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RADIATION PROTECTION

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RADIATION PROTECTION

12.1 ENSURING THAT OCCUPATIONAL RADIATION EXPOSURES ARE AS LOW AS REASONABLY ACHIEVABLE (ALARA)

12.1.1 POLICY CONSIDERATIONS

12.1.1.1 Management Policy

Union Electric Company is committed at the corporate level to maintaining occupational radiation as low as reasonably achievable. This policy is promulgated in general terms by the Senior Vice President and Chief Nuclear Officer and is implemented by specific procedures and directives at the plant level by the Senior Director, Nuclear Operations. Implementation of the ALARA program will be in accordance with the requirements of 10CFR19 and 10CFR20 and will follow the intent of the guidance provided in applicable sections of Regulatory Guides 1.8, 8.8 and 8.10.

12.1.1.2 Organizational Structure

The Senior Director, Nuclear Operations, through the Radiation Protection Department staff, is ultimately responsible for development, implementation, and continuing conduct of the overall plant Radiation Protection program of which the ALARA program is a part. The Manager, Radiation Protection directs the Radiation Protection Department and is responsible to the Plant Director for the ALARA program. The Manager, Radiation Protection has the responsibility and authority for developing, implementing and managing the plant ALARA program.

The organization of the Radiaton Protection Department is described in Section 12.5.1.

ALARA reviews can be performed by qualified nuclear engineering personnel (i.e., Design Engineering, Technical Support Engineering, Systems Engineering, or Radiation Protection) for plant modifications or maintenance activities.

12.1.1.3 Application of the Union Electric ALARA Policy to Plant Operations

The Callaway Plant ALARA program is implemented through the adherence to Administrative and Radiation Protection procedures which cover, but are not limited to, the following subjects:

a. Qualifications of and the conduct of operations of the plant radiation protection department.

b. ALARA program administration - reviewing job planning, job exposure data, radiation work permit comparisons with personnel exposure,

procedure reviews, review of design change packages for installation and long term operations and maintenance concerns, and trends of dose data for potential programmatic changes.

c. Training of personnel in the fundamentals of radiation protection and in health physics exposure control procedures.

d. Radiation Work Permit Program

e. Internal Personnel Monitoring

f. External Personnel Monitoring

g. Area Posting

h. Radioactive Material Control

i. Radiological Surveys

j. Instrumentation

k. Radiological Incidents

l. Radiation Work Practices

m. Environmental Monitoring

n. Respiratory Protection

12.4 DOSE ASSESSMENT

This section contained the dose assessment to the construction workers during the construction of Callaway Plant Unit 2. With the cancellation of Callaway Plant Unit 2 in October 1981, this section is no longer applicable.

12.5 RADIATION PROTECTION PROGRAM

12.5.1 ORGANIZATION

12.5.1.1 Radiation Protection Program Objectives

The objective of the radiation protection program for the Callaway Plant is to maintain the occupational radiation exposure of personnel working at the plant as low as is reasonably achievable (ALARA). This objective is accomplished by adherence to the requirements of Title 10 of the Code of Federal Regulations, Part 20, by following the intent of guidance given in USNRC Regulatory Guides 8.2, 8.8, 8.10, 8.34, 8.35, 8.36 and 1.8, and by using industry accepted radiation protection practices.

The radiation protection program is administered by the organization described in subsections 12.5.1.2 and 13.1.2.2.2 to accomplish the following:

a. Identify and review radiation protection training requirements for personnel assigned to work in radiological controlled areas commensurate with their duties, responsibilities, and the degree of radiation hazards anticipated. Inform these personnel of methods for maintaining occupational radiation exposure ALARA and assist them in carrying out their radiation safety responsibilities.

b. Evaluate and review the radiological status of the plant by monitoring radiation, contamination and airborne radioactivity levels to control or eliminate radiological hazards.

c. Control external and internal radiation exposure of personnel through the implementation of radiological controls during operations and maintenance.

d. Review and evaluate radiation protection records and appropriate plant operating and maintenance procedures for methods to reduce radiation exposure to personnel.

e. Maintain and evaluate personnel exposure records to ensure that occupational radiation exposures are maintained ALARA.

f. Maintain control of radioactive materials on-site and maintain releases of radioactive materials in effluents to unrestricted areas ALARA.

g. Evaluate and review the swipe samples from instruments containing radioactive sources that other Union Electric fossil power plants have provided.

