CERTIFY THAT THIS APPLICATION IS PREPARED IN CONFORMITY WITH TITLE 10, CODE OF FEDERAL REGULATIONS, PARTS 30, 32, 33, 34, 35, AND 40 AND THAT ALL INFORMATION CONTAINED HEREIN, IS TRUE AND CORRECT TO THE BEST OF THEIR KNOWLEDGE AND BELIEF.

WARNING: 18 U.S.C. SECTION 1001 ACT OF JUNE 25, 1948, 62 STAT. 749 MAKES IT A CRIMINAL OFFENSE TO MAKE A WILLFULLY FALSE STATEMENT OR REPRESENTATION TO ANY DEPARTMENT OR AGENCY OF THE UNITED STATES AS TO ANY MATTER WITHIN ITS JURISDICTION.

SIGNATURE–CERTIFYING OFFICER	TYPED/PRINTED NAME	TITLE	DATE
J. R. Poole	JAMES R. POOLE	COLONEL, GS CHIEF OF STAFF	24 Dec 87

14. VOLUNTARY ECONOMIC DATA

a. ANNUAL RECEIPTS
- [ ] < $250K
- [ ] $250K – 500K
- [ ] $500K – 750K
- [ ] $750K – 1M
- [ ] $1M – 3.5M
- [ ] $3.5M – 7M
- [ ] $7M – 10M
- [ ] > $10M

b. NUMBER OF EMPLOYEES *(Total for entire facility excluding outside contractors)*

c. NUMBER OF BEDS

d. WOULD YOU BE WILLING TO FURNISH COST INFORMATION *(dollar and/or staff hours)* ON THE ECONOMIC IMPACT OF CURRENT NRC REGULATIONS OR ANY FUTURE PROPOSED NRC REGULATIONS THAT MAY AFFECT YOU? *(NRC regulations permit it to protect confidential commercial or financial–proprietary–information furnished to the agency in confidence)*
- [ ] YES
- [ ] NO

FOR NRC USE ONLY

TYPE OF FEE	FEE LOG	FEE CATEGORY	COMMENTS	APPROVED BY
AMOUNT RECEIVED	CHECK NUMBER			DATE

PRIVACY ACT STATEMENT ON THE REVERSE

APPLICATION SUMMARY STATEMENT

1. Headquarters, US Army Armament, Munitions and Chemical Command (AMCCOM) located at Rock Island, Illinois 61299-6000, has the logistical responsibility to procure, deploy, and maintain the family of cannons currently being used with the Main Battle Tank. This application is a request for a renewal license to possess and deploy a tritium illumination device mounted on the cannon to provide an alignment capability at night. The tanks and the family of cannons equipped with the illumination device will be used by both the US Army and Marine Corps.

2. The complete illumination device will be replaced when broken or when its useful life is terminated. The source does not present an external hazard to the user, and bulk storage will be only at authorized depots in a controlled area. Tritium lamps will not be replaced, and maintenance will not involve removal of the tritium source. Defective lamps will be disposed as radioactive waste (Annex VI).

3. The renewal application contains essentially the same information as previously submitted with the exception of the following:

a. Maximum activity to be possessed at any time increased to 85,000 ci.

b. Update of resumes of License Manager, Radiation Protection Officer (RPO), and Alternate RPO.

c. Update of drawing and technical information.

Application for Renewal of
Byproduct Material License
12-00722-09

Application Package Contents

Annex	Subject	NRC Form 313 Block
I	Radioactive Material	5
II	Purpose for Which Licensed Material Will be Used	6
III	Training and Experience in Radiation	7 and 8
IV	Facilities and Equipment Involved in Fielding The Muzzle Reference Sensor	9
V	Radiation Safety Program	10
VI	Waste Management	11

ANNEX I - Radioactive Material

1. Reference NRC Form 313, block 5.

2. Headquarters, AMCCOM, has the logistical responsibility to obtain and administer NRC licenses required to deploy US Army/Marine Corps weapons and systems procured by AMCCOM. The Army and Marine Corps Tanks are fitted with a muzzle reference sensor (MRS) on the cannon. The MRS has a maximum activity per source of 10 curies of tritium (H-3) oxide with impurities not to exceed 6 percent. The maximum amount which will be possessed at any one time is 85,000 curies or 8,500 sources, whichever is reached first.

ANNEX II - Purpose for Which Licensed Material Will be Used

1. Reference NRC Form 313, block 6.

2. The Muzzle Reference Sensor (MRS) System measures and compensates for gun tube bend caused by the uneven heating and cooling effects of solar radiation, wind, rain, and main gun firing. The MRS System permits rapid main gun to gunner's primary sight bore sight correction whenever the gunner suspects tube movement and aligns the primary sight reticle with the muzzle-mounted MRS reticle and enters the change semiautomatically into the vehicle fire control ballistic computer.

3. The MRS System consists of the following components:

   a. A fixed collimator reticle bolted to the gun tube muzzle.

   b. The adjustable gunner's primary sight reticle (aiming reticle).

   c. Logic to input alignment changes to the ballistic computer.

4. The muzzle-mounted reticle is illuminated by ambient light for day viewing and by the tritium light source for night viewing.

5. The following figures are enclosed:

   a. Figure 1-1 shows the XM-1 vehicle with the muzzle reference sensor mounted on the cannon.

   b. Figure 1-2 is a close-up of the muzzle reference sensor mounted on the cannon.

   c. Figure 1-3 shows the collimator assembly.

   d. Figure 1-4 shows the cell assembly.

   e. Figure 1-5 shows the beam splitter assembly.

   f. Figure 1-6 shows the tritium light source.

6. Design of the cell assembly (figure 1-4) precludes breakage in the field due to rough handling. The tritium is contained in a sealed glass sphere under a pressure of 40 psi. The inside of the sphere is coated with a zinc sulfide phosphor that emits visible light. To prevent accidental breakage of tritium source during firing, the glass is encapsulated by a .050-inch thick layer of silicone rubber inslide a metal housing. Only a .125-inch diameter window is required in the rubber enclosure for MRS reticle night illumination.

7. The cell assembly (figure 1-4) is a complete sealed module in which the tritium source is housed. No part of the source is exposed to the user. A

defective cell assembly is defined as one which does not illuminate and will be replaced in the field as a complete module. No specific procedures are required for this operation. Organizational personnel will be authorized to requisition the cell from depot support and will be required to turn in a defective cell to obtain the replacement. No storage of this module will be authorized at any level other than depot. We are also requesting that complete muzzle reference sensors (figure 1-3) be authorized at user locations to support the tanks. It is not anticipated that these requirements will exceed 10 spare units per 100 vehicles.

