TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

Page

LIST OF TABLES

LIST OF FIGURES

4.0 RADIATION PROTECTION

The NRC previously reviewed the National Enrichment Facility SAR and concluded in NUREG-1827 (NRC, 2005a), that: "The applicant's RP program meets the requirements of Parts 19, 20, 30, 40, and 70." This Chapter describes the facility Radiation Protection Program of the Eagle Rock Enrichment Facility (EREF). The Radiation Protection Program protects the radiological health and safety of workers and complies with the regulatory requirements in 10 CFR 19 (CFR, 2008a), 20 (CFR, 2008b), 30 (CFR, 2008x), 40 (CFR, 2008y) and 70 (CFR, 2008c).

The Radiation Protection Program for the EREF is similar to that described in the National Enrichment Facility SAR (LES, 2005). The following are the significant changes that have been made in this submittal for the EREF:

- A licensed commercial laundry service is used rather than a plant laundry system.
- Information on the typical contamination monitoring equipment that may be used at the facility has been updated.
- The EREF organization is different from that described for the National Enrichment Facility.

The information provided in this chapter, the corresponding regulatory requirement and the NRC acceptance criteria from NUREG-1520 (NRC, 2002), Chapter 4, are summarized in the table below. Information beyond that required by the Standard Review Plan is included.

Information Category and Requirement	10 CFR Citation	NUREG-1520 Chapter 4 Reference
Section 4.1 Commitment to Radiation Protection Program Implementation	10 CFR 20.1101, Subpart B	4.4.1.3
Section 4.2 Commitment to an ALARA Program	10 CFR 20.1101	4.4.2.3
Section 4.3 Organization and Personnel Qualifications	10 CFR 70.22	4.4.3.3
Section 4.4 Commitment to Written Procedures	10 CFR 70.22(a)(8)	4.4.4.3
Section 4.5 Training Commitments	10 CFR 19.12 & 10 CFR 20.2110	4.4.5.3
Section 4.6 Ventilation and Respiratory Protection Programs Commitments	10 CFR 20, Subpart H	4.4.6.3
Section 4.7 Radiation Surveys and Monitoring Programs Commitments	10 CFR 20, Subparts F, C, L, M	4.4.7.3
Section 4.8 Contamination and Radiation Control	N/A	N/A
Section 4.9 Maintenance Areas – Methods and Procedures for Contamination Control	N/A	N/A

Information Category and Requirement	10 CFR Citation	NUREG-1520 Chapter 4 Reference
Section 4.10 Decontamination Policy and Provisions	N/A	N/A
Section 4.11 Additional Program Commitments	N/A	4.4.8.3

4.1 COMMITMENT TO RADIATION PROTECTION PROGRAM IMPLEMENTATION

The Radiation Protection Program meets the requirements of 10 CFR 20 Subpart B - Radiation Protection Programs (20.1101 (a)-(d)) (CFR, 2008d) and is consistent with the guidance provided in Regulatory Guide 8.2, Guide for Administrative Practice in Radiation Monitoring (NRC, 1973a). The facility develops, documents and implements its Radiation Protection Program commensurate with the risks posed by a uranium enrichment operation. The facility uses, to the extent practicable, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA). The Radiation Protection Program content and implementation are reviewed at least annually as required by 10 CFR 20.1101(c) (CFR, 2008d). In addition, in accordance with 10 CFR 20.1101(d) (CFR, 2008d), constraints on atmospheric releases are established for the EREF such that no member of the public would be expected to receive a total effective dose equivalent in excess of 0.1 mSv/yr (10 mrem/yr) from these releases. Additional information regarding compliance with 10 CFR 20.1101(d) is provided in Section 9.2.

The facility's philosophy for radiation protection is reflected in the establishment of a Radiation Protection Program that has the specific purpose of maintaining occupational radiation exposures ALARA. This program includes written procedures, periodic assessments of work practices and internal/external doses received, work plans and the personnel and equipment required to help implement the ALARA goal.

The facility's administrative personnel exposure limits have been set below the limits specified in 10 CFR Part 20 (CFR, 2008b). This provides assurance that legal radiation exposure limits are not exceeded and that the ALARA principle is emphasized. The facility administrative exposure limits are given in Table 4.1-1, Occupational Administrative Radiation Exposure Limits. Estimates of the facility area radiation dose rates and individual personnel exposures, during normal operations, are shown in Table 4.1-2, Estimated Dose Rates and Table 4.1-3, Estimated Individual Exposures. These estimates are based upon the operating experience of similar facilities in Europe.

Annual whole-body dose equivalents accrued by workers at an operating uranium enrichment plant are typically low. The maximum individual annual dose equivalents for the years 2003 through 2007 at the Urenco Capenhurst site, located in the United Kingdom, are summarized in Table 4.1-4, Annual Maximum and Average Worker Doses at Capenhurst (Urenco, 2003); (Urenco, 2004); (Urenco, 2005); (Urenco, 2006); (Urenco, 2007). The worker maximum and average doses varied over this time period. However, in general, the maximum worker dose increased from 2.03 mSv (203 mrem) in 2003 to 3.41 mSv (341 mrem) in 2007. During this same time period, the average dose also increased from 0.22 mSv (22 mrem) to 0.44 mSv (44 mrem). The Capenhurst site was expanding its processing capacity during this time. In addition, the listed worker doses also include exposures that are not directly related to enrichment plant operations (e.g., research). Therefore, since additional exposures occur at the Capenhurst Site, it is likely that the exposures at the EREF will be lower. To put these doses in perspective, note that in the United States, individuals receive an annual effective dose equivalent of approximately 3.0 mSv (300 mrem) from background radiation (NCRP, 1987).

Protection of plant personnel requires (a) surveillance of and control over the radiation exposure of personnel; and (b) maintaining the exposure of all personnel not only within permissible limits, but "as low as is reasonably achievable," in compliance with applicable regulations and license conditions. The objectives of Radiation Protection are to prevent acute radiation injuries

(nonstochastic or deterministic effects) and to limit the potential risks of probabilistic (stochastic) effects (which may result from chronic occupational exposure) to an acceptable level.

The radiation exposure policy and control measures for personnel are set up in accordance with requirements of 10 CFR Part 20 (CFR, 2008b) and the guidance of applicable Regulatory Guides. Recommendations from the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP) may also be used in the formulation and evolution of the facility Radiation Protection Program.

The facility corrective action process is implemented if (1) personnel dose monitoring results or personnel contamination levels exceed the administrative personnel limits; or if an incident results in airborne occupational exposures exceeding the administrative limits; or (2) the dose limits in 10 CFR 20 (CFR, 2008b), Appendix B (CFR, 2008m) or 10 CFR 70.61 (CFR, 2008e) are exceeded.

The information developed from the corrective action process is used to improve radiation protection practices and to preclude the recurrence of similar incidents. If an incident as described in item two above occurs, the NRC is informed of the corrective action taken or planned to prevent recurrence and the schedule established by the facility to achieve full compliance. The corrective action process and incident investigation process are described in Section 11.6, Incident Investigations and Corrective Action Process.

The subject matter discussed above is identical to the National Enrichment Facility (NEF) SAR (LES, 2005) subject matter with the exception that the information on Capenhurst doses has been updated. The NRC staff previously reviewed the National Enrichment Facility SAR (LES, 2005) application relative to the general guidelines of the occupational radiation protection program and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1827 (NRC, 2005a).

4.1.1 Responsibilities of Key Program Personnel

4.1.1.1 AREVA Enrichment Services AES

In this section the organizational structure of the Radiation Protection Program is described. The responsibilities of key personnel are also discussed. These personnel play an important role in the protection of workers, the environment and implementation of the ALARA program. Chapter 2, Organization and Administration, discusses the facility organization and administration in further detail. Chapter 2, Section 2.2, Key Management Positions, presents a detailed discussion of the responsibilities of key management personnel. The differences between the EREF and NEF organizations reflect AREVA's experience in operating fuel cycle facilities. Although some titles and scope of responsibility have been changed, the functions to be performed remain the same. Refer to Chapter 2.0 for additional information regarding these differences.

The AES president has overall responsibility for the operation of the EREF including radiation protection.

4.1.1.2 Plant Manager

The Plant Manager reports to the AES President and has direct responsibility for the safe operation of the facility including the protection of all persons against radiation exposure

resulting from facility operations and materials, and for compliance with applicable NRC regulations and the facility license.

4.1.1.3 Environmental, Health, Safety and Licensing Manager

The Environmental, Health, Safety, and Licensing (EHS&L) Manager reports to the Plant Manager and has the overall responsibility for development and implementation of the radiation protection program. The EHS&L Manager works with the other facility managers to ensure consistent interpretations of EHS&L requirements, performs independent reviews, and supports facility and operations change control reviews.

4.1.1.4 Radiation Protection/Chemistry Manager

The Radiation Protection/Chemistry Manager reports to the EHS&L Manager. In matters involving radiological protection, the Radiation Protection/Chemistry Manager has direct access to the Plant Manager. The Radiation Protection/Chemistry Manager and his staff are responsible for:

- Establishing the Radiation Protection Program
- Generating and maintaining procedures associated with the program
- Assuring that ALARA is practiced by all personnel
- Reviewing and auditing the efficacy of the program in complying with NRC and other governmental regulations and applicable Regulatory Guides.
- Modifying the program based upon experience and facility history
- Adequately staffing the Radiation Protection group to implement the Radiation Protection Program
- Establishing and maintaining an ALARA program
- Establishing and maintaining a respirator usage program
- Monitoring worker doses, both internal and external
- Complying with the radioactive materials possession limits for the facility
- Handling of radioactive wastes when disposal is needed
- Calibration and quality assurance of all radiological instrumentation, including verification of required Lower Limits of Detection or alarm levels
- Establishing and maintaining a radiation safety training program for personnel working in Restricted Areas
- Performing audits of the Radiation Protection Program on an annual basis
- Establishing and maintaining the radiological environmental monitoring program
- Posting the Restricted Areas, and within these areas, posting: Radiation, Airborne Radioactivity, High Radiation and Contaminated Areas as appropriate; and developing occupancy guidelines for these areas as needed.

4.1.1.5 Operations Manager

The Operations Manager reports to the Plant Manager and has the responsibility for the safe day-to-day operation of the facility including operating in accordance with procedures so that all effluents released to the environment and all exposures to the public and facility personnel meet the limits specified in applicable regulations, procedures and guidance documents.

4.1.1.6 Facility Personnel

Facility personnel are required to work safely and to follow the rules, regulations and procedures that have been established for their protection and the protection of the public. Personnel whose duties require (1) working with radioactive material, (2) entering radiation areas, (3) controlling facility operations that could affect effluent releases, or (4) directing the activities of others, are trained such that they understand and effectively carry out their responsibilities.

