

Chapter 9

RADIATION PROTECTION PROGRAM

9-1. Purpose. This chapter establishes the Tobyhanna Army Depot Radiation Protection Program (RPP) for both ionizing and non-ionizing radiation and establishes responsibilities and procedures for procuring, receiving, storing, shipping, using, transporting, maintaining, and disposing of ionizing radiation producing material and/or equipment. Unless otherwise specified, this regulation applies to all Tobyhanna Army Depot operations.

9-2. Definitions. Definitions related to this section are located in the glossary at the end of this chapter.

9-3. Policies.

a. Procedures for handling radioactive materials, including receipt, use, storage, transport, shipment, maintenance, and disposal will be submitted to the Radiation Control Committee for review and approval prior to implementation. Control in any project or program using radioactive materials or instruments producing ionizing radiation is necessary to assure that personal exposure to radiation is kept as low as reasonably achievable (ALARA) and within limits established by AR 11-9, AR 40-583 and Title 10, Code of Federal Regulation, Part 20 (10 CFR 20).

b. The Tobyhanna Army Depot Radiation Control Committee is established in accordance with AR 11-9. The Radiation Control Committee shall be composed of the following members or representatives and meet at least once each calendar year and at the call of the chair:

(1) Commander, Civilian Executive Assistant or Depot Operations Officer

(2) Safety Manager

(3) Radiation Protection Officer (RPO) (Chairman)

(4) Alternate Radiation Protection Officer (ARPO)

(5) Health Clinic Representative

(6) Chief Radiation Monitors from the Mission Directorates.

(7) Chief Radiation Monitor, Medical Equipment Maintenance Division.

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(8) Environmental Coordinator, Environmental Management Division.

(9) Radiation Protection Officer (RPO), Army Calibration and Repair Center.

(10) Chief or Crew Chief, Fire Department.

(11) President or Vice President of AFGE Local 1647.

(12) Radiation Protection Officer, Defense Distribution Depot Tobyhanna (DDTP).

c. Locally established Standard Operating Procedures (SOPs) are as follows:

(1) The Mission Directorate's SOP for ionizing radiation MD-23, Processing and Handling of Radioactive Material.

(2) The Mission Directorate's SOP for non-ionizing radiation MD-10, Microwave Hazards.

(3) The DDTP SOP, Safe Handling and Storage of Radioactive Materials.

(4) U.S. Army Calibration and Repair Center, TYAD, SOP 385-2, Radiation Safety for Radiac Calibration and Repair Facilities Utilizing AN/UDM-2, UDM-6, UDM-7c.

(5) Medical Equipment Maintenance Division, U.S. Army Medical Agency, TOAD, SOP 12-1, Safe Use and Management of Diagnostic X-Ray Equipment.

(6) The U.S. Army Health Clinic SOP #28, Radiation Protection Program SOP.

(7) The Safety Office SOP.

(8) Safety SOP - Surveillance Unit.

#### 9-4. Responsibilities.

a. Safety Manager will:

(1) Be responsible for the overall radiation safety effort.

(2) Ensure that the radiation protection efforts are adequately staffed.

(3) Ensure that adequate facilities, equipment and resources are available for the Radiation Protection Program.

(4) Ensure that radiation protection personnel receive required training.

b. Radiation Control Committee (RCC) members will:

(1) Attend scheduled meetings. The Chairperson is responsible for scheduling the meetings and will provide members with an agenda and necessary documents for review. Official minutes, approved by the Chairperson and depot Commander will be sent to committee member following each meeting.

(2) Recommend policies on the safe use, handling, storage, transport, receipt, shipment, and disposal of sources of radiation.

(3) Review proposals for procurement and use of radiation sources and modifications of existing radiation operations and operating procedures for appropriate radiation safety issues.

(4) Review applications for Nuclear Regulatory Commission (NRC) Licenses, or Department of the Army Radiation Authorizations (DARA).

(5) Review the qualifications of radiation users (ionizing and non-ionizing).

(6) Review radiation accident and incident reports to determine causes and recommend appropriate corrective actions.

(7) Review directives or standing operating procedures (SOPs) prior to publication or implementation.

(8) Review minutes of previous meetings until all items have been addressed.

c. Radiation Protection Officer (RPO) will:

(1) Provide the Commander, the RCC, and radiation users with advice and assistance on all matters pertaining to radiation safety.

(2) Implement the Radiation Safety Program.

(3) Review the radiological operations to determine compliance with regulations and approved procedures.

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(4) Maintain an accurate record of the inventory of radiation sources on TYAD. The record for each item should include NSN, nomenclature, quantity, isotope, activity/NSN, chemical and physical form, location, and Date of Last Inventory (DOLI). Inventory shall be updated as material are acquired and deleted.

(5) Maintain radiation protection records.

(6) Ensure proper radiation surveys and leak tests have been completed by assigned radiation monitors.

(7) Evaluate and recommend the hazard potential and adequacy of protective measures for existing and proposed operations.

(8) Determine requirements for and review SOPs for operations involving sources of radiation prior to review by the RCC.

(9) Investigate radiation accidents and incidents. Report findings of investigations in accordance with AMC Supplement 1 to AR 385-40 and Title 10, Part 21, of the CFR.

(10) Prepare applications, amendments, and renewals of NRC licenses and DA authorizations.

(11) Schedule required training.

(12) Distribute and recover film badges.

(13) Ensure employees are provided copies of their Film Badge records as they leave the depot work force if they had been assigned to the depot Radiation Film Badge Program at any time during their employment.

(14) Ensure all radiac instruments are calibrated for health and physics purposes.

(15) Ensure initial, periodic, and termination radiation physicals and ophthalmological examinations are scheduled as required by AR 11-9.

d. Alternate Radiation Protection Office (ARPO) will:

(1) Assist the RPO, as required, to ensure safe operation of radiological operations and compliance with applicable regulations.

(2) Perform the duties of the RPO in the event of

his/her absence or non-availability.

e. Chief Radiation Monitor will:

(1) Represent the directorate on the Radiation Control Committee.

(2) Monitor and coordinate with the RPO all facets of the Radiation Protection Program within their respective directorates.

(3) Assist supervisors in the development of SOPs for radiation safety.

(4) Ensure that the RPO is immediately notified in the event of loss of control of radioactive materials.

(5) Ensure radiac instruments and film badges are collected and distributed before expiration date.

f. Radiation Monitors will:

(1) Know and follow their respective SOPs, rules, and special instructions.

(2) Conduct radiation surveys using radiac instruments and smears as instructed by the RPO.

(3) Perform monthly radiation surveys in their area of assignment. Results of such surveys will be documented and furnished to the depot RPO.