12.5.1.2 Organization of the Radiation Protection Department

The experience and qualifications of the personnel responsible for administering the radiation protection program are presented in Section 13.1.3.1. The responsibilities of the personnel are discussed in Section 13.1.2.2.2.

The Radiation Protection Department is comprised of personnel in the following classifications:

a. Manager, Radiation Protection

b. Supervising Health Physicist

c. Health Physicists/Nuclear Scientists

d. Radiation Protection Supervisors

e. Radiation Protection Technicians

f. Radiation/Chemical Helpers

12.5.1.3 Personnel Training

The training of plant personnel in radiation protection is described in Section 12.5.3.4.

12.5.2 EQUIPMENT, INSTRUMENTATION AND FACILITIES

12.5.2.1 Equipment and Instrumentation

Radiation Protection instrumentation and equipment will be available for the assessment of plant radiological conditions and to support the operation of the Callaway Plant Radiation Protection Program. The three classifications of equipment that will be utilized in radiological monitoring and surveillance activities include:

a. Installed Equipment

b. Laboratory Equipment

c. Portable Equipment

Installed equipment includes both the in-plant area radiation monitoring system and the process and effluent radioactivity monitoring system. Laboratory equipment consists of analytical instrumentation used to analyze and quantify radioactivity. Portable equipment includes portable radiation detection instrumentation, air samplers and personnel dosimetry used for performing radiation and contamination surveys, airborne radioactivity monitoring and sampling and personnel monitoring.

Portable and laboratory instrumentation used in the radiation protection program will be selected in accordance with the following criteria:

a. Ability to measure the quantity of interest to an acceptable degree of precision and accuracy.

b. Ease of operation, maintenance, and calibration.

c. Appropriate sensitivity and range for various operational situations, including normal operations, anticipated operational occurrences and accident conditions, as determined by the requirements of applicable regulations.

d. Operational reliability.

12.5.2.1.1 Installed Radiation Monitoring Equipment

Installed area radiation monitors and continuous air monitors are described in Section 12.3. Process and effluent monitors are described in Section 11.5.

12.5.2.1.2 Radiation Protection Laboratory Instrumentation

Radiation protection laboratory instrumentation will include a gamma spectroscopy system, a liquid scintillation counter, a gas flow proportional counter and a geiger-mueller type counting system. Additional information on radiation protection laboratory equipment is provided in Table 12.5-1. The primary location of radiation protection laboratory equipment will be the count room, 1984' elevation of the Control Building. However, additional counting equipment will be available at other plant locations including the Emergency Operations Facility.

12.5.2.1.3 Portable Radiation Detection Instrumentation

Portable radiation detection instrumentation is described in Table 12.5-2 which includes information on the type, range, accuracy and typical quantities of instruments. Survey instruments will be available in-plant to facilitate access. Instruments requiring calibration or repair will be identified as out-of-service and segregated from in-use equipment.

12.5.2.1.4 Portable Air Sampling Equipment

Portable air sampling equipment includes high and low-volume air samplers capable of accepting particulate filters and charcoal cartridges for grab samples of radioactive particulates and iodine. In addition, portable continuous air monitors, typical of that described in Table 12.5-2, will be used for continuous surveillance of airborne radioactivity levels. Air sampling instruments are calibrated periodically in accordance with an established calibration program.