4.1.2 Staffing of the Radiation Protection Program

Only suitably trained radiation protection personnel are employed at the facility. For example, the Radiation Protection/Chemistry Manager has, as a minimum, a bachelor's degree (or equivalent) in an engineering or scientific field and four years of responsible nuclear experience. Other members of the Radiation Protection Program staff are trained and qualified consistent with the guidance provided in American National Standards Institute (ANSI) standard 3.1, Selection, Qualification and Training of Personnel for Nuclear Power Plants (ANSI, 1993).

Sufficient resources in terms of staffing and equipment are provided to implement an effective Radiation Protection Program.

4.1.3 Independence of the Radiation Protection Program

The Radiation Protection Program remains independent of the facility's routine operations. This independence ensures that the Radiation Protection Program maintains its objectivity and is focused only on implementing sound radiation protection principles necessary to achieve occupational doses and doses to members of the public that are ALARA. It was previously noted in Section 4.1.1.4, Radiation Protection/Chemistry Manager, that in matters involving radiological protection, the Radiation Protection Manager has direct access to the Plant Manager.

4.1.4 Radiation Safety Committee

A Radiation Safety Committee meets periodically to review, in accordance with 10 CFR 20.1101 (c) (CFR, 2008d), the status of projects, measure performance, look for trends and to review radiation safety aspects of facility operations. The Radiation Protection/Chemistry Manager chairs the Radiation Safety Committee. The other Radiation Safety Committee members come from quality assurance, operations, maintenance, and technical support, as deemed appropriate by the Plant Manager.

The objectives of the Radiation Safety Committee are to maintain a high standard of radiation protection in all facility operations. The Radiation Safety Committee reviews the content and implementation of the Radiation Protection Program at a working level and strives to improve the program by reviewing exposure trends, the results of audits, regulatory inspections, worker suggestions, survey results, exposure incidents, etc.

The maximum interval between meetings may not exceed 180 days. A written report of each Radiation Safety Committee meeting is forwarded to all Managers.

4.2 COMMITMENT TO AN ALARA PROGRAM

Section 4.1, Commitment to Radiation Protection Program Implementation, above, states the facility's commitment to the implementation of an ALARA program. The objective of the program is to make every reasonable effort to maintain facility exposures to radiation as far below the dose limits of 10 CFR 20.1201 (CFR, 2008f) as is practical and to maintain radiation exposures to members of the public such that they are not expected to exceed the dose constraints of 10 CFR 20.1101(d) (CFR, 2008d). The design and implementation of the ALARA program is consistent with the guidance provided in Regulatory Guides 8.2 (NRC, 1973a), 8.13 (NRC, 1999a), 8.29 (NRC, 1996), and 8.37 (NRC, 1993g). The operation of the facility is consistent with the guidance provided in Regulatory Guide 8.10 (NRC, 1977). The guidance of Regulatory Guide 4.21 will be followed to minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste (NRC, 2008).

Annual doses to individual personnel are maintained ALARA. In addition, the annual collective dose to personnel (i.e., the sum of all annual individual doses, expressed in person-Sv or person-rem) is maintained ALARA. The dose equivalent to the embryo/fetus is maintained below the limits of 10 CFR 20.1208 (CFR, 2008g).

The Radiation Protection Program is written and implemented to ensure that it is comprehensive and effective. The written program documents policies that are implemented to ensure the ALARA goal is met. Facility procedures are written so that they incorporate the ALARA philosophy into the routine operations of the facility and ensure that exposures are consistent with 10 CFR 20.1101 (CFR, 2008d) limits. As discussed in Section 4.7, Radiation Surveys and Monitoring Programs Commitments, radiological zones will be established within the facility. The establishment of these zones supports the ALARA commitment in that the zones minimize the spread of contamination and reduce unnecessary exposure of personnel to radiation.

Specific goals of the ALARA program include maintaining occupational exposures as well as environmental releases as far below regulatory limits as is reasonably achievable. The ALARA concept is also incorporated into the design of the facility. The size and number of areas with higher doses rates are minimized consistent with accessibility for performing necessary services in the areas. Areas where facility personnel spend significant amounts of time are designed to maintain the lowest dose rates reasonably achievable.

The Radiation Protection/Chemistry Manager is responsible for implementing the ALARA program and ensuring that adequate resources are committed to make the program effective. The Radiation Protection/Chemistry Manager prepares an annual ALARA program evaluation report. The report reviews (1) radiological exposure and effluent release data for trends, (2) audits and inspections, (3) use, maintenance and surveillance of equipment used for exposure and effluent control, and (4) other issues, as appropriate, that may influence the effectiveness of the radiation protection/ALARA programs. Copies of the report are submitted to the AES President, Plant Manager, Radiation Safety Committee, and the Safety Review Committee.

The subject matter discussed above is identical to the National Enrichment Facility SAR (LES, 2005) subject matter with the exception that some organizational titles have been changed. The differences between the EREF and NEF organizations reflect AREVA's experience in operating fuel cycle facilities. Although some titles and scope of responsibility have been changed, the functions to be performed remain the same. Refer to Chapter 2.0 for additional information regarding these differences.

The NRC staff previously reviewed the National Enrichment Facility SAR (LES, 2005) application relative to the general guidelines of the occupational radiation protection program

and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1827 (NRC, 2005a).

4.2.1 ALARA Committee

The Safety Review Committee (SRC) fulfills the duties of the ALARA Committee. The SRC meets at least quarterly. Additional details concerning the membership and qualifications of the SRC are provided in Chapter 2, Organization and Administration.

Programs for improving the effectiveness of equipment used for effluent and exposure control are also evaluated by the SRC. The recommendations of the committee are documented in writing. The implementation of the committee's recommendations is tracked to completion via the Corrective Action Program, which is described in Section 11.6, Incident Investigations and Corrective Action Process.

As part of its duties, the SRC reviews the effectiveness of the ALARA program and determines if exposures, releases and contamination levels are in accordance with the ALARA concept. It also evaluates the results of assessments made by the radiation protection organization, reports of facility radiation levels, contamination levels, and employee exposures for identified categories of workers and types of operations. The committee is responsible for ensuring that the occupational radiation exposure dose limits of 10 CFR 20.1201 (CFR, 2008f) are not exceeded under normal operations. The committee determines if there are any upward trends in personnel exposures, environmental releases and facility contamination levels.

The ALARA program facilitates interaction between radiation protection and operations personnel. The SRC, comprising staff members responsible for radiation protection and operations, is particularly useful in achieving this goal. The SRC periodically reviews the goals and objectives of the ALARA program. The ALARA program goals and objectives are revised to incorporate, as appropriate, new technologies or approaches and operating procedures or changes that could cost-effectively reduce potential radiation exposures.

4.3 ORGANIZATION AND PERSONNEL QUALIFICATIONS

The regulation 10 CFR 70.22 (CFR, 2008h) requires that the technical qualifications, including training and experience of facility staff be provided in the license application. This information is provided in this section.

The Radiation Protection Program staff is assigned responsibility for implementation of the Radiation Protection Program functions. Only suitably trained radiation protection personnel are employed at the facility. Staffing is consistent with the guidance provided in Regulatory Guides 8.2 (NRC, 1973a) and 8.10 (NRC, 1977).

As previously discussed, the Radiation Protection/Chemistry Manager's qualification requirements are described in Section 2.2.4 and include at least four years of responsible nuclear experience. In addition, at least one member of the Radiation Protection/Chemistry Manager's staff shall have at least two years of experience at a facility that processes uranium, including uranium in soluble form. The differences between the EREF and NEF organizations (including personnel qualifications) reflect AREVA's experience in operating fuel cycle facilities.

As stated in Section 4.1.2, Staffing of the Radiation Protection Program, other members of the Radiation Protection Program staff are trained and qualified consistent with the guidance provided in American National Standards Institute (ANSI) standard 3.1, Selection, Qualification and Training of Personnel for Nuclear Power Plants (ANSI, 1993).

The Radiation Protection/Chemistry Manager reports to the EHS&L Manager and has the responsibility for establishing and implementing the Radiation Protection Program. These duties include the training of personnel in use of equipment, control of radiation exposure of personnel, continuous determination and evaluation of the radiological status of the facility, and conducting the radiological environmental monitoring program. The facility organization chart establishes clear organizational relationships among the radiation protection staff and the other facility line managers. The facility operating organization is described in Chapter 2, Organization and Administration.

In all matters involving radiological protection, the Radiation Protection/Chemistry Manager has direct access to the Plant Manager. The Radiation Protection/Chemistry Manager is skilled in the interpretation of radiation protection data and regulations. The Radiation Protection/Chemistry Manager is also familiar with the operation of the facility and radiation protection concerns relevant to the facility. The Radiation Protection/Chemistry Manager is a resource for radiation safety management decisions.

4.4 COMMITMENT TO WRITTEN PROCEDURES

All operations involving licensed materials are conducted through the use of procedures as required by 10 CFR 70.22(8) (CFR, 2008h). Radiation protection procedures are prepared, reviewed and approved to carry out activities related to the Radiation Protection Program. Procedures are used to control radiation protection activities in order to ensure that the activities are carried out in a safe, effective and consistent manner. Radiation protection procedures are reviewed and revised as necessary, to incorporate any facility or operational changes or changes to the facility's Integrated Safety Analysis (ISA).

The radiation protection procedures are assigned to personnel qualified to develop such procedures. Initial procedure drafts are reviewed by members of the facility staff and other personnel with enrichment plant operating experience. The designated approver determines whether or not any additional, cross-disciplinary review is required. Changes to procedures are processed as follows. The writer documents the change as well as the reason for the change. The Radiation Protection/Chemistry Manager (or a designee who has the qualifications of the Radiation Protection/Chemistry Manager) reviews and approves procedures as well as proposed revisions to procedures. Final approval of the revised procedure is by the Plant Manager, or a designated alternate. Chapter 11, Management Measures, describes the program implemented for the control of procedures.

4.4.1 Radiation Work Permit Procedures

All work performed in Restricted Areas is performed in accordance with a Radiation Work Permit (RWP). The procedures controlling RWPs are consistent with the guidance provided in Regulatory Guide 8.10 (NRC, 1977). An RWP may also be required whenever the Radiation Protection/Chemistry Manager deems that one is necessary. Activities involving licensed materials not covered by operating procedures and where radioactivity levels are likely to exceed airborne radioactivity limits require the issuance of a RWP. Both routine and non-routine activities are performed under a RWP. The RWP provides a description of the work to be performed. That is, the RWP defines the authorized activities. The RWP summarizes the results of recent dose rate surveys, contamination surveys, airborne radioactivity results, etc. The RWP specifies the precautions to be taken by those performing the task. The specified precautions may include personal protective equipment to be worn while working (e.g., gloves, respirators, personnel monitoring devices), stay-times or dose limits for work in the area, record keeping requirements (e.g., time or dose spent on job) and the attendance of a radiation protection technician during the work. The RWP requires approval by the Radiation Protection/Chemistry Manager or designee. The designee must meet the requirements of Section 4.1.2, Staffing of the Radiation Protection Program. RWPs have a predetermined period of validity with a specified expiration or termination time.