(4) Report to the supervisor and Chief Radiation Monitor any accident, unusual incident, personal injury, suspected overexposure, and/or suspected internal exposure, no matter how slight as soon as possible after the occurrence.

(5) Monitor radioactive material received, shipped, used or stored in the work area to ensure compliance with established regulations and safety requirements.

(6) Utilize TB 43-0116 as a tool to identify radioactive materials.

g. All Depot Directors. Depot directors that anticipate a requirement for an item containing any radioactive material except electron tubes containing less than 1 microcurie will submit procurement requests through channels to the depot RPO. The RPO will make a determination in accordance with AR 385-11

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and AMC Regulation 385-9 as to the depot's possession authority under NRC License requirements or Department of the Army authorizations. Commodity command controlled items with available authorization for use, may be excluded from the depot's authorization actions.

h. Directors of Mission Directorates will:

(1) Apply 'use and storage labels' to all radioactive material temporarily stored in Mission Directorates areas. Tag the same equipment as it leaves the Mission Directorates to Supply for storage. Radioactive tags, and use and storage labels, may be obtained from the RPO.

(2) Appoint a Chief Radiation Monitor and Radiation Monitors as deemed necessary by the RPO.

(3) Ensure monitoring of all incoming materials for radioactive components is accomplished by referring to TB 43-0116, Identification of Radioactive Items in the Army, or by contacting the depot RPO. Under no circumstances will an item listed in TB 43-0116, or otherwise marked radioactive, be disposed of as normal waste.

i. Commander of Defense Distribution Depot Tobyhanna (DDTP) will:

(1) Receive, handle, store, package, label, mark, load, and ship radioactive material in accordance with RCC reviewed and approved procedures, and Life Cycle documents for radioactive commodities.

(2) Label incoming radioactive commodities and those leaving storage (includes intra-depot maintenance and shipping outside the depot).

(3) Ensure Transportation and Shipping Division screens all documents destined for DRMO for radioactive material regardless of the Special Control Item Code (SCIC).

(4) Demilitarize all radioactive items, as determine by the DDTP RPO.

(5) Appoint a RPO and ARPO.

(6) Conduct a yearly inventory of radioactive commodities in accordance with AMC Regulation 740-17, paragraph 9-4(12)b(1), and when requested by the RPO, due to suspected quantitative discrepancy, which is discovered during a Radiation Protection Survey. Submit all discrepancies in radioactive

inventory to the DDTP RPO.

(7) Provide the DDTP RPO with a copy of the shipment planning worksheets prior to shipment of all items containing radioactive material.

(8) Provide the DDTP RPO with notice of cancellation of radioactive shipments.

(9) Contact the radiation monitor assigned to the shipping area immediately before shipping radioactive material.

(10) Ensure that the radiation monitor, assigned to survey incoming/outgoing radioactive shipments, completes DDRE Form 4155.63 (64), May 94, Radioactive Material Record.

j. Supervisors of personnel using sources of ionizing and nonionizing equipment will:

(1) Maintain a current inventory of all sources of radiation for which they are responsible.

(2) Post appropriate warning signs and notices.

(3) Assure that their personnel have received adequate instruction and training prior to using or being exposed to radiation.

(4) Assure radiation sources are secured against unauthorized use.

(5) Prepare adequate SOPs for review by the RPO and the RCC prior to final approval.

(6) Enforce their respective SOPs, rules, and special precautions.

(7) Report to the Chief Radiation Monitor and RPO any accident, unusual incident, personnel injury, however slight, suspected overexposure, and/or suspected internal exposure as soon as possible after occurrence.

(8) Prior to being relieved of duties, secure all radioactive material and equipment containing radioactive material in such a manner as to preclude use or removal while not under the immediate supervision of a qualified and authorized individual.

(9) Ensure all personnel who are enrolled in the depot Film Badge Program contact the RPO and Health Clinic for final

clearance.

(10) Ensure that personnel do not eat, drink, smoke, chew tobacco, or apply cosmetics in any area where radioactive material is used or stored.

(12) Ensure that visitors, who enter areas where radioactive materials are stored or used, comply with applicable requirements of this regulation and SOPs, and are aware of the potential hazards to which they are exposed.

k. Personnel Using Sources of Radiation:

(1) Know and follow their respective SOPs, rules and special instructions.

(2) Use required safety equipment and protective clothing properly.

(3) Report to their supervisor any accident, unusual incident, personal injury, suspected overexposure, and/or suspected internal exposure as soon as possible after the occurrence.

(4) Do not eat, drink, smoke, chew tobacco, or apply cosmetics in any area where radioactive materials are stored or handled.

(5) Wash exposed parts of the body thoroughly after leaving the work area and before eating, drinking, smoking, chewing tobacco, or applying cosmetics.

(6) Do not handle radioactive materials with cuts or lesions on hands without the approval of the RPO and the depot medical officer.

9-5. Item Marking. Any commodity or item containing radioactive material in excess of that listed in Table 9-3, shall be marked or labeled, during maintenance and prior to leaving the depot.

9-6. Personnel Monitoring.

a. When significant amounts of radiation are present, employees will wear film badges in accordance with AR 40-14, Control and Recording Procedures for Exposure to Ionizing Radiation and Radioactive Materials. Film badges will be obtained from the RPO in accordance with TB 11-206.

b. For on-the-job exposure guidance, the film badge may be supplemented with a self-reading dosimeter.

c. Personnel on TDY will wear film badges as furnished by Tobyhanna Army Depot and will carry a control badge to monitor exposure in transit. On-site film badges may be worn in addition to the Army Badges.

d. Film badges will be stored in closed metal containers that have been approved in writing by the RPO.

e. Personnel will not tamper with or intentionally expose dosimetry devices to heat or radiation sources except as part of the normal wear of the device while the individual is exposed to radiation. Abuse or intentional misuse of dosimeters is a serious violation of safety regulations subject to severe penalties.

f. Personnel receiving exposures, in excess of the amount permitted during any calendar quarter or year, will be removed from duties involving potential exposure until authorized to return by the depot Health Clinic and RPO.

9-7. Training.

a. Personnel, including visitors, who will be exposed to radiation and/or radioactive material, will be informed when applicable of the following information annually and prior to exposure.

- (1) Presence of radiation or radioactive material.
- (2) Health hazards associated with exposure to such materials and/or radiation.
- (3) Procedures and precautions to minimize exposures.
- (4) Emergency procedures.
- (5) Right to receive a report of his/her exposure records.

b. Chief Radiation Monitors and Radiation Monitors, as deemed necessary by the RPO, shall be designated by the directors. In addition to the requirements set forth in paragraph 9-3.f. above, the monitors will receive the following training:

- (1) Monitoring and survey techniques.
- (2) Maximum exposure and contamination levels.
- (3) Procedures to minimize the spread of contamination.

