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Medical Operations

RADIATION PROTECTION PROGRAM

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This instruction implements the radiation control policies and requirements contained in Air Force Policy Directive (AFPD) 40-2, *Radioactive Materials (Non-Nuclear Weapons)*, Air Force Instruction (AFI) 40-201, *Managing Radioactive Materials in the USAF*, the USAF Master Radiation Exposure Registry, Air Force Technical Order 00-110N series (safety and control requirements in the radiation field), Code of Federal Regulations (CFR), Title 10 (Energy), Title 49 (Transportation), and Department of Defense Instruction (DoDI) 6055.8, *Occupational Radiation Protection Program*, 31 March 1989. It defines guidelines, responsibilities, procedures, and precautionary measures for the control of ionizing radiation sources/emitters. It incorporates the As Low As Reasonably Achievable (ALARA) concept and applies to all Air Force and tenant units on Malmstrom AFB that possess or use radioactive materials, or radiation producing devices. Reference AFMAN 37-139, *Records Disposition Schedule*, for all documents being created and maintained; AFI 33-332, *Air Force Privacy Act Program*, for all documents containing privacy act information; and DoD 5400.7-R, *Department of Defense Freedom of Information Act Program*, and Air Force Supplement, Chap 4, for FOUO information, for all documents containing For Official Use Only information. For a glossary of abbreviations and acronyms see attachment .

SUMMARY OF REVISIONS

This publication incorporates the changes of revised AFI 40-201, approval of contractors to use radioactive materials, and other administrative updates. A bar (|) indicates a revision from the previous edition .

1. Objective. This instruction assures the control of radioactive materials and hazards associated with machines, sources, or devices capable of producing radiation in order to safeguard the health of the military and civilian population while permitting maximum benefits from their use. This instruction describes the conduct of the Base Radiation Protection Program and implements the ALARA concept for ionizing radiation. Air Force policy requires all exposures to radiation be ALARA. There should be no exposure to ionizing radiation without an expected benefit and the dose received should be the lowest possible, con-

sistent with the state of technology, costs and operational requirements. Radiation exposures should be kept as far below existing standards as possible .

2. Requirements.

2.1. The ALARA concept incorporates all of the current radiation protection program requirements of AFI 48-125, *The US Air Force Personnel Dosimetry Program* and the USAF Master Radiation Exposure Registry; AFI 40-201, *Managing Radioactive Materials in the USAF*; and the 00-110N-series of technical orders; as well as certain additional management concepts and controls specifically designed to maintain exposures to personnel ALARA. It includes the philosophy found in current national and international radiation protection reports and consensus standards.

2.2. The requirements contained herein apply to each functional area where radioactive materials or radiation producing devices are used and to each respective Radiation Safety Officer (RSO). This instruction tasks each RSO to perform the required tasks for their specific area of responsibility. The base RSO should coordinate with the respective functional area RSOs to ensure a comprehensive, coordinated base-wide radiation protection program.

3. Responsibilities.

3.1. Wing Commander. The Wing Commander, 341st Space Wing, has ultimate responsibility for the Base Radiation Protection Program and is responsible for appointing, in writing, a base RSO and alternate. Recommendations are made to the Wing Commander by the 341 Medical Group Commander (341 MDG/CC) to appoint the 341 MDOS/SOAB Bioenvironmental Engineer as the base RSO.

3.2. Squadron Commanders. All Squadron Commanders are responsible for appointing unit RSOs if there are radiation hazards or potential radiation hazards associated with the work they accomplish or oversee. Written notification of appointments and any subsequent change is required to be made to Bioenvironmental Engineering (BE).

3.2.1. Enforce radiation protection policies and programs outlined in this instruction.

3.2.2. Ensure unit operating instructions (OI) are published, which identify and delineate location and hazards, and provide control procedures for radiation emitters or sources to limit personnel access to potentially hazardous areas.

3.2.3. Ensure incidents involving potential overexposure of personnel are reported and investigated.

3.2.4. Ensure periodic training is given to workers about radiation hazards, safety procedures, and actions to be taken in the event of accidental overexposure.

3.3. Unit RSOs will:

3.3.1. Perform periodic visits to all work areas in their organization that use or operate radiation sources to verify safety and health control requirements, warning devices, procedural controls, and maintenance of documentation and inventory by user.

