5.0 OPERATIONS

5.1 Corporate Organization And Administrative Procedures

5.1.1 Areas of Review

The staff should review the detailed description of the applicant's proposed organization and administrative procedures, including a description and/or chart depicting the key positions in the management structure, and the responsibilities and functions of each with respect to development, review, approval, implementation, and adherence to operating procedures, radiation safety programs, environmental and ground-water monitoring programs, quality assurance programs, routine and non-routine maintenance activities, and changes to any of these. These include procedures that evaluate the consequences of a spill or incident/event against 10 CFR Part 20, Subpart M and 10 CFR 40.60 criteria. In addition, the reviewer should examine the plans proposed by the applicant for establishing a Safety and Environmental Review Panel, or similarly named panel, including the proposed composition and responsibilities of the Panel.

5.1.2 Review Procedures

The staff should determine whether the proposed organization and administrative procedures are defined in sufficient detail to evaluate the responsibilities and authority of persons in positions responsible for developing, reviewing, approving, implementing, and enforcing the proposed programs related to radiological safety, environmental safety, ground-water protection, quality assurance, and maintenance. In addition, the reviewer should examine the plans proposed by the applicant for establishing a Safety and Environmental Review Panel including the proposed composition and responsibilities of the Panel.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.1.3 Acceptance Criteria

The corporate organization and administrative procedures are acceptable if they meet the following criteria:

(1) The applicant has provided adequate descriptions of the corporate organization, clearly defining management responsibilities and authority at each level.

Specifically, the radiation safety officer should have the responsibilities and authority outlined in Regulatory Guide 8.31, Section 1.2 (NRC, 2002).

(2) The organizational structure shows integration among groups that support the operation and maintenance of the facility. If the facility is new, integration between plant construction and plant management should be detailed.

Operations

(3) The applicant has established a Safety and Environmental Review Panel that will consist of at least three individuals. One member of the Safety and Environmental Review Panel will have expertise in management and will be responsible for implementing managerial and financial changes. One member will have expertise in operations and/or construction and will have responsibility for implementing any operational changes. One member will be the radiation safety officer, or equivalent, with the responsibility for assuring that changes conform to radiation safety and environmental requirements. Additional members may be included in the Safety and Environmental Review Panel, as appropriate, to address specific technical issues such as health physics, ground-water hydrology, surface-water hydrology, and specific earth sciences or other technical disciplines. Temporary members may include consultants. A description of when additional members will be used is provided.

(4) To the extent possible, proposed administrative procedures conform with Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring" (NRC, 1973) and with Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations)—Effluent Streams and the Environment, Revision 1, (NRC, 1979).

(5) Sufficient independence is available to the plant supervisor, radiation safety officer, and Safety and Environmental Review Panel such that significant safety issues can be raised to senior management.

5.1.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the corporate organization and administrative procedures, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the corporate organization and administrative procedures proposed for use at the _____*in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.1.2 and the acceptance criteria outlined in standard review plan Section 5.1.3.

The applicant has an acceptable corporate organization that defines management responsibilities and authority at each level. The applicant's definition of the responsibilities and procedures with respect to development, review, approval, implementation, and adherence to operating procedures, radiation safety programs, environmental and ground-water monitoring programs, quality assurance programs, routine/non-routine maintenance activities, and changes to any of these is acceptable. Integration among groups that support operation and maintenance of the facility is demonstrated. In the case of a new facility, integration between facility construction and plant management is acceptably detailed. The applicant has established a Safety and Environmental Review Panel with at least three individuals representing expertise in management/financial, operations/construction, and radiation safety matters. The applicant has demonstrated that specific technical issues will be dealt with by the Safety and Environmental Review Panel, with support from other qualified staff members, or consultants, as appropriate.