Standing RWPs are issued for routinely performed activities, such as tours of the plant by shift personnel or the changing of cylinders. A Standing RWP would, for example, be used for the job evolution of cylinder changing; a new RWP is not issued each time a new cylinder is changed.

Listed below are requirements of the Radiation Work Permit procedures:

- The Radiation Protection/Chemistry Manager or designee is responsible for determining the need for, issuing and closing out RWPs.
- Planned activities or changes to activities inside Restricted Areas or work with licensed materials are reviewed by the Radiation Protection/Chemistry Manager or designee for the

potential to cause radiation exposures to exceed action levels or to produce radioactive contamination.

- RWP's include requirements for any necessary safety controls, personnel monitoring devices, protective clothing, respiratory protective equipment, and air sampling equipment and the attendance of radiation protection technicians at the work location.
- RWP's are posted at access points to Restricted Areas with copies of current RWP's posted at the work area location.
- RWP's clearly define and limit the work activities to which they apply. A RWP is closed out when the applicable work activity for which it was written is completed and terminated.
- RWP's are retained as a record at least for the life of the facility.

The subject matter discussed above is identical to the National Enrichment Facility SAR (LES, 2005) subject matter with the exception that some organizational titles have been changed. The NRC staff previously reviewed the National Enrichment Facility SAR (LES, 2005) application relative to the general guidelines of the occupational radiation protection program and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1827 (NRC, 2005a).

4.5 TRAINING COMMITMENTS

The design and implementation of the radiation protection training program complies with the requirements of 10 CFR 19.12 (CFR, 2008i). Records are maintained in accordance with 10 CFR 20.2110 (CFR, 2008j). The development and implementation of the radiation protection training program is consistent with the guidance provided in the following regulatory guidance documents:

- Regulatory Guide 8.10-Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable (NRC, 1977)
- Regulatory Guide 8.13-Instructions Concerning Prenatal Radiation Exposure (NRC, 1999a)
- Regulatory Guide 8.29-Instructions Concerning Risks From Occupational Radiation Exposure (NRC, 1996)
- ASTM C986-89-Developing Training Programs in the Nuclear Fuel Cycle (ASTM, 1989)
- ASTM E1168-95-Radiological Protection Training for Nuclear Facility Workers (ASTM, 1995).

All personnel and visitors entering Restricted Areas or Controlled Areas, as defined below, receive training that is commensurate with the radiological hazard to which they may be exposed. Alternatively, visitors will be provided with trained escorts who have received radiation protection training.

The level of radiation protection training is based on the potential radiological health risks associated with an employee's work responsibilities and incorporates the provisions of 10 CFR 19.12 (CFR, 2008i). In accordance with 10 CFR 19.12 (CFR, 2008i), any individual working at the facility who is likely to receive in a year a dose in excess of 1 mSv (100 mrem) is:

- Kept informed of the storage, transfer, or use of radioactive material
- Instructed in the health protection problems associated with exposure to radiation and radioactive material, in precautions or procedures to minimize exposure, and in the purposes and functions of protective devices employed
- Required to observe, to the extent within the worker's control, the applicable provisions of the NRC regulations and licenses for the protection of personnel from exposure to radiation and radioactive material
- Instructed of their responsibility to report promptly to the facility management, any condition which may cause a violation of NRC regulations and licenses or unnecessary exposure to radiation and radioactive material
- Instructed in the appropriate response to warnings made in the event of any unusual occurrence or malfunction that may involve exposure to radiation and radioactive material
- Advised of the various notifications and reports to individuals that a worker may request in accordance with 10 CFR 19.13 (CFR, 2008k).

The radiation protection training program takes into consideration a worker's normally assigned work activities. Abnormal situations involving exposure to radiation and radioactive material, which can reasonably be expected to occur during the life of the facility, are also evaluated and factored into the training. The extent of these instructions is commensurate with the potential radiological health protection problems present in the work place.

Retraining of personnel previously trained is performed for radiological, chemical, industrial, and criticality safety at least annually. The retraining program also includes procedure changes and updating and changes in required skills. Changes to training are implemented, when required, due to incidents potentially compromising safety or if changes are made to the facility or processes. Records of training are maintained in accordance with the EREF records management system. Training programs are established in accordance with Section 11.3, Training and Qualifications. The radiation protection sections of the training program are evaluated at least annually. The program content is reviewed to ensure it remains current and adequate to assure worker safety.

The specifics of the Radiation Protection Training are described in the following section.

4.5.1 Radiation Protection Training

Radiation protection training is highlighted to emphasize the high level of importance placed on the radiological safety of plant personnel and the public. In-depth radiation protection training is provided for the various types of job functions (e.g., production operator, radiation protection technician, contractor personnel) commensurate with the radiation safety responsibilities associated with each such position. Visitors to a Restricted Area are trained in the formal training program or are escorted by trained personnel while in the Restricted Area.

Personnel access procedures ensure the completion of formal nuclear safety training prior to permitting unescorted access into the Restricted Areas. Training sessions covering criticality safety, radiation protection and emergency procedures are conducted on a regular basis to accommodate new employees or those requiring retraining. Retraining is conducted when necessary to address changes in policies, procedures, requirements and the ISA.

Specific topics covered in the training program are listed in Chapter 11, Management Measures, Section 11.3.3.1.1. The training provided includes the requirements of 10 CFR 19 (CFR, 2008a).

Individuals attending these sessions must pass an initial examination covering the training contents to assure the understanding and effectiveness of the training. The effectiveness and adequacy of the training program curriculum and instructors are also evaluated by audits performed by operational area personnel responsible for criticality safety and radiation protection.

Since contractor employees may perform diverse tasks in the Restricted Areas or Controlled Areas of the facility, formal training for these employees is designed to address the type of work they perform. In addition to applicable radiation safety topics, training contents may include RWPs, special bioassay sampling, and special precautions for welding, cutting, and grinding. Instructors certified by the Radiation Protection/Chemistry Manager conduct the radiation protection training programs.

The Radiation Protection/Chemistry Manager is responsible for establishing and maintaining the radiation protection training for all personnel, including contractor personnel who may be working at the facility. Records are maintained by the Training Manager for each employee documenting the training date, scope of the training, identity of the trainer(s), any test results and other associated information.

Individuals requiring unescorted access to a Restricted Area receive annual retraining. Contents of the formal radiation protection training program are reviewed and updated as required at least annually by the EHS&L Manager or Radiation Protection/Chemistry Manager to ensure that the programs are current and adequate.

4.6 VENTILATION AND RESPIRATORY PROTECTION PROGRAMS COMMITMENTS

The regulations contained in 10 CFR 20 (CFR, 2008b), Subpart H, define the required elements of the facility respiratory protection and ventilation programs. This section describes the design and management measures taken to ensure that the installed ventilation and containment systems operate effectively. This section also describes the worker respiratory protection program.

The design of the ventilation and respiratory protection programs is consistent with the guidance contained in the following documents:

- Regulatory Guide 8.24-Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication (NRC, 1979)
- ANSI N510-1989-Testing of Nuclear Air Cleaning Systems (ANSI, 1989b)
- DOE Nuclear Air Cleaning Handbook (DOE, 2003)
- NCRP Report No. 59-Operational Radiation Safety Program (NCRP, 1978)
- Regulatory Guide 8.15-Acceptable Programs for Respiratory Protection (NRC, 1999b)
- ANSI Z88.2-1992-Practices for Respiratory Protection (ANSI, 1992).

4.6.1 Ventilation Program

The confinement of uranium and the attenuation of its associated radiation are a design requirement for the facility. The internal radiation exposure of workers is controlled primarily by the containment of UF_6 within process equipment. The entire UF_6 enrichment process, except for liquid sampling, is operated under a partial vacuum so that leaks are into the system and not into work areas.

Ventilation systems for the various buildings control the temperature and the humidity of the air inside the building. The ventilation systems serving normally non-contaminated areas exhaust approximately 10% of the air handled to the atmosphere. Ventilation systems serving potentially contaminated areas include design features that provide for confinement of radiological contamination. Ventilation systems for potentially contaminated areas (e.g., the Ventilated Room and Decontamination Workshop) exhaust 100% of the air handled to the environment through the exhaust vents. All air released from potentially contaminated areas is filtered to remove radioactive particulates before it is released. The ventilation systems for potentially contaminated areas are designed to maintain the potentially contaminated areas at a slightly negative pressure relative to the uncontaminated areas. This ensures that the airflow direction is from areas of little or no contamination to areas of higher contamination.

Process vents from each of the Separations Building Modules are collected by the individual Separations Building Gaseous Effluent Vent Systems (GEVS). Some areas of the Technical Support Building (TSB) also have fume hoods that are connected to the TSB GEVS. Air released from the Centrifuge Test Facility and the Centrifuge Post Mortem Facilities is filtered by the Centrifuge Test and Post Mortem Facilities Exhaust Filtration System prior to release. A GEVS is also provided for these facilities. The systems operate slightly below atmospheric pressure to remove potentially hazardous vapors and particulate from confined areas of the plant. The systems contain particulate and carbon adsorption filters to remove radioactive materials from the gas stream prior to release from the plant. Continuous HF monitors are

provided upstream of the filters with high level alarms to inform operators of UF_6 releases in the plant.

Normal operation of the facility will not result in a release of radioactive material that exceeds regulatory limits. Ventilation systems for areas that do not have the potential for contamination are not monitored for radioactivity because radioactive material is not handled or processed in these areas. No emergency ventilation systems are provided for operation when the normal ventilation systems are shut down.

Several measures are in place to ensure effective operation of the ventilation systems. Differential pressure across High Efficiency Particulate Air (HEPA) filters in potentially contaminated ventilation exhaust systems is monitored monthly or automatically monitored and alarmed. Operating procedures specify limits and setpoints on the differential pressure consistent with manufacturers' recommendations. Filters are changed if they fail to function properly or if the differential pressure exceeds the manufacturers' ratings.

Filter inspection, testing, maintenance and change out criteria are specified in written procedures approved by the Operations Manager, or a designated alternate. Change out frequency is based on considerations of filter loading, operating experience, differential pressure data and any UF_6 releases indicated by HF alarms.

