4.0 RADIATION PROTECTION

This chapter describes the American Centrifuge Plant (ACP) Radiation Protection (RP) Program for keeping occupational radiation exposures and radioactive contamination below regulatory limits and as low as reasonably achievable (ALARA). The RP Program addresses the occupational radiation protection requirements set forth in 10 *Code of Federal Regulations* (CFR) Parts 19, 20, and 70. The Radiation Protection Manager (RPM) is responsible for the ACP RP Program. The RPM or designee carries out responsibilities of the RPM described in this chapter.

4.1 Radiation Protection Program Implementation

In accordance with 10 CFR 20.1101(c), the RP Program content and implementation is reviewed annually. The RPM is responsible for this annual review and preparation of a report documenting the results of the review. The ALARA Committee then reviews the report. Revisions to the RP Program, if warranted, are initiated and processed by the RPM as part of the annual review process. Any resulting changes to the Radiation Worker Training module are also implemented.

4.2 As Low As Reasonably Achievable Program

In accordance with 10 CFR 20.1101, the ACP RP Program is designed to protect personnel entering the ACP from unnecessary exposure to ionizing radiation and radioactive materials. This program is based upon the following principles and is implemented through written procedures.

- Personnel radiation exposures and the release of radioactive effluents shall be maintained in accordance with the ALARA principle.

- No individual shall receive a radiation dose in excess of any regulatory limit.

Responsibility for establishing and ensuring adherence to these principles rests with the Senior Vice President. The Director, American Centrifuge Plant has the overall responsibility and authority for the ALARA Program. The RPM is responsible for establishing and implementing the ALARA Program in accordance with written policies and procedures.

4.2.1 As Low As Reasonably Achievable Committee

The ALARA Committee is an independent advisory group to the Director, American Centrifuge Plant and the Plant Safety Review Committee on RP issues. It functions to: (1) monitor selected operational RP issues; (2) advise ACP management on RP concerns; and (3) review proposed designs, work practices, selected suggestions, and selected projects with regard to contamination control and/or ALARA.

The ALARA Committee:

- Communicates management's commitment to the ALARA Program;
- Monitors the implementation of the ALARA Program and serves as the advisor to ACP management for maintaining occupational dose and environmental dose in accordance with ALARA principles; and
- Reviews, for the purpose of occupational dose and environmental dose reduction, proposed designs, practices, selected suggestions, and selected project schedules.

The ALARA Committee also:

- Establishes the annual exposure goals;
- Provides recommendations to ACP management and/or the Plant Safety Review Committee as appropriate, regarding procedural, equipment, or design changes that could have a significant impact on personnel radiation exposure; and
- Forms subcommittees or assigns individuals to undertake special studies or conduct ALARA reviews that will be documented and presented to the ALARA Committee with any recommendations.

Membership consists of persons from various functional disciplines who have the necessary competence and experience to perform the functions of the committee. Standing committee members are the RPM who serves as the chairperson, the vice-chairperson who is appointed by the RPM, the Engineering Manager, Operations Manager, Maintenance Manager, Plant Support Manager, Regulatory Manager, and an operations technician and/or a maintenance mechanic. Participation from other functional disciplines may vary depending on the issue of concern. The committee chairperson, or designee, is responsible for requesting appropriate functional representation. Committee members may designate an alternate to attend committee meetings in their place.

The ALARA Committee meets at least annually and as directed by the chairperson. A quorum consists of five standing committee members or their alternates. Ad hoc subcommittees may be established for special studies or reviews pertinent to committee-related issues.

The chairperson ensures those functions of the committee and tasks are properly executed. Minutes are provided to the Director, American Centrifuge Plant. The committee issues special reports prepared upon request of ACP management, or as determined by the chairperson.

The committee reviews matters that have or may have an impact on contamination control and/or ALARA. The ALARA Committee reviews the ALARA Program and the review includes an evaluation of the results of audits performed by Health Physics (HP), reports of radiation levels, contamination levels, employee exposures, and effluent releases. The review

determines if there are any upward trends in personnel exposure for identified categories of workers and types of operations. The review also identifies any upward trends in effluent releases and contamination levels and determines if exposures, releases, and contamination levels are in accordance with the ALARA concept. Specific areas reviewed include, but are not limited to the following:

- Technologies for selected job tasks;
- Current work practices and completed tasks which have/had contamination control or ALARA concerns;
- Radiation protection violations;
- Lessons learned;
- Trends and resulting impacts on contamination control and/or ALARA; and
- Environmental monitoring reports.

The committee also establishes annual contamination control and exposure goals. Minutes are issued that identify committee members and/or alternates in attendance, agenda items, a summary of decisions made, and action items. Copies are made available to ACP management and the committee members. Recommendations of the ALARA Committee are documented and tracked to completion in the Corrective Action Program.

4.3 Organization and Personnel Qualifications

The RPM is responsible for providing guidance and direction for establishment and implementation of the RP Program and has direct access to the Director, American Centrifuge Plant and Senior Vice President for radiological control matters. The RPM reports to the Production Support Manager, which provides independence from operations. The RPM and designee are required to have the technical competence and experience to establish RP programs (RPM qualifications are stated in Section 2.1.4.3.1.1) and the management capability to direct the implementation and maintenance of RP programs.

The HP Group reports to the RPM and provides radiological protection support to the plant. HP is independent of the organizations responsible for production. The HP Group is staffed with suitably trained individuals who provide oversight and control of the technical aspects of the program elements that affect RP. There are sufficient HP resources available to support ACP activities.

