MAGTFTC, MCAGCC STANDARD OPERATING PROCEDURE FOR
IONIZING RADIATION SAFETY

Ref: (a) MCO 5104.3B
(b) MCO 5100.29B
(c) S0420-AA-RAD-010
(d) NAVMED P-5055
(e) SI 6665-15/1
(f) NRC Guide 8.13
(g) NRC Guide 8.29
(h) MCO P4400.150E
(i) MCO 5740.2

Encl: (1) Radioactive commodity information
(2) Selected radioactive commodities and isotopes
(3) Radiological controls, practices and procedures
(4) Glossary

1. Situation. As directed by guidance in references (a) through (h), this Standard Operating Procedure (SOP) provides policy, assigns responsibility, and presents requirements for the administration of the MAGTFTC, MCAGCC radiation safety program as a component of the Marine Corps Safety Program implemented by reference (b). This SOP delineates and enacts the program elements necessary to assure compliance with the Department of the Navy's Nuclear Regulatory Commission (NRC) master materials license.

2. Cancellation. CCO 5140.1.

3. Mission. This SOP establishes the radiation safety program for MAGTFTC, MCAGCC to minimize the risk of injury to personnel and the general public, contamination of personnel and facilities, and loss of control of sources of ionizing radiation. For the purpose of this SOP, sources of ionizing radiation are defined as radioactive materials utilized in commodities or x-ray radiation producing equipment such as the Z Backscatter vans. It does not apply to the use of any fixed or portable medical x-ray equipment used by health service personnel in support of MAGTFTC, MCAGCC operations.

4. Execution

a. Commander's Intent and Concept of Operations

(1) Commander's Intent

(a) Enhance unit and individual readiness by maintaining an effective radiation safety program.

(b) Control sources of ionizing radiation to minimize personnel exposure to level as low as reasonably achievable (ALARA) and to prevent contamination of personnel, equipment, and facilities.

(c) Provide guidance and requirements for implementing reference (a) through (h).

(2) Concept of Operations

(a) Reference (a) is the Marine Corps Radiation Safety Program and is the primary directive for guidance, information and requirements for maintaining radiation protection programs at Marine Corps commands for the control of radioactive materials and radiation sources.

(b) Reference (d) is the Radiation Health Protection Manual and is the primary directive for requirements and procedures regarding radiation exposure limits, radiation medical physical examinations, radiation dosimetry, and occupational radiation exposure records.

(c) This SOP provides additional guidance to supplement references (e), (f), (g) and (h) for radiation sources of primary interest to the MAGTFTC MCAGCC, and to provide requirements necessary for compliance with certain Nuclear regulatory material permit's (NRMP's) and NRC licenses governing Marine Corps equipment.

(d) Requirements contained in this SOP and in the references are intended for observance during peacetime and to the maximum extent possible during wartime operations.

(e) The MAGTFTC, MCAGCC Radiation Safety Program consists of the following elements.

1. This SOP is the coordinating overall radiation safety program for operations occurring aboard MAGTFTC, MCAGCC that may result in radiation exposure to personnel, spread of radioactive contamination, or improper disposal of radioactive materials.

2. The Installation Radiation Safetv Officer (IRSO) and the Radiation Protection Assistant (RPA). The IRSO is the individual appointed by the command to provide consultation and advice regarding implementation of controls for hazards associated with radioactive sources and is responsible for coordinating the base radiation safety program for radioactive materials and radiation sources physically located aboard MAGTFTC, MCAGCC. The RPA is the designated individual at the unit level for ensuring radiation safety practices and procedures are continuously observed.

3. The IRSO shall:

a. Be technically qualified by virtue of education, training, and professional experience to ensure compliance with applicable regulations governing control and disposal of radioactive materials.

b. Establish procedures to ensure proper handling and control of radioactive materials, involving receipt, storage, shipping and disposal operations, are observed aboard the MAGTFTC, MCAGCC and tenant commands. Must work closely with the Traffic Management Office (TMO) in this matter and ensure that radiological guidelines for proper notification to the IRSO of known damaged packages containing radioactive material is a part of the TMO standard operating procedures (SOP).

c. Maintain liaison with field RPA's and provide guidance, training and assistance in the proper control and handling of radioactive materials and sources. Provide adequate radiological training and maintain documentation of this training for the RPAs.

d. Identify available sources of radiological expertise for additional assistance and technical support for handling on base radiological incidents.

e. Advise MAGTFTC, MCAGCC Fire Department and emergency response personnel of the locations where radioactive materials are stored or used.

f. Maintain liaison with the local Defense Reutilization Marketing Office (DRMO) or other on base organizations as required to ensure radioactive materials are not directly or inadvertently delivered to the DRMO as prohibited in reference (c).

g. Report all radiological accidents or incidents (lost/missing/damaged) to the Logistical Radiation Safety Officer (LRSO), Logistics Command (LOGCOM) in Albany, Georgia.

h. Compile and maintain contact and notification information and telephone numbers.

i. Maintain an inventory of all low level radioactive waste (LLRW) being stored aboard MAGTFTC, MCAGCC.

j. Compile and retain decommissioning records.

k. Maintain inventories of all radio activity, detection, indications, and computation (RADIAC) devices or other assets containing radioactive material.

l. Maintain leak test records.

m. Ensure radioactive material movement forms (RAMMFs) are included with any shipment of assets containing radioactive material.

4. Unit RPA shall:

a. Be knowledgeable in the radiation safety requirements contained in technical manuals or other applicable documents for the specific items in their unit that contain radioactive materials. The IRSO will provide radiation safety training to the RPAs.

b. Coordinate with the IRSO to ensure compliance with the Combat Center Radiation Safety Order. Provide the IRSO with periodic inventory listings of radioactive materials or LLRW held at the unit.

c. Promptly notify the IRSO in the event of a radiological occurrence involving broken, damaged or missing radioactive sources or whenever any radioactive contamination has occurred or is suspected.

d. Perform all wipe tests as required and maintain documentation of those wipes.

5. Personnel Training. All personnel who work with radioactive materials or devices containing radiation sources shall be made aware of the hazards or potential hazards that may exist in their workplace from the use of these items. Users of Marine Corps equipment containing radioactive sources shall be instructed to use the equipment in accordance with the published technical manuals, which apprise the operator of the hazards associated with these devices and precautions to be observed. Personnel operating or working with items containing radioactive sources shall be informed as to the:

a. Presence and locations of the radioactive components.

b. Types of radiation emitted by these sources.

c. Safety precautions and hazards associated with these equipment items.

d. Restrictions necessary for Marine Corps compliance under the applicable NRMP or NRC license.

6. Radioactive Commodities. Marine Corps equipment items containing radioactive components are generally referred to as radioactive commodities or radioactive devices. In most cases, an individual radioactive commodity presents little or negligible external radiation exposure. However, large quantity storage of individual items may concentrate sufficient quantities of radioactive material to produce radiation restricted areas. In addition, spread of radioactive contamination as a result of improper maintenance or shipping procedures, carelessness, or fire and explosions at storage areas, can cause adverse environmental and community concerns and expensive cleanup efforts.

7. RADIAC Instrumentation. Various RADIAC instruments and dosimeters are used to detect and quantify radiation exposures. Most Marine Corps RADIAC equipment has been fielded for protection and decontamination recovery actions from nuclear warfare.

8. Technical Assistance. Radiation incidents may result in radiological situations that are beyond the capabilities of MAGTFTC, MCAGCC to abate and outside assistance may be necessary. The request for external assistance will be completed by the IRSO with concurrence from the radiation health officer of the naval hospital. If such an incident does occur, consultation, technical guidance and proper abatement procedures will be obtained from:

a. Commandant of the Marine Corps (CMC) Safety Division (SD).

b. Naval Sea Detachment (NAVSEADET) Radiological Affairs Support Office (RASO).

9. Radioactive Waste Disposal. Radioactive waste aboard MAGTFTC, MCAGCC is generally limited to disposal of equipment items containing radioactive sources. Procedures for proper disposal of radioactive material or waste are complex and involve both federal and state regulations. All units aboard MAGTFTC, MCAGCC will notify the IRSO if any radioactive materials or waste must be disposed of.