Gloveboxes are designed to maintain a negative differential pressure of about 0.623 mbar (0.25 in H_2O). This differential pressure is maintained anytime that the glovebox is in use. If the differential pressure is lost, use of the glovebox is suspended until the required differential pressure is restored.

Air flow rates at exhausted enclosures and close-capture points, when in use, are adequate to preclude escape of airborne uranium and minimize the potential for intake by workers. Air flow rates are checked monthly when in use and after modification of any hood, exhausted enclosure, close-capture point equipment or ventilation system serving these barriers. The various programs that pertain to preventive and corrective maintenance are described in Chapter 11, Sections 11.2.2, Corrective Maintenance and 11.2.3, Preventive Maintenance respectively.

Ventilation and containment systems (serving contaminated and potentially contaminated areas of the facility) will be designed and sized appropriately to reduce airborne concentrations below the occupational, derived air concentration (DAC) values specified in 10 CFR 20, Appendix B, during normal operations.

4.6.2 Respiratory Protection Program

The facility uses process and engineering controls to control the concentration of radioactive material in air. However, there may be instances when it is not practical to apply process or other engineering controls. When it is not possible to control the concentrations of radioactive material in the air to values below those that define an airborne radioactivity area, other means are implemented to maintain the total effective dose equivalent ALARA. In these cases, the ALARA goal is met by an increase in monitoring and the limitation of intakes by one or more of the following means:

- Control of access
- Limitation of exposure times
- Use of respiratory protection equipment

- Other controls, as available and appropriate**.**

If an ALARA analysis is performed to determine whether or not respirators should be used, safety factors other than radiological factors may be considered. The impact of respirator use on workers' industrial health and safety is factored into decisions to use respirators.

If the decision is made to permit the use of respiratory protection equipment to limit the intake of radioactive material, only National Institute of Occupational Safety and Health (NIOSH) certified equipment is used. The respiratory protection program meets the requirements of 10 CFR 20 (CFR, 2008b), Subpart H (Respiratory Protection and Controls to Restrict Internal Exposure in Restricted Areas).

The respiratory protection program includes the following elements:

- Air sampling to identify the potential hazard, select proper equipment and estimate doses
- Surveys and, when necessary, bioassays to evaluate actual intakes
- Performance testing of respirators for operability (user seal check for face sealing devices and functional check for others) immediately prior to each use
- Written procedures for the following:
    1. Monitoring, including air sampling and bioassays
    2. Supervision and training of respirator users
    3. Fit testing
    4. Respirator selection
    5. Breathing air quality
    6. Inventory and control
    7. Storage, issuance, maintenance, repair, testing, and quality assurance of respiratory protection equipment
    8. Record keeping
    9. Limitations on periods of respirator use and relief from respirator use.
- Determination by a physician that the individual user is medically fit to use respiratory protection equipment:
    1. Before the initial fitting of a face sealing respirator
    2. Before the first field use of non-face sealing respirators
    3. Either every 12 months thereafter, or periodically at a frequency determined by a physician.
- A respirator fit test requires a minimum fit factor of at least 10 times the Assigned Protection Factor (APF) for negative pressure devices, and an overall fit factor of at least 500 for any positive pressure, continuous flow, and pressure-demand devices. The fit testing is performed before the first field use of tight fitting, face-sealing respirators. Subsequent testing is performed at least annually thereafter. Fit testing must be performed with the facepiece operating in the negative pressure mode.
    1. Each user is informed that they may leave the area at any time for relief from respirator use in the event of equipment malfunction, physical or psychological distress,

procedural or communication failure, significant deterioration of operating conditions, or any other conditions that might require such relief.

2. In the selection and use of respirators, the facility provides for vision correction, adequate communication, low temperature work environments, and the concurrent use of other safety or radiological protection equipment. Radiological protection equipment is used in such a way as not to interfere with the proper operation of the respirator.

3. Standby rescue persons are used whenever one-piece atmosphere-supplying suits are in use. Standby rescue personnel are also used when any combination of supplied air respiratory protection device and personnel protective equipment is in use that presents difficulty for the wearer to remove the equipment. The standby personnel are equipped with respiratory protection devices or other apparatus appropriate for the potential hazards. The standby rescue personnel observe and maintain continuous communication with the workers (visual, voice, signal line, telephone, radio, or other suitable means). The rescue personnel are immediately available to assist the workers in case of a failure of the air supply or for any other emergency. The Radiation Protection/Chemistry Manager, in consultation with the EHS&L Manager, specifies the number of standby rescue personnel that must be immediately available to assist all users of this type of equipment and to provide effective emergency rescue if needed.

4. Atmosphere-supplying respirators are supplied with respirable air of quality that meets or exceeds the specifications of the Compressed Gas Association in its publications G-7.1, "Commodity Specification for Air," (CGA, 2004a) and G-7, “Compressed Air for Human Respiration,” (CGA, 2004b) as well as the requirements included in the regulations of the Occupational Safety and Health Administration (29 CFR 1910.134(i)(1)(ii)(A) through (E) (CFR, 2008l).

5. No objects, materials or substances (such as facial hair), or any conditions that interfere with the face-to-facepiece seal or valve function, and that are under the control of the respirator wearer, are allowed between the skin of the wearer's face and the sealing surface of a tight-fitting respirator facepiece.

The dose to individuals from the intake of airborne radioactive material is estimated by dividing the ambient air concentration outside the respirator by the assigned protection factor. If the actual dose is later found to be greater than that estimated initially, the corrected value is used. If the dose is later found to be less than the estimated dose, the lower corrected value may be used.

Records of the respiratory protection program (including training for respirator use and maintenance) are maintained in accordance with the facility records management program as described in Section 11.7, Records Management. Respiratory protection procedures are revised as necessary whenever changes are made to the facility, processing or equipment.

4.7 RADIATION SURVEYS AND MONITORING PROGRAMS COMMITMENTS

Radiation surveys are conducted for two purposes: (1) to ascertain radiation levels, concentrations of radioactive materials, and potential radiological hazards that could be present in the facility; and (2) to detect releases of radioactive material from facility equipment and operations. Radiation surveys will focus on those areas of the facility identified in the ISA where the occupational radiation dose limits could potentially be exceeded. Measurements of airborne radioactive material and/or bioassays are used to determine that internal occupational exposures to radiation do not exceed the dose limits specified in 10 CFR 20 (CFR, 2008b), Subpart C.

To assure compliance with the requirements of 10 CFR 20 (CFR, 2008b) Subpart F, there are written procedures for the radiation survey and monitoring programs. The radiation survey and monitoring programs assure compliance with the requirements of 10 CFR 20 (CFR, 2008b) Subpart F (Surveys and Monitoring), Subpart C (Occupational Dose Limits), Subpart L (Records) and Subpart M (Reports).

The radiation survey and monitoring programs are consistent with the guidance provided in the following references:

- Regulatory Guide 8.2-Guide for Administrative Practice in Radiation Monitoring (NRC,1973a)
- Regulatory Guide 8.4-Direct-Reading and Indirect-Reading Pocket Dosimeters (NRC,1973b)
- Regulatory Guide 8.7- Instructions for Recording and Reporting Occupational Radiation Exposure Data, Rev. 2 (NRC, 2005b)
- Regulatory Guide 8.9-Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program (NRC,1993f)
- Regulatory Guide 8.24-Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication (NRC,1979)
- Regulatory Guide 8.25-Air Sampling in the Workplace (NRC, 1992a)
- Regulatory Guide 8.34-Monitoring Criteria and Methods To Calculate Occupational Radiation Doses (NRC, 1992b)
- NUREG-1400-Air Sampling in the Workplace (NRC, 1993a)
- ANSI N13.1-1999, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities, (ANSI, 1999)
- ANSI N323-1978-Radiation Protection Instrumentation Test and Calibration (ANSI,1978)
- ANSI N13.11-2001-Dosimetry-Personnel Dosimetry Performance-Criteria for Testing (ANSI, 2001)
- ANSI/HPS N13.22-1995-Bioassay Program for Uranium (ANSI,1995)
- ANSI N13.27-1981-Performance Requirements for Pocket-Sized Alarm Dosimeters and Alarm Ratemeters (ANSI,1981)
- ANSI/HPS N13.30-1996-Performance Criteria for Radiobioassay (ANSI,1996)
- ANSI N13.6-1966 (R1989), Practice for Occupational Radiation Exposure Records Systems (ANSI,1989a)

The procedures include an outline of the program objectives, sampling procedures and data analysis methods. Equipment selection is based on the type of radiation being monitored. Procedures are prepared for each of the instruments used and specify the frequency and method of calibration. Maintenance and calibration are in accordance with the manufacturers' recommendations. Specific types of instruments used in the facility are discussed below.

The survey program procedures also specify the frequency of measurements and record keeping and reporting requirements. As stated in Section 4.1, Commitment to Radiation Protection Program Implementation, the facility corrective action process is implemented if: (1) personnel dose monitoring results or personnel contamination levels exceed the administrative personnel limits; or if an incident results in airborne occupational exposures exceeding the administrative limits, or (2) the dose limits in 10 CFR 20, Appendix B (CFR, 2008m) or 10 CFR 70.61 (CFR, 2008e) are exceeded. In the event the occupational dose limits given in 10 CFR 20 (CFR, 2008b), Subpart C are exceeded, notification of the NRC is in accordance with the requirements of 10 CFR 20, Subpart M-Reports (CFR, 2008v).

All personnel who enter Restricted Areas (as defined below) are required to wear personnel monitoring devices that are supplied by a vendor that holds dosimetry accreditation from the National Voluntary Laboratory Accreditation Program. In addition, personnel are required to monitor themselves prior to exiting Restricted Areas which may have the potential for contamination.

Continuous airborne radioactivity monitors provide indication of the airborne activity levels in the Restricted Areas of the facility. Monitoring instruments for airborne alpha emitters are provided at different locations throughout facility. These monitors are designed to detect alpha emitters in the air, which would indicate the potential for uranium contamination. When deemed necessary, portable air samplers may be used to collect a sample on filter paper for subsequent analysis in the laboratory.

Monitor data is collected for regular analysis and documentation. Monitors in locations classified as Airborne Radioactivity Areas are equipped with alarms. The alarm is activated when airborne radioactivity levels exceed predetermined limits. The limits are set with consideration being given to both toxicity and radioactivity. The volume of air sampled may have to be adjusted to ensure adequate sensitivity with minimum sampling time. The operating history of the facility, changes in technology, changes in room functions and design, and changes in regulations may necessitate adjustment of the monitors.

Continuous monitoring of direct radiation exposure rates is not performed because the uranium processed in the facility is handled in closed containers. The radionuclides of interest are primarily alpha and beta emitters. The decay data and decay chains for these radionuclides are shown in Table 4.7-1, Radiation Emitted from Natural UF_6 Feed, and Figure 4.7-1, Uranium and Decay Products of Interest, respectively.