HP Technicians and their managers perform the functions of assisting and guiding workers in the radiological aspects of the job. HP Technicians and their managers have the responsibility and authority to stop radiological work or mitigate the effect of an activity if they

suspect that the initiation or continued performance of a job, evolution, or test will result in the violation of approved RP requirements.

4.4 Written Procedures

4.4.1 Procedures

The RP Program is implemented using procedures. The procedures are prepared consistent with the requirements of 10 CFR Part 20 and are approved, maintained, and adhered to for operations involving personnel radiation exposure and toxicological exposure to soluble uranium. The procedures are reviewed and revised as necessary to incorporate any plant or operational changes, including these initiated by changes to the Integrated Safety Analysis (ISA). These procedures are prepared, maintained and made available to appropriate personnel at the plant as described in Section 11.4 of this license application.

4.4.2 Radiation Work Permits

Radiation Work Permits (RWPs) are a basic implementing tool by which radiological controls are established. RWPs provide information to the worker concerning protective clothing, job/task identification, and special instructions such as radiological hold points. Radiological surveys that supplement RWPs provide information regarding radiation and contamination levels.

RWPs are required for work activities in Contamination Areas (CAs), High Contamination Areas (HCAs), Airborne Radioactivity Areas (ARAs), Radiation Areas (RAs), High Radiation Areas (HRAs) and other areas as required by HP. Qualified HP personnel are authorized to approve, issue, update, revise, and close RWPs. The RPM may exempt the requirement for an RWP in certain RAs as specified in approved procedures.

The limits established for contamination control (surface and airborne) are based on the toxicity of soluble uranium. The contamination control program, of which RWPs are a part, is designed to ensure that the inhalation or ingestion of soluble uranium is below the limits stated in 10 CFR 20.1201(e).

An RWP may be issued for any period up to one year, based on the stability and predictability of changes in the radiological conditions of the work area. RWPs are normally closed upon job completion. HP may close an RWP at any time.

Radiological surveys are reviewed to evaluate the adequacy of RWP requirements. RWPs are updated or closed and reissued if radiological conditions change to the extent those protective requirements need to be modified.

HP management reviews the RWP closure package to ensure appropriate actions have been taken.

Continuous HP coverage may be used in lieu of RWPs when approved by the RPM. Qualified HP Technicians are authorized to provide continuous radiological coverage in lieu of an RWP for short duration (less than one shift), non-complex tasks. When continuous HP coverage is used, requirements normally specified on an RWP are communicated to the worker verbally.

4.5 Training

Radiological control is provided by controlling access to areas where radioactive material may be encountered and by requiring that each person who enters those areas or facilities receive the appropriate level of radiological worker training. Personnel are trained commensurate with the hazard per 10 CFR Parts 19 and 20. Details concerning Visitor Site Access Orientation and radiological training are provided in Section 11.3.1 of this license application. The Radiological Worker Training Program addresses the requirements of 10 CFR 19.11 and 19.12 and workers' responsibilities under the Radiation Protection Program. The Radiation Worker Training program is described in Section 11.3.1.3 of this license application.

4.5.1 Visitor Site Access Orientation

Visitors review basic information related to the site and hazards present at the ACP. Trained radiological workers escort visitors who are granted access to the Restricted Areas.

4.5.2 General Employee Radiological Training

General Employee Radiological Training covers the employee's responsibilities for maintaining exposures to radiation and radioactive materials in accordance with the ALARA philosophy.

4.5.3 Radiation Worker Training

If a person requires unescorted access to the Restricted Area, radiological worker qualification is required. Radiation Worker Training is a biennial training requirement.

4.5.4 Health Physics Technician

HP Technicians are trained and qualified in accordance with an approved qualification standard and training is delivered consistent with applicable training procedures (see Section 11.3). HP Technician training develops the skills necessary to perform assigned work in a competent manner. The training consists of initial, on-the-job, and continuing training.

HP Technician qualification consists of the standardized core course training material, ACP-specific information, and on-the-job training. Passing a final comprehensive written examination is required. The training program ensures personnel are proficient in radiation measurements, characterization of radiological conditions, release monitoring, and personnel monitoring. Formal remediation protocols are utilized.

Entry-level prerequisites are established to ensure that HP Technicians meet minimum standards for education. Task qualification for entry-level positions may be used until formal training is completed.

Following initial qualification, HP Technicians are requalified every two years. The requalification process requires successful completion of a comprehensive written examination. The written examination may be waived for personnel with National Registry of Radiation Protection Technologist certification. Personnel who maintain qualifications as HP Technicians satisfy the requirements of Radiation Worker Training.

HP Technician managers complete and maintain qualifications as HP Technicians.

4.6 Ventilation and Respiratory Protection Programs

ACP building ventilation systems are described in Chapter 1.0 of this license application and in the ISA Summary. These systems are primarily designed to maintain the building environment required for proper operation of process and associated equipment.

There are no items relied on for safety (IROFS) identified with ventilation systems in the ACP ISA. However, building ventilation systems are credited as design features that reduce the consequences of a UF_6 release in multiple analyzed events.

The ISA accident scenarios also identify use of portable ventilation units (commonly referred to as “gulpers”) during applications ranging from pigtail operations to small-scale maintenance tasks to reduce worker exposure. In addition, administrative guidance requires the shutdown of building ventilation systems following detection of a UF_6 release to minimize the consequences to personnel (on and off site) during loss of confinement events.