RADIOACTIVE COMMODITY INFORMATION

1. Purpose. Guidance on the handling, disposal, shipping, and leak testing of Marine Corps equipment containing radioactive sources and to provide reporting information for lost radioactive sources or contamination occurrences.

2. Radioactive Commodities. As general practice, items are considered to be radioactive if:

a. The item is marked as radioactive or labeled with the three bladed trefoil radiation symbol.

b. The item is identified as radioactive in technical manuals, instructions or in such publications as:

(1) Department of Defense (DoD) 60S0.S-LR or DoD 60S0.S-L Hazardous Materials Information System.

(2) TB 43-0116, Identification of Radioactive Items in the Army Supply System.

c. The item's radiation characteristics meets any of the radioactivity conditions specified in section 7.3 of reference (c).

3. Control Practices for Radioactive Commodities. Section VII of reference (c) provides procedures and defines responsibilities for the control of radioactive commodities at supply facilities, radiation protection of personnel, recommended radiological control practices, shipments of radioactive materials and emergency actions.

4. Leak or Wipe Testing. Certain radioactive commodities require periodic leak testing as a condition of the governing NRC license or NRMP to verify the integrity of the radioactive source. Generally, such commodities do not require leak tests while remaining in storage, but are required to be leak tested or have a current leak test prior to being used or shipped to a using activity. User activities retain responsibility for ensuring fielded items have current leak tests. Items failing the leak test must be immediately removed from service.

5. Emergency Guidelines. In the case of a mishap involving radioactive material, the senior person present shall take immediate steps to control the emergency and request assistance from the IRSO or RPA, and other personnel as required. The initial objective of any mishap response involving radioactive materials is to regain control over the event and prevent further spread of any radioactive contamination produced. However, actions to save life, aid the injured, fight fires, or control further spread of damage, takes precedence over concerns for radiological contamination that may arise from fielded Marine Corps equipment. To minimize personnel exposure from possible internal contamination, the following general steps should always be taken:

a. Sound the alarm. Notify personnel in the immediate area to move away.

b. In the case of tritium gas, vacate the immediate area, move and stay upwind for at least 30 minutes. If in a building, open doors and windows and operate fans to increase ventilation.

c. In the case of fire, stay away from the downwind smoke. The self-contained breathing apparatus worn by fire fighters will provide protection against inhalation of airborne radioactive contamination.

d. Notify the IRSO as soon as possible to ensure proper follow up actions are taken.

6. Contamination Control

a. Devices with broken sources and any resulting debris should only be handled while wearing rubber or plastic gloves.

b. Devices with broken sources and any resulting debris should be double wrapped in two plastic bags and sealed with tape. Clearly label the package as containing a radioactive contaminated device or materials. Obtain disposition instructions from the commodity manager.

c. Personnel who may have received contamination on bare skin should wash with a mild soap and plenty of cold water. Naval Medical Command (NAVMEDCOM) Instruction 6470.10, offers technical guidance for handling radioactively contaminated personnel and monitoring procedures for various radioisotopes.

d. Possible contamination of the immediate area or on the major end item is a judgment call based on the circumstances of the incident and on radiological measurements. Potentially contaminated areas are not to be open for normal access or potentially contaminated equipment returned to service until it has been resolved by the IRSO/RPA that radioactive contamination did not occur or that contamination levels have been reduced to below the allowable limits.

7. Disposition Instructions

a. Transfer. Do not transfer radioactive commodities or radioactive materials to DRMO which is prohibited from accepting radioactive items. Transfer of radioactive commodities to other DoD activities can be made through the DRMO, but the DRMO will not accept physical custody of radioactive sources.

b. Disposition

(1) The IRSO or RPA will request disposition instructions from Marine Corps Logistics Base (MCLB) Albany by message or letter for excess, defective, or non-serviceable radioactive items. The owning unit must provide quantity, national stock number (NSN), serial numbers, condition codes, applicable NRC license or NRMP numbers and other identifying or amplifying information. State in the remarks if the item contains "Tritium Sources" or "Radioactive Materials". If the sources are broken or radioactive contamination is known or suspected, also state "Broken Radioactive Sources" or "Possible Radioactive Contamination".

(2) When the disposition instructions are received, the owning unit will execute all instructions exactly as they are written. If the owning unit has any questions on the disposition instructions or has difficulty in complying with the instructions, they shall immediately notify the IRSO.

8. General Packaging and Shipping Guidance. Transportation of radioactive materials must comply with military, NRC and Department of Transportation (DOT) packaging and shipping regulations. The following paragraphs provides general guidance that is applicable in many cases involving Marine Corps radioactive commodities, but does not supersede or replace published hazardous material shipment regulations.

a. Intact radioactive commodities in the Marine Corps, unless otherwise specified, are usually shipped as Radioactive Material, Excepted Packages-Instruments or Articles under the provisions of DOT Regulations in Title 49 CFR 173.422.

b. Broken, leaking or contaminated radioactive commodities, unless otherwise specified, can be shipped as Limited Quantities of Radioactive Materials under the provisions of 49 CFR 173.421

c. In either case, DOT regulations shall be consulted prior to any shipment of radioactive material to ensure current regulations are being followed. The shipper of record is ultimately responsible for compliance with DOT regulations for shipment of hazardous materials.

d. Shipment of radioactive material shall be by traceable means. Shipment through the United States (U.S.) Mail should be avoided in most cases since U.S. Postal Service regulations governing mailing of radioactive materials are much more stringent with lower radioactivity limits than shipment under DOT regulations.

e. Major equipment end items with normally installed radioactive components, unless otherwise specified, can be transported or moved as military equipment without regard to radioactive shipping regulations. DOT 49 CFR 173.7 allows movement of radioactive material by DOD, exempt from the regulations of parts 170-189, when the material is escorted by personnel specifically designated by or under the authority of DOD for the purpose of national security.

f. Each radioactive commodity shall be packaged for shipment in accordance with individual packaging data sheets (PDS) or special packaging instruction (SPI), or to the requirements of 49 CFR if the PDS or SPI do not meet these requirements. The PDS and SPI are in the packaging data master file (PDMF) and listed by NSN.

g. Radioactive commodities with broken or leaking sources, or which are contaminated or suspected of being contaminated, shall be sealed in two plastic bags. Wear rubber or plastic gloves to prevent skin contamination.

(1) Clearly label the outside of the plastic bag with identifying information as to its content and whether it contains contaminated material or a broken or leaking radioactive source.

(2) Double pack the defective radioactive commodities with the same identifying information placed on the inner package and add the phrase "Contact IRSO before opening". Items shipped under the provisions of 49 CFR 173.421, limited quantities of radioactive materials do not require any external radiation markings or radiation labels if the inner package bears the appropriate warnings and information.

h. Outside surfaces of the package must have removable contamination levels that are less than 2,200 disintegrations per minute (DPM) per l00 cm2 of beta/gamma radiation or 220 DPM/100 cm2 for alpha radiation. This requirement can be met either by conducting a verification wipe test using appropriate low level counting systems, or where such radiation counting equipment is not available, by using packaging material that is new or is known to not be contaminated.

i. Include the appropriate certification statement on the shipping papers or Government Bill of Lading (GBL):

CONSIGNOR: (shipping unit's name)

THIS PACKAGE CONFORMS TO THE CONDITIONS AND LIMITATIONS SPECIFIED IN 49 CFR 173.422 FOR RADIOACTIVE MATERIAL, EXCEPTED PACKAGE, INSTRUMENTS, OR ARTICLES, United Nations 2910.

or

THIS PACKAGE CONFORMS TO THE CONDITIONS AND LIMITATIONS SPECIFIED IN 49 CFR 173.421 FOR EXCEPTED RADIOACTIVE MATERIAL, LIMITED QUANTITY, Not Otherwise Specified (NOS), United Nations 2910.

CERTIFICATION (name & signature)

j. Ensure a copy of the shipping papers are attached to the outside of the package. For broken or contaminated radioactive items, add the following warning on the shipping papers: "Contact RSO Before Opening".

k. Reporting of lost radioactive materials or radioactive contamination events.