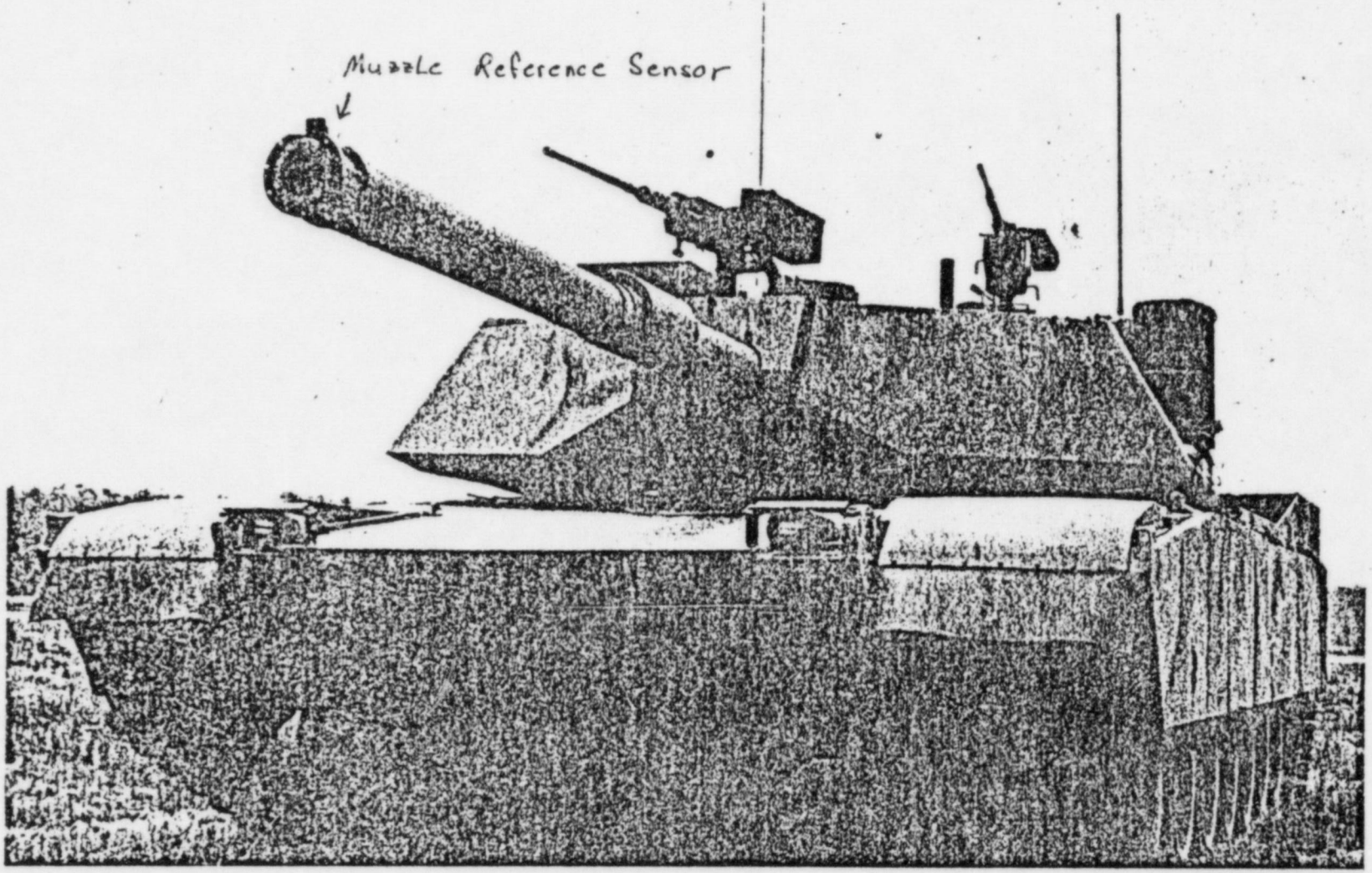


FIGURE 1-1 .... XM1 VEHICLE WITH MUZZLE REFERENCE SENSOR MOUNTED ON M68 CANNON

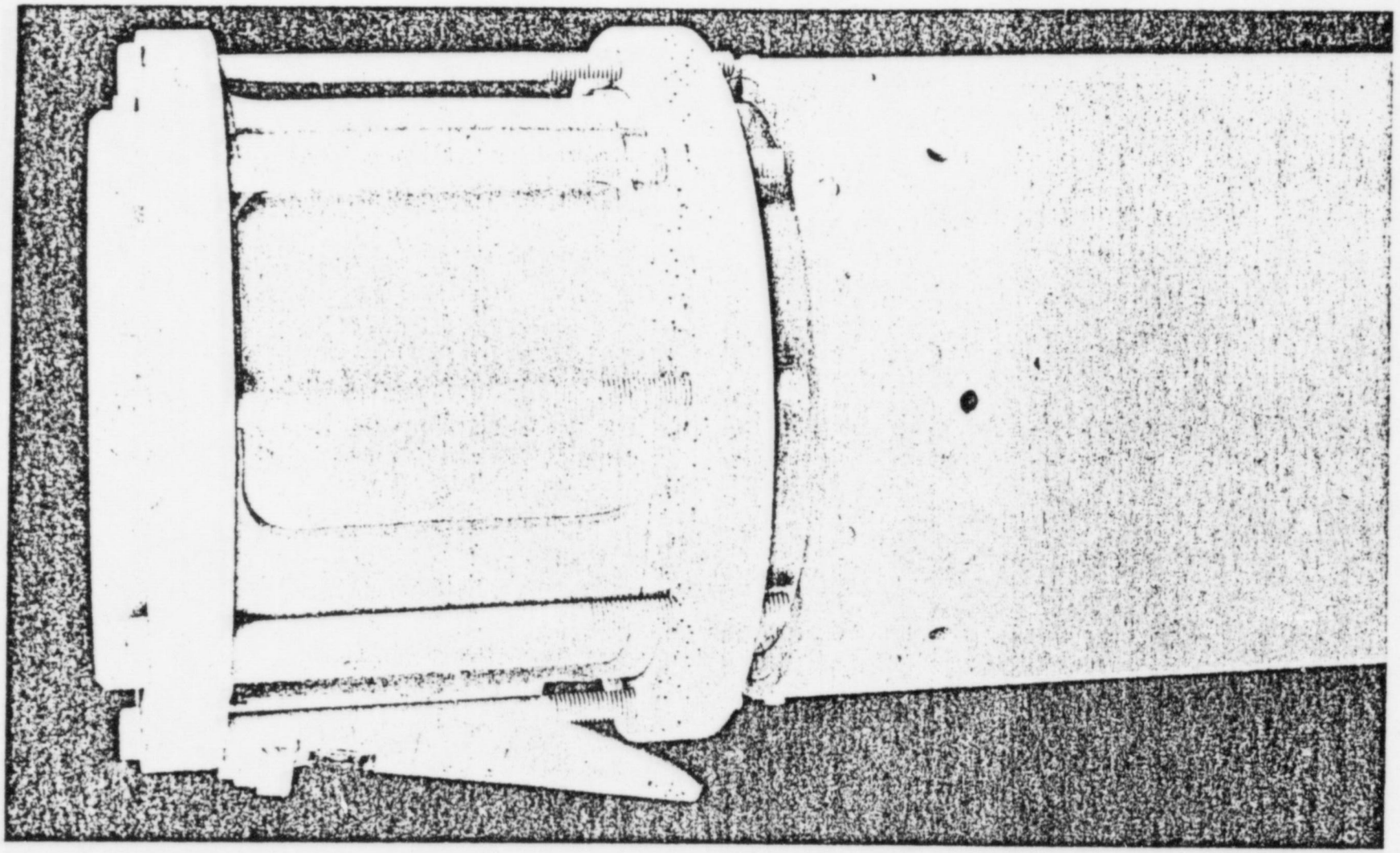


FIGURE 1-2 .... CLOSE-UP OF MUZZLE REFERENCE SENSOR MOUNTED ON M68 CANNON

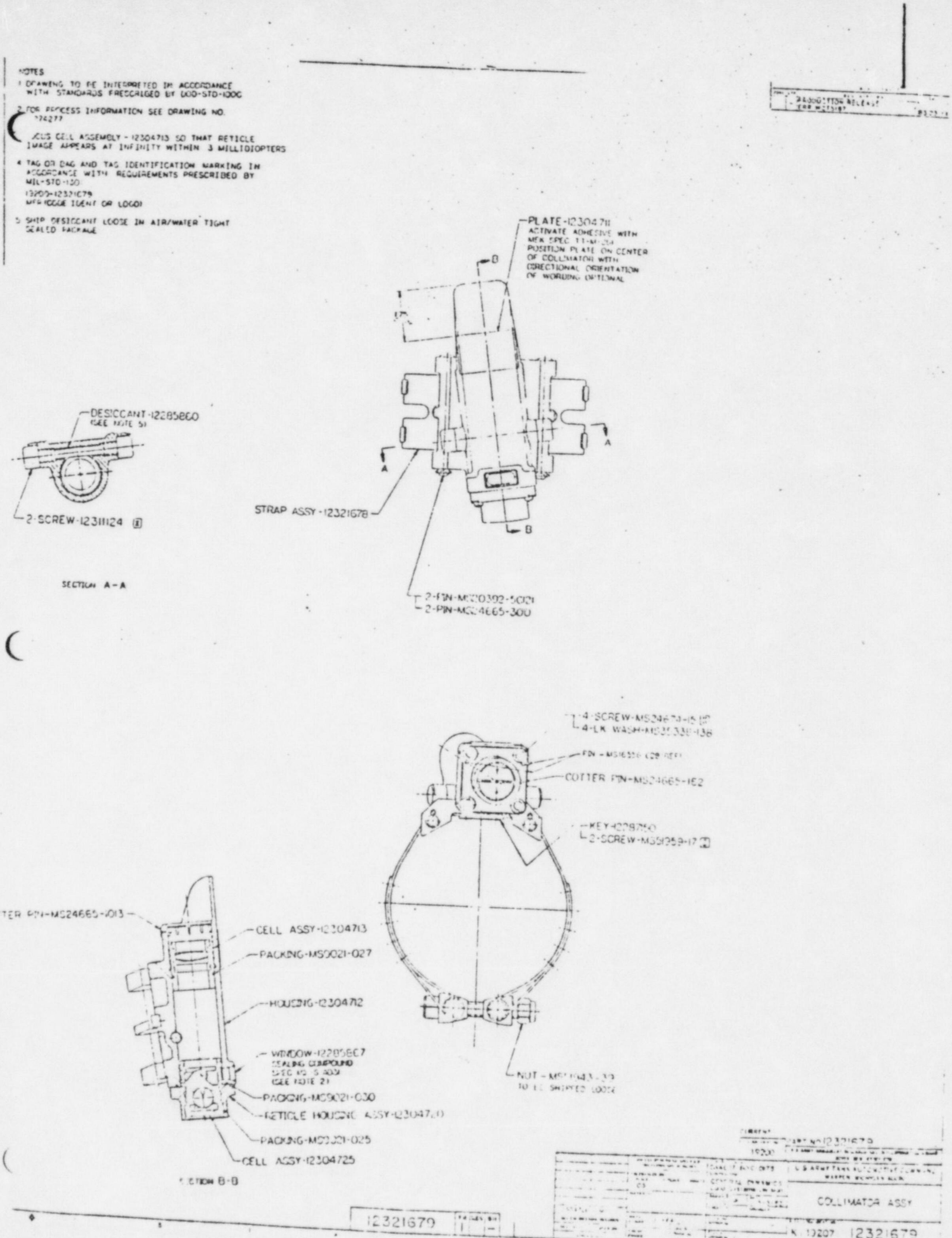
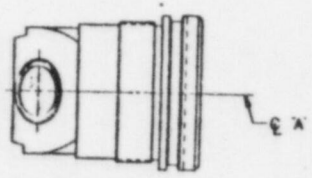
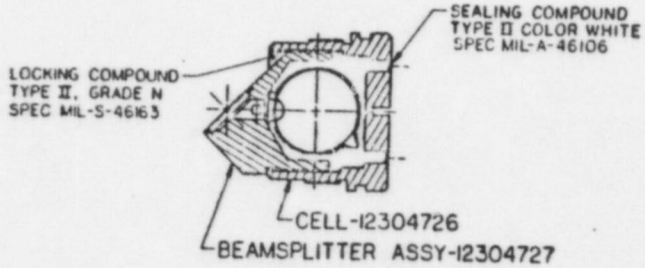
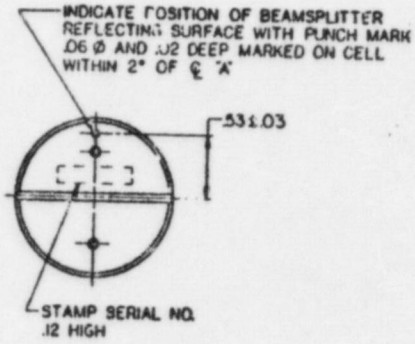