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c. Emergency and Security Personnel will be trained and equipped to cope with radiological hazards that may be encountered in the performance of their duties. Training will be sufficient to enable such personnel to function without waiting for guidance of the RPO.

d. Training will be recorded on SIOTY Form 514, Record of Training, and placed in each employee's official personnel file.

9-8. Receipt of Radioactive Material.

a. The presence of radioactive material can be identified by any of the following methods:

(1) Reference to "Radioactive Materials" on shipping papers.

(2) Labeling on vehicle or packaging.

(3) Reference to radioactive Special Control Item Code (SCIC) 8, A, B, F, G, H, K, S, T, U, W, and X, or Type Cargo A on shipping paper.

(4) Radiation Monitor performing survey with radiacmeter.

(5) Referencing TB 43-0116 for radioactive NSNs.

(6) Contacting RPO or Radiation Monitor with NSN.

b. DDTP, Quality Assurance Branch will:

(1) Note labeling discrepancies.

(2) Prepare and send SF 364, Report of Discrepancy (ROD) on applicable incoming radioactive shipments.

(3) Send ROD reports to the RPO when action has been completed along with subsequent documentation.

(4) Maintain a copy of the report and further documentation received.

c. DDTP Radiation Protection Officer will:

(1) Ensure that all packages containing radioactive materials have been monitored in accordance with 10 CFR 20 and AR 385-11, within 3 hours after arrival during duty hours (monitoring at time of receipt is preferred). Radioactive packages arriving during non-duty hours will be monitored within

18 hours of receipt (monitoring at time of receipt is preferred, if monitor is available).

(2) Ensure results of the survey of the shipment are documented on Radioactive Material Record.

(3) Maintain a file on all incoming shipments to include RODs and replies to such actions.

d. DDTP will:

(1) Notify the appropriate radiation monitor of all incoming radioactive shipments.

(2) Assign a radiation monitor to the Receiving Area to perform the following:

(a) Survey all radioactive receipts to include taking radiation level readings, swipes, and completing Radioactive Material Record.

(b) Copies of the Radioactive Material Record will be forwarded to the depot RPO, DDTP RPO, and one copy retained with other receipt documents in the Receiving Area.

(c) Notify the RPO immediately for all white I, yellow II, and yellow III shipments.

(d) Apply use and storage labels IAW MIL-STD-129J. All information required on the label will be printed on the label and signed before application.

#### 9-9. Storage of Radioactive Materials.

a. Radioactive material storage areas will be established by the DDTP in coordination with the RPO.

b. An individual item or lot of items with a total activity in excess of 1 microcurie or with a specific activity exceeding .002 microcuries per gram or emitting a dose rate of 0.1mR/hr at contact require storage in a radioactive material storage area.

c. Storage areas and individual radioactive storage items will be marked by the DDTP in accordance with this regulation, AR 385-30, AR 700-64, and MIL-STD129J.

d. A Radiation Monitor will be designated for each radioactive material storage area. These monitors shall be provided sufficient instrumentation for the detection of contamination resulting from inadvertent loss of control over

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radioactive material.

e. A radiation Safety Standard Operating Procedure for these storage areas shall be established in accordance with AR 700-64 and DDREM 6055.20.

9-10. Shipment of Radioactive Material.

a. The Chief of Transportation and Shipping Division, or his designee will notify the RPO or Radiation Monitor prior to packing whenever possible and whenever a shipment of radioactive material is leaving the depot. The presence of radioactive material will be identified by and special instructions and precautions will be given in any of the following methods:

(1) Reference to "radioactive" material on shipping papers.

(2) Labeling on package.

(3) Reference to radioactive Type Cargo Code "A" in Block G of obligated DD Form 1348-1, "DOD Single Line Item Release/Receipt Document".

(4) Label all shipments IAW DOT Regulations.

(5) Shipping container marking will be in accordance with AR 11-9, Title 49, CFR, Section 173.414.

(6) Instruct the motor vehicle driver in special precautions to be taken and give to the driver a completed DD Form 836, Special Instructions for Motor Vehicle Drivers, on each occasion when a shipment requires Department of Transportation labeling.

(7) Plan shipments to ensure compliance with AR 11-9 and Title 49, Code of Federal Regulations, Chapter 1, Transportation and DDREM 6055.20.

(8) Notify RPO in the event that the shipment has been delayed or cancelled.

b. The Radiation Protection Officer or Radiation Monitor will:

(1) Ensure outgoing shipments and packages are surveyed properly.

(2) Perform survey with a radiacmeter.

(3) Reference TB 43-0166 for Radioactive NSNs.

(4) Furnish the Transportation Officer with results of the survey and certification statements both of which will become part of the shipping papers, and placed on file.

(5) Document results of the survey of the shipment on Radioactive Material Record.

9-11. Disposal of Radioactive Surplus Material and Radioactive Waste.

a. All depot activities will coordinate disposal actions concerning radioactive materials with the depot RPO to assure complete compliance with regulations.

b. Transportation Division will screen all hazardous shipping documents destined for DRMO.

c. Presence of radioactive material will be identified by any of the following methods:

(1) Reference to "radioactive" material on shipping papers.

(2) Radioactive labeling on material.

(3) Reference to radioactive SCIC 8, A, B, F, G, H, K, S, T, U, W, and X or Type Cargo Code A on shipping papers.

(4) Perform survey with a radiacmeter by Radiation Monitor.

(5) Reference TB 43-0116 for Radioactive NSNs by Radiation Monitor.

d. All radioactive items (exclusive of electron tubes) will be demilitarized regardless of Demil code IAW procedures set by the RPO and demil instructions provided by the item manager.

e. All documents involving radioactive material destined for DRMO will be signed by a RPO or ARPO.

f. Directorate of Public Works and the Mission Directorates will not maintain containers for temporary storage of radioactive waste material. Instead, they will contact their local radiation monitor for immediate removal to the Radioactive Waste Storage Facility.

g. The RPO or designated representative will transfer all radioactive waste to the Radioactive Waste Storage Facility.

h. Final transfer of radioactive waste beyond the TYAD limits will be arranged by contacting the RAD Waste Division, IOC.

i. Depot activities generating radioactive waste will develop a SOP for disposal of this material. Each SOP will include provisions for:

(1) Monitoring and reporting of radiation levels from this material to the RPO.

(2) Labeling of material shall include:

(a) NSN of actual radioactive component or NSN of end item from which component was removed.

(b) Isotope contained in components.

(c) Quantity of radioactive material contained in components (in microcuries).

(d) Number of components contained in each bag.

(3) Safe packaging, handling, and transporting of the material for disposal by the RPO.

(4) Emergency procedures in event of loss of control over this material.

9-12. Microwave and Radio Frequency (RF) Radiation.

a. Introduction.

