Chapter 2

SAFETY

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2.1 INTRODUCTION

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2.1.1 Purpose and Scope

This chapter provides information concerning safety and radiation protection for personnel and equipment. It applies to all licensed and registered activities involving sources of ionizing radiation.

2.1.2 ALARA Philosophy

All authorized users and personnel involved with equipment containing radioactive materials must know and practice the ALARA philosophy – to keep radiation exposure As Low As Reasonably Achievable. It is the policy of the Florida Department of Transportation (FDOT) that all operations are to be conducted in a way that keeps exposure As Low As Reasonably Achievable.

2.1.3 Management Commitment

Management is committed to the ALARA philosophy of minimizing occupational and public radiation doses. The oversight and review of the radiation safety program is performed by the RSO, the position, which is occupied by a Professional Engineer (P.E.), indicating the high level of management commitment by the Department.

2.1.3.1 All personnel using density gauges will be made aware of our commitment to the ALARA philosophy and they will be instructed in the procedures necessary to keep their exposures as low as possible.

2.1.3.2 The DRSO and/or their designees will be delegated authority to ensure adherence to ALARA principles. Management will support the DRSO and/or their designees in instances where this authority be asserted.

2.1.3.3 All reasonable modifications will be made to procedures, equipment, and facilities to reduce exposures, unless the cost is considered unjustified. Management will be prepared to describe the reasons for not implementing modifications that have been recommended.

2.2 TRAINING

Proper training is the most important factor contributing to safety in the handling, transporting, and use of nuclear equipment. Chapter 64E-5, F.A.C., states: “Radioactive materials shall be used by individuals who are qualified by training and experience to protect public health, safety and the environment.” Only personnel who have received proper training are permitted to operate, transport, or handle equipment containing radioactive materials or equipment producing ionizing radiation. Evidence of required training is the possession of a FDOT Certificate of Qualification. When handling, operating, or transporting nuclear equipment, Department personnel must provide evidence of proper training by showing their Certificate of Qualification, a reproduction, or the wallet card issued with the Certificate. Training requirements are described in Chapter 8.

2.3 PERSONNEL SAFETY

2.3.1 Means of Limiting Radiation Exposure

In practicing the ALARA philosophy, no matter how low the exposure rate, some means are available to limit the exposure, and we should use them. In radiation safety, there are three ways to limit or reduce exposure. These are time, distance, and shielding.

(1) Time – Radiation exposure is denoted in an exposure per time. For example, the longer a person stays in a radiation field, the greater the exposure.

(2) Distance – Radiation exposure decreases drastically over distance. Radiation obeys the “inverse square” law that states radiation intensity falls as the inverse square of the distance from the center of the source to the “target”. For example, if a person standing one meter from a source was receiving 40 millirem [(400 microsieverts (μSv)] per hour, moving back another meter would cut the intensity to 10 millirem (100 μSv) per hour.

(3) Shielding – The best means of decreasing radiation exposure is to place something between you and the source to limit the radiation. This is why the source of any nuclear equipment should be in the shielded or "safe" position when not required for use. The gauge is acting as a shield in the "safe" position.

2.3.2 Personnel Monitoring

2.3.2.1 Personnel monitoring badge – The Department uses the Landauer Luxel optically stimulated luminescent dosimeter capable of measuring X-ray, beta and gamma radiation. The dosimeters are for external exposure monitoring of the whole body: head, trunk arms above the elbow, or legs above the knee. They are exchanged on a quarterly basis.

2.3.2.2 Control dosimeter – A control dosimeter is included with each shipment of dosimeters to determine radiation doses received during transit, and should be stored in a radiation-free area during the wear period. The control dosimeter reading is subtracted from the dosimeter reading of each participant. Failure to include the control dosimeter will cause transit doses to be reflected in the participant dose.

2.3.2.3 Required Information from Dosimeter Users – The following must be provided to the DRSO prior to issuing a dosimeter:

Name (first and last with middle initial)
FDOT employee ID number
Date of birth
Permanent mailing address

2.3.2.4 Instructions for Use of Dosimeters

(1) Personnel are not permitted to handle, transport, use or assist in the use of nuclear equipment unless wearing a dosimeter.

(2) Each dosimeter shall be worn only by the individual to whom it is assigned.

(3) Clip-on dosimeters should be worn on the chest area as indicated by the visual body location icon on each badge.

(4) After replacement, exposed dosimeters must be promptly submitted to the vendor for analysis.

(5) If a dosimeter is lost, the immediate supervisor shall be contacted at once for a replacement.

2.3.2.5 Care of Dosimeters − It is necessary that dosimeters receive the proper care, so true exposure values are provided when read. Besides jeopardizing the accuracy of the dosage, unusual exposure values require additional effort by others in checking the reliability of the dosimeter reading. When not wearing a dosimeter, the following actions should be taken:

(1) Do not allow the dosimeter to be exposed to radiation when the employee is not receiving exposure,

(2) Do not store the dosimeter near radiation sources,

(3) Do not wear the dosimeter during medical X-rays because they are not occupational exposures,

(4) Do not expose dosimeter to direct sunlight for long periods,

(5) Do not store on dashboards where there can be both heat and sunlight,

(6) Do not store in glove compartments nor in vehicles with closed windows where there can be excessive heat, and

(7) If caught in the rain while wearing a dosimeter, try to keep it dry.

2.3.3 Occupational Dose Limits

2.3.3.1 Annual Occupational Dose Limit for adults − 5,000 millirem per year, whole body (total effective dose equivalent).