(1) Loss of control of radioactive materials can result in contamination of personnel or equipment. In general, such situations would be:

(a) The release of radioactive material from a device through accidental breakage, leakage, explosion or fire.

(b) The loss, theft or destruction of devices containing radioactive materials or radiation sources which could pose a potential hazard to other personnel.

(c) Radiation mishaps and incidents which require reporting as defined in sections 2.10 and 4.10 of reference (b) for NRC licensed materials and x-ray radiography.

(2) The purpose for reporting the loss of radioactive materials or contamination occurrences is to allow follow-up actions by addressees when deemed necessary, and if required, provide notification to the NRC. In the event that a serious threat to health or adverse publicity may exist, the IRSO will submit an OPREP-3, per reference (i).

(a) For radiation mishaps and incident situations defined in reference (c), the IRSO will submit reports as specified and include CMC (SD) as an addressee.

(b) For other abnormal occurrences involving loss, theft or breakage of radioactive sources or contamination events not covered by sections 2.10 and 4.10 of reference (c), the IRSO will submit notification reports by message or letter within 5 working days to CMC (SD), the appropriate NRMP or NRC license manager, Albany and Barstow, with information copies to NAVSEADET RASO and appropriate addresses in the chain of command, containing the following minimum information:

1. Type of occurrence: loss, theft or breakage.

2. NSN and quantity of devices lost, stolen or broken.

3. Description of the circumstances under which the loss, theft or breakage occurred.

4. Statement of the disposition or probable disposition of the devices.

5. IRSO assessment of radiation exposures to individuals and the extent of possible hazards to other personnel, if applicable.

6. Other amplifying information.

7. Point of contact and phone numbers.

(3) MCLB, Albany and MCLB, Barstow will notify originating units when incoming shipments are received that contain radioactive devices that were not indicated to be contaminated or broken or where the exterior surfaces of the package are found to be contaminated. Commands originating such shipments must take follow-up actions to determine if an extensive contamination problem exists where the items were stored, handled or packaged. Special timely notification requirements are specified in 10 CFR 20.205, including immediate notification of the final delivery carrier, when removable contamination levels in excess of 0.01 microcuries (22,000 DPM) per lOO cm2 are found on external surfaces.

9. Radiological Units. The System International (SI) units have been adopted by a number of countries and are increasingly being incorporated in various shipping regulations. RADIAC instruments being fielded in the operational forces for example employ SI units. The following comparison factors are provided for converting between the traditional radiological units [Radiation Absorbed Dose (RAD), Roenpgen Equivalent Man (REM) and Curie] and the SI units (Gray, Sievert and Becquerel).

1 gray = 100 rad
1 rad = 1 centigray -.01 gray
1 millirad = .001 centigray

1 sievert = 100 rem
1 millisievert = l00 millirem
1 microsievert = 0.1 millirem
1 rem = 1 centisievert = .01 sievert
1 millirem = .001 centisievert

1 becquerel = 1 disintegrations/sec = 2.7xl0E-ll curie
1 curie = 37xl0E9 becquerel
1 millicurie = 37xl0E6 becquerel
1 microcurie = 3.7xl0E4 becqueral

SELECTED RADIOACTIVE COMMODITIES AND ISOTOPES

1. Purpose. To supplement reference (a) in providing information on certain groups of radioactive isotopes and selected items containing radioactive materials of particular interest to MAGTFTC, MCAGCC and to promulgate requirements necessary for compliance with NRC licenses governing certain equipment items.

2. General

a. Section VII of reference (c) provides information and requirements on handling and storing radioactive commodities. Understanding the basic requirements for handling different types of radioactive items is simplified when based upon the radiological characteristics of the particular item, i.e., all items containing tritium, uranium, promethium, or thorium fluoride.

b. This enclosure will summarize the radiological characteristics and controls specified in various NRC licenses and technical manuals for certain items fielded in the Marine Corps and for certain widely used radioisotopes. This information is primarily intended to guide the IRSO and unit RPAs in overseeing radioactive storage and control procedures and in establishing precautions for the proper handling of radioactive materials. This information is not intended to supersede requirements that may be specified in applicable technical manuals and work procedures.

c. In some commodities, NSNs or other identifying model numbers may be provided.

3. The commodities and isotopes are arranged in the following order:

a. Tritium Radio Luminescent Devices

(1) Tritium is commonly used as a radio luminescent source for nighttime viewing of scales, counters, level vials, reticules, aiming post lights, compasses, watches and other indicators on various military equipment items. In most applications, tritium gas is sealed inside Pyrex tubes of various sizes and shapes containing a phosphorous coating or incorporated into luminous paints. The beta particle from the radioactive decay of tritium interacts with the phosphor to produce light. The tritium filled tubes are permanently fixed or glued in a holder or module which is then fastened to the device. (TI-5140-15/2A NOTAL)

(2) Tritium is a radioisotope of hydrogen and decays by emitting a very low energy beta particle {0.0186 MeV maximum energy, 0.0057 MeV average energy), with a radiological half-life of 12.3 years. Tritium commonly exists as a gas, or as tritium oxide {tritiated water or water vapor). Other tritiated compounds or molecules exist whenever one or more of the hydrogen atoms are replaced with tritium atoms.

(3) Tritium presents absolutely no external radiation exposure hazard. The very (relative) low energy beta particles cannot penetrate the walls of the sealed tubes or even the most outer skin layer of the body. There will be no measurable ionizing radiation emitted from a sealed tritium source. Tritium presents an internal radiation exposure depending upon the amount that enters the body through skin absorption, inhalation or ingestion.

As hydrogen gas, tritium is not significantly absorbed into the body. As tritiated water vapor, tritium is readily absorbed through the lungs, skin and gastrointestinal tract and disbursed throughout the body's tissues, where the beta particle interacts with living cells resulting in whole body irradiation.

(4) The sealed tritium sources on fielded Marine Corps equipment contain almost pure tritium gas with less than 1% in the form of tritiated water. There is often a very small amount of seepage of tritium gas from these sealed tubes. Procurement specifications permit a leak rate of up to 0.030 microcuries per day per source. Storage of large numbers of individual tritium devices in a closed area without ventilation can result in a build-up of tritium in the air and lead to increased surface contamination.

(5) Most of the tritium escaping from a broken or leaking source will rapidly dissipate harmlessly into the atmosphere. However, there may be some contamination resulting from the small amount of tritiated water vapor in the tubes and from tritium bound to the phosphor residue. Also, tritium gas can become absorbed or bonded to various surfaces including metals, or even undergo isotopic exchange with hydrogen atoms in other molecules. Release of the tritium gas in the presence of fire or explosion will result in the conversion of more tritium gas to the more hazardous tritiated water vapor.

(6) MCLB, Albany and MCLB, Barstow have been designated as bulk storage facilities for tritium devices and as tritium maintenance facilities for the replacement of tritium sources. Both MCLB's have instituted detailed radiological control programs for handling tritium sources.

(7) Storage and Inventory

(a) A maximum of 1,000 curies of tritium or 2,264 sources of tritium, whichever value is reached first, shall be stored in any one field storage area or enclosure of at least 1,000 cubic feet. Areas where personnel are working must have ventilation sufficient to provide at least 1 air exchange every 3 minutes. More than one such storage area may exist in the same building if the storage areas do not share a common air space.

(b) Tritium components that are not physically installed as part of the major end item will be stored in an area designated for the storage of radioactive materials, with personnel access limited to prevent unauthorized removal, and the storage area posted with the standard "Caution - Radioactive Material" signs.

(c) The light emitting ability of all tritium devices continuously decreases from the time of manufacture due to the radioactive half-life of tritium (12.3 years) and degradation of the phosphorous coating. Components whose illumination appears to be too weak for operational use should be identified and disposition instructions requested.

(8) Maintenance

(a) Only authorized maintenance shall be performed on tritium containing devices as indicated by the maintenance allocation charts in the applicable technical manuals.

(b) Presence of illumination shall be checked each time tritium containing devices are handled. Loss of illumination may be an indicator that leakage has occurred, and will require returning the item or module containing the source to the MCLB for repair or disposal.

(c) Under no circumstances shall permanently fixed tritium sources be removed from their mountings.