4.6.1 Ventilation

In addition to general ventilation systems, portable ventilation units may be employed for short duration jobs when the unprotected worker could potentially exceed 0.8 Derived Air Concentration (DAC)-hours of exposure. These portable ventilation units are equipped with high efficiency particulate air (HEPA) filters and are designed to discharge room air at low velocities.

The differential pressure of portable HEPA filtered ventilation units is checked per operating procedure for radiological purposes. The operating differential pressure range is based on manufacturer's recommendations or as specified in the technical design basis. HEPA filter systems, both fixed and portable, are efficiency tested in accordance with American Society of Mechanical Engineers (ASME) N510-1989, *Testing of Nuclear Air- Treatment Systems,* as it applies to radiological contaminants likely to be found at the ACP. Portable HEPA filter unit use is normally specified on the RWP.

HEPA filter systems used to implement ALARA principles and to control worker exposures are tested in accordance with ASME N510-1989. For those systems not designed in accordance with ASME N509-1989, *Nuclear Power Plant Air-Cleaning Units and Components*, ASME N510-1989 is used as testing guidance.

The average air velocity through openings in uranium sampling and handling hoods containing readily dispersible uranium is a minimum of 100 linear feet per minute (lfpm). This velocity is checked at least annually.

If radiological containments are used, when they are in use and have the potential to generate airborne radioactivity, they will be maintained at a negative differential pressure.

4.6.2 Respiratory Protection

The Respiratory Protection Program follows the requirements of 29 CFR 1910.134 and 10 CFR Part 20 for use, issuance, training, and qualifications for respirator users. Procedures for respirator usage follow the requirements of 10 CFR 20.1703(c)(4). RWPs specify respiratory protection required for radiological protection purposes. Respirator use is considered for activities where an individual may be exposed to soluble uranium that may exceed 0.8 DAC-hours or an intake of 1 milligram (mg) of soluble uranium during a work shift.

Engineering and administrative controls, including access restrictions and the use of specific work practices designed to minimize airborne contamination or loss of contamination control are used to minimize worker internal exposure. When engineering and administrative controls have been applied and the potential for airborne radioactivity still exists, respiratory protection is used to limit internal exposures. Use of respiratory protection is considered under any of the following conditions:

- During entry into posted ARAs;
- During breach of contaminated systems or components;
- During work in areas or on equipment with removable contamination levels greater than 100 times the levels in Table 4.6-1; and
- During work on contaminated surfaces with the potential to generate airborne radioactivity.

In specific situations approved by the RPM, respiratory protection may not be used due to physical limitations, such as heat stress, or the potential for significantly increased external exposure. In such situations, stay time controls to limit intakes are established and continuous workplace airborne monitoring is provided along with expedited analysis of results.

Table 4.6-1 Contamination Levels

Nuclide[a]	Removable (dpm/100 cm^2)[b]	Total (Fixed + Removable) (dpm/100 cm^2)
U-natural, ^{235}U, ^{238}U, and associated decay products, Transuranics $\leq$ 2 percent by alpha activity, ^{99}Tc, and beta-gamma emitters	1,000	5,000
Transuranic modified materials containing > 2 percent and < 8 percent transuranics by alpha activity, Th-natural, ^{232}Th, ^{223}Ra, ^{224}Ra, and ^{232}U	200	1,000
^{226}Ra, ^{228}Ra, ^{230}Th, ^{228}Th, ^{231}Pa, ^{227}Ac, ^{125}I, ^{129}I, and Transuranics $\geq$ 8 percent by alpha activity	20	500

[a] The values in this table apply to radioactive contamination deposited on, but not incorporated into the interior of, the contaminated item. Where contamination by both alpha and beta-gamma-emitting nuclides exists, the levels established for the alpha- and beta-gamma-emitting nuclides apply independently.

[b] The amount of removable radioactive material per 100 square centimeters (cm^2) of surface area is determined by swiping the area with a dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. For objects with a surface area less than 100 cm^2, the entire surface is swiped; and the activity per unit area is based on the actual surface area. Except for transuranics $\geq$ 8 percent by alpha activity, ^{228}Ra, ^{227}Ac, ^{228}Th, ^{230}Th, ^{231}Pa, and alpha emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination is within the levels for removable contamination.

The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the level specified. For purposes of averaging, any square meter of surface is considered to be above the level G if: (1) from measurements of a representative number of n of sections it is determined that $1/n \, \Sigma_n \, S_i \geq G$, where S_i is the disintegration per minute (dpm)/100 cm^2 determined from measurements of section i; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds 3G. (G is defined as the levels listed above.)

4.7 Radiation Surveys and Monitoring Program

The Radiation Surveys and Monitoring Programs are based on the requirements of 10 CFR Part 20, Subpart F and ALARA principles. Written procedures are prepared for the elements of the Radiation Survey and Monitoring Programs discussed in this section. Deficiencies associated with surveys and the monitoring program or results that exceed the administrative control levels are dispositioned in accordance with the Corrective Action Program, described in Section 11.6 of this license application.

4.7.1 Surveys

The radiological survey program consists of routine, work support, and material release surveys (refer to Section 4.8.2.4 below). Surveys are conducted to support plant activities in a manner that ensures radiological hazards associated with each activity are properly identified, and relative radiation levels and concentrations of radioactive material are determined. Radiological surveys for the purposes of establishing personnel protection equipment or for posting requirements are performed by qualified HP Technicians. Decontamination is performed as appropriate considering the gained benefit from waste minimization, ALARA principles and worker access.