Figure 1-3

1854







ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED
A8 B5	A	(1) PROCESS NOTE REMOVED NOTES RENUMBERED (2) NOTE REVISED MIL-A-46106 TYPE II COLOR WHITE W/AS MIL-S-11031 ECP X1301	5/11/81	H.R.
B5 C5	B	12304726 REVISED PER DETAIL ECP X1471	11/11	R.L.
	C	INITIAL RELEASE CODE IDENT AND COMMAND CHANGED ERR W2T2500-AK	82-05-19	DP

1. APPLY PER MIL-STD-130:
   19200-12304725

NOTE

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-STD-100

CAGE	PART NO. 12304725
19200	

U.S. ARMY TANK AUTOMOTIVE COMMAND
WARREN, MICHIGAN 48090

CELL ASSY

SEE SEPARATE PARTS LIST 12304725

12304730	A8
SEE ENGINEERING RECORD	
NEXT ASSY	USED ON
APPLICATION	

CONTRACT DAAK-30-77-C-0086
CONTRACTOR CHRYSLER CORP. DETROIT DIV.

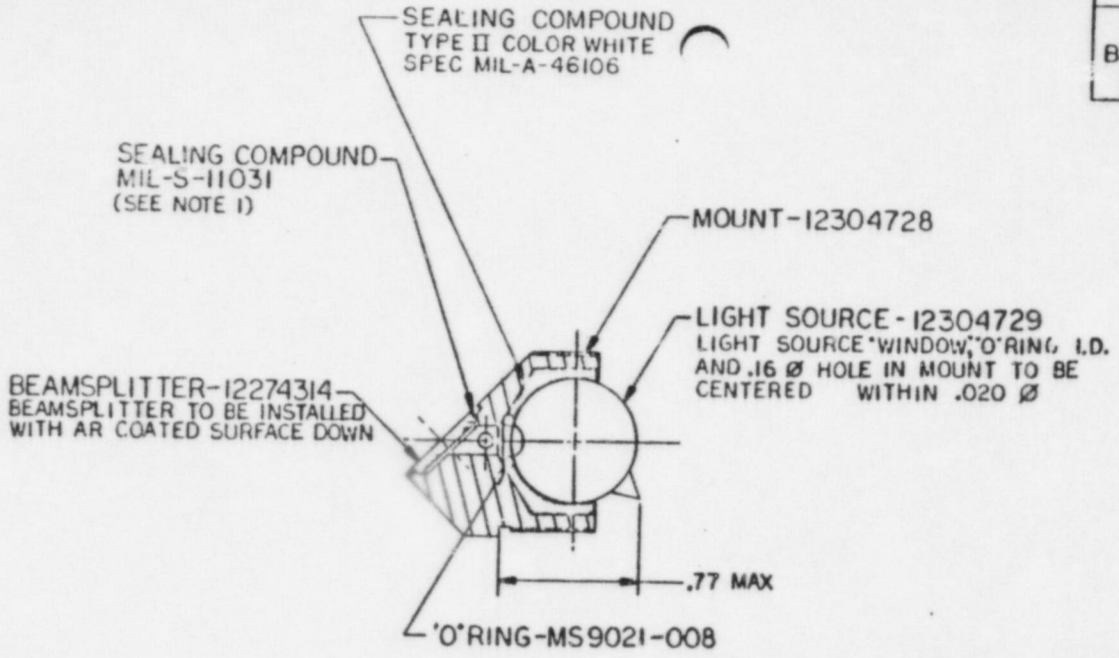
SIZE	CAGE IDENT NO.	DRAWING NO.
D	19207	12304725

SCALE 2/1 SHEET 1 OF 1

Figure 1-4

XM-ECP
W2T2500-AK

A	MIL-A-46106, TYPE II COLOR WHITE ADDED ECP-X1301	5/1/81	
B	INITIAL RELEASE CODE IDENT AND COMMAND CHANGED ERR W2T2500-AK	82-05-19	



2. APPLY PER MIL-STD-130:
   19200-12304727

1. FOR PROCESS INFORMATION
   SEE DRAWING 12274277

NOTES:

GEOMETRIC CHARACTERISTIC SYMBOLS

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-STD-100

SEE SEPARATE PARTS LIST 12304727

12304725	M1
SEE ENGINEERING RECORDS	
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TOLERANCES ON:
2 PLACE ± ——— 3 PLACE ± ——— ANGLES ± ———

MATERIAL

MATL. ENGR. 9/4/80

CONTRACT NUMBER DAAK-30-77-C-0006

CONTRACTOR CHRYSLER CORP. DEFENSE DIV.

DRAWN BY [signature] DATE 4-23-80

CHECKER [signature] 6-2-80 ENGINEER [signature]

DRAWING APPROVAL [signature]

DESIGN APPROVAL [signature]

CODE IDENT NO. 19200

PART NO. 12304727

U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
DOVER, NEW JERSEY 07801

~~U.S. ARMY TANK AUTOMOTIVE COMMAND~~
~~WARREN, MICHIGAN 48090~~

BEAMSPLITTER ASSEMBLY

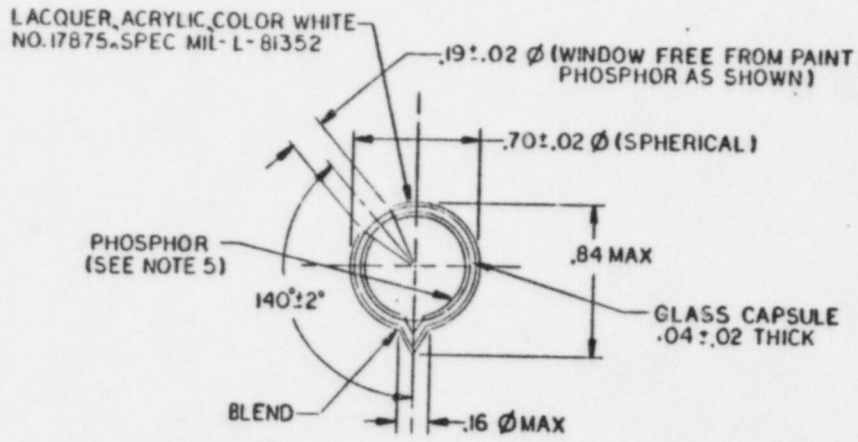
SIZE C | CODE IDENT. NO. ~~19207~~ | 12304727

SCALE 2/1 | UNIT WT. | SHEET ———

Figure 1-5

XM-ECP
W2T2500-AK

LTR	DESCRIPTION	DATE	APPROVED
A	NOTE 3 REVISED ECP X1301	9/1/81	
B	INITIAL RELEASE CODE IDENT AND COMMAND CHANGED ERR W2T2500-AK	82-05-19	



7. QUALITY ASSURANCE REQUIREMENTS (QAR'S) APPLY TO THIS DRAWING (QAR NO. SAME AS PART NO.)
6. APPLY PER MIL-STD-130: 19200-12304729
5. PHOSPHOR COLOR-GREEN (5260±50 ANGSTROMS) BANDWIDTH AT 50 PERCENT INTENSITY LEVEL TO BE 75 MILLIMICRONS
4. MAXIMUM LEAKAGE RATE OF .05 MICROCURIES PER 24 HOURS MEASURE BY LIQUID SCINTILLATION TECHNIQUE IN ACCORDANCE WITH ANSI N540
3. TYPICAL TRITIUM CONTENT 10.0±.2 CURIES
2. SOURCE BRIGHTNESS SHALL NOT BE LESS THAN 5.0 FOOT LAMBERTS
1. MATERIAL: BOROSILICATE GLASS

NOTES:

GEOMETRIC CHARACTERISTIC SYMBOLS (USE PER ANSI Y14.5 1973)

INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-STD-100

12304727	M1
SEE ENGINEERING RECORDS	
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES

TOLERANCES ON: 2 PLACE ± —— 3 PLACE ± —— ANGLES ± ——

MATERIAL: SEE NOTE

MATL. ENGR. [signature] 9/4/80

CONTRACT NUMBER DAAK-30-77-C-0008

CONTRACTOR CHRYSLER CORP. GIFFORD DIV.