(9) Emergency Actions. To minimize personnel exposure to possible internal contamination in the event of source breakage, the following steps should be taken:

(a) Sound the alarm. Notify personnel in the immediate area to move out and stay upwind for at least 30 minutes or the "All CLEAR" word is passed.

(b) Vacate the surrounding area, again moving and staying upwind for at least 30 minutes. If in a building, open doors and windows and operate fans to increase ventilation while exiting the building.

(c) In the case of fire, stay away from the downwind smoke. The self-contained breathing apparatus worn by firefighters provide protection against inhalation of the airborne tritium.

(d) The IRSO or unit RPA must be notified as soon as possible to ensure proper follow up actions are taken.

(10) Contamination Control

(a) Devices with broken sources and any resulting debris should only be handled while wearing rubber or plastic gloves. Double wrap and seal devices with broken or leaking sources in two plastic bags. Clearly label the package as containing a radioactive contaminated device or materials.

(b) Personnel who may have received tritium contamination on bare skin should wash with a mild soap and plenty of cold water.

(c) Possible contamination of the immediate area or on the major end item is a judgment call based on the circumstances of the incident since immediate access to a liquid scintillation counter will not be available. Thorough cleaning with a mild detergent is suggested, especially on floors and work surfaces.

(d) Removal of tritium contamination can be difficult, especially if the surface is porous or has a coating of oil or grease which easily absorbs tritium atoms. Tritium contamination sometimes tends to reappear even after cleaning such surfaces. Actual experiences indicate that tritium contamination can be found on devices containing a broken source at many times the allowable contamination limit.

(e) Items or areas are considered contaminated if the removable tritium activity on a wipe of 100 square centimeters is greater than 450 picocuries.

(11) Personnel Exposure Estimates

(a) The biological half-life of tritium in the body is about 12 days, that is about half of the tritium remaining will be eliminated every 12 days due to the constant turnover in body water volume. Radio bioassay of urine (4 hours after suspected exposure) for tritium is the preferred method of measuring internal body tritium contamination, and is required to be performed if it is likely that an internal deposition of tritium will cause the body to receive a radiation dose of 50 mrem or more. As general guidance, it is highly unlikely that an individual will ever ingest a measurable quantity of tritium in the body, from a single exposure event to a tritium source on Marine Corps equipment that has been broken in the open air or in a ventilated area.

(b) The following formula can be used to approximate internal exposures to airborne concentrations of tritiated water vapor to determine if urine samples need to be collected and analyzed. If samples are required the custody chain must be followed.

Estimated Exposure (mrem) =

[100 mrem x air concentration (uci/ml) x exposure time (hours) / [2 x 10 E-4 uci/ml/hr)

where uci = amount of tritium oxide in microcuries
ml = volume in milliliters or cubic centimeters
hr = time in hours or fractions of an hour

(c) If airborne tritium concentrations are unknown, a worst case estimate can be made by dividing the number of curies of tritium from the broken source by the room volume in milliliters or cubic centimeters. This worst case situation assumes there has been no reduction in airborne levels due to ventilation and that all of the tritium is in the form of tritiated water vapor. In the absence of fire or explosion, a conservative assumption is to assume 10% of the amount of tritium gas in the particular device is in the form of tritiated water vapor.

(d) If the estimated exposures indicate that an individual may have received an exposure in excess of 50 mrem, then internal monitoring should be performed to assess and document the internal exposure. Internal monitoring may also be conducted whenever considered prudent to do so in the judgment of the IRSO or medical officer.

(12) Disposition. Devices containing tritium will be treated as controlled items and will require special disposition regardless of the item condition code when they are replaced.

(13) Tritium Exit Signs. These signs are a commercially available item which is manufactured under a NRC license imposed on the manufacturer. Each sign is labeled with its date of manufacture, amount of tritium and disposal guidance. There are no reporting or licensing requirements imposed on the purchaser. Typically, such signs contain 10 to 25 curies of tritium.

b. Depleted Uranium Armor/Ammunition

(1) Natural uranium is composed of three primary isotopes: U-238 (99.2%), U-235 (0.72%) and U-234 (0.006%). During the uranium enrichment process, the concentration of U-235 is increased for use as fuel in nuclear reactors. The residue from the enrichment process is referred to as depleted uranium and consists almost entirely of U-238 with most of the U-234 and U-235 atoms removed. Physical properties which make DU metal useful in various applications are its high density and strength, ease and relatively low cost of fabrication and its availability. DU is employed as a penetrator in certain ammunition rounds, as a component part of the heavy armor for the M1A1 battle tank, and as counterweights in various types of aircrafts, missiles and industrial machines.

(2) Uranium undergoes a complex radiological decay scheme. U-238 has a 4,500 million year half-life and emits either a 4.2 or a 4.7 MeV alpha particle. The radioactive daughters have shorter half-lives and emit alpha, beta and gamma radiations of various energies. Most of the radiation from DU is from the daughter products and not from uranium. The predominant radiation emission is the 2.3 MeV beta particle from protactinium-234.

(3) Uranium is a silvery metal which readily oxidizes and supports combustion at temperatures between 700 to 1,000 degrees Centigrade. When exposed to air, DU oxidizes to first take on a yellow color and then changes to a gray/black color. DU is usually protected against corrosion by either plating the surface with cadmium or sealing the surface with paint or other sealants.

(4) External radiation exposure from DU is generally not of concern, since in most situations there is little direct skin contact with bare DU metal or there is no extended duration in close proximity to large quantities of DU. Radiation exposures from the gamma rays are usually minor from individual DU items at a distance of two or three feet. Alpha particles from bare DU surfaces have a limited range in air of only about 6 inches. Clothing or the outer dead skin layer will stop the alpha particle before any living cells are reached. There will be no detectable alpha particles if the DU is covered or inside a container. Beta particles contribute most of the radiation dose rates from bare DU surfaces but decreases rapidly with distances of one or two feet due to attenuation in air.

(5) Internal radiation exposure is of concern if small particles of uranium are inhaled or ingested. Internally deposited uranium produces intense ionization in the first 0.1 mm of tissue from the 4.2 or 4.7 MeV alpha particle. The maximum permissible body burden from DU is 0.005 microcuries, which is 15 milligrams in weight. Actually, internal contamination by uranium is more of a chemical hazard than a radiological concern since the toxicity of uranium as a heavy metal poison is about the same as lead.

(6) The potential for internal contamination exists from handling severely damaged DU, from cleanup of fires or explosions involving DU, and from any cutting, sanding, or drilling of DU metal. When involved in fires, DU may oxidize and produce a downwind plume of DU oxide dusts, especially when accompanied by explosions.

(7) DU Armor. M1A1 tanks incorporating DU inside the heavy armor can be identified by the turret serial numbers having "U" as a suffix. DU armor components are coated for corrosion resistance, sealed inside a stainless steel security container, and encased in welded armor steel plating. The actual design, manufacturing processes and specific location of the M1A1 armor DU component are classified. Any exposed DU armor components shall be protected as SECRET material.

(a) Based on a radiation characterization study, there is no measurable radiation exposure to the tank commander, loader or gunner from the DU armor when inside the tank. The maximum radiation levels on contact with any external surface will be less than 0.5 mrem/hour. Even with DU-munitions onboard and the ammunition doors closed, exposure levels will be less than 0.03 mrem/hour. Radiation levels at the driver's head, without a helmet, can range from 0.09 to 0.16 mrem/hour when the hatch is open and the gun in the firing position, or when the gun is in the travel position and the bustle contains DU munitions.

(b) There are no radiological controls or radiation restrictions applied to M1A1 tanks containing DU armor, except for accidental situations, which may expose the DU components. The armor plating covering the DU components can be stripped of paint, sandblasted, repainted or any other required operations as long as there is no penetration of the encased DU components.