3.3.2. Act as a single point of contact for the unit on radiation safety matters and maintain active liaison with BE and Public Health personnel.

3.3.3. Ensure all newly assigned personnel whose duties involve ionizing radiation are reported to the base RSO for entry into the personnel dosimetry program.

3.4. Supervisors of personnel using, operating, or working on radiation devices/sources or in radiation areas:

3.4.1. Write OIs which delineate safety and health precautions when operating or using radiation sources as specified in hazard evaluations. The OIs shall include management and administration action to keep radiation exposure ALARA, and provide procedures for reporting an overexposure.

3.4.2. Maintain an inventory of all radiation sources which shows receipt, quantities on-hand and items disposed. Notify the Base and unit RSO of any changes or modification to equipment, parameters, or facility in writing.

3.4.3. Ensure personnel do their work in the way that keeps their exposure to radiation ALARA and in all cases below the occupational exposure limits.

3.4.4. Ensure workers are properly trained in safe work practices and are told about specific hazards in their work place and the procedures to be followed to avoid those hazards.

3.4.5. Ensure that any suspected or alleged overexposures are immediately reported to the base/unit RSO and that persons involved are promptly transported to the medical clinic for examination.

3.4.6. Coordinate with BE/Base RSO prior to initiating any project including procurement, utilization, or storage of radioactive sources or ionizing radiation equipment, or any change in working conditions or activities which would involve radioactive material.

3.4.7. Upon request, provide the Base RSO with a list of all personnel who perform duties with ionizing radiation off-duty.

3.5. **Base RSO (Bioenvironmental Engineer):**

3.5.1. Conducts the base-wide radiation protection program, which includes surveillance of all radioactive materials and radiation producing devices .

3.5.2. Coordinates and assists unit RSOs as necessary to ensure a comprehensive, coordinated radiation protection program.

3.5.3. Performs initial and periodic hazard evaluations of all radiation sources or modifications as needed. Defines health hazards, hazardous areas, and recommends proper control measures to commanders and users .

3.5.4. Compiles and maintains a current inventory of Air Force-owned and operated radiation sources on the base.

3.5.5. Operates the Base Personnel Dosimetry Program. Issues personnel dosimeters and reviews all dosimetry results.

3.5.6. Conducts or arranges for investigations of alleged personnel over-exposures to radiation.

3.6. **Public Health:**

3.6.1. Establishes medical examination requirements for personnel potentially exposed to hazardous radiation sources.

3.6.2. Performs initial and periodic training of all personnel who use, store, or operate radiation sources. Maintains documentation of training as outlined in this instruction.

3.6.3. Provides briefings and other health education consultations concerning radiation when requested by unit RSOs or commanders.

3.6.4. Starts actions to investigate alleged or suspected radiation overexposures. Prepares and distributes AF Form 190, *Occupational Illness/Injury Report*, and additional documentation as appropriate.

3.7. Individuals Using or Working on Radiation Sources or in Radiation Areas. These persons have a responsibility to protect themselves and their fellow workers from possible harm from radiation by:

3.7.1. Following procedures for safe work given in equipment technical orders and manuals, unit OIs, etc.

3.7.2. Ensuring required warning signs and safety devices are in place or properly set before beginning work and that everyone understands the procedures and signals to be used for the task being done.

3.7.3. Provides the Base RSO with a copy of all dosimetry results obtained while working off-duty.

4. ALARA. It is Air Force policy that all exposures to ionizing radiation be ALARA. There should be no exposure to ionizing radiation without an expected benefit and the dose received should be the lowest possible. While the established maximum permissible doses are conservative and offer a low risk of adverse health effects compared to other hazards of life and occupation, it is prudent that every effort be made to reduce exposures to the lowest level that is reasonably achievable and thereby lower the health risk associated with the exposure. This instruction implements the ALARA concept by establishing a comprehensive; coordinated base-wide radiation protection program that incorporates all of the current radiation protection requirements as well as certain additional management concepts and controls specifically designed to maintain exposures to personnel ALARA. It implements Department of Defense Instruction (DoDI) 6055.8, *Occupational Radiation Protection Program*.