DRAWN LW 5-2-80

CHKR [signature] 6-2-80

ENGINEER [signature]

DESIGNG APPROVAL [signature]

DESIGN APPROVAL [signature]

CODE IDENT NO. 19200

PART NO. 12304729

U S ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND DOVER, NEW JERSEY 07801

~~U.S. ARMY TANK AUTOMOTIVE COMMAND WARREN, MICHIGAN 48090~~

LIGHT SOURCE TRITIUM

SIZE C | CODE IDENT. NO. ~~19207~~ | 12304729

SCALE 2/1 | UNIT WT | SHEET —

Figure 1-6

XM-ECP

W2T2500-AK

ANNEX III - Training and Experience in Radiation

1. Reference: NRC Form 313, blocks 7 and 8.

2. Headquarters, AMCCOM - has the responsibility for the procurement and life-cycle management of the Muzzle Reference Sensor (MRS) System, including custodianship of the NRC license for possession and deployment. The HQ, AMCCOM, Radiation Protection Officer (RPO) provides health physics guidance and serves as the technical advisory point for the Command Staff. The HQ, AMCCOM, license manager acts for the Commander to provide management guidance and enforcement of NRC license conditions. Resumes for the License Manager, RPO, and Alternate RPOs are provided as encl 1.

3. Bulk Storage Locations - will be limited to depots (ANNEX IV) currently being utilized to store other NRC licensed tritium lamps or devices. The RPOs at these locations all have training and experience commensurate with their responsibilities. Personnel at these locations have received instructions and training and will not be authorized to perform any maintenance on the Muzzle Reference Sensor System. In addition, these installation RPOs will have, as a minimum, one of the following:

a. A Bachelors degree, or specialty, in Science, Engineering, Health Physics, or equivalent discipline.

b. 80 hours of formal training to include the following areas:

(1) Principles and practices of radiation protection.

(2) Radioactivity measurement standardization and monitoring techniques and instruments.

(3) Mathematics and calculations basic to the use and measurement of radioactivity.

(4) Biological effects of radiation.

(5) Applicable Federal and Army regulations.

c. Successful completion of US Army Radiological Safety Course (7K-F3) satisfies this requirement.

4. User Storage Locations - User storage locations will not be authorized more than 10 spare MRS at any one time and are required to have a military RPO or CBR officer. This RPO/CBR officer will provide control and responsibility for safe use and handling of the Muzzle Reference Sensor System. User storage locations will be at US Army or Marine Corps installations.

AMCCOM License Manager

Resume of Training and Experience of
David P. Skogman

1. Educational Background:

University of Minnesota - BSAE - Aeronautical Engineering 1962-1968
Texas A&M University - MEIE - Industrial Engineering 1970-1972

2. Formal Training in Radiation Protection Methods, Measurement and Effects:

a. Radiological Health (211 and 212) — 3 Weeks
Given by Eastern Environmental
Radiation Laboratory at Field
Safety Activity, Charlestown, IN (3/72)

b. Laser Safety — 1 Week
Field Safety Activity
Charlestown, IN (10/75)

3. Experience in Radiation Protection Methods, Measurement and Effects:

a. ARMCOM Alternate Radiation Protection Officer - 4/74 to 6/75.

b. ARMCOM Radiation Protection Officer - 6/75 to 11/76.

c. Member and Secretary of ARMCOM Ionizing Radiation Control Committee - 4/75 to 7/76.

d. ARMCOM NRC License Manager - 11/76 to Present.

e. Group Leader of Safety Office Division - 6/75 to Present. Responsible for ARRCOM Radiation Safety Program.

f. Chairman of ARRCOM Ionizing Radiation Control Committee - 7/76 to Present.

g. Acting Chief, Headquarters US Army ARRCOM Safety Office - 7/78 to 2/79.

h. Chairman of AMCCOM Ionizing Radiation Control Committee - 7/76 to Present.

RESUME OF TRAINING AND EXPERIENCE OF
BYRON MORRIS
AMCCOM RPO/HEALTH PHYSICIST

1. General Educational Background:

Hannibal LaGrange College	Undergraduate Work	Journalism	1948-49
St. Ambrose College	4 Years - BA	Physics/Math	1950-54
Texas Christian University	Graduate Work	Physics/Math	1957-59
Augustana College	Graduate Work	Physics/Math	1970-72
University of Illinois	Graduate Work	Physics	1974

2. Formal Training in Radiation Safety:

a. Principles and Practices of Radiation Protection.

Course	Duration of Training	Completion
Radiological Safety Fundamentals 133 Correspondence Course Aberdeen, MD	13 Credit Hours	September 1976
Radiological Safety Applications 134 Correspondence Course Aberdeen, MD	9 Credit Hours	October 1976
Introduction to Health Physics Oak Ridge Assoc. Univ. Oak Ridge, TN	100 Hours	December 1976
Depleted Uranium Safety Battelle PNL Department of Energy Richland, WA	40 Hours	April 1978
Laser Safety Field Safety Activity Charlestown, IN	24 Hours	October 1979
Depleted Uranium Safety in Processing Army Materiels and Mechanics Research Center Watertown, MA	40 Hours	October 1979

Course	Duration of Training	Completion
On-Scene Commanders Training Radiation Accident Course Defense Ammo Center & School Savanna, IL	8 Hours	October 1980
Radioactive Waste Disposal Workshop US Ecology, Inc. Rock Island, IL	16 Hours	March 1981
Radioactive Waste Packaging Transportation, and Disposal Chem-Nuclear Systems, Inc. Midlands Technical College Columbia, SC	27 Hours	October 1981

b. Radioactivity Measurement Standardization and Monitoring Techniques and Instruments.

Course	Duration of Training	Completion
Counting Room Operation and Analyses of Foil Detectors General Dynamics Ft. Worth, TX	1 Year (On-Job)	1957
Theory and Operation of Radiation Detection Instrumentation General Dynamics Ft. Worth, TX	3 Years (On-Job)	1960
Basic Radiation Monitor Foil Activation Analyses Course Nevada Test Site Mercury, NV	40 Hours	1962
Senior Officers Nuclear Accident Course Kirtland AFB Albuquerque, NM	28 Hours	September 1977

c. Mathematics and Calculations Basic to the Use and Measurement of Radioactivity.

Course	Duration of Training	Completion
Undergraduate Courses St. Ambrose College Davenport, IA	36 Semester Hours Credit	1954
Various Mathematics Courses Texas Christian University Ft. Worth, TX	18 Semester Hours Credit	1959
Advance Probability and Statistics Augustana College Rock Island, IL	27 Hours	1970

d. Biological Effects of Radiation.

Course	Duration of Training	Completion
Health Physics in Radiaton Accidents REAC Center, Oak Ridge Universities Oak Ridge, TN	40 Hours	January 1977
Laser/Microwave Hazards US Environmental Hygiene Agency Aberdeen, MD	40 Hours	April 1977

3. Experience with Radioisotopes:

Isotope	Maximum Activity	Duration of Experience	Type of Experience
Co-60	500 Curies	8 Years	Calibration, Leak Test, Inventory, Lab Analyses
Po-Be	10 Curies	8 Years	"
Pu-Be	10 Curies	8 Years	"
Cs-137	120 Curies	8 Years	"
Pm-147	Millicuries	4 Years	Survey, Inspection, Inventory, Lab Analysis
H-3	10 Curies	4 Years	"

4. Experience with Other Radiation Producing Machines:

Radiation Machine	Duration of Experience	Completion
Texas Nuclear Neutron Generator General Dynamics Ft. Worth, TX	2 Years	Operation for Various Shielding Experiments
Aerospace Shield Test Reactor (10 MW) General Dynamics Ft. Worth, TX	6 Years	Operation for Various Shielding Experiments
Tower Shielding Facility Reactor Oak Ridge National Lab Oak Ridge, TN	3 Months	Various Shielding Experiments
Linear Accelerator Nuclear Effect Lab White Sands Missile Range White Sands, NM	2 Weeks	Test Components of VADS for Vulnerability to Radiation

5. General Nuclear Background:

Was employed by General Dynamics at Ft. Worth, TX, from 1956-1970, and assigned to Nuclear Research and Development Division. Participated in all phases of nuclear experimental and analytical projects. Obtained experience in counting room with foil activation and analyses, becoming familiar with counting equipment and techniques. Spent considerable time in reactor area operating detection devices; such as, fast neutron detectors (FNDs), scintillation detectors (ASDs), and boron trifloride counters (BF_3s). Was responsible as crew chief for a variety of larger experiments involving radiation penetration and heating of candidate shield materials, with responsibilities involving safety and supervision of 3-6 nuclear engineers and support personnel in reactor area. Authored numerous technical reports from 1960-1970.