2.3.3.2 Quarterly Limit − The Department has set a limit for exposure at 100 millirem per wear period. If this limit is reached or surpassed, an investigation into the cause of the exposure will begin as described in 2.3.7.2.

2.3.3.3 Annual Occupational Dose Limit for Minors − 500 millirem (10 percent of the annual dose limits for adults). The Department does not permit employees under 18 years of age to receive occupational exposures

2.3.4 Requirements for Declared Pregnancies

2.3.4.1 Definition. A declared pregnant woman is a woman who has voluntarily informed her immediate supervisor in writing of her pregnancy and the estimated date of conception. See Form F-5 for a suggested format of declaration.

2.3.4.2 Embryo/Fetus Dose Limits. Florida regulations limit the dose to an embryo or fetus during the entire pregnancy from occupational exposure of a declared pregnant woman to 500 millirem. Efforts must be made to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman so as to satisfy the 500 millirem limit. FDOH recommends that no more than 50 millirem be received by the embryo or fetus in any one month. The dose to an embryo or fetus will be equal to the dose for the declared pregnant woman. If by the time the woman declares pregnancy, the dose to the embryo/fetus has exceeded 500 millirem or is within 50 millirem of 500 millirem, the Department will be considered in compliance with the limit, provided the additional dose to the embryo/fetus does not exceed 50 millirem during the remainder of the pregnancy.

2.3.4.3 Procedure for Declared Pregnant Women. A declared pregnant woman must complete the Declaration of Pregnancy form, and review the FDOT procedures for personal monitoring requirements. They must wear their assigned dosimeter at waist level at all times at work to estimate the fetal dose. No additional badge is needed.

2.3.4.4 Procedure for Immediate Supervisor. The supervisor must obtain the written declaration of pregnancy, complete the pertinent information and immediately forward it to the DRSO, requesting waist-level monitoring. Declared pregnant women will not be removed from working with gauges unless requested in writing by the individual. The supervisor must ensure that the employee wears her badge at waist level.

2.3.4.5 Procedure for DRSO/RSO. Upon receipt of a declaration of pregnancy, the DRSO must verify that declared individual the employee has not requested removal from gauge work, ensure that the employee wears her badge at waist-level, maintain records, and ensure compliance with the dose limit.

2.3.5 Public Dose Limits

Anyone who does not work directly with sources of ionizing radiation is a is a member of the public and is subject to two public dose limits: 2 millirem in any one hour and 100 millirem per year. Members of the public who enter restricted areas remain subject to the dose limits. The Department conducts its operations so that compliance with both dose limits is maintained. The RSO and DRSOs are responsible for verifying radiation levels and establishing restricted areas.

2.3.6 Instruction to Workers

Anyone who works directly with portable gauges will be instructed in the following:

(A) The Department's storage, transfer, or use of sources of radiation;

(B) Health protection problems associated with exposure to radiation or radioactive material, precautions or procedures to minimize exposures, and purposes and functions of protective devices;

(C) Applicable regulations and license provisions for the protection of personnel from exposures to radiation or radioactive material;

(D) Responsibility to report promptly to FDOH any condition which may constitute, lead to, or cause a violation, or unnecessary exposure to radiation or radioactive material;

(E) Appropriate response to warnings made in the event of any unusual occurrence, incident or malfunction that may involve exposure to radiation or radioactive material; and

(F) Advised of the radiation exposure reports workers must be furnished in accordance with 64E-5.903, F.A.C.

2.3.7 Notifications and Reports to Individuals

2.3.7.1 Radiation Dosimetry Reports. The vendor mails a copy of each dosimetry report to the DRSOs for their respective districts. Electronic copies of the reports are available on the vendor's website. The reports provide quarterly, year-to-date, and lifetime dose data. The Deep Dose Equivalent (DDE) is the dose of record.

2.3.7.2 Review of Exposure Report. The DRSOs review reports upon receipt and make them available for review by employees. Absent badges, unassigned badges with doses, assigned badges with elevated doses warrant special attention. Absent badges must be located and sent in for processing. The DRSO investigates the cause of doses reported on unassigned badges, and elevated doses on assigned badges. If a dose reported on an unassigned badge is found to be from an occupational exposure, the dose is assigned to the wearer of the badge. If the cause of an elevated dose cannot be determined, the reported dose will remain unchanged. If the dose is determined not to be an occupational exposure, the worker's dose record will be corrected.

2.3.7.3 Annual Dose Reports. Monitored employees will be provided a written copy of their annual dose. Annual dose reports will include the statement specified in 64E-5.903(1), FAC. Copies of annual reports will be maintained for 3 years. DRSOs should update monitored worker's mailing addresses annually

to have them available should the worker's employment with the Department be terminated.

2.3.7.4 Termination Dose Reports. After their monitoring ends due to termination of employment or because they no longer work with gauges, a written notification of occupational radiation dose received during employment with the Department is provided to monitored personnel. The notifications are issued within 30 days of termination or within 30 days of the worker's dose being determined (whichever is later).

2.3.7.5 Other Dose Records. When subject to reporting to the state, records of surveys, measurements or calculations made to determine exposures are also provided to the exposed individual(s) and the records are maintained until license termination.

2.3.8 Retention of Occupational Dose Records

Personnel monitoring results must be retained until termination of the Department's license. Other dose records and dose-related reports will be retained for three years after the records were made. Required records must be legible for the specified retention period. Records may be originals or reproductions, and can be stored in electronic media. Records will include all pertinent information, such as signatures, and will be safeguarded against tampering or loss.