12.5.2.1.5 Instrument Calibration

Calibration of portable and laboratory radiation protection instrumentation will be performed in accordance with an established calibration program. Requirements of this program include as a minimum:

a. written procedures for operation and calibration of each instrument.

b. a mechanism for tracking and recall of instruments for calibration.

c. established calibration frequencies for each instrument and recalibration following maintenance and repair that could change the instrument performance characteristics established during the previous calibration.

d. use of calibration standards which are traceable to the National Institute of Standards and Technology (NIST).

e. required calibration accuracies and tolerances.

f. periodic response checking of instruments to verify continuing proper operation.

g. maintenance of records documenting calibration activities.

h. tagging and labeling of instruments.

12.5.2.1.6 Protective Clothing

Protective clothing is prescribed and issued to plant personnel by the radiation protection staff based upon the actual or potential radiological conditions expected for the job assignment. Protective clothing stations are established at strategic locations within the plant as required to ensure efficient operations and to preclude the spreading of contamination. Protective clothing available at the plant includes the following:

a. Coveralls.

b. Caps and hoods.

c. Shoe covers.

d. Plastic, rubber, and cotton gloves.

e. Plastic suits.

f. Face shields/masks

12.5.2.1.7 Respiratory Protection Equipment

Respiratory protection equipment is available to plant personnel and is also prescribed and issued to individuals as required by actual or potential radiological conditions of the work assignment. The Callaway Plant Respiratory Protection Program follows the guidance of Regulatory Guide 8.15 and complies with the requirements of 10 CFR Part 20. Respiratory devices available at the Callaway Plant include the following:

a. Full-face respirators with high-efficiency particulate and/or charcoal filters.

b. Full-face respirators with supplied air.

c. Hoods with supplied air.

d. Full-face respirators in self-contained breathing apparatuses.

e. Half-face respirators with HEPA and/or charcoal filters.

Purchases of respiratory protection equipment such as air purifying respirators, supplied air respirators, self-contained breathing apparatuses and accessory equipment are made following the guidance given by 30 CFR Part 11 and the NIOSH Certified Equipment Manual.

12.5.2.1.8 External Dosimetry

All personnel entering the plant's Radiological Controlled Area (RCA), are monitored for occupational radiation dose in accordance with the requirements of 10CFR20. Optical Stimulated Luminescent Dosimetery (OSL) is the primary method of monitoring occupational radiation dose from exposure to beta and photon radiation. CR-39 is the primary method of monitoring occupational radiation dose from exposure to neutron radiation. Primary dosimetry is processed by a vendor that is accredited by the National Voluntary Laboratory Accrediation Program (NVLAP) in accordance with the requirements of 10CFR20. An appropriate secondary monitoring device is issued to each individual who enters the RCA. Portable neutron survey instruments and stay time calculations are used as a secondary method for determining neutron dose. Exposure records for each individual will be maintained in accordance with Regulatory Guide 8.7.

12.5.2.1.9 Internal Dosimetry

Internal radiation exposure is assessed using either in vivo counting, specimen analysis or calculational techniques based on surveillance program data. The methodology for internal radiation exposure assessment will follow the guidance of the International Commission on Radiological Protection (ICRP). The concepts, models, equations and assumptions used for internal radiation exposure assessment will reflect the appropriate recommendations of the ICRP.

An in vivo counter is located at the plant for measurement of plant personnel, visitors, or support personnel. The in vivo counter will provide preliminary background information, periodic evaluation, and emergency capability for detecting internal exposure conditions. Assessment of internal radiation exposure of those individuals who regularly enter areas where the potential exists for inhalation, ingestion, or absorption of radioactive material will be performed annually.

12.5.2.2 Facilities

12.5.2.2.1 Radiation Protection Facilities

The radiation protection facilities consist of a radiation protection office, counting room, hot laboratory, and personnel decontamination shower located at elevation 1984' of the Control Building.