Was advisor and coordinator to ORNL scientists for General Dynamics' radiological detection devices used by Oak Ridge for several shielding experiments at the Tower Shield Facility.

Participated in the nuclear bomb test designated "SMALLBOY" at Nevada Test Site (NTS), and was designated Radiation Monitor for five-man team investigating shielding properties of US Army tanks. Received certification as "Basic Radiation Monitor" at NTS.

Appointed advisor to the US/Federal Republic of Germany Joint Design Team on matters pertaining to enhancement of nuclear radiation protection for Main Battle Tank 70. Provided analysis of family of F-111 Aircraft radiation protection for Air Force.

Was employed as Research Physicist for Rock Island Arsenal from 1970-1976. Was responsible for nuclear vulnerability/survivability (vs) analyses of US Army weapons systems as WECOM/ARMCOM VS Project Officer. Directed tests involving initial nuclear radiation, blast, and EMP threats directed at US Army systems.

Was responsible for development and operation of computer procedures to evaluate laser reflectivity from targets for several newly developed guided projectiles. Became familiar with the design and operation of US Army combat systems including the XM198, XM204, M109, and M110 Howitzers, the M551 Sheridan, and M60 Tank.

Am currently employed as Health Physicist for HQ, AMCCOM, Rock Island, IL. Major duties include serving as AMCCOM Radiological Protection Officer, advisor to the Commanding General on matters of radiological safety, and administrator of NRC licenses and DA permits held by the command for radioactive items of issue. Am listed as prime RPO on NRC licenses for byproduct, source, and special nuclear audits and provide advice for all radioactive waste generated and shipped in the Army system.

Resume of Training and Experience of
Elizabeth A. Peterson
Health Physicist/AMCCOM Alternate RPO

1. General Education Background.

Mary Washington College, 4 years, BS Chemistry/Math/Physics 1960-1964.
Oklahoma State University, Graduate work, Inorganic Chemistry 1964-1966.

2. Formal Training in Radiation Safety:

a. Principles and Practices of Radiation Protection:

Course	Duration of Training	Completion
Radiological Safety Fundamentals 133 Correspondence Course Aberdeen, MD	13 credit hours	September 1975
Radiological Safety 7K-F3 Aberdeen, MD	120 hours	October 1975
Laser Safety Field Safety Activity Charlestown, IN	24 hours	October 1980
Nuclear Accident/Incident Control Operations and Planning Defense Ammo Center & School Savanna, IL	80 hours	December 1980
Radioactive Waste Disposal Work Shop US Ecology Inc. Rock Island, IL	16 hours	March 1981
Applied Health Physics Oak Ridge Assoc U. Oak Ridge, TN	200 hours	June 1983
Depleted Uranium Safety Course Battelle PNL US Army Belvoir Research and Development Center Fort Belvoir, VA	40 hours	March 1984

b. Radioactive Measurement Standardization and Monitoring Techniques and Instruments:

Course	Duration of Training	Completion
Alpha, Beta, Gamma, and Liquid Scintillation Counting Rock Island Arsenal Rock Island, IL	1966-1977 (on the job)	1977
Applied Health Physics Oak Ridge Assoc U. Oak Ridge, TN	200 hours	June 1983

c. Mathematics and Calculations Basic to the Use and Measurement of Radioactivity:

Course	Duration of Training	Completion
Shielding, Decay Calculations	1966-1978 (on the job)	1978
Applied Health Physics	200 hours	June 1983

d. Biological Effects of Radiation:

Course	Duration of Training	Completion
Radiological Safety 7KF3	120 hours	October 1975
Applied Health Physics Oak Ridge Assoc U. Oak Ridge, TN	200 hours	June 1983
Radiation Emergency Response Radiation Management Corp. US Army Belvoir Research and Development Center Fort Belvoir, VA	40 hours	January 1984

3. Experience with Radioisotopes:

Isotope	Max. Activity	Duration of Experience	Type of Experience
Co60	120Ci	6 years	leak tests, irradiation experiments

Isotope	Max. Activity	Duration of Experience	Type of Experience
Pm147	1mCi	3 years	leak tests of sealed sources, tracer studies
Po210	180mCi	5 years	leak test of sealed sources
H_3	10Ci	10 years	leak test sealed sources, inventory, lab. analysis
S35	10mCi	4 years	tracer studies
Sr90	10mCi	4 years	tracer studies
Mo99	10mCi	4 years	tracer studies

4. Experience with Other Radiation Producing Machines:

Instrument	Duration of Experience	Completion
X-Ray Diffraction Spectrometer	10 years	1977
X-Ray Fluorescence Spectrometer	10 years	1977
Scanning Electron Microscope with energy and wave length dispersive spectrometers	5 years	1980

5. General Radiaction Work Background:

a. Was employed by Rock Island Arsenal at Rock Island, IL from 1966-1980 and assigned to the Materials Evaluation Branch of the Engineering Directorate. Conducted tracer analyses, leak tests, surveys, and calibrations of various types of radiation detection equipment.

b. Am currently employed as a Health Physicist for Headquarters, US Army Armament, Munitions and Chemical Command (HQ, AMCCOM) at Rock Island. Duties include working as alternate AMCCOM Radiological Protection Officer, advising the Commanding General on radiological safety matters, preparing NRC licenses and DA authorizations for radioactive items of issue managed by AMCCOM, conducting inspections of radiation safety programs at army ammunition plants, and conducting inspections of compliance to NRC license requirements at user and storage locations.

ANNEX IV - Facilities and Equipment Involved in Fielding the Muzzle Reference Sensor

1. Reference: NRC Form 3[illegible] Item 9.

2. Storage operations will be conducted under the supervision of each installation RPO. The following facilities are requested to be designated as bulk storage facilities:

Anniston Army Depot, Anniston, AL
Letterkenny Army Depot, Chambersburg, PA
Lexington-Blue Grass Army Depot Activity, Lexington, KY
New Cumberland Army Depot, New Cumberland, PA
Red River Army Depot, Texarkana, TX
Sacramento Army Depot, Sacramento, CA
Sharpe Army Depot, Lathrop, CA
Tooele Army Depot, Tooele, UT

Individual storage areas of at least 1,000 cubic feet at these installations will be utilized to store a maximum of 500 Muzzle Reference Sensor Systems.

3. No radiation detection equipment is necessary at user level or temporary field storage sites. Storage of muzzle reference sensors in any quantity exceeding 10 sensors will not be authorized at temporary field sites. Replacement of a system will be by exchange at an authorized depot.

4. Installations authorized bulk storage of muzzle reference sensors will have the equipment listed below (or equivalent) available at all times.

Instrument	Radiation Detected	Sensitivity Range	Use
Liquid Scintillation System, Beckman Model LS-100 or Equivalent	Beta	$0-10^6$cpm	Measuring
Air Monitor, Johnson Model 955-B or Equivalent	Beta	$0-10^4$u Ci/m^3	Monitoring

5. Calibration of the liquid scintillation system is accomplished each time the system is use, with standards supplied by the manufacturer.

6. The air monitors are checked at least every 3 months according to methods supplied by the manufacturer.

7. The complete illumination device will be replaced when its useful life is terminated. Tritium lamps will not be replaced, and maintenance will not involve removal of the tritium source.

8. Independent testing agencies have been selected by the AMCCOM Product Assurance Directorate and are subject to the approval of the AMCCOM RPO. These agencies are used for testing, evaluation, and review of the products throughout the life cycle to assure that no health hazards exist. Surveillance tests on the Muzzle Reference Sensor System have shown no significant removable contamination. Copies of surveillance tests can be made available to the NRC upon request.

ANNEX V - Radiation Safety Program

1. Reference - NRC Form 313, block 10.

2. The license RPOs will be responsible for assuring compliance with licensing requirements and for monitoring the overall radiation protection program for effectiveness and adequacy. Specific duties of the HQ, AMCCOM, License RPOs and License Manager are detailed in the HQ, AMCCOM, Radiation Protection Program, encl 1 to this ANNEX. A copy of "Radiation Protection Special Study" and "Hazard Analysis and Storage Criteria" for the muzzle reference sensor are attached (encl 2-3). Copies of the following rules and regulations are maintained at HQ, AMCCOM, ATTN: AMSMC-SFS, Rock Island, IL 61299-6000. Copies may be requested, or information pertinent to these rules and regulations obtained, by contacting the HQ, AMCCOM, Radiological Protection Officer (RPO) AV 793-2964/2965;, commercial 309-794-2964/2965.

a. 10 CFR Part 19-Notices, Instructions, and Reports to Workers; Inspections.

b. 10 CFR Part 20-Standards for Protection Against Radiation.

c. 10 CFR Part 21-Reporting of Defects and Noncompliance.

d. NRC license, license conditions, and license application.

3. Field RPOs will implement radiation protection programs at their installations in accordance with license conditions and technical manuals. Technical manuals are provided to the field for all US Army equipment. These manuals provide safety as well as technical information. Personnel in the field will not be authorized to remove or replace any tritium lamps or perform any maintenance on the radioactive cell.