Alpha and beta radiation cannot penetrate the container walls. Typical area radiation monitors measure gamma radiation. At this facility, the gamma radiation is not present at sufficient levels to provide representative indications. Instead, periodic radiation monitoring is performed with portable survey meters and "wipe tests" for contaminations are taken to evaluate radiological conditions in the facility.

A calibration is performed in accordance with written established procedures and documented prior to the initial use of each airflow measurement instrument (used to measure flow rates for air or effluent sampling) and each radioactivity measurement instrument. Periodic operability checks are performed in accordance with written established procedures. Calibrations are performed and documented on each airflow measurement and radioactivity measurement

instrument at least annually (or according to manufacturers' recommendations, whichever is more frequent) or after failing an operability check, or after modifications or repairs to the instrument that could affect its proper response, or when it is believed that the instrument has been damaged.

Unreliable instruments are removed from service until repairs are completed. Portal monitors, hand and foot monitors and friskers have the required sensitivity to detect alpha contamination on personnel to ensure that radioactive materials do not spread to the areas outside the Restricted Areas. Instruments are calibrated with sources that are within ±5% of the reference value and are traceable to the National Institute of Standards and Technology or equivalent.

The background and efficiency of laboratory counting instruments, when used for radiation protection purposes, is determined daily. This determination may be less frequent only if necessary due to long counting intervals.

The subject matter discussed above is identical to the National Enrichment Facility SAR (LES, 2005) subject matter with the exception that ANSI N13.15 has been deleted based on the EREF's commitment to the later version of ANSI N13.11. The NRC staff previously reviewed the National Enrichment Facility SAR (LES, 2005) application relative to the general guidelines of the occupational radiation protection program and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1827 (NRC, 2005a).

4.7.1 Radiological Zones

Radiological zones within the facility have been established to (1) control the spread of contamination, (2) control personnel access to avoid unnecessary exposure of personnel to radiation, and (3) to control access to radioactive sources present in the facility. Table 4.1-2, Estimated Dose Rates, lists general dose rate estimates for the facility. These dose estimates were prepared based upon historical data from similar operating centrifuge enrichment facilities. Areas associated with higher dose rates may be restricted from public access, as determined by facility management. Areas where facility personnel spend substantial amounts of time are designed to minimize the exposure received when routine tasks are performed, in accordance with the ALARA principle.

The following definitions of areas are provided to describe how the facility Radiation Protection Program is implemented to protect workers and the general public on the site.

4.7.1.1 Unrestricted Area

NRC regulation 10 CFR 20.1003 (CFR, 2008n) defines an unrestricted area as an area, access to which is neither limited nor controlled by the licensee. The area adjacent to the facility site where the EREF does not normally exercise access control is an Unrestricted Area. This area can be accessed by members of the public, indigenous wildlife, or by facility personnel. The Unrestricted Area is governed by the limits in 10 CFR 20.1301 (CFR, 2008o). The total effective dose equivalent to individual members of the public from the licensed operation may not exceed 1 mSv (100 mrem) in a year (exclusive of background radiation). The dose in any Unrestricted Area from external sources may not exceed 0.02 mSv (2 mrem) in any one hour. In addition to the NRC limit, the Environmental Protection Agency, in 40 CFR 190 (CFR, 2008p), imposes annual dose equivalent limits of 0.25 mSv (25 mrem) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other organ of any member of the public as the

result of exposures to planned discharges of radioactive materials to the general environment from uranium fuel cycle operations and to radiation from these operations.

4.7.1.2 Restricted Area

The NRC defines a restricted area as an area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. Access to and egress from a Restricted Area at the plant site is through a radiation protection control point known as a Monitor Station. Monitoring equipment is located at these egress points. All personnel are required to monitor themselves prior to exiting Restricted Areas that have the potential for contamination, using monitoring instruments that detect gross alpha contamination.

Examples of Restricted Areas include storage areas for UF_6 in the Cylinder Receipt and Shipping Building and the potentially contaminated areas in the Technical Support Building. Personnel who have not been trained in radiation protection procedures are not allowed to access a Restricted Area without escort by trained personnel.

The areas defined below may exist within a Restricted Area. These areas may be temporary or permanent. The areas are posted to inform workers of the potential hazard in the area and to help prevent the spread of contamination. These areas are conspicuously posted in accordance with the requirements of 10 CFR 20.1902 (CFR, 2008q).

- An area in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.05 mSv (0.005 rem) “in 1 hour at 30 centimeters” from the radiation source or from any surface that the radiation penetrates is designated a “Radiation Area” as defined in 10 CFR 20.1003 (CFR, 2008n).
- As defined in 10 CFR 20.1003 (CFR, 2008n), “Airborne Radioactivity Area” means a room, enclosure, or area in which airborne radioactive materials, composed wholly or partly of licensed material, exist in concentrations: (1) In excess of the derived air concentrations (DACs) specified in appendix B to 10 CFR 20.1001 - 20.2401, or (2) To such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC-hours. Note that entry into this area does not automatically require the wearing of a respirator.
- A “High Radiation Area” as defined in 10 CFR 20.1003 (CFR, 2008n), is an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 1 mSv (0.1 rem) “in 1 hour at 30 centimeters” from the radiation source or from any surface that the radiation penetrates. No examples of this type of area are expected during routine operation of the facility. This designation is provided here only for the purposes of emergency situations (drills and actual).
- The EREF defines a “Contaminated Area” as an area where removable contamination levels are greater than 0.33 Bq/100 cm^2 (20 dpm/100 cm^2) of alpha activity or 16.7 Bq/100 cm^2 (1,000 dpm/100 cm^2) beta/gamma activity.

The NRC limits the soluble uranium intake of an individual to 10 milligrams in a week in consideration of chemical toxicity. The EREF posts areas where the intake of soluble uranium in one week is likely to exceed 1 milligram, if respiratory protection is not utilized.

4.7.1.3 Controlled Area

In 10 CFR 20.1003 (CFR, 2008n), the NRC defines a "Controlled Area" as an area, outside of a Restricted Area but inside the site boundary, access to which can be limited by the licensee for any reason. The area of the plant within the perimeter fence but outside any Restricted Area is part of the Controlled Area. Due to the presence of the owner controlled area fence, members of the public do not have direct access to this Controlled Area of the site and must be processed by security and authorized to enter the site. Training for access to a Controlled Area is provided commensurate with the radiological hazard.

Site visitors include delivery people, tour guests and service personnel who are temporary, transient occupants of the Controlled Area. Area monitoring demonstrates compliance with public exposure limits for such visitors. All individuals who are contractor or EREF employees and who work only in the Controlled Area are subject to the exposure limits for members of the public as stated in 10 CFR 20.1301 (CFR, 2008o).

4.7.2 Access and Egress Control

The facility establishes and implements an access control program that ensures that (a) signs, labels, and other access controls are properly posted and operative, (b) restricted areas are established to prevent the spread of contamination and are identified with appropriate signs, and (c) step-off pads, change facilities, protective clothing facilities, and personnel monitoring instruments are provided in sufficient quantities and locations.

Because there are no High Radiation Areas in the facility, there are no areas where access is physically prevented due to radiation level. Access control is by administrative methods. Access to certain areas may be physically prevented for security reasons. Personnel who have not been trained in radiation protection procedures are not allowed access to a Restricted Area without escort by other trained personnel.

Access to and egress from a Restricted Area is through one of the monitor stations at the particular Restricted Area boundary. Access to and egress from each Radiation Area, Contaminated Area or Airborne Radioactivity Area within a Restricted Area may also be individually controlled. A contamination monitor (e.g., frisker, hand and foot monitor or portal monitor, step-off pad and container for any discarded protective clothing may be provided at the egress point from certain of these areas to prevent the spread of contamination.

Action levels for skin and personal clothing contamination at the point of egress from Restricted Areas and any additional designated areas within the Restricted Area (e.g., a Contaminated Area which is provided with a step-off pad and contamination monitor) shall not exceed 2.5 Bq/100 cm^2 (150 dpm/100 cm^2) alpha or beta/gamma contamination (corrected for background). Clothing contaminated above egress limits shall not be released unless it can be laundered to within these limits. If skin or other parts of the body are contaminated above egress limits, reasonable steps that exclude abrasion or other damage shall be undertaken to effect decontamination.

4.7.3 Posting for Radiation Protection Awareness

Restricted Areas and other areas within the Restricted Areas (e.g., Airborne Radioactivity Area) are clearly identified by physical means such as placarding or boundary marking, so that facility personnel can identify these areas and use their training to minimize their exposure. This identification is done in accordance with 10 CFR 20.1902 (CFR, 2008q). The radiation and contamination levels from the most recent survey are clearly noted on each posting.

4.7.4 Protective Clothing and Equipment

The proper use of protective clothing and equipment can minimize internal and external exposures to radioactivity. Personnel working in areas that are classified as Airborne Radioactivity Areas or in Contaminated Areas must wear appropriate protective clothing. If the areas containing the surface contamination can be isolated from adjacent work areas via a barrier such that dispersible material is not likely to be transferred beyond the area of contamination, personnel working in the adjacent area are not required to wear protective clothing. Areas requiring protective clothing are posted at each of their entry points.

Radiation protection management and associated technical staff are responsible for determining the need for protective clothing in each work area. Areas requiring protective clothing are identified by posting signs at all area entry points.

4.7.5 Personnel Monitoring for External Exposures

External exposures are received primarily from the radioactive decay products of ^{235}U and ^{238}U. Most notably these progeny are ^{231}Th (several gammas, all low energy and low abundance), ^{234}Th (several gammas, most low abundance and low energy), and ^{234}Pa and ^{234m}Pa (many gammas, variable abundance, low and high energy). The ^{234m}Pa is the primary gamma source and is expected to contribute to a significant portion of the external exposure.

Over the life of the facility, the number of full depleted uranium tails cylinders placed on the storage pads may increase to the pads' design capacity. In addition, the facility may reach its design capacity of feed and product cylinders. As a result, it is possible that the neutron contribution to the total worker dose may require monitoring. The neutrons are due to spontaneous fission in uranium as well as the alpha, neutron reaction on fluorine. Workers receive training regarding ALARA concepts such as time-distance-shielding to minimize their exposures.

All personnel whose duties require them to enter Restricted Areas wear individual external dosimetry devices, e.g., passive dosimeters such as thermoluminescent dosimeters (TLDs) that are sensitive to beta, gamma and neutron radiation. External dosimetry devices are evaluated at least quarterly to ascertain external exposures. Administrative limits on radiation exposure are provided in Table 4.1-1, Occupational Administrative Radiation Exposure Limits.