12.5.2.2.2 Access Control Facilities

Radiation protection facilities at the 1984' level of the Control Building are designed to function as the primary access point for entry to the radiological controlled areas of the plant. The plant arrangement is such that traffic between radiological controlled areas and uncontrolled areas is routed through this access control area. The purpose of the access control point is to provide positive control over access to radiological controlled areas for exposure control purposes and to prevent the spread of contamination to uncontrolled areas of the plant. Contamination control features of access control include controlled entrance and exit locations with contamination monitoring provisions at the exit of the radiologically controlled area.

In addition to the primary access control point described above, auxiliary radiological control points can be established at necessary locations within the plant for the purpose of personnel and contamination control. These radiological control points are equipped with protective clothing, portable survey equipment and other radiation protection materials and are established at locations of strategic importance for contamination and exposure control.

12.5.2.2.3 Equipment Decontamination Facilities

Equipment used for the cleaning and maintenance of contaminated parts, instruments and equipment is located at elevation 2000' adjacent to the Auxiliary Building. When hand decon is not practical (such as for high level of contamination or ALARA constraints), special cleaning equipment will be used for removing radioactive contamination from items requiring repair or maintenance.

12.5.2.2.4 Personnel Decontamination Facilities

A personnel decontamination area separated from normal showering facilities is provided on the 1984' level of the Control Building in the access control area. Facilities provided include decontamination sinks, shower, and a drying and monitoring area.

12.5.2.2.5 Radiation Protection Count Room

A counting room is located near access control and is used for radioactivity analyses. A separate hot laboratory is provided for sample preparation. The count room is equipped to perform routine analyses required for personnel protection, surveys, and related radiation protection functions. The counting room is equipped with the necessary instrumentation to perform routine counting on plant radioactivity samples (water, air, swipe survey, etc.).

12.5.2.2.6 Laundry Decontamination Facility

The laundry decontamination facility is located on the 2000 elevation adjacent to the Auxiliary Building. It is equipped with washer-extractors, dryers, a clean laundry monitor and clothes sorting tables.

12.5.2.2.7 Radiation Protection Office

The radiation protection office is located adjacent to the entrance to the access control area and will allow radiation protection personnel to observe personnel entering and leaving the radiological controlled area. The radiation protection office provides work space for radiation protection personnel to perform routine administrative activities such as completing survey records and generating RWP's. It also provides a location from which plant radiation protection activities can be coordinated and plant personnel can obtain information concerning work activities or plant radiological conditions.

12.5.2.2.8 Locker and Change Facilities

Change areas consisting of lockers and benches are provided within the plant. A storage area for protective clothing is provided adjacent to the change areas, thus allowing personnel to dress-out for activities near the contaminated areas.

12.5.2.2.9 Calibration Facilities

Instrument calibration facilities are provided for the calibration, routine maintenance and storage of portable radiation protection instrumentation. The radiation protection calibration facilities will be equipped with fixed and portable calibration sources of sufficient range and strength to allow calibration of most portable radiation detection instruments and personnel dosimetry devices used at the Callaway Plant.

12.5.2.2.10 Dosimetry Processing Facilities

Primary dosimetry is processed by a vendor.

12.5.2.2.11 Respiratory Protection Facilities

On-site facilities set aside for respiratory protection functions include areas for conducting quantitative fit testing and an area for administering pulmonary function testing as part of the medical qualification program for respirator users.

Other on-site areas are set aside for washing, drying, repair and storage of respirators which are used for supporting day to day work. The plant warehouse serves as the bulk storage point for receiving and storing respiratory protection equipment held in reserve for future use.

12.5.2.2.12 Respirator Issue and Storage Area

A Respirator Issue Area is provided within the Access Control Area for issuing of respirators to individuals as required by actual or potential radiological conditions of the work assignment.

12.5.3 PROCEDURES

The radiation protection administrative, departmental and technical procedures used at the Callaway Plant are an integral part of the plant ALARA program. The provisions and guidance of Regulatory Guides 8.2, 8.7, 8.8, 8.10, 8.13, 1.8, and 1.39, are used in the development of the plant radiation protection procedures. Exception to Reg. Guide 1.33 has been submitted under separate correspondence to the NRC.