Based on the information provided in the application and the detailed review conducted of the corporate organization and administrative procedures for the _____*in situ* leach facility, the staff concludes that the proposed corporate organization and administrative procedures are acceptable and are in compliance with 10 CFR 20.1101, which defines radiation protection program requirements. In addition, the requirements of 10 CFR 40.32(b), (c), and (d) are also met as they relate to the proposed corporate organization and Safety and Environmental Review Panel functions.

5.1.5 References

NRC. Regulatory Guide 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills Will Be As Low As Is Reasonably Achievable." Rev. 1. Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002.

———. Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations)–Effluent Streams and the Environment." Revision 1. Washington, DC: NRC, Office of Standards Development. 1979.

———. Regulatory Guide 8.2, "Guide for Administrative Practices in Radiation Monitoring." Washington, DC: NRC, Office of Standards Development. 1973.

5.2 Management Control Program

5.2.1 Areas of Review

The staff should review the management control program and administrative procedures proposed to ensure that activities affecting health, safety, and the environment will be conducted in accordance with written standard operating procedures, including records keeping and reporting. The reviewer should evaluate the management control and decision bases to be used by the Safety and Environmental Review Panel in deciding when it is necessary to apply for a license amendment. Procedures governing non-routine work or maintenance that is not covered by a standard operating procedure, such as use of radiation work permits, should be reviewed.

The staff should examine the applicant's program for cultural resources protection.

The staff should review the applicant's record keeping and retention plans for the materials control and tracking program; the radiation protection program; the sampling, survey and calibration programs; for planned special exposures; to track doses to workers and members of the public; for the disposal of source, and byproduct materials made under 10 CFR 20.2002 and 20.2003; and for the records important to decommissioning the facility, including records of spills or unusual occurrences involving the spread of contamination, cleanup actions taken, and the location of remaining contamination. The staff should also review the licensee's plans and arrangements to identify and maintain the records that must be retained for the life of the facility and ultimately be transferred to NRC at the termination of the license.

Operations

While occupational and safety concerns are important and need to be included in the development of standard operating procedures, NRC regulatory authority is limited to those instances where occupational safety concerns may affect radiological operations or accidents.

5.2.2 Review Procedures

The reviewer should determine that the proposed management control program and administrative procedures are sufficient to assure that any activities affecting health, safety, and the environment, including compliance with any license commitments or conditions, will be conducted in accordance with written operating procedures. The review should include the process for identifying and developing standard operating procedures for routine work, and the review and approval process to be used by the radiation safety staff to modify standard operating procedures when appropriate. Methods for review and approval of non-routine work or maintenance activity by the radiation safety staff should be examined.

The reviewer should determine whether the licensee has agreed to administer a cultural resources inventory before engaging in any development activity not previously assessed by NRC. The reviewer should verify that any disturbances to be associated with such development will be completed in compliance with the National Historic Preservation Act, the Archeological Resources Protection Act, and their implementing regulations. Additionally, the reviewer should evaluate if the licensee has committed to cease any work resulting in the discovery of previously unknown cultural artifacts to ensure that no unapproved disturbance occurs. The reviewer should confirm that any such artifacts will be inventoried and evaluated, and no further disturbance will occur until the licensee has received authorization from the NRC to proceed.

The reviewer should determine whether the proposed record keeping and retention programs are adequate to ensure that the licensee will be able to track, control, and demonstrate control of, the source and byproduct material at the site, such that on-site and off-site dose limits will not be exceeded. The reviewer should determine whether records important to decommissioning, such as descriptions of spills and other unusual occurrences, will be maintained by the licensee, and will be in an identifiable or, preferably, separate file. The reviewer should also determine whether the licensee has a plan to maintain the records that will be turned over to NRC at license termination.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.2.3 Acceptance Criteria

The management control program is acceptable if

(1) The proposed management control program is sufficient to assure that all proposed activities that may affect health, safety, and the environment, including compliance with any license commitments or conditions, will be conducted in accordance with written

operating procedures. These shall include procedures that evaluate the consequences of a spill or incident/event against 10 CFR Part 20, Subpart M and 10 CFR 40.60 reporting criteria.