If 25% of the annual administrative limit (i.e., 2.5 mSv or 0.250 rem) is exceeded in any quarter, then an investigation is performed and documented to determine what types of activities may have contributed to the worker's external exposure. The administrative limit already reflects ALARA principles, so this action level is appropriate. This investigation may include, but is not limited to procedural reviews, efficiency studies of the air handling system, cylinder storage protocol, and work practices.

Anytime an administrative limit is exceeded, the Radiation Protection/Chemistry Manager is informed. The Radiation Protection/Chemistry Manager is responsible for determining the need for and recommending investigations or corrective actions to the responsible Manager(s). Copies of the Radiation Protection/Chemistry Manager’s recommendations are provided to the Safety Review Committee.

The subject matter discussed above is identical to the National Enrichment Facility SAR (LES, 2005) subject matter with the exception that some organizational titles have been changed. Although some titles have been changed, the functions to be performed remain the same. Refer to Chapter 2.0 for additional information regarding these differences. The NRC staff previously reviewed the National Enrichment Facility SAR (LES, 2005) application relative to the

general guidelines of the occupational radiation protection program and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1827 (NRC, 2005a).

4.7.6 Personnel Monitoring for Internal Exposures

Internal exposures for all personnel wearing external dosimetry devices are evaluated via direct bioassay (e.g. in vivo body counting), indirect bioassay (e.g., urinalysis), or an equivalent technique. For soluble (Class D) uranium, 10 CFR 20.1201(e) (CFR, 2008f) limits worker intake to no more than 10 milligrams (mg) of soluble uranium in a week. This is to protect workers from the toxic chemical effects of inhaling Class D uranium. The facility annual administrative limit for the Total Effective Dose Equivalent (TEDE) is 10 mSv (1.0 rem). Internal doses are evaluated at least annually.

The subject matter discussed above is identical to the National Enrichment Facility SAR (LES, 2005) subject matter. The NRC staff previously reviewed the National Enrichment Facility SAR (LES, 2005) application relative to the general guidelines of the occupational radiation protection program and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1827 (NRC, 2005a)

Continuous air monitoring in Airborne Radioactivity Areas may be performed to complement the bioassay program. Alarm setpoints on the continuous air monitors in the Airborne Radioactivity Areas may be used to provide an indication that internal exposures may be approaching the action limit.

If the facility annual administrative limit is exceeded as determined from bioassay results, then an investigation is performed and documented to determine what types of activities may have contributed to the worker's internal exposure. The action limit is based on ALARA principles. Other factors such as the biological elimination of uranium are considered. This investigation may include, but is not limited to procedural reviews, efficiency studies of the air handling system, and work practices.

4.7.7 Evaluation of Doses

Dose evaluations may be performed at more frequent intervals and should be performed when reasonable suspicion exists regarding an abnormal exposure. The internal and external exposure values are summed in accordance with 10 CFR 20.1202 (CFR, 2008r). Procedures for the evaluation and summation of doses are based on the guidance contained in Regulatory Guides 8.7 (NRC, 2005b) and 8.34 (NRC, 1992b).

4.7.8 Monitor Stations

Monitor stations are the entry and exit points for Restricted Areas. Monitors are provided to detect radioactive contamination on personnel and their personal items, including hard hats. All personnel are required to monitor themselves, any hand-carried personal items, and hard hats prior to exiting a Restricted Area. Radiation protection management is responsible for Monitor Station provision and maintenance. Figure 4.7-2, Projected Radiological Zones shows the

anticipated Restricted Areas. Monitor Station locations are evaluated and moved as necessary in response to changes in the facility radiological conditions.

4.7.9 Locker Rooms

Locker rooms for men and women are provided for personnel to change into appropriate work clothing and store personal belongings. The following facilities are provided for in the locker room area:

- Shower Rooms - shower rooms for men and women are provided as a place for personnel to wash/clean up after work. These shower rooms are not intended for personnel decontamination.
- Restrooms - restrooms for men and women are provided. These rooms are not for personnel decontamination.
- First Aid Station - a first aid station is provided to treat injured personnel.
- Information Area - an information area is provided to notify personnel of information important to radiation protection.

4.7.10 Storage Areas

Storage areas are provided for the following items:

- Protective (i.e., anti-contamination) clothing
- Respiratory protection equipment
- Shower rooms supplies
- Radiation protection supplies.

4.8 CONTAMINATION AND RADIATION CONTROL

The goal of maintaining occupational internal and external radiation exposures ALARA encompasses the individual's dose as well as the collective dose of the entire working population. Since the total effective dose equivalent (TEDE) is the sum of the internal and external exposures, the Radiation Protection Program addresses both contamination control and external radiation protection.

Listed below are examples of design and operating considerations that are implemented at the facility to reduce personnel radiation exposures:

- The enrichment process, with the exception of the Liquid Sampling part, is maintained under subatmospheric pressure. The constant containment of UF_6 precludes direct contact with radioactive materials by personnel.
- Self-monitoring is required upon exit from Restricted Areas. Personnel are required to notify a member of the radiation protection staff if contamination is detected.
- All personnel are trained in emergency evacuation procedures in accordance with the facility Emergency Plan.
- Air flow rates at exhausted enclosures and close-capture points, when in use, are adequate to preclude escape of airborne uranium and minimize the potential for intake by workers. Air flow rates are checked monthly when in use and after modification of any hood, exhausted enclosure, close-capture point equipment or ventilation system serving these barriers.
- The Radiation Monitoring Room in the Technical Support Building (TSB) has a personnel decontamination area to handle cases of accidental radioactive contamination. A handwashing sink and a shower are provided for contamination removal.

4.8.1 Internal Exposures

Because the radionuclides present in this facility under routine operations are primarily alpha and beta emitters (with some low-energy gamma rays), the potential for significant internal exposure is greater than that for external exposure. Parameters important to determining internal doses are:

- The quantity of radioactive material taken into the body
- The chemical form of the radioactive material
- The type and half-life of radionuclide involved
- The time interval over which the material remains in the body.

The principal modes by which radioactive material can be taken into the body are:

- inhalation
- ingestion
- absorption through the skin
- injection through wounds.

4.8.1.1 Bioassay

Internal radiological exposures are evaluated at least annually, or more frequently if conditions warrant, as noted in Section 4.7.7, Evaluation of Doses. Based on the results of air sample monitoring data, bioassays are performed for all personnel who are likely to have had an intake of one milligram of uranium. This is 10% of the 10 mg in a week regulatory limit (10 CFR 20.1201(e) (CFR, 2008f)) for intake of Class D uranium. The bioassay program has a sensitivity of 5 micrograms per liter (5 µg/L) of uranium concentration, assuming that the sample is taken within ten days of the postulated intake and that at least 1.4 L of sample is available from a 24-hour sampling period. Until urinalysis results indicate less than 15 µg/L uranium concentration, workers are restricted from activities that could routinely or accidentally result in internal exposures to soluble uranium.

It might not be possible to achieve a sensitivity of 5 micrograms per liter; if for example, all reasonable attempts to obtain a 1.4 liter 24-hour sample within 10 days fail. In such a case, the sample is analyzed for uranium concentration (if measurable) and the worker's intake is estimated using other available data.

The subject matter discussed above is identical to the National Enrichment Facility SAR (LES, 2005) subject matter. The NRC staff previously reviewed the National Enrichment Facility SAR (LES, 2005) application relative to the general guidelines of the occupational radiation protection program and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1827 (NRC, 2005a).

4.8.1.2 Air Monitoring and Sampling

Airborne activity in work areas is regularly determined in accordance with written procedures. Continuous air sampling in airborne radioactivity areas may be performed to complement the bioassay program. Alarm setpoints on the continuous air monitors in the airborne radioactivity areas may be used to provide an indication that internal exposures may be approaching the action limit. Using the values specified in 10 CFR 20 Appendix B (CFR, 2008m), if a worker could have inhaled radionuclide concentrations that are likely to exceed 12 DAC-hours in one week (7 days), then bioassay is conducted within 72 hours after the suspected or known exposure. Follow-up bioassay measurements are conducted to determine the committed effective dose equivalent. Until urinalysis results indicate less than 15 micrograms per liter uranium concentration, workers are restricted from activities that could routinely or accidentally result in internal exposures to soluble uranium.

Continuous air monitors for airborne alpha emitters are used to measure representative airborne concentrations of radionuclides that may be due to facility operation. On-line monitoring for gross alpha activity is performed assuming all the alpha activity is due to uranium. When airborne activity data is used for dose calculations, the assumption is that all the activity is due to 234U , class D material. The lower limit of detection is either 0.02 milligrams of uranium in the total sample or 3.7 nBq/ml (1E-13 µCi/ml) gross alpha concentration. An action level is established at 1 mg of total uranium likely to be inhaled by a worker in seven days. When deemed necessary, portable air samplers may be used to collect a sample on filter paper for subsequent analysis in the laboratory.

Continuous air monitors provide indication of the airborne activity levels in the Restricted Areas of the facility. These monitors are designed to detect alpha emitters in the air, which would indicate the potential for uranium contamination. Continuous air monitors are permanently

located in Restricted Areas. These permanent monitors are operated to collect continuous samples. Continuous air monitors in locations classified as Airborne Radioactivity Areas are equipped with alarms. The alarm is activated when airborne radioactivity levels exceed predetermined limits. The limits are set with consideration being given to both toxicity and radioactivity. The volume of air sampled may have to be adjusted to ensure adequate sensitivity with minimum sampling time. The operating history of the facility, changes in technology, changes in room functions and design, and changes in regulations may necessitate adjustment of the monitors.

When deemed necessary, portable air samplers may be used to collect a sample on filter paper for subsequent analysis in the laboratory. When air sampling is conducted using continuous air sampling devices, the filters are changed and analyzed at the following frequencies:

- Weekly and following any indication of release that might lead to airborne concentrations of uranium that are likely to exceed (1) 10% of the values listed in 10 CFR 20.1003 (CFR, 2008n), or (2) the total uranium action level of one milligram of total uranium inhaled in one week.
- Each Shift, following changes in process equipment or process control, and following detection of any event (e.g., leakage, spillage or blockage of process equipment) that are likely to exceed (1) 10% of the values listed in 10 CFR 20.1003 (CFR, 2008n), or (2) the total uranium action level of one milligram inhaled by a worker in one week.

The representativeness of the workstation continuous air samplers shall be checked annually and when significant process or equipment changes have been made. Facility procedures specify how representativeness is determined.

Plant areas surveyed as described in this section include as a minimum UF_6 processing areas, decontamination areas, waste processing areas and laboratories. Continuous air samplers may be substituted when appropriate, as when continuous monitoring may not be reasonably achieved.