Procedures for personnel radiation protection shall be prepared consistent with the requirements of 10 CFR Part 20 and shall be approved, maintained and adhered to for all operations involving personnel radiation exposure.

12.5.3.1 Radiation Surveys

Radiological surveys are performed periodically during operation and shutdown at the Callaway Plant for the assessment of radiation-fields, radioactive contamination, and airborne radioactivity levels. Portable instruments, equipment, and techniques for surveys are addressed in department and technical procedures.

12.5.3.1.1 Radiation - Surveys

Routine measurements of radiation field intensities are performed in accessable areas of the plant, using portable instrumentation appropriate for the type of radiation present. These surveys are performed on a schedule which is determined by:

a. Actual or potential radiation levels.

b. The variability of radiation level.

c. The occupancy factor of the location.

Radiation surveys are conducted to monitor and detect any significant changes in radiation levels and to evaluate the effectiveness of radiological controls. High radiation areas are usually surveyed upon entry and periodically thereafter while work in the area is in progress. Additional radiation surveys are performed as necessary to evaluate and minimize personnel radiation exposure during operational and maintenance functions.

Records are maintained of the results of these surveys, by location, so that trends in the radiation level are readily identified. Results of these radiation surveys are correlated with the readings of the Area Radiation Monitoring System, where appropriate.

Prior to the initiation of any operation for which a radiation work permit is required, a survey will be made of the radiation field in the vicinity where the operation is to be performed. The results of this survey are recorded on the radiation work permit.

12.5.3.1.2 Surface Contamination Surveys

Contamination surveys are performed on a regularly scheduled basis in all accessible areas during operation and shutdown to evaluate the hazard due to removable and non-removable radioactive contamination. Locations of importance for controlling the potential spread of contamination are surveyed at a frequency commensurate with the contamination hazard present using the "smear" technique or an appropriate portable instrument. These survey frequencies could increase or decrease depending on factors such as the actual or potential radioactive concentration, occupancy factor, location, and plant status.

Contamination surveys are also made on personnel, equipment, and materials from time to time as necessary to ensure complete control over the levels and spread of removable contamination. Appropriate techniques, instruments, and frequency of surveys will be delineated in the radiation protection procedures.

The results of these surveys are recorded and tabulated by location so that trends in the data may be readily observed.

12.5.3.1.3 Airborne Radioactivity Surveys

Surveys to assess airborne radioactivity levels are performed to ensure 10 CFR Part 20 limits are not exceeded, engineering controls are functioning, and respiratory protection techniques are adequate.

The results of routine airborne radioactivity surveys are recorded by location so that trends in the radiation levels can be readily identified. Air sampling surveys are performed on a routine basis in areas with both a high occupancy factor and a high potential for the existence of airborne radioactivity. Other locations are surveyed periodically depending on the significance of the location as a source of occupational radiation exposure from airborne radioactivity. These survey frequencies could increase or decrease depending on factors such as the actual or potential radioactive concentration, occupancy factor, location, and plant status.

Airborne samples are collected and analyzed for operations and maintenance activities which are expected to produce airborne radioactivity.

12.5.3.2 Radiation Exposure Control

In order to control occupational radiation exposures and the spread of radioactive contamination, varying degrees of access to plant areas will be established. Area access and exposure time for personnel will be determined by the necessity for such access and by radiation and contamination levels.

Areas of the plant are subject to access control restrictions proprortionate to the potential for radiation exposure in each area. The particular access control requirements for each area will be specified by Radiation Protection Supervision. A radiological controlled area is any area where actual or potential radiological hazards exist in the form of radiation, contamination, airborne radioactivity, or stored radioactive materials. Radiation areas, contamination areas, high radiation areas, very high radiation area, airborne radioactivity areas and radioactive material areas will be considered radiological controlled areas. Radiological controlled areas will be posted and controlled in accordance with the requirements of 10CFR20. Access to such areas is controlled as warranted by the degree of radiological hazard involved via use of access control, auxiliary radiological control points and the radiation work permit program.