5. USAF Radioactive Material Permits. A single broad scope Nuclear Regulatory Commission (NRC) license has been issued to the USAF Radioisotope Committee (AFMOA/SGOR). The committee is the sole authority within the Air Force to approve and control use, possession, receipt, transfer, and disposal of all radioactive materials for which the NRC has jurisdiction.

5.1. Permit Procedures. The application procedures for renewal, amendment, and new permits will follow the procedures outlined in AFI 40-201, *Managing Radioactive Materials in the USAF*, and Technical Order (T.O.) 00-110N-3, *Requisition, Handling, Storage, and Identification of Radioactive Material*. Those organizations applying for authority to use, process, receive, transfer, or dispose of radioactive material which are licensable materials (covered under 10 CFR 30) submit applications using appropriate NRC forms and NRC regulatory guides. Applications are reviewed and approved or disapproved by the USAF Radioisotope Committee. The Base RSO (341 MDOS/SGOAB) will be the focal point for all permit activities on Malmstrom AFB .

5.2. Inventory and Control Procedures. The using agency must be in compliance with the specific inventory requirements and health and safety precautions contained in the USAF Permit. All receipts, transfers, and disposals of radioactive material will be annotated on the inventory. A radiation protec-

tion survey is conducted at least annually by the Base RSO to assure compliance with applicable publications. Swipe/leak tests are performed by the permittee and results must be maintained by the user and reviewed by the Base RSO.

5.3. Documentation. All documentation concerning the radioactive material is maintained by the using organization until actual elimination of the using organization. Termination of use and or permit does not relieve the user of documentation requirements.

5.4. Loss of Material. Notification of accidents and/or incidents, which were reportable to the NRC, will now be reported to the USAF Radioisotope Committee. The committee provides the required notification to the NRC as necessary .

6. Radioactive Material Receipt, Storage, Shipment, and Labeling :

6.1. Receiving:

6.1.1. Upon receipt of radioactive material or commodities containing radioisotopes, the individual user or appropriate storage organization will monitor the item (reference T.O. 00-110N-3, paragraph 14). If not capable, contact the base BE.

6.1.2. The container should be visually inspected and labeled with AFTO Form 9B, *Radioactive Material Warning*, (reference T.O. 00-110N-3, paragraph 14). The properly packaged and labeled radioactive material should be forwarded immediately to the using organization or storage area as applicable.

6.1.3. No damaged containers or containers with broken seals will be accepted from shippers. Isolate the container and notify the unit and Base RSO if the shipments are received damaged, with seals broken, or show evidence of tampering. Discrepancies are reported as outlined in T.O. 00-110N-3, paragraph 9d.

6.2. Storage. Radioactive materials are stored in secured and identified areas. All commodities which contain radioactive material are labeled in accordance with T.O. 00-110N-3, paragraph 11 and 14. Provisions must be made to preclude unauthorized removal of radioactive material or items. Photographic film should not be stored at distances less than 50 feet from any quantity of any radioactive material.

6.2.1. Unrestricted Storage Area. Area where the radiation intensity at 1 foot from any single container or item in storage configuration does not exceed 2 milliRoentgen per hour (mR/hr). The base RSO performs annual radiation protection surveys in these areas .

6.2.2. Restricted Storage Area. Area where the radiation intensity is in excess of 2 mR/hr at 1 foot from any single container or item in the storage configuration. The Base RSO performs quarterly radiation protection surveys in these areas. The interior and exterior of each restricted area must be posted with appropriate AFTO placards outlined in T.O. 00-110N-3, paragraph 14.

6.3. Shipping. Commodities containing radioactive material are not consolidated with other materials for shipment since radioactive items are designated as "hazardous." Contact the Base RSO to determine if a particular commodity contains radioactive material. Items must be shipped in accordance with AFJMAN 24-204, *Preparing Hazardous Materials for Military Air Shipments*, and T.O. 00-110N-3, paragraph 12. Air Force activities shipping or transporting NRC licensed radioactive materials must follow 10 CFR 71, and 49 CFR 172 through 173. Chain of custody must be strictly

enforced. The base RSO will ensure that exterior radiation levels on the surface on the container are below acceptable level of 0.5 mrem per hour on any surface of the container.

6.4. Marking and Identification. All commodities, packages, containers, work and storage areas containing radioactive material must be identified. Requirements for radioactive material warning labels and placarding are outlined in T.O. 00-110N-3, paragraph 14.