4. The following safety precautions will be complied with and will provide the basis for the radiation protection program at the user level:

a. The muzzle reference sensor on the end of the main gun tube contains a sealed tritium gas light to serve as an alignment aid. The sealed tritium sources are constructed of a borosilicate glass capsule which is internally coated with phosphorous, filled with high purity tritium gas under pressure of 40 to 50 psi. The phosphor (color green) is excited by the beta emissions of tritium. Every source is bedded in a shock absorbing material within a steel cell, which is assembled into the optical collimator. The low energy beta particles are too weak to penetrate the glass walls of the source. There is, therefore, no external radiation hazard, and consequently, no time limit for personnel handling this equipment. Breakage of a glass source would release the tritium gas, but dissipation into the atmosphere is immediate. The primary means for identifying a leaking H-3 source will be a loss of illumination.

b. Be aware that tritium lights are potentially hazardous when broken.

c. In case of source breakage, brightness decay, or loss of brightness during storage or field operations, inform the local Radiation Protection Officer, immediately.

d. Glass from broken sources must be handled as radioactive waste.

e. Broken sources will be disposed of as radioactive waste as stated in ANNEX VI of this application.

f. Tampering with this source in the field is prohibited by Federal law.

5. The following actions will be taken in regards to bulk storage of the muzzle reference sensors:

a. An inventory record of the radioactive source will be maintained IAW AR 700-64 at each storage depot. The following information will be considered for inclusion in the record: date of transaction, national stock number, radioisotope, activity per item (in curies, millicuries, or microcuries), storage location, number of items received or transferred, balance of items, and total radioactivity at the transaction. A copy of local inventory records will be furnished to key personnel who would be expected to respond to an emergency; e.g., security, safety, fire personnel.

b. A physical inventory count shall be made at least annually at bulk storage depots IAW AR 700-64. Containers will not be opened for this purpose.

c. In case of emergencies where assistance is required, the RPOs can be contacted as below:

Monday thru Friday, 0700-1600
Radiation Protection Officer
HQ, AMCCOM, ATTN: AMSMC-SFS, Rock Island, IL 61299-6000
AV 793-2964/2965
Commercial 309-794-2964/2965

All other times, including holidays, notify one of the license RPOs below:

Byron E. Morris (319) 391-9037 (home) or
Elizabeth A. Peterson (309) 762-8114 (home)

6. More stringent controls have been established for control of radioactive items than for other Army supplies, as distribution of these devices are limited to authorized activities. These controls include identifying and insuring that these systems are coded in the Commodity Command Standard System (CCSS) Automated Data Processing Program as radioactive in accordance with Appendix A of AR 708-1, cataloging and supply management data. These systems are coded with a special control item code (SCIC) of radioactive. Requisitions are processed initially by computers and, due to the radioactive SCIC designation, are then processed manually by the National Inventory Control Point (NICP) item manager to verify that the requisitions are authorized to receive the system.

ANNEX V - Continued

Radiation Protection Program, HQ, US Army AMCCOM

Organizational Responsibilities

a. AMCCOM Ionizing Radiation Control Committee (IRCC)

(1) The AMCCOM IRCC was established by AMCCOM Regulation 10-1.

(2) The purpose of the AMCCOM IRCC is to serve as an advisory committee for the AMCCOM Commanding General in the supervision and control of the fielding and use of radioactive material. Specific functions of this committee include, but are not limited to the following:

a. Review and assist in the preparation of applications for NRC licenses for AMCCOM radioactive commodities. Provide concurrence for each of the directorates represented.

b. Review the NRC license application, the conditions imposed by the license and requirements covering procurement, acceptance from contractor, fielding, use, storage, and disposal of radioactive items of supply. Initiate any actions which may be necessary as a result of the review.

b. AMCCOM RPO

(1) A qualified person appointed by letter by the AMCCOM Command Staff. The present AMCCOM RPO is Mr. Byron Morris Health Physicist. The Alternate RPO is Mrs. Elizabeth Peterson. In the absence of the RPO, the Alternate RPO will perform all duties assigned to the RPO.

(2) Duties of the AMCCOM RPO include, but are not limited to the following:

a. Provide the AMCCOM Commander, the Ionizing Radiation Control Committee, and radiation users with advice and assistance on all matters pertaining to radiation safety.

b. Implement the radiation protection safety program for HQ, AMCCOM.

c. Review radiological operations utilizing radioactive material to determine compliance with regulations and approved procedures.

d. Review inspection and test reports on radioactive materials. Initiate any action which may be necessary as a result of the review.

e. Perform required radiation surveys or cause such surveys to be performed. The accuracy of tests and surveys if performed by others remains the responsibility of the AMCCOM Radiological Protection Officer.

f. Evaluate the hazard potential and adequacy of protective measures for existing and proposed operations involving AMCCOM radioactive commodities at US Army installations and activities.

g. Act as advisor on matters pertaining to any NRC license or DA authorization and respond to questions regarding radiation hazards.

h. Assure that incidents/accidents involving AMCCOM radioactive items are properly investigated and reported by the involved personnel.

i. Assist in the provision of radiation safety input into documentation relative to AMCCOM radioactive commodities.

j. Act as the point of contact for HQ, AMCCOM, on all matters pertaining to the NRC license, the conditions imposed by the NRC license, and license material.

k. Prepare input as necessary for the AMCCOM License Manager to obtain, amend, and maintain licenses and authorizations for radioactive commodities managed by AMCCOM.

c. AMCCOM License Manager

(1) A qualified individual appointed by the AMCCOM Commanding General. The present License Manager is the IRCC Chairman, Mr. Dave Skogman.

(2) Duties of the AMCCOM License Manager include the following:

a. Coordinate, administer, and review necessary licenses and authorizations for radioactive commodities managed by AMCCOM through the AMCCOM RPO.

b. Provide information and guidance to the AMCCOM Commandser with respect to limitations, constraints, and special data, conditions, or procedures which affect the responsibilities for each radioactive commodity.

c. Monitor the various elements of the life-cycle program of the radioactive commodities to assure compliance with conditions of the license or authorization.

d. Assure that licensed or authorized material is not transferred to unauthorized persons or organizations.

d. AMCCOM Safety Office, AMSMC-SF, is assigned the responsibility for the AMCCOM Radiological Safety Program.

e. Maintenance Directorate, AMSMC-MA.

(1) Prepare any special instructions required to the field and make necessary changes to technical publications on the radioactive material.

(2) Assure special instructions to the field contain safety and handling instructions.

(3) Provide or recommend training, as required, to other Army agencies or the Marine Corps for maintenance, rebuild, and rework of AMCCOM radioactive commodities.

(4) Obtain concurrence of AMCCOM RPO on above actions.

f. Materiel Management Directorate, AMSMC-MM.

(1) Maintain records of total quantities procured in the supply chain for worldwide assets.

(2) Maintain records of warehouse storage locations.

(3) Maintain records on total quantities disposed of.

(4) Make available above records as required to the AMCCOM RPO.

(5) Provide an annual inventory report to the AMCCOM RPO for review.

(6) Coordinate all transfers and disposal actions with the AMCCOM RPO.

g. Procurement Directorate, AMSMC-PC.

(1) Assure that the contract for purchase of any radioactive material or item of equipment containing radioactive sources is identified as a hazardous item contract. This will provide that a pre-award survey of the contractor will be performed. During the Radiation Protection Program pre-award survey, determination will be made that the contractor does have or will obtain an NRC license and the capability to perform the work involved safely.

(2) Assure the necessary safety clause identifying the hazardous item (radioactive material) is included in the solicitation and resultant contract.

(3) Assure information pertaining to the product assurance acceptance procedures are included in the solicitation and resultant contract.

(4) Assure the technical data package and the solicitation have been coordinated with the concurred in by AMCCOM RPO.

(5) Coordinate procurements and reporcurements with the AMCCOM RPO and Item Manager.

h. Product Assurance Directorate, AMSMC-QA.

(1) Coordinate and monitor broad overall command policy and procedures concerning AMCCOM quality assurance functions for production.

(2) Determine and apply requirements for contractual inspection and acceptance clauses/provisions which complement and/or ensure implementation of the quality assurance provisions in the design engineering activity's technical data package. Also, develop and maintain Storage Serviceability Standards for AMCCOM assigned radioactive items.

(3) AMSMC-QAF will provide the interface required between the Government agency designated inspection and acceptance functions and the AMCCOM RPO.

(4) During the acceptance inspection at the contractor's facility, the Government Inspector will reject the lot of material represented by the appropriate sample, when the sample fails to meet acceptance criteria. It will be the contractor's responsibility to screen the lot of rejected material and take necessary corrective action to preclude occurrence in future lots. Handling and disposal of defective radioactive source shall be by the contractor as specified in the contract. Additionally, quality audits by an independent testing laboratory (Government or industrial) shall be conducted by random sampling of production lots. The random samples selected from production are to be inspected to specified requirements to assure there are no health hazards with the product.