The plant arrangement is such that traffic between radiological controlled areas and uncontrolled areas is routed through access control. The access control facilities for normal traffic are located in the control building where people entering and leaving all controlled areas will check for contamination. Within the controlled area, access is controlled by utilizing locked and/or annunciated doors and gates, fences, alarms, rope barriers, and the posting of signs.

High radiation areas in which the radiation field is greater than 100 mrem/hr but less than 1000 mrem/hr will be posted as a high radiation area and entrance into the area will be controlled by the radiation work permit program. High radiation areas in which the radiation field is greater than or equal to 1000 mrem/hr will be provided with locked doors to prevent unauthorized entry. For individual areas accessible to personnel that are located within large areas, such as the Containment, where no enclosure exists for purpose of locking, and where no enclosure can be reasonably constructed, the individual area shall be barricaded, conspicuously posted and a flashing

light activated as a warning device. The flashing light may be omitted if positive control of access to the area is provided.

Very high radiation areas with radiation levels in excess of 500 rads in one hour at one meter from the radiation source will be conspicuously posted as a very high radiation area. Entrances to these areas will be barricaded and locked.

Administrative measures for access control in high radiation areas include the requirement for issuance of a radiation work permit for any operation to take place in such an area. Depending upon the operation, a radiation protection technician may be assigned to supervise stay-time and make appropriate surveys while the operation is in progress.

The radiation work permit (RWP) program will be established as an integral part of the ALARA policy implementation. This program will be the responsibility of the Manager, Radiation Protection. In addition to entries into and work performed in high radiation areas, RWP's may be required for the following type activities:

a. Entries into designated airborne radioactivity areas, radiation areas, contamination areas and radioactive material storage areas.

b. Work involving maintenance or other adjustments to any system or component which contains, stores, transports or collects radioactive materials.

c. Other activities which in the judgement of Radiation Protection Supervision warrant the issuance of a radiation work permit prior to initiating the operations.

The radiation work permit stipulates the purpose of entry, work location, radiation conditions, surveillance and dosimetry requirements, stay-time, protective clothing and equipment, and other procedural requirements and precautions.

The primary objectives of the radiation work permit program are to insure that:

a. Radiological conditions are known as accurately as possible.

b. Proper protective measures are taken to safely perform the required duties.

c. Each person involved in these operations acknowledges his understanding of the radiation conditions, the protective and safety measures required, and his willingness to follow the radiation work permit requirements.

d. Appropriate supervisors are aware of the task being performed, the radiation conditions, and the prescribed protective measures.

e. A means for maintaining the accountability of personnel is provided.

12.5.3.3 Contamination Control

Areas that may be contaminated with radioactive material will be decontaminated to a level that is reasonably achievable using available methods and techniques. Since the complete removal of surface contamination from parts of the plant is a practical impossibility, certain plant areas may be designated as "contamination areas". These areas will be posted with the proper warning placards and barricaded. Entry to these areas will be controlled by radiation protection personnel and allowed only through the issuance of an appropriate radiation work permit. Personnel, equipment, and material exiting from contaminated areas will be monitored to prevent the spread of contamination to clean areas. All contaminated equipment will be properly packaged and identified before removal from a contaminated area. At access control facilities near the radiation protection office, a final survey will ensure that all personnel, material, and equipment are free of significant contamination, and thus will provide assurance that no radioactive material will spread to the uncontrolled areas of the plant.

12.5.3.4 Radiation Protection Training

The Manager, Technical Training is responsible for the radiation protection training program at the Callaway Plant. Plant personnel, both permanently assigned and temporary, receive training in the principles of radiation protection commensurate with the individual's job function and the anticipated radiation hazards.