(8) Notification Procedures. Events involving theft, loss, fire, explosions or accidents where DU armor may have been damaged or where DU may have been released to the environment, shall be reported immediately through the chain of command. For reporting guidance, ensure that the following commands are included in the notification:

CMC WASHINGTON DC (SD)
TACOM Rock Island, IL
NAVSEADET RASO, Yorktown, VA
MARCORLOGBASES, ALBANY GA
TECOM, Quantico, VA
MCIWEST, Camp Pendleton, CA

(9) Emergency Guidelines. Actions to combat the emergency, save lives, assist the injured and control the area take precedent over radiation or contamination concerns. DU presents no acute threat to health and no threat if inhalation of DU dust is prevented. Technical assistance in radiological monitoring is discussed in enclosure (3). For major accidents involving widespread contamination, a radiological monitoring team may be required to properly conduct and document the recovery and clean-up operations.

(a) DU Accident/Incidents without fire or explosions:

1. Control the area. Although only a minimal hazard exists to personnel from this type of situation, persons entering the area where DU may have been scattered should be kept to a minimum to prevent further scattering and to avoid unnecessary exposure to radioactive contamination.

2. Inspect the armor to determine the extent of damage. Exposure of the DU in the heavy armor must also be controlled as material assigned a SECRET security classification. Cover the exposed portion with a blanket, field jacket, mud, etc., and guard from further viewing by uncleared personnel.

3. If it appears that DU components have been damaged or exposed, perform a radiological survey to determine whether any DU has been scattered and to verify that equipment, containers or other items are free of contamination.

(b) DU Accident/Incidents with fire or explosions:

1. When involved in a fire, DU may oxidize, generating a downwind plume of DU oxide dust.

2. Personnel should remain upwind and use any means available to prevent smoke from entering the eyes, nose and throat. The techniques for fighting a fire containing DU are the same as those used in fighting fires with the same explosive classification or for similar hazardous materials. Fire-fighters self-contained breathing apparatus or respirators provide protection against inhalation of DU oxide dust in the smoke plume.

3. Guidance on policies, procedures and detailed actions for recovery from accidents involving DU are contained in the following publications:

a. Army Technical Bulletin, TB 9-1300-278, "Guidelines for Safe Response to Handling, Storage and Transportation Accidents Involving Army Tank Munitions and Armor Containing Depleted Uranium"

b. NAVSEAINST SO20.1JA "Transportation Accident Prevention and Emergency Response Involving Conventional DOD Munitions and Explosives".

(10) DU Ammunition

(a) The firing of any form of DU ammunition, either by armor, small arms or aircraft, requires a NRMP be issued to the firing unit and to the range being utilized. MAGTFTC, MCAGCC has no range with the necessary NRMP. The firing of any form of DU ammunition on board MAGTFTC MCAGCC is prohibited.

(b) The Center Magazine Area (CMA) does not and will not store ammunition containing DU. However, in the event that DU ammunition is transshipped through the CMA or possibly brought on board by a training unit, the following data and information is provided. The 20mm, 25mm, lO5mm, and l20mm ammunition is under license to the Navy and they have cognizance over these items. The Air Force has cognizance over 30mm ammunition. The Army has cognizance over the other l05mm, l20mm, and the 25mm Bradley round. The l05mm round and the mine contains only trace amounts of DU and is not under license.

(c) The following table lists the ordnance produced with DU:

CALIBER NOMENCLATURE	NSN	MODEL
20mm DS MK 149 LNKD	1305-00-193-4227 A675	MK149 MOD O
20mm DS MK 1049 LNKD	1305-01-087-6742 A675	MK149 MOD O
20mm APDS	1305-01-185-3265 A676	MK149 MOD 2
25mm API	1305-01-136-3623 A979	PGU-20/U
25mm API	1305-01-251-2582 A979	PGU-20/U
25mm APFSDS-T	1305-01-304-9977 A986	M919
30mm HEI & APIT	1305-01-061-2214 B102	PGU-13/14B
30mm HEI & APIT	1305-01-063-2167 B102	PGU-13/14B
30mm API-T & HEI	1305-01-056-4626 B103	
30mm	1305-01-056-4907 B103	
30mm	1305-01-083-5998 B103	
30mm	1305-01-093-3340 B103	
30mm	1305-01-095-1062 B103	
30mm	1305-01-057-7912 B103	
30mm	1305-01-057-7913 B103	
30mm	1305-01-113-2462 B103	
30mm	1305-01-146-1530 B103	
30mm	1305-01-157-2627 B103	
30mm	1305-01-161-0622 B103	
30mm API-T	1305-00-416-5809 B128	PGU-14/B
30mm API-T	1305-01-023-1909 B128	PGU-14/B
105MM APFSDS-T	1315-01-082-9856 C523	M774
105MM APFSDS-T	1315-01-227-0008 C523	M774
105MM APFSDS-T	1315-01-136-9631 C524	M833
105MM APFSDS-T	1315-01-245-4019 C524	M833
105MM APFSDS-T	1315-01-324-6633 C543	M900
120mm APFSDS-T	1315-01-168-6108 C786	M829
120mm APFSDS-T	1315-01-226-7418 C786	M829
120mm APFSDS-T	1315-01-292-7753 C786	M829
120mm APFSDS-T	1315-01-269-2256 C380	M829Al
120mm APFSDS-T	1315-01-316-1211 C380	M929Al
155mm HE ADAM	1320-00-434-8856 D501	M692
155mm HE ADAM	1320-01-261-6043 D501	M692
155mm HE ADAM	1320-00-434-8861 D502	M731
155mm HE ADAM	1320-01-260-8719 D502	M731
Mine, AP, PDM	1345-01-243-5089 K152	M86

(d) These items should never be disposed of by burning or detonation. These are full service rounds which may only be fired during war emergency. All peace time firings are prohibited. Loss or unauthorized firings of these rounds must be reported to the cognizant HQ within 24 hours of the discovery. Telephone reports should be followed with an appropriate written report to:

ARMY

Commander
USA AMCCOM
Attn: AMSMC-CG
Radiological Protection Officer (RPO)
Rock Island, IL 61299
DSN: 793-2962/2965/2969
COMM: (309)782-2962/2965/2969

NAVY

Commander
Naval Surface Warfare Center Crane Division, Attn: RSO
Crane, IN 47522
DSN: 482-3578
Comm: (812)854-3578

c. Promethium 147

(1) Promethium-147 (PM-147) has a half-1ife of 2.6 years and emits a 0.22 MeV beta particle while undergoing radiological decay. While no gamma radiation is emitted during this decay, there may be some low level radiation detected from absorption of the beta particles by the material surrounding the promethium source.

(2) Light Antitank Weapon (LAW)

(a) The M72 series LAW Rocket System incorporates 3 millicuries of Promethium-147 as a radio luminescent source in the front sight, NSN 1340-01-050-8850, of the rocket launcher. Each sight is identified by the standard radiation symbol. Marine Corps authorization for this material derives from NRC license #12-00722-07 issued to AKCCOM Rock Island, IL.

(b) No maintenance is performed on the sight. The sights are painted with a luminous paint containing Pm-l47 bound in spherical ceramic microspheres of 5 to 60 microns in diameter. After the weapon is fired, remove the sight for disposal as radioactive waste. If the sight becomes damaged or crushed, notify the unit RPA or the IRSO, who will supervise the removal and sealing of the sight in plastic bags for disposal as radioactive waste. These requirements are not expected to be immediately observable when rockets are expended during combat.

(c) Request disposition instructions. Report loss, theft or unaccountability of sights.

d. Thorium 232

(1) Thorium 232 (Th-232) is a naturally occurring radionuclide which is found in a number of manufactured articles, such as incandescent gas mantles, electron tubes, lamps, certain types of welding rods, optical coating on lenses, and as magnesium- thorium and nickel-thorium alloys in aircraft/missile engine and structural components. Thorium fluoride coating is used on the Gunner's Primary Sight (GPS) on the MlAl tank.

(a) Th-232 has a very long half-life of 14 billion years. Like uranium and radium, the radiological decay scheme is complex and involves emissions of gamma, alpha and beta radiation.

(b) Th-232 is controlled as source material under NRC regulations. Generally, an exemption is granted from NRC licensing requirements for possession or use of incandescent gas mantles and welding rods containing thorium; electric lamps having no more than 50 milligrams of

thorium; germicidal lamps, sunlamps, exterior and industrial lamps having no more than 2 milligrams of thorium; optical lenses containing less than 4' thorium by weight.