7. Radioactive Waste Disposal. This is an extremely sensitive issue and is of great concern to the general population, State and Federal Regulatory Agencies, and the Department of Defense. Even minor infractions of the Department of Transportation (DOT), NRC, Environmental Protection Agency (EPA), State or local regulations can mean adverse public reaction, possible legal action (fines and imprisonment), and suspension of the use of the commercial radioactive material burial sites .

7.1. No Air Force agency may enter into a radioactive waste disposal contract or agreement without approval of USAF Radioisotope Committee through the Air Force Institute of Environment, Safety, and Health Risk Analysis (AFIERA)/SDRH.

7.2. Electron Tube Disposal. Licensed items containing radioactive material must be disposed of as radioactive waste in accordance with 10 CFR Part 20. Section 30.15 of 10 CFR list items that are exempt from licensing requirements and are therefore exempt from publications pertaining to receiving, processing, and disposal. Electron tubes are listed among the exemptions provided certain levels of activity and measurable radiation defined in Section 30.15(a) (8) are not exceeded. Exempted electron tubes may be disposed of as ordinary refuse as outlined in T.O. 00-110N-7, *Handling and Disposition of Radioactive Electron Tubes and Spark Gaps*. Contact BE to determine if an electron tube is exempt prior to disposal. The unserviceable electron tube should be placed in the replacement tube's container and disposed of as ordinary trash. Do not break the tube nor accumulate the electron tubes.

8. Industrial, Medical, and Dental X-Ray Units. All equipment capable of producing x-rays must be monitored for potential exposure to workers and the public. The Base RSO maintains an inventory of all equipment and performs annual evaluations of all work areas.

8.1. Medical and Dental Units. The Base RSO evaluates these units annually to assure all safety and health precautions are enforced by the user.

8.2. Testing of Protective Clothing. All leaded gloves, aprons, and gonadal shields must be tested annually for safety defects by the using agency, except dental clinics. Radiographic inspection must be used because visual inspection for cracks or defects are impossible.

8.2.1. If a fluoroscopic unit is available, place the protective clothing on the x-ray table and quickly scan the item for any damaged areas or defects.

8.2.2. If a fluoroscopic unit is unavailable, place the protective clothing on the x-ray table with a film cassette underneath. A technique of 90 kVp, 200 mA, 0.4 secs, using screens should reveal any defects. Several shots may be required to inspect an item completely (reference USAF Occupational and Environmental Health Laboratory (OEHL) Newsletter, No. 4, Oct 1980) .

8.2.3. Defective items should be removed from use and replaced. Document the annual inspection in a logbook or by a letter. The documentation should reflect the local identification number for the item, date of inspection, and any findings.

9. Base Personnel Dosimetry Program. All personnel whose occupation involves the operation of x-ray equipment or handling of radioactive material run the risk of occupational exposure to ionizing radiation. A monitoring device must be issued to each person (military and civilian) who, exclusive of background or medical radiation, is at risk of receiving occupational exposure to ionizing radiation above limits determined locally. Specific risk criteria and exposure levels are outlined in AFI 48-125, *The US Air Force Personnel Dosimetry Program*.

9.1. Personal Dosimetry. The primary monitoring device for use in determining occupational exposure to ionizing radiation on any Air Force installation is the Thermo-Luminescent Dosimeter (TLD). The TLD must be worn by the individual while performing any task involving potential exposure to ionizing radiation. When not in use, the dosimeter must be kept in appropriate storage areas. When in use, the "whole body" dosimeter should never be worn on the collar, a separate "collar" badge is issued for this purpose. When issued a collar and a whole body badge, both badges must be worn at all times.

9.2. Issuance of Personal Dosimeters. The BE, 341 MDOS/SGOAB, is responsible for the operation of the USAF Personnel Dosimetry Program on Malmstrom AFB. TLDs may be obtained at any time. All records are maintained by this section.

9.3. Pregnant Member Policy. The individual's supervisor or physician may restrict a pregnant member's duties involving radiation. There is no blanket policy to remove them from radiation duties. Each pregnancy is handled on a case-by-case basis depending upon their potential to receive radiation exposure. BE is responsible for evaluating potential exposure that could be received by a pregnant female working in a radiation area.