(2) The applicant provides a process that will be used to identify and prepare operating procedures for routine work.

There is an adequate mechanism for the development, approval, and review (on an annual basis) of standard operating procedures by the radiation safety staff. Subsequent inspections will ensure that standard operating procedures are adequate and applied correctly.

The process includes procedures covering all aspects of radiation safety, routine maintenance activities (especially in radiation areas), and Safety and Environmental Review Panel reviews and activities.

For standard operating procedures for radiation safety, refer to Regulatory Guide 8.31, Section 2 (NRC, 2002).

(3) The applicant presents methods for review and approval of non-routine work or maintenance activity by the radiation safety staff. The methods include the preparation and issuance of radiation work permits for activities where standard operating procedures do not apply.

(4) The applicant provides for the establishment of a Safety and Environmental Review Panel. (A detailed review of Safety and Environmental Review Panel composition is addressed in Section 5.1 of this standard review plan.) Procedures governing the functioning of the Safety and Environmental Review Panel ensure that approvals of any changes in the facility, the operating procedures, or the conduct of tests or experiments are appropriately documented and reported. These changes, tests, or experiments may be effected without obtaining a license amendment pursuant to 10 CFR 40.44, so long as the change, test, or experiment does not

(a) Create a possibility for an accident of a different type than previously evaluated in the license application (as updated)

(b) Create a possibility for a malfunction of a structure, system, or control with a different result than previously evaluated in the license application (as updated)

(c) Result in a departure from the method of evaluation described in the license application (as updated) used in establishing the final safety evaluation report or the environmental assessment or technical evaluation reports or other analyses and evaluations for license amendments

Quantitative likelihood and consequence analyses may not be required for changes at uranium *in situ* leach facilities.

Operations

The Safety and Environmental Review Panel records will include written safety and environmental evaluations made by the Safety and Environmental Review Panel that provide the basis for determining whether changes, tests, or experiments were implemented in accordance with the bases described in Section 5.2.3. Changes pages should have both a change indicator for the area changed (e.g., a bold line vertically drawn in the right margin adjacent to the portion actually changed) and a page change indication (date of change or change number, or both).

The annual Safety and Environmental Review Panel report and page changes may be furnished along with reports normally submitted to satisfy 10 CFR 40.65 reporting requirements.

(5) The licensee is exempted from the requirements of 20 CFR 1902(e) for areas within the facility, provided that all entrances to the facility are conspicuously posted with the words "ANY AREA WITHIN THIS FACILITY MAY CONTAIN RADIOACTIVE MATERIAL."

(6) The licensee has agreed to administer a cultural resources inventory before engaging in any development activity not previously assessed by NRC. Any disturbances to be associated with such development will be completed in compliance with the National Historic Preservation Act, the Archeological Resources Protection Act, and their implementing regulations. The licensee has committed to cease any work resulting in the discovery of previously unknown cultural artifacts to ensure that no unapproved disturbance occurs. Any such artifacts will be inventoried and evaluated, and no further disturbance will occur until the licensee has received authorization from the NRC to proceed.

(7) The record keeping and retention plans demonstrate that the licensee will maintain and retain records of the receipt, transfer, and disposal of any source or byproduct material processed or produced at the licensed facility, for the period set out in the license conditions, or until the Commission terminates the license.

(8) The following will be permanently maintained and retained until license termination:

(a) Records of on-site radioactive waste disposal such as by deep well injection, land application, or burial under 10 CFR 20.2002 and 20.2007.

(b) Records required by 10 CFR 20.2103(b)(4).

(c) Records required by 10 CFR Part 40, Appendix A, Criteria 8 and 8A and included in Regulatory Guide 3.11.1 (NRC, 1980).