(1) Because of the low energy content of RF and microwave radiation, it does not ionize materials, thus is known as non-ionizing radiation. Therefore, transfer of energy to a biological system results in something other than molecular ionization. Since biological systems are primarily water, RF and microwave energy transfer to water molecules and dissolved ions and small molecules probably accounts for the majority of the absorption by these systems.

(2) Absorption of RF and microwave energy generally results in heating of the absorbing medium. If heat gain exceeds compensatory capability, the overall temperature may increase to dangerous levels. Significant amounts of absorbed RF energy could cause localized increase in body temperature with concurrent effects on other biochemical and physiological processes.

(3) A rule of thumb is that effective depth of penetration in a biological medium is one-tenth the free space wavelength. Therefore, high frequency (short wavelength) microwave radiation exposure will result in mainly heating of superficial tissues. However, in the range of several hundred Mhz to a few Ghz, deep and superficial heating may be expected.

b. PURPOSE. This section represents a guide for protection of all depot and tenant activities personnel working in the vicinity of microwave/RF producing devices.

c. Radar Microwave Devices.

(1) X-ray emission. Some of the high voltage components of microwave equipment emit X-rays. Periodic and regular surveys for X-ray radiation are to be made by shop personnel. In the event the equipment is emitting X-rays greater than 1 milliroentgen per hour, the Chief Radiation Monitor will be notified. The Chief Radiation Monitor will contact the RPO who will survey the equipment and make a record of the survey. Personnel working with such equipment will wear film badges and follow the methods established for the film badge program.

(2) Hazard Criteria. The following criteria refers to power densities in the presence of microwave testing devices:

(a) Safe Level. A safe, indefinite exposure level of microwave power density less than 10 mW/cm<sup>2</sup>.

(b) Potential Hazard (Limited Occupancy). A possible hazard exists when the accessible microwave energy has an incident power density level between 10 mW/cm<sup>2</sup> and 50 mW/cm<sup>2</sup>.

(c) Hazard (Denied Occupancy). A definite hazard exists when the power density level exceeds 50mW/cm<sup>2</sup>. No personnel will be allowed in the beam area.

(3) All limited or denied occupancy areas will be marked when testing is being done.

(4) All areas of suspected or potential hazard will be routinely surveyed by the Chief Radiation Monitor, Maintenance Directorate, as deemed necessary by the RPO.

(5) All radar systems or microwave producing devices not covered by the Maintenance SOP MD-10, or which have not been approved by the RPO for use within the confines of the depot, must be presented to the RPO for approval before purchase, operation or testing by depot personnel.

d. RF/Microwave Operation.

(1) Radiation protection controls are required for every RF system capable of producing power density levels in excess of permissible exposure levels. Such a program will be coordinated with the RPO and included in the operational SOP, MD-10.

(2) No practice will be adopted or operation conducted involving the planned overexposure to radio frequency radiation (RFR).

(3) The permissible exposure level (PEL) is 0.4 watts per kilogram (W/kg) whole body specific absorption rate (SAR) as averaged over any 6 minute period of maximum exposure potential.

(4) For the purpose of determining compliance with the 0.4 W/kg whole body SAR power limit, the derived equivalent PELs appear in Tables 9-1 and 9-2. The derived equivalent PELs were determined experimentally and theoretically and will ensure that individuals exposed in a uniform RFR field, at those levels, will receive a whole body SAR less than 0.4 W/kg. Derived equivalent PELs are provided for exposures that may occur in restricted areas (Table 9-1) and in non-restricted areas (Table 9-2).

Table 9-1  
Derived Equivalent PELs For Restricted Areas

Frequency (f) MHz	Power Density (mW <sup>2</sup> /cm)	Electric Field Strength <sup>2</sup> (V <sup>2</sup> /m <sup>2</sup> )	Magnetic Field Strength <sup>2</sup> (A <sup>2</sup> /m <sup>2</sup> )
0.01-3	100	400,000	2.5
3-30	(900/f) <sup>2</sup>	400(900/f) <sup>2</sup>	0.025(900/f) <sup>2</sup>
30-100	1.0	4000	0.025
100-1000	f/100	4000(f/100)	0.025(f/100)
1000-300,000	10	40,000	0.25

(5) The derived equivalent power density PELs in Tables 9-1 and 9-2 are for far-field (plane wave) conditions and only apply where a strict far-field relationship between both electric and magnetic fields exists. In near-field and reactive nearfield conditions or at low frequencies (10 Khz to 3 Mhz), the electric and magnetic field strength limits in above tables must be used to determine PEL compliance.

Table 9-2  
Derived Equivalent PELs for Non-restricted Area

Frequency (f) MHz	Power Density (mW <sup>2</sup> /cm)	Electric Field Strength <sup>2</sup> (V <sup>2</sup> /m <sup>2</sup> )	Magnetic Field Strength <sup>2</sup> (A <sup>2</sup> /m <sup>2</sup> )
0.01-3	100	400,000	2.5
3-30	$(900/f)^2$	$400(900/f)^2$	$0.025(900/f)^2$
30-100	1.0	4000	0.025
100-1000	$f/300$	$4000(f/100)$	$0.025(f/300)$
1000-300,000	5	40,000	0.125

1. Restricted areas are those areas to which access is controlled for the purpose of excluding entry of persons of less than 140 centimeters (55 inches) in stature per ANSI C95.1.
2. Unrestricted areas are those areas where access is not controlled to exclude persons of less than 140 centimeters (55 inches) in stature. The precedent for this is ANSI C95.1.
3. Values in these tables were derived using a value of the impedance of free space of 400 ohms. This value is rounded up from the generally accepted value of 377 ohms to allow for ease of calculations under ANSI C95.1.
4. When both the electric and magnetic fields are measured, both values must be equal to or less than their applicable derived equivalent PEL.

Tables apply only to whole body exposure and are based on the overall PEL of 0.4 W/kg.

(6) RF radar equipment which radiates at frequencies below 1,000 Mhz and delivers less than 7 watts of RF power to the radiating device is considered non-hazardous.

(7) All exposures will be limited to a maximum (peak) electric field intensity of 100,000 volts/meter (V/m) in a single pulse.

(8) For mixed and broadband fields at a number of frequencies for which there are different PEL values, the fraction of the PEL incurred within each frequency interval shall be determined, and the sum of all such fractions should not exceed unity. When multiple transmitters are in use in the same frequency interval, the total from all transmitters emitting simultaneously will not exceed the PEL.

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(9) All TYAD employees whose occupation or assignment may have a risk of exposure to potentially hazardous microwave or RF radiation levels will be included in TOAD's RFR Medical Surveillance Program.

9-13. Lasers. Purchase, installation and SOPs on lasers will be staffed and approved through the RPO.