(c) This NRC exemption does not authorize use of thorium in the eyepieces of binoculars or other optical instruments, the shaping, polishing or grinding of lenses containing thorium, or the chemical, physical, or metallurgical processing of thorium alloys.

(2) Thorium-Fluoride Optical Coating

(a) Thorium-232 Fluoride (ThF4) is utilized as multi-layer antireflective optical coating on thermal imaging lenses for the Forward Looking Infrared System (FLIR) and on Night Vision Devices (NVD). Use of thorium-fluoride, not to exceed 0.218 microcuries per optical system, is authorized under an NRC license issued to the U.S. Army Communication Electronics Command (CECOM), which is the designated Primary Inventory Control Activity (PICA) for night vision equipment. Under this license, maintenance and serviceability of thermal imaging systems is limited to the necessary removal/exchange of ThF4 coated optics. No maintenance is authorized which involves grinding or removal of the ThF4 coating from the lenses.

(b) Request disposition instructions from MCLB Albany.

(3) Thorium Commodities and Alloys. Basic radiological precautions apply to thorium containing items: Minimize large quantity storage of thorium commodities in close proximity to each other to minimize gamma radiation levels if measurable.

e. Nickel 63

(1) Nickel 63 as used in military and civilian applications aboard the MCAGCC is a low level beta emitter. The nuclide is used to energize the ionization chamber of several military and civilian end items. These items include the Chemical Agent Monitor (CAM), Automatic Chemical Agent Detector Alarm (ACADA), Vapor Tracer 2, Itemizer 3, APD 2000 and GID-3.

(2) There are no special radiological precautions that need to be taken when using these end items. By following the precautions and guidelines of the other nuclides included in this order safety of use is assured.

f. Miscellaneous Sources (Electron Tubes, High Voltage Electronic Equipment, Moisture Density Gauges)

(1) Electron Tubes

(a) Numerous types of electron tubes contain small amounts of various radioactive materials. Unless otherwise specified for a particular type of electron tube, the radioactive materials in these tubes are usually license exempt under 10 CFR.

(b) The following general precautions apply:

1. Storage rooms with large numbers of electron tubes containing radioactive material should be periodically surveyed with low level gamma survey meters. In some cases involving large quantities, it may be necessary to redistribute the tubes among different shelves or bins.

2. Wear rubber or disposable plastic gloves when cleaning up the debris from broken tubes containing radioactive material. If skin contamination is suspected, wash hands with soap and cool water.

3. Request disposal procedures.

(2) Klystrons. High Voltage Tubes. Cathode Ray Tubes capable of producing x-rays. The flow of electrons between high voltage potentials above 10,000 volts can be a source of x-ray radiation. Generally, the applicable technical manuals will contain warnings where x-rays could be generated and reminders to replace the installed tube shields after maintenance actions.

(3) RADIAC capabilities. Explosive Ordnance Disposal (EOD). Applicational RADIAC equipment required by EOD detachments for initial response to nuclear accidents or incidents:

AN/PDR-56 ( )
Type: Scintillation Range: O-lM
Detects: Alpha Energy Response:> or equal to 3 MeV
Measures: Alpha Use: Alpha contamination survey
Readout: CPM

(4) Moisture Density Gauge

(a) Moisture Density Gauges containing radioactive material shall be used under the supervision of, and in the physical presence of, an individual trained per the requirements of a NRMP.

(b) The gauges shall be secured against access or removal by unauthorized personnel when not in use or under the direct surveillance of an individual trained per the requirements of a NRMP (including transportation to a temporary job site).

(c) When not in use, gauges shall be stored in secure, properly posted storage areas, which are not normally occupied.

RADIOLOGICAL CONTROLS, PRACTICES AND PROCEDURES

1. Purpose. The normal combat training exercises, support operations and supply activities conducted on board MAGTFTC, MCAGCC does not necessitate the creation of defined radiation areas and zones beyond that which are currently emplaced at the armories, maintenance facilities, and supply/storage locations. Under special circumstances, such as new radiation sources, apparatus or monitoring device testing, radiation areas and zones must be established. Standing operating procedures must be written and procedures established to ensure the safety of personnel directly and indirectly involved with the operation. This enclosure to the radiation safety order is included to assist any unit in radiological control practices and procedures for apparatus not found in MCBul 3000. The following definitions, parameters, requirements, exposure limits, procedures, and practices will be adhered to in the establishment of the required radiation areas, zones, and personnel protection policies and procedures.

2. Definitions

a. Controlled Area. An area outside of a restricted area but inside the site boundary, access to which can be limited by the activity for any reason. The area must be declared in writing. (NAVMED P-5055)

b. Restricted Area. An area, access to which is limited by the activity for purposes of protection of individuals against undo risk from exposure to radiation and radioactive material. Restricted areas must not include areas used as residential quarters, but separate rooms in a residential building may be set apart as a restricted area. (NAVMED P-5055)

c. Unrestricted Area. Any area access to which is neither limited or controlled by the activity and any area used for residential quarters. (NAVMED P-5055)

LIMITS IN UNRESTRICTED AREA: (NAVMED P-5055)

Not more than 2 mrem (0.02 msv) in any one hour.

Not more than 100 mrem (1 msv) in a year.

d. Radiation Area. Any area accessible to personnel in which there exists ionizing radiation at dose-rate levels such that an individual could receive a deep dose equivalent in excess of 5 mrem (0.05 msv) in one hour at 30 centimeters (11.811") from the radiation source or from any surface that the radiation penetrates. (NAVMED P-5055)

e. High Radiation Area. A radiation area accessible to personnel in which there exists ionizing radiation at such levels that an individual could receive in excess of 100 mrem (1 msv) in one hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. [NAVSEA S0420-AA-RAD-0l0 (RAD-010), Glossary]

f. Very High Radiation Area. Any area accessible to personnel in which there exists ionizing radiation at such levels that an individual could receive in excess of 500 rad (5 gray) in one hour at 1 meter from the radiation source or from any surface that the radiation penetrates.

3. Posting of Radiation Areas. Open facility posting:

a. Radiation Area. A physical barrier will be established at the 2 mrem in any one-hour line. The sign will have the radiation symbol and the words “CAUTION: RADIATION AREA". (RAD-010, SECT IV, 4.5.1.4) NOTE: The Navy does not post the restricted area and the radiation area separately. The radiation area sign shall be posted at the boundary of the restricted area. This in effect moves the radiation area outward to the restricted area boundary.

b. High Radiation Area. A physical barrier shall be conspicuously posted at the calculated 100 mrem/hr boundary with the radiation symbol and the words ”DANGER: HIGH RADIATION AREA". (RAD-010, SECT. IV, 4.5.1.1) NOTE: Under no circumstances will the high radiation boundaries be surveyed. The survey of this boundary is unnecessary and not in keeping with the concept of ALARA.

c. Tube Head. If radiography is being conducted, there shall be located next to the tube head a rotating or flashing red light with a sign stating "X-RAY ON WHEN FLASHING”. The warning light shall be interlocked to the x-ray console so that it is illuminated when lit. (RAD-010, SECT. IV, 4.5.1.5)

d. Access/Area Control. The senior individual shall have "DIRECT AND CONTINUOUS SURVEILLANCE" over the entire radiation boundary to ensure the security of the boundary. This may be accomplished by use of barrier monitors in direct communication with the senior individual. The 2 mrem/hr boundary shall be monitored utilizing a currently calibrated measurement device, commensurate with the radiological source.