(d) Records containing information important to decommissioning and reclamation, including

(i) Descriptions of any spills, excursions, contamination events or unusual occurrences, including the dates, locations, areas, or facilities affected; assessments of hazards; corrective and cleanup actions taken;

assessment of cleanup effectiveness, and the location of any remaining contamination; nuclides involved; quantities, forms and concentrations, and descriptions of hazardous constituents; descriptions of inaccessible areas that cannot be cleaned up; and sketches, diagrams, or drawings marked to show areas of contamination and places where measurements were made. Significant spills that should be included are any radiological spills that have the potential to exceed site cleanup standards and any radiological spill that leaves the site. A license condition will be established to this effect.

(ii) Information related to site characterization; residual soil contamination levels; on-site locations used for burials of radioactive materials; hydrology and geology, with particular emphasis on conditions that could contribute to ground-water or surface-water contamination; and locations of surface impoundments, waste water ponds, lagoons, and well field aquifer anomalies.

(iii) As-built drawings or photographs of structures, equipment, restricted areas, well fields, areas where radioactive materials are stored, and any modifications showing the locations of these structures and systems through time.

(iv) Drawings of areas of possible inaccessible contamination, including features such as buried pipes or pipelines.

(v) Pre-operational background radiation levels at and near the site.

These records will be maintained with adequate safeguards against tampering and loss.

(9) The licensee demonstrates that records can be provided to a new owner or new licensee in the event that the property or license is transferred, or to NRC, after license termination.

(10) New licensees or owners demonstrate that any such records received from a previous owner or licensee will be retained, along with their own records, to be turned over to NRC after license termination.

(11) Records will be maintained as hard copy originals, as copies on microfiche, or will be electronically protected, and will be readily retrievable for NRC inspection.

(12) Reports of spills; evaporation pond leaks; excursions of source, 11e.(2) byproduct material, or process chemicals; will be made to the Headquarters Project Manager by telephone or electronic mail (email) within 48 hours of the event. This notification shall be followed, within thirty (30) days of the notification, by submittal of a written report to the NRC Headquarters Project Manager, detailing the conditions leading to the spill or incident/event, corrective actions taken, and results achieved. A license condition will be established to this effect.

Operations

(13) An annual report will be submitted to the NRC that includes the as low as is reasonably achievable audit report, land use survey, monitoring data, corrective action program report, one of the semiannual effluent and environmental monitoring reports, and the Safety and Environmental Review Panel information. A license condition will be established to this effect.

5.2.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the management control program, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the management control program proposed for use at the _____*in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.2.2 and the acceptance criteria outlined in standard review plan Section 5.2.3.

The applicant has an acceptable management control program that assures that all safety-related operating activities can be conducted according to written operating procedures. The applicant has provided acceptable operating procedures or a process that will be used to develop standard operating procedures. The applicant has acceptably identified radiation protection, maintenance activities (especially in radiation areas), development of well fields, and Safety and Environmental Review Panel reviews as areas where standard operating procedures are acceptable and correctly applied. The applicant has demonstrated that non-routine work or maintenance activity will comply with radiation safety requirements and that radiation work permits will be issued for activities where standard operating procedures do not apply.

The applicant will administer a cultural resources protection program in compliance with the National Historic Preservation Act, the Archeological Resources Protection Act, and their implementing regulations. The applicant will cease any work resulting in the discovery of previously unknown cultural artifacts until such artifacts are inventoried and evaluated and authorization has been obtained from the NRC to proceed.

The applicant has acceptable record keeping and retention and reporting programs that will be adequate to ensure that the licensee is able to track, control, and demonstrate control over the source and byproduct materials that are processed, produced, or stored at the facility during its operating life, through decommissioning, and to license termination. The record keeping and retention plans will assist in ensuring that both on-site and off-site exposures are kept within regulatory limits and in documenting compliance with NRC regulations. The applicant has demonstrated an acceptable program to maintain records on spills, likely contamination events, and unusual occurrences for use in calculating annual surety amounts and to ensure acceptable decommissioning. The applicant will maintain records for decommissioning, on-site and off-site disposal, personnel exposure, and off-site releases of radioactivity, as permanent records for the facility that will be transferred to any new owner or licensee, and ultimately to NRC, before license termination. Reports will be made to the NRC as required by regulations.