(5) Prepare and implement a Surveillance Program for item with light sources in storage and in use. This program will be coordinated with the NICP item manager and AMCCOM RPO.

a. An annual random sample shall be selected from items with light sources in storage and in use and forwarded to an independent testing laboratory. The sample size shall be in accordance with 10 CFR Part 32.110 for a lot tolerance percent defective 10 percent.

b. The NICP item manager shall determine location and quantity of items containing light sources to be selected for random samples in storage and in use.

c. Surveillance of materiel in storage is the responsibility of the depot/installation RPO to be conducted in accordance with the Storage Serviceability Standard, technical manuals, or special AMCCOM instructions.

(6) Assure all records of testing, inspection, and pertinent information are maintained and made available to the AMCCOM RPO and NICP item manager as appropriate and as required for their actions.

i. Engineering Support Directorate, SMCAR-ES, ARDC, and SMCCR-ES, CRDC.

(1) Shall be responsible for coordination of all R&D activities related to development and improvement of fire control containing H3 sources and licensed by the US Army AMCCOM.

(2) Shall be responsible for insuring that retrofits and product improvements connected with aforementioned items are in full compliance with the NRC license or DA permit.

(3) Provide current information, drawings, manuals, and technical input to the RPO for systems under their management. This input will be sufficient for inclusion in an NRC license application.

(4) Shall coordinate above activities with the AMCCOM RPO.

j. Weapons Systems Management Directorate, AMSMC-AS.

(1) Inform the RPO when a malfunction of AMCCOM supported equipment results in a release of radioactive material.

(2) Provide guidance and assistance to the RPO in matters of enforcement and inspection at depots, manufacturers, in the field, etc., to assure full compliance with conditions of the NRC license.

k. Surgeon General's Office, AMSMC-SG.

(1) Shall provide technical review of nonmedical radioactive material to determine possible existence of health hazards.

(2) Shall coordinate above reviews with the AMCCOM RPO.

l. Not used.

m. International Logistics, AMSMC-IL.

(1) Shall monitor all foreign military sales (FMS) of radioactive material. For sales involving radioactive material, shall provide AMSMC-SF with sufficient information to obtain an export license prior to mailing the letter of offer through channels to the FMS customer. This action will be accomplished by staffing all such offers through AMSMC-SF and by forwarding to AMSMC-SF, at the time of coordination, a separate sheet containing export license data.

(2) Shall keep history records of FMS shipments of Military Articles and Service List (MASL) items that contained radioactivity. These records will include the quantity of items shipped and the date they were shipped. Records will be made available to NRC inspectors upon request only.

n. Installations and Services Directorate, AMSMC-IS.

(1) Shall provide guidance in th development of environmental documentation necessary to obtain NRC licenses.

(2) Shall provide review of environmental data and assessments submitted by AMCCOM subordinate installations. Review will result in recommendations, if required, to improve submissions.

(3) Shall provide support required to maintain AMCCOM facilities and equipment as required by Federal regulations and NRC license conditions.

o. Office of Counsel, AMSMC-GC.

(1) Shall provide legal interpretations and guidarce for all matters pertaining to radioactive licensing.

(2) Shall assist RPO in administering the Army wide radioactive waste disposal program wherever necessary.

p. Defense Ammunition Supply Directorate, AMSMC-DS.

(1) Shall provide administrative support and keep records involved with the operation of the Army radioactive waste disposal program.

(2) Shall provide concurrence of AMSMC-SF prior to shipment of all radioactive waste to a consolidation site, broker, or burial site.

q. Transportation, AMSMC-TM. Shall provide guidance on all matters concerning transport of radioactive items within CONUS and to/from OCONUS.

r. Public Affairs Office, AMSMC-IN.

(1) Shall coordinate and release all information to non-Government organizations as requested.

(2) Shall obtain concurrence of AMSMC-SF for matters pertaining to NRC license responsibilities and radiation safety.

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

Mr. Edge/lm/AUTOVON
584-3526

HSE-RH/WP

28 SEP 1979

SUBJECT: Radiation Protection Special Study No. 28-43-0923-79, XM1 Tank System Tritium Self-Luminous Light Source Used to Illuminate the Muzzle Reference Sensor Reticle for Night Viewing, 3 May 1979

Project Manager
XM1 Tank System
Warren, MI 48090

1. AUTHORITY.

a. AR 40-5, Health and Environment, 25 September 1974.

b. Message DRCPM-GCM-SW, Project Manager XM1, Tank System, 051535Z Jan 79, subject: XM1 Tank System, with indorsements thereto.

2. REFERENCES.

a. AR 70-1, Research and Development, Army Research, Development, and Acquisition, 1 May 1975.

b. AR 70-10, Research and Development, Test and Evaluation During Development and Acquisition of Materiel, 29 August 1975.

c. AR 700-64, Radioactive Commodities in the DoD Supply Systems, 18 November 1976.

d. Title 10, Code of Federal Regulation (CFR), 1979 ed., Part 32, Specific Domestic Licenses to Manufacture or Transfer Certain Items Containing Byproduct Material.

e. American National Standards Institute (ANSI) N540; Classification of Radioactive Self-Luminious Light Sources - 1975.

HSE-RH/WP
SUBJECT: Radiation Protection Special Study No. 28-43-0923-79, XM1 Tank System Tritium Self-Luminous Light Source Used to Illuminate the Muzzle Reference Sensor Reticle for Night Viewing, 3 May 1979

3. PURPOSE. This special study was performed to determine the presence and extent of any health hazards resulting from the use of tritium self-luminous light sources located on the muzzle reference sensor reticle for night viewing.

4. GENERAL.

a. The radiological health hazard evaluation to user personnel, from the tritium self-luminous light sources, was not initiated as early as possible in the field testing cycle. Therefore, pertinent data from each field test was not made available to this Agency to provide a basis for evaluating the radiological health hazard assessment.

b. This special study consisted of two parts: an onsite radiation protection survey of a tritium self-luminous light source mounted on a XM1 Tank which was located at Aberdeen Proving Ground (APG), Maryland; and laboratory testing of tritium self-luminous light sources after they had supposedly been subjected to appropriate field test operations.

5. FINDINGS.

a. Onsite Radiation Protection Survey.

(1) The onsite radiation protection survey was performed by 1LT John Sykes III, MSC, Health Physics Division, this Agency, on 3 May 1979.

(2) The study was conducted on XM1 Tank number PV-3, located at the Materiel Testing Directorate (MTD) Maintenance Facility, APG.

(3) The vehicle was equipped with the tritium muzzle reference source which contained approximately 7 curies of tritium gas. The source serial number was inaccessible.

(4) Approximately 3,000 rounds of ammunition had been fired through the muzzle with the reference source in place.

(5) The muzzle reference source and the distal end of the gun tube were surveyed using an Eberline RASCAL, ratemeter/scaler, serial number 222, calibrated 11 March 1979.

HSE-RH/WP
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(6) Using the RASCAL with an Eberline HP-210, thin-end-window, Geiger Mueller detector, calibrated in milliroentgen per hour (mR/hr) to cesium-137, no readings were observed above 0.01 mR/hr (background was determined to be 0.01 mR/hr).

(7) Using the RASCAL with an Eberline PG-1, low-energy gamma scintillation detector, calibrated in gross counts per minute (CPM) which was equivalent to a 1200 volts bias setting, no readings were observed above 100 CPM (background was determined to be 100 CPM).

(8) Four wipe test samples, using membrane filter paper, were performed on the exterior of the muzzle reference source and its fitting on the gun tube. Each wipe test sample was placed in a liquid scintillation "cocktail solution" and returned to Radiological and Biological Chemistry Division (RBCD) for analysis. Results of wipe test samples are listed in Table 1 below.

Table 1. Results of Wipe Test Samples

Sample Identification	RBCD Lab Number	Microcurie Per Wipe Test Sample ±2 Standard Deviation
153	L614	$4.0 \times 10^{-5} \pm 7.1 \times 10^{-6}$
154	L615	$<9.8 \times 10^{-6}$
155	L616	$<9.8 \times 10^{-6}$
156	L617	$<9.8 \times 10^{-6}$
157 (control)	L618	$<9.8 \times 10^{-6}$

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(9) The maximum removable radiological contamination measured was 40 picocuries per 50 square centimeters (cm^2) which was below applicable contamination limits established in Table 1, AR 700-64.

b. RBCD Laboratory Evaluation.

(1) Three tritium self-luminous light sources were received by RBCD on 14 May 1979 for the radiological laboratory evaluation.

(2) Each light source reportedly contained approximately 7 curies of tritium gas.

(3) Each light source was wipe tested with a moistened metrical filter. The wipe test samples were counted for beta activity using a liquid scintillation counter. The results were less than 24 disintegrations per minute per wipe test sample.

(4) Each light source was soak tested to determine the leakage of tritium gas. Each light source was submerged in distilled water for 24 hours. A ten (10) milliliter aliquot was collected and counted for beta activity using the liquid scintillation counter. The results are in Table 2.

TABLE 2. Results of Soak Tests

XM1 Collimator Identification	Picocurie Per 24 Hour Soak Test ±2 Standard Deviations
Serial Number 4	<214.7
Serial Number 9	217.0 ± 130.0
Serial Number 12	620.0 ± 140.0

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(5) All observed leakage rates were less than the maximum leakage rate of .05 microcurie per 24 hours as specified in the current quality assurance requirements for the tritium source and which were in accordance with ANSI N540.