The routine survey program involves surveys to determine workplace radiological conditions, effectiveness of contamination control measures, and proper identification and posting of radiological hazards. Routine survey frequencies are established based on the stability of operations as demonstrated by the consistency of survey results. Areas within the plant are categorized and scheduled for survey commensurate with their relative radiological hazard and contamination potential. Survey frequencies are based on area occupancy, potential for spread of contamination, and process knowledge. The routine survey program is reviewed annually by the RPM, documented, maintained, and modified to reflect changes in radiological conditions. Table 4.7-1 provides the contamination survey program frequencies for ACP areas.

In the event that large areas of removable contamination are identified on accessible surfaces exceeding the levels specified in Table 4.6-1, the area will be re-posted as a CA or HCA and actions will be taken to locate the source of contamination. If access is required to the area, decontamination of the area is initiated as soon as practical with consideration of ALARA principles.

Work support surveys are a fundamental element of the RWP process. In-process surveys are conducted as necessary to verify radiological conditions at various points in the work activity and to ensure exposure potentials are maintained in accordance with the ALARA principle. When required by work activities, surveys are conducted by qualified personnel to support decontamination efforts and the release of tools, equipment, and waste material from the work area.

4.7.2 Personnel Monitoring

Both the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) regulated sources of radiation and radioactive materials are interspersed on the reservation. This situation makes separation of personnel exposure between NRC and DOE regulated sources impractical.

To comply with the personnel monitoring requirements of 10 CFR 20.1502(a) and (b), 10 CFR 20.1202, and the reporting requirements of 10 CFR 19.13, 20.2106, and 20.2206, the ACP tracks exposures for personnel issued National Voluntary Laboratory Accreditation Program (NVLAP)-accredited dosimeters regardless of whether the exposure is from an NRC or DOE regulated source. Whenever worker notification is required by 10 CFR 19.13, the individual's "total exposure" while on the site is reported without differentiating between exposure from NRC-regulated sources and DOE-regulated sources.

The established personnel monitoring program consists of the following:

- An Administrative Control Level (ACL) of 500 millirem (mrem) per year Total Effective Dose Equivalent per person;
- The intake limit for soluble uranium is set at 10 mg per week;
- Personnel dosimeters to measure the external exposure of personnel;
- Analysis of personnel occupational exposure and maintenance of exposure records; and
- A network of Fixed Nuclear Accident Dosimeters (FNADs) situated in the ACP areas requiring a Criticality Accident Alarm System. A NVLAP accredited dosimeter reader processes dosimeters in the FNADs. The ACP maintains onsite capability to determine neutron flux and energy. The FNADs also serve as area monitors.

Personal dosimeters are also evaluated for neutron dose. In addition, security badges contain an indium foil that can be evaluated for neutron activation. If the indium foil indicates exposure to a neutron flux exceeding 10 rads, the dosimeter is read and/or biological materials of personnel may be evaluated.

4.7.3 External

Persons requiring radiation exposure monitoring per 10 CFR 20.1502(a) wear beta-gamma-sensitive dosimeters which are processed and evaluated by a processor holding current NVLAP accreditation from the National Institute of Standards and Technology (NIST). Dosimeters are exchanged at least quarterly (plus or minus two weeks) unless authorized in writing by the RPM. The dosimeters may be supplemented, as appropriate, by other types of dosimeters (e.g., finger rings, direct-reading dosimeters, and neutron dosimeters) and by

radiation measurements made with radiation survey instruments. Self-reading or alarming dosimeters are used for entry into HRAs or Very High Radiation Areas.

If an individual exceeds 50 percent of the ACL during a calendar quarter or the ACL in the calendar year, an evaluation is performed by the RPM for approval by the Director, American Centrifuge Plant. The evaluation is performed to determine the types of activities that may have contributed to the worker's exposure. This may include, but is not limited to, procedural reviews, and review of work practices, work locations, and job assignments. Depending upon the conclusions of the evaluation, the individual may be allowed to continue radiological work; however, work restrictions may be imposed on individuals whose exposure exceeds the ACL.

Approval for continued work is documented in the evaluation, as described in the preceding paragraph, which requires approval by the Director, American Centrifuge Plant. Investigations to determine cause, assess the exposure, and document the results are conducted in accordance with written procedures.

HP determines any unusual trends or exposures during reviews of external dosimetry results. If the external exposure status of an individual is uncertain, the individual is removed from further exposure until HP determines the exposure status and advises management of any special controls or restrictions to be applied.

To comply with the reporting requirements of 10 CFR 20.2206, the site submits personnel monitoring information for the Radiation Exposure Information Reporting System (REIRS) report based on the personnel exposure database. Dose reports are completed as required for personnel monitored in accordance with 10 CFR 20.1502(a).

The occupational exposure received by ACP employees, subcontractors, and visitors must not exceed the 10 CFR Part 20, Subpart C limits. The ACP requires current year exposure history of an occupational worker as required by 10 CFR 20.2104.