Based on the information provided in the application and the detailed review conducted of the management control program for the _____*in situ* leach facility, the staff concludes that the proposed management control program is acceptable and is in compliance with 10 CFR Part 40, Appendix A, Criteria 8 and 8A, which specify documentation requirements for airborne effluents and waste retention systems; 10 CFR 20.1101, which defines radiation protection program requirements; the National Historic Preservation Act and the Archeological Resources Protection Act, which define requirements for the protection of cultural resources; 10 CFR Part 20, Subpart L and Subpart M, which define requirements for record keeping and reporting; and 10 CFR 40.61(d) and (e), which also define requirements for record keeping.

5.2.5 References

NRC. Regulatory Guide 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills will be as low as is Reasonably Achievable." Rev. 1. Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002.

—— Regulatory Guide 3.11.1, Revision 1, "Operational Inspection and Surveillance of Embankment Retention Systems for Uranium Mills." Washington, DC: NRC, Office of Standards Development. 1980.

5.3 Management Audit and Inspection Program

5.3.1 Areas of Review

The staff should review the proposed management audit, inspection, and as low as is reasonably achievable program, including the frequencies, types, and scopes of reviews and inspections; action levels; corrective action measures; and the responsibilities of each participant. The staff should also review the program for ensuring that employee exposures (to both airborne and external radiation) and effluent releases are as low as is reasonably achievable.

5.3.2 Review Procedures

The reviewer should determine whether the management audit and inspection program is acceptable and will provide reasonable assurance that employee exposures and effluent releases will be as low as is reasonably achievable. The reviewer shall ensure that yellowcake drying and packaging operations are in accordance with 10 CFR Part 40, Appendix A, Criterion 8, and inspection of waste retention systems is in accordance with Criterion 8A.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

Operations

5.3.3 Acceptance Criteria

The management audit, and inspection program is acceptable if it meets the following criteria:

(1) The proposed frequencies, types, and scopes of reviews and inspections; action levels; and corrective action measures are acceptable to implement the proposed controls.

Management responsibilities for audit and inspection are adequately defined. Acceptable programs for inspection of embankment systems on a regular basis are described in Regulatory Guide 3.11 (NRC, 1977) and Regulatory Guide 3.11.1 (NRC, 1980).

Acceptable programs for annual as low as is reasonably achievable audits are described in Regulatory Guide 8.31 (NRC, 2002).

5.3.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the management audit and inspection program, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the management audit and inspection program proposed for use at the _____*in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.3.2 and the acceptance criteria outlined in standard review plan Section 5.3.3.

The applicant has an acceptable management audit and inspection program that provides frequencies, types, and scopes of reviews and inspections; action levels; and corrective action measures sufficient to implement the proposed actions.

Based on the information provided in the application and the detailed review conducted of the management audit and inspection program for the _____*in situ* leach facility, the staff concludes that the proposed programs are acceptable and are in compliance with 10 CFR 20.1702, which requires the use of process or other engineering measures to control the concentrations of radioactive material in the air; and 10 CFR 20.1101 which contains requirements for maintaining radiation exposure limits as low as is reasonably achievable. In addition, the requirements of 10 CFR 40.32(b), (c), and (d) are met as they relate to the acceptability of management audits to ensure protection of health and minimize danger to life and property. The requirements of 10 CFR Part 40, Appendix A, Criteria 8 and 8A are met as they relate to yellowcake drying and packaging operations, and inspection of waste retention systems.

5.3.5 References

NRC. Regulatory Guide 8.31, “Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills will be as low as is Reasonably Achievable.” Rev. 1. Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002.

—— Regulatory Guide 3.11.1, Revision 1, “Operational Inspection and Surveillance of Embankment Retention Systems for Uranium Mills.” Washington, DC: NRC, Office of Standards Development. 1980.