9-14. Radioactive Material. Purchase of any radioactive material in any form must be staffed through the RPO.

TABLE 9-3  
RADIOACTIVE MATERIAL

MATERIAL	MICROCURIES (uCi)
Americium 241	0.01
Cobalt 60	1.00
Krypton 85	100.00
Plutonium 239	0.01
Radium 226	0.01
Strontium 90	0.10
Thorium 232	100.00
Uranium 233, 234, or 235	0.01
Mixture of Alpha Emitter of Unknown Composition	0.01
Radioactive Materials Not Listed Above	0.10

NOTE: Markings are required for any values above those specified in this chart. Reference paragraphs 9-5 and 9-6, for information on markings.

9-15. Decontamination.

a. General.

(1) Radioactive contamination is defined as the undesired presence of radioactive materials in amounts that may be considered harmful to the health and safety of personnel, or the validity of experiments or products.

(2) Sources of radioactive contamination normally encountered at Tobyhanna Army Depot preclude major incidents or accidents. Sources of potential minor incidents exist in the form of:

- (a) Radioactive electron tubes.
- (b) Unshielded alpha emitting check samples
- (c) Unshielded alpha emitting calibration sources.
- (d) Radium 226, promethium 147, or tritium used as a phosphor exciter to produce luminosity.

b. Decontaminating Procedures.

(1) Whenever practical, decontamination procedures will reduce the contamination to within twice the level of natural background radiation. However, radioactive contamination will not exceed the maximum levels shown in Table 9-4.

(2) No allowance shall be made for particle size, or for the use of protective clothing and equipment for determining whether an individual is exposed to radioactive concentrations in excess of authorized levels.

(3) Items which cannot be decontaminated will be marked and tagged to indicate their condition, and will be removed from use pending further decontamination or disposal.

(4) Personnel.

(a) Every person who might have been contaminated shall be monitored and immediate steps taken to remove any radioactive contamination. The following external monitoring procedures will be conducted:

- (1) Monitor both sides of hands and forearms.
- (2) Monitor the entire front of the body, starting at the top of the head -- the forehead, nose, mouth, neckline, torso, knees, and the ankles shall be thoroughly checked; have the person turn around, repeat the procedure from head to ankle.
- (3) Have the person raise one foot, then monitor the sole; repeat the procedure for the other foot.

(4) Personnel with cuts or abrasions will be monitored under the supervision of or by medical personnel of the U.S. Army

Health Clinic.

Table 9-4  
Maximum Permissible Contamination Levels

Contaminated Item	Fixed or Removable	ALPHA DPM	BETA/GAMMA DPM
CLOTHING: Personnel	F R	200 None	0.05* None
CLOTHING: Anti-contamination	F R	1000 None	0.2* None
CONTAINERS	F R	200 None	0.2* 100
TOOLS & EQUIP.	F R	200 50	0.05* 100
VEHICLES	F R	500 30	0.05* 500
SHIPPING CONTAINERS	F R	500 None	0.2* None
SKIN	F and R	None detectable above background	None detectable above background

\* millirem per hour

All permitted dpm levels reflect amount above background.

(b) The following steps shall be taken to remove external contamination from individuals:

(1) Wash the contaminated area with soap and warm water. If the initial washing with soap and water alone does not succeed in decontaminating the individual, use a very soft bristle hand brush to aid in cleaning. Ensure that special care is taken not to chafe or abrade the skin area.

(2) Monitor the skin after each washing with appropriate survey instrument.

(3) Do not wash area more than 3-4 times to avoid chapping skin.

(4) Contain rinse water, if possible, to minimize the

uncontrolled release of radioactive contamination.

(5) If contamination exists over a large portion of the body, the individual shall be placed in a lukewarm shower and shall wash himself with a mild soap, starting from the top down. After thoroughly rinsing and drying, he should step out of the shower and be monitored for remaining contamination. The process should be repeated as needed.

(6) If washing does not remove contamination, the individual will be transmitted to a medical facility immediately after initial decontamination.

(c) If internal contamination is suspected, individual will be transferred to a medical facility immediately after initial decontamination.

(d) If alpha contamination is suspected and alpha monitoring equipment is not available, smear tests will be performed. The ear canals, nostrils, and body folds will be swabbed with disposable tissue, cotton tipped applicators, or filter paper. Smear samples will be placed in a moisture vaporproof bag for monitoring by the RPO.

(e) Individuals whose injuries require immediate medical treatment will be transferred directly to the Health Clinic without prior decontamination. Medical personnel will be notified immediately upon arrival of the contamination, the isotope involved and the amount involved.

(5) Equipment and Facilities.

(a) When decontaminating equipment, care will be taken to avoid the spread of contamination to other areas and personnel. Workers will wear disposable coveralls, rubber gloves, and shoe covers as a minimum. Respirators with appropriate cartridge air filters will be used as needed. The area, equipment, and personnel will be monitored before and after decontamination.

(b) The following general procedures should be used in order to decontaminate equipment and surfaces:

- <1> Wiping with a damp cloth.
- <2> Washing with detergent and water.
- <3> Cleaning with solvents other than water.
- <4> Steam cleaning.

<5> Surface removal by using corrosives, abrasives or sand blasting.

(c) The direction of decontamination should be from areas of least contamination toward those of greatest contamination.

(d) Liquids and cleaning utensils used in decontamination efforts will be contaminated, and treated accordingly. Contaminated liquids will be soaked up using vermiculite, or equivalent material approved of by the RPO. The material will be placed in plastic lined drums and put into radioactive waste storage.

(e) Cleansing agents containing chelating agents will not be used. Such agents may not be disposed of at current burial sites due to extensive stabilization requirements and maximum allowable by volume of 1%. Chelating agents may be labeled as chelates, chelants, etc., and include amine polycarboxylic acids, hydroxy-carboxylic acids, and polycarboxylic acids. These agents bond to metals to create chelate complexes. This chemical combination aids in the cleaning process of detergents. However, this same process aids in the migration of radioactive material in the burial trench. The following common cleansers contain chelates - Dow Bathroom Cleaner, Lift-Away and Radiac-Wash.

(f) For the decontamination of specific materials, the following methods may be used:

<1> Glass. Attempt to clean with an approved detergent solution. If unsuccessful, soak in chromic acid cleaning solution or concentrated nitric acid.

<2> Plastic. Clean with ammonium citrate or dilute acids.

<3> Paint. Use paint remover or strip paint from surface. Do not grind the paint off.

<4> Metal. Remove oil using organic solvents. Soak in solution of citric acid or ethylene diamine tetra-acid (EDTA), one pound of acid to one gallon of water. Soak in solution of hydrochloric acid, one part acid to four parts water. Always add acid to water, never water to acid.