Personnel declaring pregnancy are advised to control radiation exposure to an embryo or fetus in accordance with the ALARA principle during the entire gestation period. The ACP complies with the guidelines of Regulatory Guide 8.13, Revision 2*, Instructions Concerning Prenatal Radiation Exposure.*

4.7.4 Internal

The chemical characteristics and retention times of soluble uranium processed at the ACP are such that renal toxicity limitations are the limiting conditions for health effects. A bioassay program is employed to confirm the results of radioactive material contamination control and respiratory protection programs. Bioassay results are the primary means of calculating internal doses. Personnel who have the potential to receive intakes resulting in a Committed Effective Dose Equivalent (CEDE) greater than or equal to 0.1 roentgen equivalent man (rem) CEDE in a year or intakes of 1 mg of soluble uranium per week participate in the routine bioassay program.

Personnel submit bioassay samples, such as urine or fecal samples, and participate in *Invivo* monitoring as required by the bioassay program. Table 4.7-2 provides a summary of the bioassay program description and the analytical methods employed. The routine sample submission frequencies and administrative control levels are listed in Table 4.7-3.

Because chemical toxicity is limiting when personnel are exposed to soluble uranium, the uranium action levels have been selected to limit an individual's chronic intake to 10 mg of soluble uranium per week. Personnel participate in follow-up bioassay monitoring when their bioassay results exceed administrative control levels or as determined by HP. Special bioassay studies are performed as necessary and investigations performed when intakes are confirmed or suspected to exceed 1 mg of soluble uranium per week.

The ACP collects "random single void" urine samples from personnel. Isotopic analysis of fecal samples and 24-hour urine sampling are not routinely performed, however, these analyses will be considered when dose assessments exceed 0.5 rem CEDE. Bioassay results are used to assign internal dose. The sensitivities of lung counting systems are not as effective as urinalysis for Class D uranium; lung counting is considered when intake estimates exceed 0.5 rem CEDE.

The CEDE per unit of intake by inhalation from Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion,* is used to calculate internal dose.

HP determines unusual trends during reviews of urinalysis results. If bioassay sample results indicate an internal exposure that exceeds action levels or appears uncertain, additional analyses and removal of the individual from further exposure are considered.

4.7.5 Airborne Radioactivity

Routine general area air sampling is established in areas where airborne radioactivity concentrations may exceed 10 percent of the DAC listed in Table 4.7-4, averaged over 8 hours. Table 4.7-4 also summarizes the airborne radioactivity posting levels. Investigations are performed when airborne radioactivity data indicates personnel exposures exceed 0.8 DAC-hours. Special bioassay sampling is required when air samples exceed 0.8 DAC-hours. Adjustment for respirator use is considered in determining bioassay monitoring.

A combination of low-volume, high-volume, and lapel air samplers are used for job coverage and general area air sampling. Low-volume air samplers are used for routine air sampling and are exchanged at least weekly. Due to radon and radon daughter products, routine air samples are allowed to decay for a minimum of three days.

Air sample data is not used as the primary method to determine internal dose, however the data is used to prompt bioassay monitoring. Only air samples collected in the workers' breathing zone (approximately 30 cm) are considered representative.

Air sample flow measurement devices are calibrated under standard laboratory conditions at least annually. The NIST traceable standards used have accuracy and precision of 20 percent or better. Lapel samplers are calibrated in accordance with a procedure.

Table 4.7-1 Routine Contamination Survey Frequencies

Area Surveyed	Survey Frequency
Uranium Centrifuge Area	Yearly[a]
Contaminated Maintenance Areas	Quarterly
Contamination Control Zones (CCZ)	Quarterly
Lunchrooms/Breakrooms	Note c
Permanent Boundary Control Stations (BCS)[b]	Weekly
Change Rooms	Monthly
UF_6 Sample Handling Areas and Feed and Withdrawal Areas	Monthly[a]

[a] Localized area surveys are taken following an indication of release and during maintenance activities.

[b] When personnel contamination is detected at the BCS, the ensuing follow-up activities include a physical survey of the BCS.

[c] Surveys are performed daily during normal working days (i.e., Monday through Friday). Weekends and plant holidays are excluded.

Table 4.7-2 Bioassay Program

Urine Bioassay Capabilities	Comment
Workers Participation	Selected based on work locations
Frequency of Urine Monitoring	Monthly[a]
Routine Urine Sample Volume	Single void sample, between 60 and 100 mL
Primary Uranium Analysis Methods	Fluorimetry or Inductively Coupled Plasma (ICP) Mass Spectroscopy
ICP Mass Spectroscopy Minimum Detectable Concentration	<0.006 : g/L ^{235}U <0.015 : g/L ^{238}U
Fluorimetry Minimum Detectable Concentration	5 : g/L Total Uranium

Additional Analytical Capabilities	
Alpha Spectroscopy	0.1 pCi/sample[b]
Uranium Alpha with Proportional Counter	40 dpm/L Total Uranium in urine
Invivo Lung Counting	0.2 nCi ^{235}U 4 nCi ^{238}U
Dose Assessment Software	INDOS (Routine Analysis) CINDY (Developmental and Special)

[a] Samples scheduled for submission every four weeks.
[b] Equipment also used for loose contamination and airborne radioactivity samples for characterization efforts.

Table 4.7-3 Internal Dosimetry Program Action Levels

Bioassay Technique	Frequency	Action Level	Actions to be Taken
Urinalysis Routine	Monthly[a]	5 :g U/L	Resample to confirm result and determine intake[b]
	Monthly	20 :g U/L	Restrict individual and resample to determine intake[b]
Urinalysis Special	2-6 hours after intake	5 :g U/L 300 :g U/L	Resample to confirm result and determine intake[b] Restrict individual and resample to determine intake[b]
	16-30 hours after intake	5 :g U/L 50 :g U/L	Resample to confirm result and determine intake[b] Restrict individual and resample to determine intake[b]
Lung Counting	As Required	>100 :g ^{235}U or 7 nCi Total U	Recount to confirm result and perform urinalysis

[a] In addition, personnel may be assigned a special frequency if deemed necessary by HP.
[b] When intake is confirmed to be > 1 mg uranium, an investigation is performed to identify the source of the exposure, assess the impact, and if practical, a means to prevent reoccurrence.