9.3.1. Continue individual in radiation duties if it is unlikely that the worker receives a radiation exposure in excess of 500 milliroentgens equivalent man (mRem) during the term of the pregnancy (including the period preceding confirmation of her pregnancy).

9.3.2. Restrict individual's specific duties contributing to significant exposures if it is likely that the worker would receive a total whole body dose during pregnancy exceeding 500 mRem. This may result in total removal from radiation duties or only partial removal.

9.3.3. Pregnant members are placed on monthly dosimetry and the base involved is notified of the results within 24 hours of receipt of the dosimeters by the AFIERA/SDRH.

9.4. TLD Action Level. The BE reviews all TLD results monthly for each work area. Action is taken as described below:

9.4.1. Pregnant Members Action Level. Personnel dosimetry results which if continued for the term of the pregnancy would exceed the 500 mRem exposure limit for the fetus (reference AFI 48-125). This action level corresponds to 50 mRem on a monthly TLD. If excessive dosimeter results are received, investigate and report results to the Base RSO and the Aerospace Medicine Council.

9.4.2. Investigation Action Level. AFIERA Listing 1499 is reviewed monthly. If any person receives a result in excess of established ALARA levels for the month, or quarter, an investigation is initiated. A memo for record or a formal report is written as necessary when recommended correction action is deemed appropriate for reducing monthly exposure levels.

9.4.3. Abnormal Exposure Level. This level is shop specific depending upon historical exposure data.

9.4.4. Occupational Exposure Limits:

9.4.4.1. Total effective dose equivalent (TEDE) shall not exceed five rems.

9.4.4.2. Total organ dose equivalent (TODE) limit to any organ other than the skin or the lens of the eye of 50 rem. The TODE is the sum of the deep dose equivalent (DDE) from external sources to a particular organ and the committed dose equivalent (CDE) from internally deposited radionuclides.

9.4.4.3. The annual occupational dose limits to the eye, skin, and extremities are an eye dose equivalent of 15 rem and a shallow dose equivalent of 50 rem to the skin or any extremity.

9.5. The dose limits for members of the general public are as follows (10 CFR part 20.1301 (a)):

9.5.1. A yearly TEDE (as defined above) of 0.1 rem per year. This includes both internal and external doses.

9.5.2. A maximum external dose rate of two millirem in any one hour.

10. Accident and Overexposure Reporting Procedures. All accidents and overexposure to ionizing radiation is reported to the Base RSO. The Base RSO will initiate action to investigate the alleged incident in accordance with AFI 40-201. Results of the investigation must be documented and filed accordingly. Medical exams will be coordinated and scheduled by Public Health. All results are reported to the individual shop supervisor, unit commander, Aerospace Medicine Council, and HQ Space Command as appropriate.

11. Review of Radiation Facility/Source Installation Plans.

11.1. Review of Construction and Facility Maintenance. All Plans for modification of facilities or design of new facilities which involve the use of radioactive material or radiation producing devices must be reviewed by the unit/base RSO to ensure ALARA is considered.

11.2. The AFIERA, Radiation Services Division (AFIRA/SDRH), Brooks AFB, Texas 78235, DSN 240-3406, is contacted for design reviews that are beyond the technical capability of the local RSO.

12. Contractor Use of Radioactive Material on Malmstrom AFB. Prior to any contractor use of radioactive material on an Air Force installation provide the following information to the Base RSO to ensure contractor qualifications:

12.1. Evidence of a valid Nuclear Regulatory Commission (NRC) or agreement State Radioactive Material License.

12.2. A copy of an NRC Form 241, *NRC Radioactive Material Warning*, or similar document, listing the specific licensable items the contractor wishes to use on the base.

12.3. Proof of a valid Air Force contract.

12.4. Equipment manufacture specifications (power output, source of radioactivity, etc.), model and serial numbers.

12.5. Proposed storage location on MAFB.

12.6. Duration of use.

13. Contracting.

13.1. Contracting will ensure that all contracts contain a standard clause identifying the above requirements and that all contractors notify the contracting officer of their intent to utilize radiation producing equipment/radioactive material equipment.

13.2. Contracting will ensure that all coordinated contractor requests, whether approved or disapproved, are received and properly filed with other contracting documents .