4. Protection of Personnel Handling Radioactive Commodities. Responsibility for minimizing radiation exposure and controlling radioactive materials is shared by IRSO's, RPA's, unit commanders, supervisors and individual radiation workers. This responsibility includes orientation and indoctrination of personnel who are subject to occupational exposure to ionizing radiation; promulgation and implementation of applicable directives and SOPs; provision for personnel dosimetry, medical examinations, RADIAC instrumentation, and the fostering of a work environment that encourages an emphasis on maintaining occupational radiation exposure ALARA. Requirements:

a. All radiation workers-and limited radiation workers shall be trained and records maintained as required by RAD-0l0.

b. Control procedures shall be developed for the protection of personnel handling radioactive commodities (e.g., shipment, inspection, storage, use, maintenance and disposal operations).

c. All units whose personnel handle radioactive commodities shall prepare standing operating procedures. These procedures shall be tailored to the operation being performed and the type of commodities handled.

d. Personnel exposure to ionizing radiation shall be maintained ALARA and shall conform to the requirements of Section 11, Part I of RAD-010.

e. Removable loose radioactive contamination in all areas shall not exceed the limits in Table 4 of RAD-0l0.

f. Written SOPs which specify measures to minimize internal hazards from such operations as handling leaking sources, repairing broken radioactive commodities, working in contaminated areas or in airtight storage areas containing leaking gaseous sources and incident response shall be prepared.

g. Smoking, eating, drinking and chewing shall be prohibited in areas where radioactive materials are stored or handled.

h. Storage of food, beverages, tobacco products and materials, cosmetics, and eating and drinking utensils shall be prohibited in areas where radioactive materials are stored or handled.

5. Control Practices and Procedures. This section provides general guidelines which shall be included in SOPs applicable to use, storage, maintenance, and disposal of radioactive commodities. These procedures shall be developed in coordination with designated radiation protection personnel and tailored to the operation being performed and the type and number of commodities handled.

a. Administrative Control Requirements. All activities storing, stocking or performing maintenance on radioactive commodities shall develop administrative controls to:

(1) Assure safe handling, storage and shipment of radioactive commodities.

(2) Assure safe operation of repair and maintenance facilities handling radioactive components.

(3) Assure procedures are prepared for handling credible emergencies during receipt, storage, maintenance and shipment.

(4) Report defective radioactive commodities to the material inventory control point.

(5) Comply with all applicable directives for the disposal of excess, surplus and condemned radioactive commodities and or radioactive waste.

(6) Conduct a physical inventory of all radioactive commodities at least annually.

(7) In conjunction with each physical inventory, ensure an audit of the general radioactive material accountability system shall be conducted by a person other than the custodian. This audit shall include a comparison of the results of the previous inventory, after deletion of all items transferred or shipped from the organization and addition of all items received by the organization, with the current inventory results. This audit shall also include a visual search for marked radioactive material that is not accounted for. The audit report shall state the results of the comparison and search. Discrepancies shall be reported in writing to the Commanding Officer. All discrepancies shall be investigated and resolved. Complete audit reports together with reports of any corrective action taken shall be retained for three years or until the next inspection from NAVSEADET RASO, whichever is longer.

(8) The supply, and where appropriate, the stocking activity shall establish a computer inventory program for radioactive commodities. The program shall be able to printout all radioactive commodities in storage by NSN, hazard code, name, and if available, quantity, radioisotope, activity, location and status. The IRSO shall be able to obtain this printout upon request and distribute to emergency support elements, as required.

(9) All losses of radioactive material shall be reported in accordance with instructions contained in the control literature for that commodity and as required by Federal Regulations.

(10) All radioactive commodities shall be marked with a label or sign containing the three-bladed radiation symbol and the words "CAUTION RADIOACTIVE MATERIALS", along with the isotope and activity, if known. MIL-STD 129 (Military Standard Marking for Shipment and Storage) applies.

b. General Storage Areas

(1) All storage areas containing radioactive material, and entrances to such areas, shall be labeled with signs containing the three-bladed radiation symbol and the words "CAUTION RADIOACTIVE MATERIALS". Signs, either permanent or temporary, shall be securely fixed to barriers, walls, doors, fences, or ropes.

(2) Areas used for storage of radioactive commodities shall be kept to the minimum for adequate control.

(3) Radioactive commodities shall not be stored in the same warehouse section with explosives, flammable materials, photosensitive items (e.g., photographic film), food products or other incompatible commodities.

(4) Radioactive materials shall be stored so that they are protected from adverse weather or conditions which may deteriorate the packaging materials.

(5) Commodities that contain radioactive gasses, tritium containing devices, or radium shall be stored in ventilated structures.

c. Fire Protection Requirements. Proper selection of a fire resistant storage area for radioactive material will minimize release of radioactivity to the environment in the case of a fire. The following considerations and practices shall be observed when selecting storage areas for radioactive material:

(1) Whenever feasible, radioactive materials shall be stored in fire resistant containers to minimize contamination spread.

(2) Smoking, eating, drinking, and chewing shall NOT be permitted in radioactive material storage areas.

(3) A current list of locations where radioactive materials are stored shall be available to fire fighting personnel. This list should also identify unusual hazards located at the storage site.

(4) Semiannual inspections of radioactive material storage areas shall be made to identify fire hazards by personnel trained in fire protection procedures. Deficiencies shall be promptly corrected.

d. Contamination Control. Contaminated items are often stored in plastic bags, which may break. Liquid, inadvertently left in a container may leak out, and condensation of moisture from the atmosphere may drip on exposed, contaminated surfaces. Unless all contaminated surfaces of stored materials are appropriately wrapped or contained to prevent the spread of contamination, the entire storage location shall be considered potentially contaminated. When all contaminated surfaces are appropriately wrapped, personnel may walk through these areas without anti-contamination clothing. Requirements:

(1) Personnel in potentially contaminated storage areas, particularly if they handle contaminated materials, shall wear necessary anti-contamination clothing.

(2) Reasonable care shall be taken in packaging and storing contaminated items to prevent the spread of contamination and to ensure that entry to areas where such storage is permitted does not result in the contamination of personnel or other areas.

e. Storage of Calibration, Test Sources and Devices. Radioactive materials, particularly calibration and test sources, which contain more than one millicurie of radioactivity and can be easily stolen or mishandled because of their small size, require special attention. Requirements:

(1) Small radioactive sources containing more than one millicurie of activity shall be stored in locked areas or cabinets, access to which is limited to authorized individuals.

(2) Small RADIAC calibration or test sources shall be attached to encumbering devices, such as large rings, mounting boards or storage boxes to the extent practical so as not to interfere with normal use of the source.

f. Radiation Survey Requirements

(1) Surveys of all areas where quantities of radioactive materials in excess of those listed in Table 3 of the RAD-010 are used or stored shall be performed at least every six months and records maintained for three years.

(2) Radiation protection surveys shall document:

(a) Location and extent of any radioactive contamination and radiation levels, appropriateness of boundaries, signs, markings, and protective equipment and procedures.

(b) Corrective action(s) taken to correct observed deficiencies.

(c) Date of survey, model, serial number, and date of calibration of RADIAC instrument, and name and signature of surveyor.

(3) Results of surveys shall be reported to operating supervisors with recommendations for corrective actions as necessary.

(4) Closeout radiation surveys shall be made and documented for all storage and maintenance locations when operations involving radioactive commodities have terminated. Limits of Table 4 (RAD-0l0) shall be met. Surveys must be forwarded to NAVSEADET RASO for review and approval, and shall be kept on file indefinitely.

g. Personnel Dosimetrv Requirements. Personnel dosimeters shall be used per Chapter 6, NAVMED P-5O55.

GLOSSARY

ABNORMAL OCCURRENCE. Failure to meet conditions required for the safe operation of radiation producing equipment or safe use of radioactive material.

ABSORBED DOSE. The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The unit of absorbed dose is the rad. One rad equals 100 ergs/gm.

AIRBORNE RADIOACTIVE MATERIAL. Any radioactive material dispersed in air in the form of dusts, mists, vapors or gasses.

ALARA. Concept of controlling the possession, use and transfer of radioactive material or a radiation producing machine in such a way that the total dose to the individual worker is kept as low as reasonably achievable (ALARA) considering the state of technology and the economics of improvement versus the benefits to public health and safety, and consistent with the purpose for which the activity is undertaken.

AUTHORIZED USER. An individual that uses or operates a radiation source item, who has had the appropriate training and is determined by the Installation Radiation Safety Officer (IRSO) to be qualified to work with radioactive material.

BYPRODUCT MATERIAL. Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to radiation incident to the process of producing or utilizing special nuclear material.

CALIBRATION. The act of standardization by determining variation of deviation from a standard so as to ascertain the proper correction factors.

CNO. Chief of Naval Operations.