<5> Rubber. Wash with detergent and water.

(g) Clothing. Special laundry facilities must be utilized to decontaminate clothing. Usually these are not

available or worth the effort and cost. Therefore, clothing should be considered as radioactive waste and disposed of accordingly except as specifically instructed otherwise by the RPO.

9-16. Emergency Procedures.

a. The RPO will be notified as soon as possible of any mishap, incident, or accident involving radioactive materials or sources.

b. The TOAD Disaster Control Plan will include procedures for radiation accidents and incidents. Procedures set forth in the plan will be rehearsed annually.

c. The following emergencies will be addressed in these procedures:

- (1) Uncontrolled release of radioactive material.
- (2) Fire.
- (3) Overexposure of employees and other personnel.
- (4) Loss of radioactive materials or sources.
- (5) Transportation accidents.
- (6) Medical.

d. Specific guidance for each emergency is as follows:

- (1) Uncontrolled release of radioactive material.
  - (a) Personnel not involved in decontamination procedures will leave the area of release immediately. These personnel will remain nearby until the RPO has determined if they require decontamination or bioassay testing.
  - (b) Injured personnel will be handled as indicated in paragraph (7) below.
  - (c) Contain the spread of contamination.
  - (d) Monitor all personnel who may have been contaminated.
  - (e) Decontaminate personnel.
  - (f) Determine corrective actions and equipment required

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to afford safe re-entry into the area. Ensure that equipment is used by personnel trained in its usage.

(g) Enter area and determine cause of release, and take corrective action to prevent further contamination.

(h) Decontaminate the area and equipment.

(i) The RPO will verify that the area has been decontaminated and is acceptable for re-entry of non-radiation workers prior to allowing personnel into the area.

(2) Release of radioactive gases, dusts, and fumes. In addition to the above procedures, the following steps will be taken:

(a) Hold breath, and turn off any air circulating devices. Leave area immediately.

(b) Close and seal all entrances into the area, and post warning signs or guards to prevent doors from being opened accidentally.

(c) Personnel suspected of having inhaled radioactive material will be reported to the RPO. The RPO will determine when such personnel will report to the Health Clinic for evaluation and referral.

(d) Determine protective clothing and equipment, including respiratory protection, required to re-enter and work in the area. Air sampling of the area will be conducted prior to re-entry.

(e) Determine the source of the leak prior to the reentry if possible.

(f) Re-enter the area, seal off the leak, and decontaminate the area and equipment. The RPO will verify the area and its contents have been decontaminated prior to allowing personnel into the area.

(3) Fire. In addition to the actions listed in (1) above, the following actions will be taken:

(a) Notify the fire department and other emergency personnel at 911.

(b) Fire department personnel will make every practical effort to fight fires from upwind positions. Use of self-contained breathing apparatus will be used when fighting fires

containing radioactive materials.

(c) Direct contact of water or fire-fighting chemicals with radioactive materials should be avoided. Run off will be contained as much as possible, and treated as contaminated waste until determined otherwise by the RPO.

(d) The RPO will advise the Fire Chief on the location of radioactive sources and special precautions to be taken.

(e) All personnel in the emergency area will be monitored for radioactive contamination prior to release from the area.

(f) Areas downwind from the fire will be monitored for radioactive contamination. Only personnel who are trained in monitoring procedures will be allowed in this area.

(4) Overexposure.

(a) All cases of overexposure, actual or potential, will be reported to the RPO as soon as possible.

(b) The RPO, in coordination with medical authorities, will determine appropriate actions to be taken.

(5) Loss of radioactive source.

(a) The RPO and Director, Security and Law Enforcement, will be notified as soon as possible of any lost radioactive source.

(b) If the material has been lost on depot property, a search will be conducted for the material.

(c) If the material is lost off Government property, the appropriate state agency for radiation control will be notified.

(d) Every available means will be utilized to expeditiously locate the missing material.

(6) Transportation accidents.

(a) The RPO will be advised as soon as possible of any accident involving vehicles containing radioactive material. Assistance for accidents occurring off-post will be provided upon request.

(b) The accident should be approached from upwind if the radioactive material or extent of the accident is unknown.

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(c) Traffic shall not be permitted through the accident site until it is determined that the roadway is not contaminated, or appropriate measures have been taken to prevent the spread of contamination by vehicles.

(d) Injured personnel will be handled as indicated in paragraph 9 (Medical) below.

(e) The radioisotope, type of release, and extent of contamination will be assessed and measures taken to contain further spread of contamination.

(f) The type of accident will determine which of the foregoing paragraphs contains the appropriate actions to be taken.

(g) Further guidance is given in paragraph 4-7, and AR 385-40, Chapter 10.

(7) Medical.

(a) Report all injuries resulting from mishaps, incidents, or accidents involving radioactive material to the RPO and medical officer at once. Unless an emergency medical reason requires that the injured individual be removed immediately, the injured person will not be transported until a litter or ambulance is available. If, however, other emergencies exist (i.e., fire or possible explosion), good common sense judgement should be used. Moving of the patient may become imperative.

(b) Minor wounds will be decontaminated immediately under running water. The wound area will be surveyed with an appropriate instrument to determine remaining contamination. It may be necessary to swab the wound to determine removable contamination. Personnel should be decontaminated to as close to the level of natural background radiation as possible. Caution will be taken to prevent further spread of contamination.

(c) Major injuries may require the patient to be transported immediately to the nearest medical clinic capable of treating the patient. If possible, this will be done using an ambulance or other emergency vehicle. Personnel transporting the patient will inform the medical authorities at the clinic that the patient may be contaminated by radioactive materials. The RPO or trained medical personnel will accompany the patient if possible, and assist the treating doctor as necessary. When practical, emergency vehicles will be monitored and, if needed, decontaminated before being released.

(d) Personnel receiving injuries from laser and RFR will be treated as directed by medical authorities.

(e) Personnel receiving a radiation injury will not be returned to duties, where they may be exposed to radiation, until approval is granted by the medical officer and the RPO.

9-17. References.