Action levels are based on trending of data collected during facility operation. Investigations are performed if airborne activity:

a. Exceeds 10% of the values listed in 10 CFR 20.1003 (CFR, 2008n) for Airborne Radioactivity Areas
b. Shows a short-term increase of a factor of 10 over historical data from the previous 12 months.

Corrective actions include investigation of the adverse trend and an evaluation of the need for changes, consistent with the principles of ALARA.

4.8.2 External Exposures

As noted previously, the potential for significant external exposure to personnel under routine operating conditions is less significant than that for internal exposures. This is primarily due to the nature of the radionuclides present in the facility.

Parameters important in determining dose from external exposures are:

- The length of time the worker remains in the radiation field
- The intensity of the radiation field
- The portion of the body receiving the dose.

Historical data from European facilities of similar construction show relatively low doses compared to nuclear power plant doses.

4.8.3 Procedures

Procedures are provided in the following areas to administratively control personnel radiation exposure:

- Operation
- Design
- Maintenance
- Modification
- Decontamination
- Surveillance
- Procurement.

4.8.4 Instrumentation

Three basic types of personnel monitoring equipment are used at the facility. These are count rate meters (also known as “friskers), hand/foot monitors and portal monitors.

4.8.4.1 Friskers

These typically consist of a hand-held Thermo Scientific HP 210 (or equivalent) probe connected to an RM-25 (or equivalent) count rate meter. Instructions for the use of these instruments are posted in a prominent location near the instrument. Hand held friskers are typically placed in locations where conditions restrict the use of other monitors or for short-term use as necessary to ensure effective control of the spread of contamination.

4.8.4.2 Hand and Foot Monitors

These typically consist of multiple detectors arranged to monitor only hands and feet. Instructions for the use of these monitors are prominently posted on or near the instrument. Hand and foot monitors are used in applications where "pass-throughs" are frequent and where hand and foot monitoring is the major requirement.

4.8.4.3 Portal Monitors

Portal monitors can quickly scan large surface areas of the body. Portal monitors typically use large area beta/gamma sensitive detectors to monitor personnel passing through. Additional detectors are provided to monitor the hands, head and feet. These monitors may be used where the number of personnel exiting an area, available space, etc., makes their use advantageous.

4.8.5 Contamination Control

Small contamination areas (i.e., less than 1/4 of the room) may be roped off or otherwise segregated from the rest of a Restricted Area. Appropriate clothing and/or other equipment is

used to minimize exposure to radioactive material and prevent the spread of contamination. Provisions for monitoring contamination and airborne activity levels are discussed below. A contamination monitor (frisker), a step-off pad and a container for any discarded protective clothing may be placed at the access/egress point to the work area. The entire Restricted Area is not posted as a Contaminated Area.

4.8.5.1 Surface Contamination

Contamination survey monitoring is performed for all UF_6 process areas and areas in which uranic materials are handled or stored. Surveys include routine checks of non-UF_6 process areas, including areas normally not contaminated. Monitoring includes direct radiation and removable contamination measurements. Survey procedures are based on the potential for contamination of an area and operational experience. The Restricted Areas are surveyed at least weekly. The lunch room and change rooms are surveyed at least daily.

Removable surface contamination is considered uranium contamination that is present on a surface and that can be transferred to a dry smear paper by rubbing with moderate pressure. The facility uses various instruments such as proportional counters, alpha scintillation counters and thin window Geiger-Mueller tubes, to evaluate contamination levels.

Laundered protective clothing is periodically surveyed for gross alpha and gross beta contamination. Levels of less than 2.5 Bq/100 cm^2 (150 dpm/100 cm^2), alpha or beta/gamma are acceptable. This action level should be readily achievable since most of the radioactive material that can contaminate protective clothing at the facility is in soluble form and is easily removed by laundering. Monitoring of laundered protective clothing may be performed by the licensed commercial nuclear decontamination laundry company described in Section 4.9.2, Contaminated Laundry Program.

If surface contamination levels exceed the following levels, clean-up of the contamination is initiated within 24 hours of the completion of the analysis:

- Removable contamination: 83.3 Bq/100 cm^2 (5000 dpm/100 cm^2) alpha or beta/gamma
- Fixed contamination: 4.2 kBq/100 cm^2 (250,000 dpm/100 cm^2) alpha or beta/gamma.

The subject matter discussed above is identical to the National Enrichment Facility SAR (LES, 2005) subject matter. The NRC staff previously reviewed the National Enrichment Facility SAR (LES, 2005) application relative to the general guidelines of the occupational radiation protection program and concluded that the descriptions, specifications or analyses provided an adequate basis for safety review of the facility operations and that the construction and operation of the facility would not pose an undue risk to public health and safety. The specific discussion is in NUREG-1827 (NRC, 2005a).

4.9 MAINTENANCE AREAS – METHODS AND PROCEDURES FOR CONTAMINATION CONTROL

Designing processes and equipment that contain radioactive material to require as little maintenance as possible ensures that personnel radiation exposures are ALARA. Additional exposure reductions are achieved by:

- Removing as much radioactive material as possible from the equipment and the area prior to maintenance, thereby reducing the intensity of the radiation field
- Providing adequate space for ease of maintenance reducing the length of time required to complete the task, thereby reducing the time of exposure
- Preparing and using procedures that contain specifications for tools and equipment needed to complete the job
- Proper job planning, including practice on mockups
- Reviews of previous similar jobs
- Identification and communication of the highest contamination areas to the workers prior to the start of work.

4.9.1 Decontamination Facilities

The Decontamination Facilities at the EREF comprise five rooms:

- Chemical Trap Workshop
- Mobile Unit Disassembly and Reassembly Workshop
- Valve and Pump Dismantling Workshop
- Decontamination Workshop
- Maintenance Facility

All of the rooms are located in the TSB. The decontamination systems in the workshops are designed to remove uranium hexafluoride (UF_6) and its associated breakdown products from materials and equipment used in uranium hexafluoride systems, waste handling systems, and miscellaneous other areas of the plant. Space is provided to break down and strip contaminated equipment prior to decontamination. The workshops may also be used for the temporary storage and dismantling of failed equipment.

The only significant forms of radioactive contamination found in the facility are uranium hexafluoride (UF_6), uranium tetrafluoride (UF_4) and uranyl fluoride (UO_2F_2).

The process carried out within the Decontamination Facilities begins with receipt and storage of contaminated pumps, out-gassing, PFPE oil removal and storage, and pump stripping. Activities for the dismantling and maintenance of other plant components are also carried out. Other components commonly decontaminated besides pumps include valves, piping, instruments, sample bottles, tools, flexible hoses, and scrap metal. This area has appropriate access controls and contamination monitoring facilities.

The decontamination part of the process consists of a series of steps following equipment disassembly including degreasing and draining as necessary decontamination, drying, and inspection. Ultrasonic agitators, heated baths, including degreasing water baths, citric acid, and

deionized water are available for use. In addition, heated compressed air and ovens are available to ensure decontaminated items are totally dry.

The EREF routine contamination control procedures, including the use of radiation monitoring equipment, are implemented in these facilities. These rooms are provided with general HVAC and a ventilation exhaust system with ductwork connected to a fan/filter that exhausts filtered air to the atmosphere.

4.9.2 Contaminated Laundry

The EREF utilizes the services of a licensed commercial nuclear decontamination laundry company. The EREF implements a contaminated laundry program to ensure that contaminated and soiled clothing and other articles which have been used throughout the plant, are cleaned. Clothing and articles are taken in plastic bags from containers strategically positioned within the plant. Clean clothing and articles are delivered to storage areas located within the plant.

Laundry collection is divided into two groups: articles with high or low possibility of contamination. Expected contaminants on the laundry include slight amounts of uranyl fluoride (UO_2F_2) and uranium tetrafluoride (UF_4). Articles likely to be contaminated are collected in water absorbent bags. Articles unlikely to be contaminated are collected in bin bags and sorted into lightly and heavily soiled articles. Lightly soiled articles are shipped off-site to be laundered. Heavily soiled articles are inspected first, and if too difficult to clean, are sent to the Solid Waste Collection System. Otherwise, they are shipped off-site to be laundered as well.

Laundry is sorted on a table underneath a vent hood that is connected to the Technical Support Building (TSB) Gaseous Effluent Vent System. The Laundry Sorting Room is located in the TSB.

The licensed commercial laundry transports the plant's laundry using its own fleet of vehicles in strict adherence to applicable Department of Transportation and state regulations. The commercial laundry processes articles according to type and contamination level. The plant's garments are laundered separately from those of other customers and all process equipment is cleaned between customers, eliminating cross-contamination.

4.10 DECONTAMINATION POLICY AND PROVISIONS

Removing radioactive material from equipment, to the extent reasonably possible prior to servicing reduces exposures to personnel who work around and service contaminated equipment. Surface contamination is removed to minimize its spread to other areas of the facility. Surfaces such as floors and walls are designed to be smooth, nonporous and free of cracks so that they can be more easily decontaminated.

Decontamination facilities and procedures for the Technical Support Building and the Separations Building Modules have been previously discussed. For the remaining areas of the Separations Building decontamination requirements involve only localized clean-up at areas where maintenance has been or is being performed that involves opening a uranium-containing system. All decontamination of components removed from their systems for maintenance is performed in Technical Support Building. No other areas of the facility normally require decontamination.

The facility follows NRC Branch Technical Position: “Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material” (NRC, 1993e). This guide applies to the abandonment or release for unrestricted use, of surfaces, premises and equipment.

4.11 ADDITIONAL PROGRAM COMMITMENTS

The following section describes additional program commitments related to the Radiation Protection Program.

4.11.1 Leak Testing Byproduct Material Sources

In addition to the uranium processed at the facility, other sources of radioactivity are used. These sources are small calibration sources used for instrument calibration and response checking. These byproduct material sources may be in solid, liquid, or gaseous form; the sources may be sealed or unsealed. Both types of sources present a small radiation exposure risk to facility workers. Typical byproduct material quantities and uses for a uranium enrichment centrifuge plant are summarized in Table 4.11-1, Typical Quantities of Byproduct Material for a Uranium Enrichment Centrifuge Plant. The byproduct materials for the EREF will be identified during the design phase and the Safety Analysis Report will be revised accordingly. Leak-testing of sources is performed in accordance with the following NRC Branch Technical Positions (BTPs):

- License Condition for Leak-Testing Sealed Byproduct Material Sources (NRC,1993b)
- License Condition for Leak-Testing Sealed Source Which Contains Alpha and/or Beta-Gamma Emitters (NRC,1993c)
- License Condition for Leak-Testing Sealed Uranium Sources (NRC, 1993d).