The radiation protection training program will include as a minimum the following topics:

a. Fundamentals of radiation and radioactivity.

b. Biological effects of radiation on humans.

c. Measurement of radiation and radioactivity.

d. Principles and techniques of radiation protection.

e. Use of protective clothing and equipment.

f. General regulatory and specific facility license radiation protection requirements.

g. Emergency planning.

h. ALARA program - concepts and methods.

The radiation protection training program will maintain the proficiency of these employees through periodic retraining lectures and exercises.

12.5.3.5 Personnel Dosimetry

12.5.3.5.1 External Radiation Dosimetry

See Section 12.5.2.1.8.

12.5.3.5.2 Internal Radiation Dosimetry

See Section 12.5.2.1.9.

12.5.3.6 Airborne Radiation Evaluation and Control

Airborne radioactivity will be routinely assessed using local sampling, portable continuous air monitors, and the fixed radiation monitoring system. Airborne radioactive materials (particulates, noble gases, halogens, tritium) will be sampled and analyzed using appropriate techniques. Since local sampling will provide better estimates of airborne contamination levels existing in a work area than will a monitor reading, such special air sampling will be used in the radiation work permit program to keep radiation exposure due to airborne radioactivity ALARA. Portable continuous air monitors and fixed airborne radioactivity monitors will be used to provide alarm indications and additional information which will be used with local sampling for the assessment of airborne radioactivity.

Control of airborne radioactivity levels will be assured through the use of the plant's heating, ventilation, and air conditioning (HVAC) systems, portable air movers and filters. The HVAC systems provide controlled air movement and filtration for those areas with a high potential for airborne radioactivity problems. Special control techniques can be used, such as plastic enclosures which isolate and vent airborne radioactivity arising from special work projects. Respiratory protection equipment will be available for use in those situations where airborne radioactivity hazards exist and other control measures are inadequate at the location and time.

12.5.3.7 Respiratory Protection Program

The respiratory protection program will be developed through the guidance of Regulatory Guide 8.15 and will satisfy the requirements of 10CFR20. As a minimum, the respiratory protection program will provide the following:

a. Procedures to implement the selection, use, maintenance and storage of respiratory protection devices.

b. Adequate facilities to support the storage, issue, cleaning and maintenance of respiratory protection devices.

c. Use of only NIOSH certified or NRC approved equipment.

d. Medical certification program for respirator users.

e. Periodic review of the overall effectiveness of the respiratory protection program via the internal dosimetry program.

12.5.3.8 Radioactive Materials Handling

Methods and procedures will be developed to control, handle, and store by-product, source, and special nuclear material in accordance with regulatory requirements.

Subjects to be covered by these procedures will include the following:

a. Storage of radioactive material in appropriately shielded, labeled and secured containers.

b. Minimizing the distance that radioactive samples are transported by personnel and the use of special extension and remote handling tools when applicable.

c. Use of shielded sample transporters as appropriate

d. Periodic testing to verify the integrity of the sealed material.

e. Emergency procedures which detail the proper actions to be taken in the event of leakage and spills.

f. Accountability of any by-product or special nuclear material.

TABLE 12.5-1 RADIATION PROTECTION LABORATORY EQUIPMENT

INSTRUMENT	RADIATION DETECTED	DETECTOR	TYPICAL QUANTITY	LOCATION	REMARKS
Gamma Spectroscopy System	Gamma	HPGe w/graded shield	4	Counting Room and/or Maintenance Training Annex/ Operations Support Facility	Provides Gamma Isotopic analysis capabilities
Gas Proportional Counter	Alpha, Beta, Gamma	Gas Flow Proportional	1	Counting Room	Used for counting smears, effluent and radio chemistry samples.
Liquid Scintillation Counter	Beta	---	1	Counting Lab	Tritium determination
In Vivo Counter	Gamma	NaI (Tl) and/or HPGe	1	In Vivo Count Room Central Processing Facility	Personnel In Vivo Counting; Multidetectors

Note: Sensitivities of this analytical instrumentation are dependent upon counting parameters such as sample geometry, count time and background, however, equipment from various manufacturers will be evaluated to ensure that the equipment when purchased will be sufficiently sensitive to perform the tasks for which it was intended. Instruments will be selected to satisfy measurement and reporting requirements in effect at the time the equipment is ordered.