CONTAMINATED AREA. An area where surface contamination exceeds the values of Table 4 of NAVSEA SO42O-AA-RAD-O1O (RAD-O1O).

CONTAMINATION. The presence of radioactivity where it is not wanted.

CONTROLLED AREA. Any area in which radioactive material or radiation producing devices are used or stored and access to which is controlled for the protection of individuals from exposure to radiation.

CURIE. A unit of nuclide radioactivity equal to 3.7xlOElO disintegrations per second.

DOSE. The total quantity of radiation absorbed per unit mass during a specific time period. For special purposes, it must be appropriately qualified. If not qualified, it refers to absorbed dose.

DOSE EQUIVALENT. A quantity used in radiation protection to express all radiations on a common scale for calculating the effective absorbed dose. Defined as the product of the absorbed dose in rads and certain modifying factors. The unit of dose equivalent is the rem.

DOSIMETRY: PERSONNEL MONITORING EQUIPMENT. Devices designed to be worn or carried by an individual for the purpose of detecting and measuring an individual's exposure to ionizing radiation.

1. Technical: A measure of the ionization produced in air by photons (x or gamma rays); or sum of the electrical charge on all ions of one sign produced in air when electrons liberated by photons are completely stopped in air, divided by the mass of the air in the volume element.

2. General: The act of an individual receiving a dose of radiation.

FACILITY. The location at which one or more devices or sources of ionizing radiation are installed or located within one building, vehicle or under one roof and are under the same administrative control.

FACILITY RE-EVALUATION. An evaluation of an existing facility due to a change in equipment, shielding, workload, or occupancy in adjacent areas.

INTERNAL AUDIT AND INSPECTION. A documented examination by a responsible management individual (i.e., IRSO, AIRSO, RPA, ARPA} of the radiation safety program of any element thereof (training, posting, operations, procedures, records, etc.} to verify compliance with requirements and established procedures.

IONIZATION. Process by which a neutral atom, molecule, or ion gains or loses electrons.

IONIZING RADIATION. Electromagnetic or particulate radiation capable of producing ion pairs in its passage through matter.

ISOTOPE. Nuclides that have the same number of protons in their nuclei (the same atomic number) but different numbers of neutrons (different mass numbers).

LEAK TEST/WIPE TEST. A test to determine if a sealed source has lost its integrity and allows leakage of radioactive material through holes or cracks. The test is normally performed by wiping the source with filter paper or absorbent material to determine the presence of radioactive contamination which indicates a leakage.

LICENSE EXEMPT MATERIAL. Items containing radioactive material not subject to Nuclear Regulatory Commission (NRC) regulations or radioactive material exempt from licensing by the NRC as specified in 10 CFR or in a specific license issued by the NRC or state.

LICENSED MATERIAL. Radioactive material that is received, possessed, used or transferred under a general or specific license issued by the Nuclear Regulatory Commission.

MML (MASTER MATERIALS LICENSE). Combined individual NRC licenses into one master license.

NAVMED P-5055. Radiation Health Program Manual.

NAVSEADET RASO. Naval Sea Systems Command Detachment, Radiological Affairs Support Office.

NAVY RADIOACTIVE MATERIALS PERMIT (NRMP). Authorization issued by the Navy Radiation Safety Committee for accelerator produced radioactive material and in lieu of a specific Nuclear Regulatory Commission for the receipt, possession, use or transfer of licensable radioactive material.

NRC. Nuclear Regulatory Commission.

NRC LICENSE. Specific authority granted by the NRC for utilization of regulated materials and isotopes.

OCCUPANCY. The type and degree that an area is occupied by personnel. The type of occupancy refers to the activity in the area such as office, berthing, utility room or closet. The degree of occupancy is the fraction of time the area is occupied.

QUALITY FACTOR. A factor used for radiation protection purposes that accounts for differences in biological effectiveness between different radiations.

RAD. The unit of absorbed dose equal to the absorption of energy in the amount of 100 ergs/gram of any material. For this order, one rad is considered to be the dose delivered by one Roentgen of x or gamma radiation.

RADIATION. For purposes of this order, any or all of the following radiations: alpha, beta, gamma or x-rays, neutrons, high-speed protons and other atomic particles. This order does not pertain to sound or radio waves or visible, infrared or ultraviolet light.

RADIATION AREA. Area in which an individual could receive a radiation dose of five mrem or more in anyone hour or 100 mrem or more in any five consecutive days.

RADIATION AREA-VERY HIGH. Ionizing radiation at a level in excess of 500 rad (5 gray) during one hour at one meter from the radiation source.

RADIATION INCIDENT. Unplanned loss of control of radioactive or machine sources which result in over exposures or excessive levels of contamination as defined by NAVSEA S0420-AA-RAD-010.

RADIATION MACHINE. Any device or equipment capable of generating ionizing radiation when the associated control panel is operated, but excluding devices which produce radiation only by the use of radioactive materials.

RADIATION PROTECTION ASSISTANT. A qualified individual, appointed at the unit level, who is responsible for all unit activities involving radiological affairs.

RADIATION PROTECTION SURVEY. An evaluation of the radiation hazards incident to the protection, use, release, disposal or presence of radioactive material or other sources of radiation under a specific set of conditions including a physical survey of the location of materials and equipment and measurements of levels of radiation.

INSTALLATION RADIATION SAFETY OFFICER. A qualified individual, appointed by the Commanding General, who is responsible for activities which will assure adequate radiation protection for MAGTFTC MCAGCC.

RADIOACTIVE COMMODITY. An item of government property composed in whole or part of radioactive material, or any item that contains radioactivity equal to or in excess of limits established in 10 CFR 20, Appendix C or contains a specific activity greater than 0.002 microcuries per gram of radioactive material and is license/NRMP exempt to the end user.

RADIOACTIVE DEVICE. A manufactured article having radioactive material in a non-dispersible form (non-liquid) as a component part.

RADIOACTIVE MATERIAL. Any material or combination of materials which spontaneously emit ionizing radiation.

RADIOACTIVE WASTE. Any radioactive material that meets all of the following conditions: (1) material that is no longer needed or usable; (2) material that cannot be returned to the manufacturer; (3) material that requires controlled exposure; and (4) material that has been declared to be waste by an inventory control point.

RADIOGRAPHIC EXPOSURE DEVICE. Any device containing a sealed source which can be unshielded for purposes of making a radiographic exposure.

RADIOGRAPHER. Any individual who performs radiography or who is in attendance at the Bite, personally supervising radiographic operations.

RADIOGRAPHY. The examination of the structure of material by nondestructive methods utilizing sealed sources of radioactive material or radiation producing machines.

REM. The special unit of dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor.

RESTRICTED AREA. Any area access to which is controlled by the command for purposes of protection of individuals from exposure to radiation and radioactive material.

ROENTGEN. The special unit of x ray or gamma exposure.

SEALED SOURCE. Any radioactive material that is encased in a capsule designed to prevent leakage or escape of radioactive material.

SIGNIFICANT ABNORMAL OCCURRENCE. An abnormal occurrence which is not reportable as a radiation accident or incident but results in evident damage or requires immediate action in the interest of safety or security.

SOURCE MATERIAL. Uranium or thorium or any combination thereof in any physical or chemical form or ores which contain by weight 1/20 of one percent (0.05%) or more of uranium and/or thorium but not including special nuclear material.

SPECIAL NUCLEAR MATERIAL. Plutonium, uranium-233, uranium enriched in the isotope 233 or isotope 235, or any material artificially enriched by the foregoing but not including special nuclear material.

TYPE "A" PACKAGING. A packaging procedure designed to retain the integrity of containment and shielding required by 49 CFR under normal conditions of

transport as demonstrated by the tests set forth in 49 CFR 173.465 or 173.466, as appropriate.

TYPE "B" PACKAGING. A packaging procedure designed to retain the integrity of containment and shielding required by 49 CFR when subjected to the normal conditions of transport and hypothetical accident test conditions set forth in 10 CFR 71.

UNRESTRICTED AREA. Any area access to which is not controlled by the command for purposes of protection of individuals from exposure to radiation or radioactive materials and any area used for residential quarters.