4.11.2 Records and Reports

The facility meets the following regulations for the additional program commitments applicable to records and reports:

- 10 CFR 20 Subpart L-Records (CFR, 2008w), Subpart M-Reports (CFR, 2008v)
- 10 CFR 30.50 (Reporting Requirements) (CFR, 2009a)
- 10 CFR 40.60 (Reporting Requirements) (CFR, 2009b)
- Section 70.61 (Performance requirements) (CFR, 2008e)
- Section 70.74 (Additional reporting requirements) (CFR, 2008s).

The facility Records Management program is described in Section 11.7, Records Management. The facility maintains complete records of the Radiation Protection Program for at least the life of the facility.

The facility maintains records of the radiation protection program (including program provisions, audits, and reviews of the program content and implementation), radiation survey results (air sampling, bioassays, external-exposure data from monitoring of individuals, internal intakes of radioactive material), and results of corrective action program referrals, RWPs and planned special exposures.

By procedure, the facility will report to the NRC, within the time specified in 10 CFR 20.2202 (CFR, 2008t) and 10 CFR 70.74 (CFR, 2008s), any event that results in an occupational exposure to radiation exceeding the dose limits in 10 CFR 20 (CFR, 2008b). The facility will prepare and submit to the NRC an annual report of the results of individual monitoring, as required by 10 CFR 20.2206(b) (CFR, 2008u).

As previously noted in this chapter, the EREF will refer to the facility's corrective action program any radiation incident that results in an occupational exposure that exceeds the dose limits in 10 CFR 20 (CFR, 2008f), Appendix B (CFR, 2008m), or is required to be reported per 10 CFR 70.74 (CFR, 2008s). The facility reports to the NRC on both the corrective action taken (or planned) to protect against a recurrence and the proposed schedule to achieve compliance with the applicable license condition or conditions.

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TABLES

Table 4.1-1 Occupational Administrative Radiation Exposure Limits
(Page 1 of 1)

	Administrative Limit
Total Effective Dose Equivalent (TEDE)	10 mSv/yr (1 rem/year)

Notes:

(a) Excludes accident situations.

(b) No routine extremity or skin monitoring is required.

(c) TEDE is the sum of internal dose and external dose received during routine operations.

(d) The Administrative Limit represents 20% of the NRC limit of 50 mSv/yr (5 rem/yr) given in 10 CFR 20.1201 (CFR, 2008f).

Table 4.1-2 Estimated Dose Rates
(Page 1 of 1)

Area or Component	Dose Rate, µSv/hr (mrem/hr)
Plant General Area (excluding Separations Building)	<0.1 (<0.01)
Separations Building – Cascade Halls	0.5 (0.05)
Separations Building	1 (0.1)
Empty Used UF_6 Shipping Cylinder	100 on contact (10.0) 10 at 1 meter (1.0)
Full UF_6 Shipping Cylinder	50 on contact (5.0) 2 at 1 meter (0.2)

Table 4.1-3 Estimated Individual Exposures
(Page 1 of 1)

Positiion	Annual Dose
General Office Staff	<50 µSv (<5.0 mrem)
Typical Operations & Maintenance Technician	1 mSv (100 mrem)
Typical Cylinder Handler	3 mSv (300 mrem)

Table 4.1-4 Annual Maximum and Average Worker Doses at Capenhurst
(Page 1 of 1)

Year	Maximum Annual Worker Dose Equivalent, mSv (mrem)	Average Annual Worker Dose Equivalent, mSv (mrem)
2003	2.03 (203)	0.22 (22)
2004	2.57 (257)	0.31 (31)
2005	2.15 (215)	0.22 (22)
2006	2.61 (261)	0.39 (39)
2007	3.41 (341)	0.44 (44)

Table 4.7-1 Radiation Emitted from Natural UF_6 Feed
(Page 1 of 1)

Element	Nuclide Symbol	Half-Life	Maximum Radiation Energies (Mev) and Intensities (%)		
			Alpha (α)	Beta (β)	Gamma (γ)
92 uranium	^{238}U	4.5E+9 years	4.15 25% 4.20 75%	None	0.013 8.8%
90 thorium	^{231}Th	26 hours	None	0.39 ~ 100%	0.025 14.7%
90 thorium	^{234Th}	24 days	None	0.19 73% 0 10 27%	0.06 3.8% 0.09 5.4%
91 protactinium	^{234m}Pa	1.2 minutes	None	2.28 99%	0.766 0.21% 1.001 0.60%
92 uranium	^{234}U	2.5E+5 years	4.72 28% 4.78 72%	None	0.053 0.12%
92 uranium	^{235}U	7.0E+8 years	4.37 17% 4.40 55% 4.60 14%	None	0.143 12% 0.185 54% 0.205 6%

Table 4.11-1 Typical Quantities of Byproduct Material for a Uranium Enrichment Centrifuge Plant

(Page 1 of 1)

Radionuclide	Quantity	Use
^{3}H	19 GBq (5.14E-01 Ci)	Instrument calibration or response checking
^{36}Cl	8.35 kBq (2.26E-07 Ci)	Instrument calibration or response checking
^{57}Co	930 MBq (2.51 E-02 Ci)	Instrument calibration or response checking
^{90}Sr	1.04 kBq (2.81 E-08 Ci)	Instrument calibration or response checking
^{99}Tc	3.09 kBq (8.35E-08 Ci)	Instrument calibration or response checking
^{109}Cd	37 MBq (1.00E-03 Ci)	Instrument calibration or response checking
^{131}Cs	390 Bq (1.05E-08 Ci)	Instrument calibration or response checking
^{133}Ba	0.7 MBq (1.89E-05 Ci)	Instrument calibration or response checking
^{137}Cs	2.05 GBq (5.53E-02 Ci)	Instrument calibration or response checking
^{210}Po	63 MBq (1.70E-03 Ci)	Instrument calibration or response checking
^{226}Ra	38 MBq (1.03E-03 Ci)	Instrument calibration or response checking
^{233}U	3.7 GBq (1.00E-01 Ci)	Instrument calibration or response checking
^{234}U	4.4 Bq (1.19E-10 Ci)	Instrument calibration or response checking
^{235}U	3.7 GBq (1.00E-01 Ci)	Instrument calibration or response checking
^{236}U	3.7 GBq (1.00E-01 Ci)	Instrument calibration or response checking
^{237}Np	2.0 kBq (5.41 E-08 Ci)	Instrument calibration or response checking
^{238}U	164.5 Bq (4.45E-09 Ci)	Instrument calibration or response checking
^{241}Am	1.1 GBq (2.97E-02 Ci)	Instrument calibration or response checking

Byproduct material may be in solid, liquid, or gaseous form.

Byproduct material is not necessarily restricted to sealed sources.

FIGURES

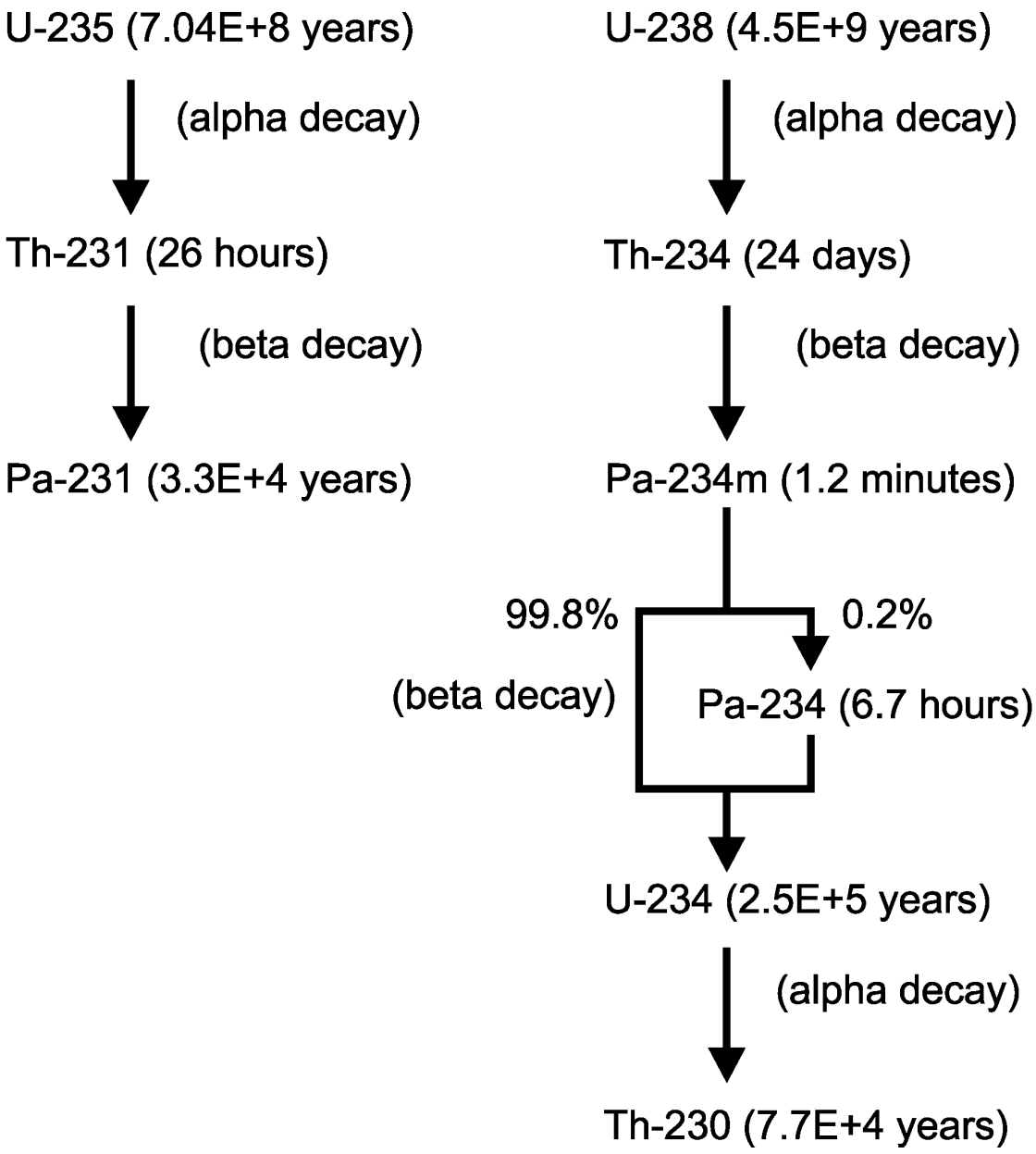

Figure 4.7-1 **Rev. 2**

Uranium and Decay Products of Interest

EAGLE ROCK ENRICHMENT FACILITY
SAFETY ANALYSIS REPORT

Figure 4.7-2, Projected Radiological Access Zones, contains Security-Related Information Withheld from Disclosure under 10 CFR 2.390