Table 4.7-4 DAC and Airborne Radioactivity Posting Levels

NUCLIDE[a]	DAC[c, d]	POSTING LEVEL[b]
Gross Alpha based on Class D ^{234}U and 2 percent Class W ^{230}Th	1.0×10^{-10}	1.0×10^{-11}
Gross Alpha based on Class D ^{234}U and 8 percent Class W ^{230}Th	3.0×10^{-11}	3.0×10^{-12}
Gross Alpha based on Class W ^{230}Th	3.0×10^{-12}	3.0×10^{-13}
Gross Beta-Gamma based on Class Y ^{234}Th	6.0×10^{-8}	6.0×10^{-9}

[a] All values are listed with units of :Ci/mL.
[b] Posting Levels are 10 percent of DAC.
[c] The values above are assumed as worst case, i.e., ^{230}Th is present in each mixture at the highest concentration per category as described.
[d] Area may be posted based on calculated DACs from actual airborne radioactivity concentration data.

4.8 Additional Program Elements

4.8.1 Posting and Labeling

Caution signs for Radioactive Material Areas (RMAs), ARAs, RAs, and HRAs are maintained as required by 10 CFR 20.1901, 20.1902, 20.1903, 20.1904, and 20.1905. RMAs located within a posted CCZ, CA, HCA, ARA, RA, HRA or other posted radiological area are not required to be posted as an RMA since a higher level of control is already required. In addition, as noted in Section 1.2.5 of this license application, the following exceptions to the applicable 10 CFR Part 20 requirements have been taken and require an exemption:

- UF_6 feed, product, and depleted uranium cylinders, which are routinely transported inside the reservation boundary between plant locations and/or storage areas at the plant, are readily identifiable due to their size and unique construction, and are not routinely labeled as radioactive material. Qualified radiological workers attend UF_6 cylinders during movement.

- Containers located in Restricted Areas within the ACP are exempt from container labeling requirements of 10 CFR 20.1904, as it is deemed impractical to label each and every container. In such areas, one sign stating that every container may contain radioactive material will be posted. By procedure, when containers are to be removed from contaminated or potentially contaminated areas, a survey is performed to ensure that contamination is not spread around the reservation.

- In lieu of the requirements of 10 CFR 20.1601(a), each High Radiation Area with radiation reading greater than 0.1 rem/hour at 30 cm but less than 1 rem/hour at 30 cm is conspicuously posted "Caution, High Radiation Area" and entrance into the area is controlled by an RWP. Physical and administrative controls to prevent inadvertent or unauthorized access to High and Very High Radiation Area is maintained.

4.8.2 Contamination Control

4.8.2.1 Access to Restricted Areas

Restricted Areas are areas to which access is limited to protect individuals against undue risks from exposure to radiation and radioactive materials. Unescorted access to Restricted Areas requires the successful completion of the appropriate level of radiological worker training and, if required, a personnel dosimeter. Depending upon the type and extent (or amount) of radioactive material present, Restricted Areas are further identified as RMAs, CCZs, CAs, HCAs, ARAs, RAs, or HRAs.

Radiological control is provided by controlling access to areas where radioactive material may be encountered and by requiring that each person who enters those areas receive the appropriate level of radiological worker training. Access and departure requirements are specified by procedure and/or reiterated in RWPs. Radiological posting is used to alert

personnel to the presence of radiation and radioactive materials, aid in minimizing exposures, and prevent the spread of contamination. Where contamination is present, contamination controls are implemented.

Table 4.8-1 provides definitions and criteria used for posting ACP Restricted Areas.

4.8.2.2 Equipment and Personnel Monitoring

Personnel exiting areas controlled for removable contamination (CCZs and CAs) are required to monitor themselves for contamination after removing their protective clothing and prior to leaving the step-off pad area. Personnel monitoring requirements are specified on RWPs. Equipment and materials are monitored and decontaminated if required prior to removal from CCZs and CAs, or are contained and controlled as radioactive material.

4.8.2.3 Personal Protective Equipment

Personal Protective Equipment (PPE) is provided for personnel entering contaminated areas. The type(s) of PPE required is consistent with the individual's work assignment and is dependent upon the type and level of contamination anticipated. With the exception of emergency evacuations, protective clothing is removed prior to exiting the Boundary Control Station as specified in Radiation Worker Training, RWP, area posting, or procedures. During emergency evacuations, personnel report to designated assembly points and/or monitoring stations where protective clothing is removed and contamination monitoring is performed.

Industrial safety equipment, such as face shields, goggles, and acid suits are available. In addition full-face negative pressure respirators and full-face positive pressure respirators and other National Institute for Occupational Safety and Health and Mine Safety and Health Administration approved devices may also be utilized for respiratory protection in accordance with Section 4.6.2 of this chapter.

4.8.2.4 Release of Materials and Equipment

Materials and equipment are not released for unrestricted use unless the surface contamination levels are less than the levels specified in Table 4.6-1. Contamination surveys are performed on materials, equipment, and facilities to be released from radiological controls.