14. Personnel Training. All individuals working in or frequenting any portion of an area where radioactive material or radiation producing devices are used must receive initial and annual radiation protection training. Initial training is conducted before or as soon as possible after assignment to work areas involving radiation exposure. Annual refresher training will be conducted to re-emphasize and reinforce training objectives .

14.1. Training Requirements. The shop supervisor in conjunction with the Base RSO and Public Health conduct the radiation safety training classes. Course content and instruction include:

14.1.1. Risk from radiation exposure.

14.1.2. Health risks to children of women who are occupationally exposed to radiation during pregnancy.

14.1.3. Maximum permissible dose limits.

14.2. Protective measures required. This should be tailored to specific radiation work.

14.2.1. ALARA philosophy and practice.

14.3. Documentation. Training documentation is maintained locally by the respective unit RSO and a copy is forwarded to Public Health for inclusion in Tab F of the facility case files. AF Form 2767, *Occupational Health Training and Protective Equipment Fit Testing*, can be used to document this training .

15. Quality Control Program. The Base RSO conducts quality assurance review of the radiation protection program to include :

15.1. Monthly review of personnel dosimetry results to ensure overexposure, abnormal exposure, investigation, and pregnant female action levels have not been exceeded. Personnel dosimetry results above the specific action level are investigated and the results of the investigation reported to the Aerospace Medicine Council.

15.2. Personnel dosimetry results for pregnant female workers are reviewed monthly and documentation maintained on all actions taken to ensure that the total dose to the fetus does not exceed 500 mRem during the term of pregnancy. Positive efforts should be made to limit the dose to no more than 50 mRem per month.

15.3. Yearly radiation protection program reviews are accomplished and documented. The results are presented to the Aerospace Medicine Council. The reviews will include:

15.3.1. A review of all personnel dosimetry results for the previous year to ensure adverse trends are noted and that all personnel dosimetry results which exceed action levels outlined in this instruction are acted upon.

15.3.2. All radiation protection survey results for the previous year to ensure all required surveys have been performed and documented properly and that corrective action, if necessary, has been accomplished.

16. Record Management. All records generated by this instruction are maintained in accordance with AFMAN 37-139, *Records Disposition Schedule*.

C. DONALD ALSTON, Col, USAF
Commander, 341 Space Wing

Attachment 1**GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION*****References***

US Nuclear Regulatory Commission (NRC) Regulatory Guide 8.10, *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Reasonably Achievable* .

US Nuclear Regulatory Commission (NRC) Regulatory Guide 8.18, *Information Relevant to Ensuring That Occupational Radiation Exposures at Medical Institutions Will Be As Low As Reasonably Achievable*.

Department of Energy Report DOE/EV/1830-T5, Apr 84, *A Guide to Reducing Radiation Exposure to As Low As Reasonably Achievable (ALARA)*.

AFI 40-201, *Managing Radioactive Materials in the USAF*.

AFI 48-125, *The US Air Force Personnel Dosimetry Program*.

TECHNICAL ORDER 00-110N-2, *Radioactive Waste Disposal*.

TECHNICAL ORDER 00-110N-3, *Requisition, Handling, Storage, and Identification of Radioactive Materials*.

Abbreviations and Acronyms

ALARA—As Low As Reasonably Achievable

AFI—Air Force Instruction

AFIERA—Air Force Institute for Environment, Safety, and Occupational Health

AFMOA—Air Force Medical Operations Agency

AFOSH —Air Force Occupational Safety and Health

AFSC—Air Force Specialty Code

AFSPC—Air Force Space Command

BE —Bioenvironmental Engineering

CFR—Code of Federal Regulations

DDE—Deep Dose Equivalent

DoDI—Department of Defense Instruction

DOT —Department of Transportation

DSN —Defense Switched Network

MAFB —Malmstrom Air Force Base

MDOS—Medical Operations Squadron

mRem—Milliroentgens equivalent man

mR/hr—Milliroentgens per hour

NRC —Nuclear Regulatory Commission

OEHL —Occupational and Environmental Health Laboratory

OI—Operating Instructions

RSO —Radiation Safety Officer

SEI —Special Experience Identifier

TEDE—Total Effective Dose Equivalent

TLD —Thermoluminescent Dosimeter

T.O.—Technical Order

TODE —Total Organ Dose Equivalent