- a. AR 11-9, The Army Radiation Safety Program
- b. AR 55-355, Military Traffic Management Regulation.
- c. AR 385-10, Army Safety Program.
- d. " Reserved"
- e. AR 385-30, Safety Color Code Marking and Signs.
- f. AR 385-40, Accident Reporting and Records.
- g. AR 385-63, Policies and Procedures for Firing Ammunition for Training, Target Practice, and Combat (Chapter 19, LASERS).
- h. AR 700-64, Radioactive Commodities in the DOD Supply System
- i. AMC 385-25, Radiation Protection.
- j. IOC 385-2, Radiation Protection.
- k. MIL-STD-129M, Marking for Shipment and Storage.
- l. SB 11-206, Film Badge (Photodosimetry) Supply and Services for Technical Radiation Exposure Control.
- m. TB 43-0116, Identification of Radioactive Items in the Army Supply System.
- n. TB 43-0122, Instructions for Safe Handling and Identification U.S. Army Electronics Command Managed Radioactive Items in the Army Supply System.
- o. TB 43-0141, Safe Handling, Maintenance, Storage and Disposal of Radioactive Commodities Managed by U.S. Army Troop Support and Aviation Material Readiness Command (Excludes Aircraft Components).
- p. TB 43-0197. Handling, Maintenance, Storage, and Disposal

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of Radioactive Items.

q. TB 43-0108, Handling, Storage, and Disposal of Army Aircraft Components Containing Radioactive Materials.

r. TB 385-4, Safety Precautions for Maintenance of Electrical/Electronic Equipment.

s. TB MED 523, Control of Hazards to Health from Microwave and Radio Frequency Radiation and Ultrasound.

t. TG No. 153, Guidelines for Controlling Potential Health Hazards from Radio-Frequency Radiation, AEHA.

u. Title 10, Code of Federal Regulations, Chapter 1, Energy.

v. Title 29, Code of Federal Regulations, Chapter XVII, Occupational Safety and Health Administration.

w. Title 49, Code of Federal Regulations, Parts 100 to 199, Transportation.

x. TM 3-261, Handling and Disposal of Unwanted Radioactive Material.

y. DDREM 6055.20, DTD 1 July 94, Radiation Safety Program.

9-18. Glossary.

1. Absorption. The process by which radiation imparts some or all of its energy to any material through which it passes.

2. Absorbed Dose. The energy imparted to matter by ionizing radiation per unit of mass of irradiated material at the place of interest. The unit of dose is the rad, which equals 100 ergs per gram.

3. Activity (Radioactivity). The number of nuclear transformations occurring in a given quantity of material per unit of time. The unit of measure is the Curie (Ci).

4. Acute Exposure. Radiation exposure of a high activity but short duration.

5. Airborne Radiation Material. Any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases.

6. ALARA. An acronym for as low as reasonably achievable.

This refers to the operating philosophy in which occupational exposures to radiation are reduced to as low a level as practical.

7. Alpha Particle. An alpha particle is made up of two neutrons and two protons, giving it a unit charge of plus two. It is emitted from the nucleus of a radioactive atom and causes high density ionization. Alpha particles transfer their energy in a very short distance and are readily absorbed. Alpha radiation is therefore primarily an internal hazard.

8. Atom. The smallest unit of an element that is capable of entering into a chemical reaction.

9. Atomic Weight. The atomic weight is the approximate sum of the number of protons and neutrons found in the nucleus of the atom.

10. Attenuation. The process by which a beam of radiation is reduced in intensity or energy when passing through some material.

11. Authorized Material. Radioactive material not requiring a specific NRC license.

12. Background Radiation. Radiation arising from radioactive material other than the one directly under consideration. Background radiation is due to cosmic rays and emissions from radioactive materials naturally present in the earth, water, and air.

13. Beam. An unidirectional or approximately unidirectional flow of electromagnetic radiation or of particles.

14. Becquerel. Unit of measurement in the System International method of radiation measurement. One becquerel (Bq) equals one disintegration per second.

15. Beta Particle. Beta particles are small electrically charged particles emitted from the nucleus of radioactive atoms. They are identical to electrons and have a negative electric charge of one. Beta particles are emitted with various levels of energy and are often penetrating enough to cause skin burns and pose an exposure hazard.

16. Bioassay. The analysis of excreta, urine, blood samples, whole body count, or other material of biological origin to determine the presence and quantities of internally deposited radionuclides.

17. Bremsstrahlung. The electromagnetic radiation associated with the deceleration of charged particles.

18. Calibration. The determination of a measuring instrument's variation from a standard which is traceable to the National Bureau of Standards to ascertain necessary correction factors, or acceptability of detection capability within a specified error range.

19. Chronic Exposure. Radiation exposure of long, but not necessarily high activity or continuous duration.

20. Commodity (Radioactive). An item of Government property made up in whole or in part of radioactive material to which a national stock number (NSN) or part number has been assigned. A radioactive commodity is any item in the DOD Supply System that contains radioactivity equal to or greater than quantities listed in 10 CFR, Part 20, Appendix C; or contains a specific activity greater than 0.02 microcuries per gram of radioactive material (49 CFR, Part 173.389) and is license exempt.

21. Contamination (Radioactive). The deposition of radioactive material in any place where it is not desired, and particularly in any place where its presence might be harmful.

22. Controlled (Restricted) Area. Any area to which access is controlled for the purpose of protecting persons from exposure to ionizing radiation or radioactive materials. This means that a controlled (restricted) area requires control of access, occupancy, working conditions, and egress. This does not apply to facilities which use ionizing radiation sources for food preservation.

23. Critical Organ. That organ which will receive the greatest exposure and whose damage by a radionuclide entering the human body will result in the greatest potential impairment to the body.

24. Cross-Contamination. Contamination not from an original source, but acquired from another contaminated object.

25. Cumulative Dose. The total dose resulting from repeated exposures to radiation.

26. Curie. A unit of activity, or degree of radioactivity, of a radioactive substance. One curie (Ci) equals 37,000,000,000 (3.7E10) nuclear transformations per second.

27. DARA. Department of the Army Radiation Authorization is a document issued by the Department of the Army IAW AR 385-11 that

gives the installation the right to produce, receive, store, transfer, use, export and import specified radioactive items under specific terms. All radioactive materials on depot must have either an approved DARA or NRC license.

28. Decay (Radioactive). The disintegration of the nucleus of an unstable nuclide by the spontaneous emission of charged particles and/or photons.

29. Decontamination. The reduction or removal of radioactive contamination from any given surface, such that the level of radiation is, at a minimum, less than twice the level of the natural background radiation.

30. Detector (Radiation). Any device for converting radiant energy to a form more suitable for observation. An instrument used to determine the presence, and sometimes the amount, of radiation.

31. Disintegration. A spontaneous nuclear transformation (radioactivity) characterized by the emission of energy and/or mass from the nucleus. When numbers of nuclei are involved, the process is characterized by a definite half-life.

32. Dose. A general term denoting the quantity of radiation or energy absorbed.

33. Dose Equivalent. A quantity which expresses all types of radiation on a common scale for calculating the effective absorbed dose. It is defined as the product of the absorbed dose in rads and certain modifying factors. The unit of dose equivalent is the rem. The SI unit is the sievert.

34. Dosimeter. A device used to detect and measure an accumulated dose of radiation; i.e., film badges, thermoluminescent device (TLD) etc.