Use histories are used to supplement surveys of materials or equipment that have inaccessible surfaces. Use histories are summaries of the operational history of the item. Use history information includes the function, location(s) where the item was used, and other relevant evidence to assess the item’s potential for internal contamination.

Total contamination in bulk, aggregate materials, or waste to be released for unrestricted use or disposal is specified in plant procedures.

4.8.3 Radioactive Source Control

The Radioactive Source Control Program maintains administrative and physical control of sealed radioactive sources. The Source Control Program establishes source custodians and requires leak testing, accountability, and control of sealed radioactive sources.

Each sealed source containing more than 100 microcuries (:Ci) of beta and/or gamma emitting material or more than 10 :Ci of alpha emitting material, other than ^{3}H, with a half-life greater than 30 days and in any form other than gas, is tested for leakage and/or contamination at intervals not to exceed six months. In the absence of a certificate from a transferor indicating that a test has been made within six months prior to the transfer, the sealed source is not put into use until tested.

Sealed plutonium alpha sources containing 0.1 :Ci or more of plutonium, when not in use, are stored in a closed container designed and constructed to contain plutonium that might otherwise be released during storage. When in use, the ACP will test the sources at least every three months using radiation detection instruments capable of detecting 0.005 :Ci of alpha contamination.

Leak tests are taken from the source or from appropriate accessible surfaces of the container or from the device where the sealed source is mounted or stored where one might expect contamination to accumulate. Leak testing is conducted by HP. The test is capable of detecting the presence of 0.005 :Ci or more of removable contamination, or if a plutonium source has been damaged or broken, the source will be deemed to be loosing plutonium.

The ACP will immediately withdraw the sealed source from use and repair or dispose of the source, if determined to be leaking. Within five days after determining that any source has leaked, the ACP will file a report with the NRC Director, Nuclear Material Safety and Safeguards, describing the source, test results, extent of contamination, apparent or suspected cause of source failure, and corrective action taken. A copy of the report will be sent to the NRC Regional Administrator, Region II.

The periodic leak test does not apply to sealed sources that are stored and not being used. The sources excepted from this test will be tested for leakage prior to any use or transfer to another person unless they have been leak tested within six months, or three months for a sealed plutonium source, prior to the date of use or transfer.

4.8.4 Radiation Protection Instrumentation

Radiation dose rate and contamination survey instruments are selected to measure the types and energies of radiation encountered with gas centrifuge enrichment operations. The primary complement of instrumentation includes alpha/beta count rate and scaler instrumentation plus ion chambers used to evaluate shallow dose and deep dose equivalent readings. Table 4.8-2 describes typical instrumentation available to support the operation of the ACP.

The RPM is responsible for maintaining adequate quantities of calibrated radiation detection and measurement instruments.

Radiological portable instruments are calibrated based on specifications derived from applicable vendors manuals and other nationally recognized guidance as appropriate (e.g., National Council on Radiation Protection 112). The standards found in the American National Standards Institute (ANSI) N323 (1978) are followed except for Sections 4.6 and 5.1(3). The following requirements apply to all such equipment and instruments:

- Portable radiation detection and measurement instruments are inspected, maintained, and calibrated at least annually or removed from service.

- Instruments are calibrated following any maintenance, modification, or repair deemed likely to affect operation before being returned to service.

- Calibration sources and equipment used for dose rate instruments are within 5 percent (at 2 sigma) of the stated value and have documented traceability links to the NIST. Large area uranium slab sources are certified to 10 percent by NIST. Calibration sources used to calibrate contamination-monitoring equipment are within 20 percent (at 2 sigma) for activity and 10 percent (at 2 sigma) for surface emission rate.

- Portable HP instruments that are in use but do not have a built in automatic functional test feature are source checked daily, or prior to using the instrument if not used on a daily basis. Instruments with the automatic functional test feature that are in use are checked once a week.

4.8.5 Records and Reports

Radiological protection records demonstrate the effectiveness of the overall program and document personnel exposure. Records are maintained in the form required by 10 CFR 20.2110 and are retained as required by 10 CFR 20.2101 through 20.2106.

Reports and notifications of RP issues are made as required by 10 CFR Part 20, Subpart M and/or 10 CFR 70.74. Details of reporting and notification for ACP incidents are described in Section 11.6 of this license application.

Table 4.8-1 Posting Criteria

AREA	CRITERIA	POSTING
Radiation Area measured at 30 cm	>0.005 rem/hr but ≤ 0.1 rem/hr	"CAUTION, RADIATION AREA" "TLD and RWP Required for Entry"
High Radiation Area measured at 30 cm	>0.1 rem/hour but ≤ 1.0 rem/hr	"CAUTION, HIGH RADIATION AREA" "TLD, Supplemental Dosimeter and RWP Required for Entry"
High Radiation Area measured at 30 cm	>1.0 rem/hr	"DANGER, HIGH RADIATION AREA" "TLD, Supplemental Dosimeter and RWP Required for Entry"
Very High Radiation Area measured at 1 m	> 500 rads/hr	"GRAVE DANGER, VERY HIGH RADIATION AREA" "Special Controls Required for Entry" "Contact PSS Before Entry"
Contamination (Removable)	Levels > 1 time but ≤ 100 times Table 4.6-1 values	"CAUTION, CONTAMINATION AREA" "RWP Required for Entry"
High Contamination (Removable)	Levels >100 Times Table 4.6-1 values	"CAUTION, HIGH CONTAMINATION AREA" "RWP Required for Entry"
Fixed Contamination[a]	Removable Contamination < Table 4.6-1 levels and total contamination levels > Table 4.6-1 column 3 values	"CAUTION, FIXED CONTAMINATION AREA"
Airborne Radioactivity Area	Levels 0.1 Times Table 4.7-4 DAC values	"CAUTION, AIRBORNE RADIOACTIVITY AREA" or "CAUTION AIRBORNE RADIOACTIVITY AREA" "Respiratory Protection Required"
Contamination Control Zone	Levels normally less than Table 4.6-1 removable column values with potential to exceed Table 4.6-1 removable column values	"CAUTION, CONTAMINATION CONTROL ZONE"
Radioactive Material Area or Radioactive Material Storage Area[b]	An amount of radioactive material used or stored exceeding 10 times the quantity of such material specified in 10 CFR Part 20, Appendix C	"CAUTION" "Radioactive Material Area" or "Radioactive Material Storage Area"