TABLE 12.5-2 PORTABLE RADIATION PROTECTION EQUIPMENT

TYPE	TYPICAL DETECTOR TYPE[1]	APPROXIMATE RANGE	ACCURACY	TYPICAL QUANTITY	LOCATION
Portable Count Rate Meter/ Frisker	Geiger-Mueller/ Scintillation	0-500,000 CPM	± 10% FS	10	See Note 3
Low-Range Survey Meter	Geiger-Mueller/ IIonization Chamber	0-2 R/hr/ 0-5 R/hr	± 10% FS	25	
High-Range Extendable Probe Survey Meter	Geiger-Mueller	0-1000 R/hr	± 10% FS	4	
Mid-Range Survey Meter	IGeiger-Mueller/ IIonization Chamber	0-50 R/hr 0-100 R/hr	± 10% FS	5	
High-Range Survey Meter	IGeiger-Mueller/ IIonization Chamber	0-1000 R/hr IIndication	± 20% FS	3	
Neutron Survey Meter	BF Tube Inside Polyethylene Sphere	0.2 mrem/hr 10 rem/hr	± 10% FS	4	
Ultra-High Range Survey Meter	Geiger-Mueller/ IIonization Chamber	0-10,000 R/hr	± 10% FS	2	
Alpha Count Rate Meter/ Frisker	Scintillation	0-500,000 CPM	± 10% FS	5	
Portal Monitor/Personnel Contamination Monitor	Gamma Scintillation/ Gas Flow Proportional	Variable	-----	6	
Beta-Gamma Count Ratemeter/Frisker	Geiger-Mueller	0-500,000 CPM	± 10% FS	20	
Electronic Dosimeter	Solid State	0-100 R/hr/ 0-1000 R	± 10% FS	250	

TABLE 12.5-2 (Sheet 2)

TYPE	TYPICAL DETECTOR TYPE[1]	APPROXIMATE RANGE	ACCURACY	TYPICAL QUANTITY	LOCATION
Electronic Dosimeter Reader	Not Applicable	Not Applicable	Not Applicable	8	See Note 3
Calibration Transfer Instrument	IIonization Chamber	Various	± 5%	1	
Portable Area Monitor	IGeiger-Mueller/ Ionization Chamber/ Solid State	0-2 R/hr 0-100 R/hr	± 25% Max.	5	
Gamma Survey Meter	NaI	0-500k CPM	± 10%	2	
High Volume Air Sampler	Not Applicable	> 15 CFM	± 20%	5	
Low Volume Air Sampler	Not Applicable	0-3 CFM	± 20%	15	
Portable Continuous Air Monitor (3 channel type)	NaI (I-131); Beta Scintillation (Particulate and Gaseous)	1E-11 to 1E-5 (I-131 and particulate) 1E-11 to 1E-1 (gaseous)	± 20% of Indication	4	

Note 1: The detector types listed are typical of the instrumentation used. As instrumentation technology improves, an equivalent or better type of instrumentation may be substituted.

Note 2: The quantities listed for each type of instrumentation are the typical numbers calibrated and ready for use.

Note 3: Instrumentation is located in the RP Facilities on 1984' elevation of the Control Building, the Calibration Facilities, Dosimetry Processing Facilities or at specific work locations in the plant while in use.

Note 4: The above information is referenced in the Radiological Emergency Response Plan, Section 6.7.3, and complies with Regulatory Guide 1.97.