35. Electro-Magnetic Radiation. A traveling wave form consisting of oscillating electric and magnetic fields that are perpendicular to each other, and are mutually perpendicular to the direction of wave propagation.

36. Electron. A minute atomic particle possessing the smallest amount of negative charge (-1). Orbital electrons rotate around the nucleus of an atom. The mass of an electron is approximately 1/1820 the mass of a neutron or proton.

37. Electron Volt. A small unit of energy, the amount of energy that an electron gains when it is acted upon by one volt. Radioactive materials emit radiations which may have energies of

up to several million electron-volts (MeV) or higher.

38. Exposure. The incidence of radiation upon living matter by accident or intent. For X-rays and gamma radiation, the sum of the electrical charges of all the ions of one sign produced in air when all electrons liberated by photons in a suitable small volume of air are completely stopped in air, divided by the mass of the air in the volume. The usual exposure rate is expressed as roentgens per hour (R/hr).

39. Film Badge. A package of photographic film and filters used to determine radiation exposure for an extended period.

40. Gamma Rays. Gamma rays are electromagnetic photons which are emitted from the nuclei of radioactive atoms. They are highly penetrating and present an external radiation exposure hazard.

41. Geiger-Mueller Counter. A highly sensitive, gas-filled radiation measuring device.

42. Half-Life, Biological. The time required for the body to eliminate one half of an administered dosage of any substance by process of elimination.

43. Half-Life, Radioactive. The time required for a radioactive substance to lose 50% of its activity by decay.

44. High Radiation Area. Any area that is accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive a dose of 100 millirem or more during any one hour.

45. Ingestion. The entry of material into the body through the mouth and stomach.

46. Inhalation. The entry of material into the body through the breathing process.

47. Internal radiation Hazard. Exposure resulting from deposition of radioactive material within the body through ingestion, inhalation or absorption through the skin.

48. Ion. An atom or group of atoms that carries a positive or negative charge as a result of having lost or gained one or more electrons.

49. Ionization. The process by which a neutral atom or molecule acquires a positive or negative charge.

50. Ionizing Radiation. Electro-magnetic or particulate

radiation capable of producing ions directly, in its passage through matter. For the purpose of this regulation, alpha and beta particles, gamma rays, X-rays, and neutrons are examples of ionizing radiation.

51. Isotope. Any atom(s) having the same atomic number and chemical characteristics, but with different atomic mass, mass number, and physical properties.

52. License (Specific). A document issued by the Nuclear Regulatory Commission under 10 CFR that gives the holder the right to produce, receive, store, transfer, use, export and import specified radioactive items under specific terms.

53. Micro. Prefix indicating one millionth part, symbolized by the letter "u".

54. Microwave. An electromagnetic wave with a wavelength of approximately 1 millimeter to 1 meter and corresponding frequencies of about 300 to 300,000 megacycles per second.

55. Milli. Prefix indicating one thousandth part, symbolized by the letter "m".

56. Neutron. One of three basic atomic particles. The neutron weighs about the same as the proton, but does not possess an electrical charge.

57. Non-Ionizing Radiation. Generic name for those forms of radiation most commonly produced during operation of lasers and radio-frequency systems.

58. Occupationally Exposed Individual. An individual whose work is performed in a controlled (restricted) area and who might be exposed to more than 10% of the radiation exposure standards as a result of employment or duties in a controlled (restricted) area. The term is synonymous with the term "radiation worker".

59. Proton. One of the basic particles of the atomic nucleus (the other is the neutron). It has a positive electric charge of one.

60. RAD. The unit of absorbed dose equal to 0.01 Joules/kilogram in any medium.

61. Radiation. Emission of energy through space in the form of waves, particles or bundles called photons.

62. Radiation Accident. Any event that causes or threatens to cause exposure of the whole body of any individual to 25 rems or

more of radiation; exposure of the skin of the whole body of any individual of 150 rems or more; exposure of the feet, ankles, hands or forearms of any individual to 375 rems or more; the release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5000 times the limits specified in 10 CFR, Part 20, Appendix B, Table II; loss of one working week or more of operation of any facilities affected; or damage to property in excess of \$200,000.

63. Radiation Area. An area in which an individual could receive a radiation dose of 5 millirem or more in any 1 hour, 100 millirems or more in any 7 consecutive days.

64. Radiation Hazard. A condition under which persons might receive radiation doses in excess of the applicable maximum permissible dose, or where radiation damage might be caused to materials or personnel.

65. Radiation Incident. Any exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more; exposure of the feet, ankle, hand, or forearms to 75 rems or more; the release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in 10 CFR, Part 20, Appendix B, Table II; a loss of one day or more of the operations of any facilities affected; or damage to property in excess of \$2,000.

66. Radiation Protection Officer (RPO). An individual designated by the Commander to provide consultation and advice on the degree of hazards associated with radiation, and the effectiveness of measures to control these hazards.

67. Radiation Sources. Materials or devices which generate or are capable of generating radiation, including:

- (a) Naturally occurring radioactive materials.
- (b) Bi-product materials.
- (c) Special Nuclear materials.
- (d) Fission products.
- (e) Material containing induced or deposited radioactivity.
- (f) Source materials.

- (g) Radiographic and fluoroscopic equipment.
- (h) Particle generators and accelerators.
- (i) Electronic equipment that uses klystrons, magnetrons, or other electron tubes that produce X-rays.
- (j) Lasers or high intensity optical sources.
- (k) Microwave equipment.
- (l) Radio-frequency devices.
- (m) Ultrasound equipment.

68. Radiation Worker. Any individual who might be exposed to more than 10 percent of the radiation exposure standards (1.25 rem per quarter, 5 rem per year) as a result of employment or duties in a controlled (restricted) area.

69. Radioactive Material. Any material or combination of materials that emits ionizing radiation.

70. Radioactivity. A natural and spontaneous emission process by which the unstable atoms of an element emit or radiate excess energy from their nuclei as particles or photons, and thus change (or decay) to atoms of a different element or to a lower energy form of the original element.

71. REM. Radiation Exposure Man. A special unit of dose equivalent (see dose equivalent). One REM is an absorbed dose of any ionizing radiation which will produce the same biological effect in man as the absorbed dose from exposure to one Roentgen of X or gamma radiation.

72. Roentgen. One roentgen is the quantity of charge liberated by gamma radiation or X-rays, and is equal to  $2.58 \times 10^{-4}$  coulombs per kilogram of dry air.

73. Sealed Source. Any radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent the release or dispersal of radioactive material under the most severe conditions that may be encountered in normal use or handling.

74. Sievert. Unit of measurement in the System International method of radiation measurement. One sievert (S) equals 100 REM.

75. Specific Activity. The total activity of a given radio-nuclide per gram of an element, compound, or radioactive nuclide.