[a] If the area has been sealed with contrasting fixatives or alternative methods and labeled in accordance with methods approved by the RPM, the area is exempt from posting as a Fixed Contamination Area.

[b] Areas posted as a Contamination Control Zone, Contamination Area, High Contamination Area, Airborne Radioactivity Area, Radiation Area, High Radiation Area, or Very High Radiation Area need not be posted as Radioactive Materials Area.

Table 4.8-1 Posting Criteria (continued)

Definitions

Airborne Radioactivity Area (ARA) — Any area where the measured concentration of airborne radioactivity, above natural background, may be reasonably expected to exceed either: (1) 10 percent of the DAC sampled over 8 hours, (2) a peak concentration of 1 DAC sampled over no more than 1 hour, or (3) soluble uranium concentration exceeds 50 : g/m^3 averaged over 8 hours.

Contamination Area (CA) — An area where transferable contamination levels are greater than the release limits stated in Table 4.6-1, but less than or equal to 100 times those limits.

Contamination Control Zone (CCZ) — An area where transferable contamination levels are less than the release limits stated in Table 4.6-1. CCZs are essentially buffer zones established where discrete areas of contamination may be occasionally encountered as a result of plant size.

Fixed Contamination Area (FCA) — An area containing radioactive material that cannot be readily removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.

High Contamination Area (HCA) — An area where transferable contamination levels are greater than 100 times the limits stated in Table 4.6-1.

High Radiation Area (HRA) — An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent in excess of 0.1 rem Deep Dose Equivalent (DDE) in 1 hour at 30 cm from the radiation source or 30 cm from any surface that the radiation penetrates.

Radiation Area (RA) — An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent in excess of 0.005 rem DDE in 1 hour at 30 cm from the source or from any surface that the radiation penetrates.

Radioactive Material Area (RMA) — An area or structure where radioactive material is used, handled or stored.

Restricted Area — An area, to which access is limited for the purpose of protecting individuals against undue risk from exposure to radiation and radioactive materials.

Very High Radiation Area (VHRA) — An area, accessible to personnel, in which radiation levels could result in a person receiving an absorbed dose in excess of 500 rads in one hour at 1 meter from a radiation source or 1 meter from any surface that the radiation penetrates.

Table 4.8-2 Radiological Protection Instrumentation and Capabilities

Instrument	Manufacturer	Use	Detection Limit
LB5100	Tennelec	Air sample counting and Removable contamination sample counting	alpha - 4 pCi beta-gamma - 8 pCi alpha- 20 dpm/100 cm^2 beta-gamma - 40 dpm/100 cm^2
LB1043AS	Berthold	Personnel contamination monitoring	5,000 dpm/100 cm^2 total contamination[a]
PCM2	Eberline	Personnel contamination monitoring	5,000 dpm/100 cm^2 total contamination
Ludlum 12 with GM probe	Ludlum	Alpha personnel contamination monitoring and removable contamination surveys	100 cpm above background[b]
Ludlum 12 with alpha scintillator	Ludlum	Beta-gamma personnel contamination monitoring and removable contamination surveys	100 cpm above background[b]
REM 500	Health Physics Instruments	Neutron Dose/Dose Rate	0.001 rem (rad)/hr - 999 rem (rad)/hr
Teletector	Eberline	Beta-gamma Dose/Dose rate	0 mR/hr - 1,000 R/hr
RO2	Ludlum	Beta-gamma Dose/Dose rate	0 mR/hr - 5 R/hr

[a] The Berthold Monitors are set to alarm with 95 percent confidence upon detection of less than or equal to 5,000 dpm total contamination per detector. The actual detection limits are approximately 3-sigma above background, and depends on detector size, efficiency, background, and count time.

[b] Personnel are trained in Radiation Worker Training to notify HP when contamination is detected greater than 100 counts per minute (cpm) above background. The maximum acceptable background count rate is 300 cpm.

[c] Minimum calibration frequency is annual or manufacturer recommendations.

The instruments listed above are used for routine operations. Additional instruments are available to support emergency response.

4.9 References

1. ASME N509-1989, *Nuclear Power Plant Air-Cleaning Units and Components*

2. ASME N510-1989, *Testing of Nuclear Air-Treatment Systems*

3. ANSI N323-1978, *Radiation Protection Instrumentation Test and Calibration*

4. Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*

5. NUREG-1520, *Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility*

6. Regulatory Guide 8.13, Revision 2, *Instructions Concerning Prenatal Radiation Exposure*

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