6. DISCUSSION. This special study was initially performed to determine the radiological health hazard to user personnel from the XM1 Tank tritium light source. The study consisted of an evluation of one tritium self-luminous source mounted on an XM1 Tank at APG, MD, and RBCD laboratory testing of

three tritium self-luminous sources. The three tritium self-luminous sources received from the XM1 System Project Manager's Office should have been field tested in typical user operations as outlined in AR 70-1, AR 700-64, and Title 10, CFR, Part 32. It could not be determined from the information received by this Agency if the tritium self-luminous sources had been subjected to any designed field tests. These designed field tests are required in order to establish and prove the radiological safety of the tritium sources during normal use, storage, and transportation. Consequently, a radiological health hazard evaluation to user personnel could not be determined from this special study. Previous radiological health hazard evaluations performed by this Agency were coordinated with the US Army Test and Evaluation Command which gave this Agency the opportunity to support materiel test and evaluation milestones prior to key decision points.

7. CONCLUSION. A review of the findings indicated that there were no radiological health hazards resulting from removable radiological contamination and the leakage of tritium gas from the tritium self-luminous sources evaluated. However, the potential radiological health hazard to user personnel could not be determined.

8. RECOMMENDATION. Radiological health hazard evaluation should be considered as early as possible in the test planning cycle and continue throughout the acquisition process as an element of the normal test program for evaluation at each decision review point. Additionally, pertinent data from all tests should be used to provide the basis for evaluating safety and health characteristics in accordance with paragraph 2-21, AR 70-10.

FOR THE COMMANDER:

Frank E McDermott

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HAZARD ANALYSIS AND STORAGE CRITERIA

1. HQ, AMCCOM, as the requesting authority for this license, is fully cognizant of the NRC concept of "As low as reasonably achieveable." This command will conduct operations relating to this license within the concept of ALARA. Our procedures are not based on the allowance of any exposures or releases of radioactivity. The numbers cited in the following hazard calculations as maxium requirements are so stated because of title 10, CFR. To date we know of no instances where any personnel have been exposed to as much as 10 percent of the permissible levels by tritium sources currently licensed to this headquarters. Nor have we released any effluents to unrestricted areas in excess of 1 percent of the MPC.

2. The calculations on the following pages are not intended to present situations which we feel are likely to occur. In fact, we have never experienced a problem as severe as these situations in connection with the tritium lamps currently used by the Army. These assessments are made only with the intent of demonstrating the relatively low degree of hazard associated with tritium-sealed sources in the amounts and size requested by this application.

Tritium Storage Limitations

1. Storage of Tritium Gas Souces

The procurement specifications (Govt. Drawings) permit a leak rate of a maximum of 0.050 uCi/day per source IAW American National Standard N540.

MPC (Maximum Permissible Concentration) for Tritium from 10 CFR 20:

unrestricted area: 2×10^{-7} uCi/ml air
restricted area: 5×10^{-6} uCi/ml air

Air changes taking place under average conditions, exclusive of air provided for ventilation, in a room with no windows or exterior doors*: 1/2 per hour (12 changes/day).

Allowed number of sources (storage) per 1000 cubic feet:

unrestricted area:
MPC x conversion factor ml/ft^3 x N air change/day
Permissible leak rate/source/day (from Procurement drawings)

$$= \frac{2 \times 10^{-7} \text{ uCi/Ml} \times 2.83 \times 10^{7} \text{ ml/1000 ft}^3 \times 12 \text{ air chg/day}}{0.05 \text{ uCi/source/day}}$$

$$= 1358 \text{ Sources/1000 ft}^3$$

Allowed number of sources (storage) per 1000 cubic feet

restricted area:

$$= \frac{5 \times 10^{-6} \text{ uCi/ml} \times 2.83 \times 10^{7} \text{ ml/1000 ft}^3 \times 12 \text{ air chg/day}}{0.05 \text{ uCi/Source/day}}$$

$$= 33{,}960 \text{ sources/1000 ft}^3$$

The above quantities exceed maximum storage of sources at any one installation due to physical restrictions.

*ASHRAE Guide and Data Book, Fundamentals and Equipment American Society of Heating, Refrigerating, and Air-Conditioning Engineers 1963, p432.

Maximum Hazard Assessment of a Fire Involving Breakage of Tritium Gas Souces

The maximum accident which could occur involving a storage area fire would result in the release of all of the tritium in a short period of time. An estimate of the hazard may be obtained using Sutton's equation:

$$\overline{X}(x,y) = \frac{2Qe^{\left[\left(\frac{1}{C^2 x^{2-n}}\right)(y^2+h^2)\right]}}{(3.14)\, C^2 u x^{2-n}}$$

where

$\overline{X}$ = volumetric concentration of the contaminant mCi per M3

Q = emmission rate, mCi/sec

x,y = coordinates of point of measurement from point of release, meters

u = mean wind speed, meters per second

C = virtual diffusion coefficients in lateral and vertical directions

n = dimensionless parameter determined by the atmospheric stability

h = effective chimney height, meters

At any distance from the point of release, the ground level concentration will be a maximum when the center line of the plume is at ground level, y=o. Assuming that the release occurs at ground level, and neglecting the effects of the heated air, the above equation becomes:

$$\overline{X}(x,0) = \frac{2Q}{(3.14)\, C^2 u x^{2-n}}$$

Assume that 1,000 Ci of tritium gas is released in all directions during 1 hour. Thus Q = 1,000 Ci/60 min = 16.67 Ci/min = 277.8 mCi/sec.

From Smith and Singer* for a lapse metrological condition

n = 0.24 and C = 0.4.

*M.E. Smith and I.A. Singer. Am Ind Hyg. Assoc. Quart. 18, 319 (1957)

Assuming a mean wind speed of 10 meters per minute, the resulting concentration of tritium at ranges of 100, 500, and 1000 meters would be as follows:

Range (Meters)	Concentration of H-3 (mCi/M3)
100	2
500	0.12
1000	0.03

The maximum hazard to man would result only in the unlikely event of the fire converting all of the tritium to tritium oxide. The standard man, while performing light work, breathes 1200 liters (1.2 cubic meters) of air per hour, thus, the maximum tritium intake at the above ranges for a 10-minute stay time in the radioactive smoke would be as follows:

Range (Meters)	H-3 Intake for a Standard Man (mCi) (10-min Stay Time)
100	0.67
500	0.023
1000	0.007

Standard practices in SOP's used by all Army activities require evacuation of personnel to an upwind area in case of fire involving radioactive materials and should preclude any exposure.

However, the maximum quantity of material permitted in any field storage area will be 1,000 curies or 1,358 sources, whichever limit is reached first.

At bulk storage locations available instrumentation and safety equipment to detect tritium is sufficient to allow a maximum of 10,000 curies or 33,960 sources, whichever limit is reached first, to be stored in a storage area. These areas will have forced ventilation and tritium air monitors installed as well as be relatively fire-proof.

Hazard Assessment of Accidental Breakage of One or More Tritium Sources

1. Postulated accident: The accidental breakage of one of the H-3 sources by a user with the following input:

a. Less than 1 percent of H-3 is converted to tritiated H_2O; therefore, 0.10 curies tritiated H_2O released in 1 minute.

b. Standard man breathes 20 liters per minute.

c. Maximum permissible body burden = 2×10^3 uCi.

d. Ten minute exposure time.

2. Assumption: The concentration of tritium gas following the breakage is of the form of a time dependent gradient with respect to distance from source. Assume the average concentration a user is exposed to is equivalent to having the activity uniformly dispersed in a spherical volume of radius 10 feet, i.e.:

$$\text{Concentration} = \frac{10.0 \times 10^4 \text{ uCi}}{\left(\frac{4\pi}{3}\right)(10)^3(12)^3(2.54)^3(10^{-3}) \text{ liter}}$$

Concentration = 0.84 uCi/liter

3. Exposure: Assuming even an unlikely 10 minute exposure, a man would inhale and retain the following amounts of tritiated water:

$$\text{Intake} = 0.84 \text{ uCi/liter} \times 20 \frac{\text{liters}}{\text{min}} \times 10 \text{ min}$$

Intake = 168 uCi tritiated water.

Intake = 1/11 Maximum permissible body burden for continuous exposure

4. Breakage of a source in the open air should not constitute any radiological hazard to the user.

ANNEX VI- Waste Management

1. Reference: NRC Form 313, block 11.

2. Radioactive waste generated by Army users is disposed of in accordance with AR 385-11, and current NRC and DOT regulations. At the present time, HQ, AMCCOM, is the focal point and issues instructions to all Army users on proper packaging and marking of shipments of radioactive waste. This headquarters also conducts on-site audits of radioactive waste shipments. The shipments are audited for full compliance with DOT, NRC, and burial site criteria.

3. Radioactive waste disposal methods and procedures used by all organizations covered by this application will be in accordance with NRC regulations and multi-service regulation AR 700-64.