———. Regulatory Guide 3.11, “Design, Construction, and Inspection of Embankment Retention Systems for Uranium Mills.” Revision 2. Washington, DC: NRC, Office of Standards Development. 1977.

5.4 Qualifications for Personnel Conducting the Radiation Safety Program

5.4.1 Areas of Review

The staff should review descriptions of the minimum qualifications and experience levels required for personnel who will be assigned the responsibility for developing, conducting, and administering the radiation safety program. The staff should also review the qualifications of people specifically proposed for these positions.

5.4.2 Review Procedures

The reviewer should determine whether the minimum qualifications and experience levels required for personnel who will be assigned the responsibility for developing, conducting, and administering the radiation safety program are sufficient to meet the guidance provided by Regulatory Guide 8.31 (NRC, 2002). The staff should also determine whether the qualifications of people specifically proposed for these positions are consistent with the minimum qualifications and experience levels.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.4.3 Acceptance Criteria

The qualifications of radiation safety personnel are acceptable if they meet the following criteria:

(1) The personnel meet minimum qualifications and experience for radiation safety staff that are consistent with Regulatory Guide 8.31, Section 2.4 (NRC, 2002). The emphasis of this guidance is for uranium recovery facilities; however, the training requirements apply equally to *in situ* leach facilities.

Operations

5.4.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the qualifications of facility personnel conducting the radiation safety program, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the qualifications of facility personnel conducting the radiation safety program at the _____ *in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.4.2 and the acceptance criteria outlined in standard review plan Section 5.4.3.

Based on the information provided in the application and the detailed review conducted of the qualifications of the personnel conducting the radiation safety program for the_____ *in situ* leach facility, the staff concludes that the qualifications of the personnel are acceptable and are in compliance with 10 CFR 20.1101, which defines radiation protection program requirements, and 10 CFR 40.32(b), which provides requirements for applicant qualifications. The qualifications of personnel conducting the radiation safety program are acceptable consistent with NRC Regulatory Guide 8.31 (NRC, 2002).

5.4.5 Reference

NRC. Regulatory Guide 8.31, “Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills Will Be As Low As Is Reasonably Achievable.” Rev. 1. Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002.

5.5 Radiation Safety Training

5.5.1 Areas of Review

The staff should review the proposed radiation safety training program, including the content of the initial training or indoctrination, testing, on-the-job training, and the extent and frequency of retraining. The staff should also review the proposed written radiological safety instructions that will be provided to employees to include personal hygiene, contamination surveying before eating or leaving the operating area, requirements for personal monitoring devices and respirators, house keeping requirements, spill cleanup procedures, and emergency actions.

5.5.2 Review Procedures

The staff will examine plans for initial training or indoctrination, testing, on-the-job training, and the extent and frequency of retraining to determine whether they are consistent with Regulatory Guide 8.31 (NRC 2002), Regulatory Guide 8.13 (NRC, 1999), and Regulatory Guide 8.29 (NRC, 1996).

The staff should determine whether the applicant has a radiation safety training program that is adequate to provide radiological safety instructions to the employees. The staff should also

determine whether the proposed radiological safety instructions that will be provided to employees will be sufficiently detailed to meet acceptance criteria identified in Section 5.5.3.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.5.3 Acceptance Criteria

The training program is acceptable if it meets the following criteria:

(1) It is consistent with the approach described in Regulatory Guide 8.31, Section 2.5 (NRC, 2002).

This guide recommends that before beginning their jobs, all new employees should be instructed, by means of an established course, in the inherent risks of exposure to radiation and the fundamentals of protection against exposure to uranium and its daughters.

(2) It is consistent with Regulatory Guide 8.13, “Instruction Concerning Prenatal Radiation Exposure, Revision 3” (NRC, 1999).

This guide provides guidance for protection of the fetus.

(3) It is consistent with Regulatory Guide 8.29, “Instruction Concerning Risks from Occupational Radiation Exposure, Revision 1” (NRC, 1996).

This guide provides a basis for training employees on the risks from radiation exposure in the work place.

5.5.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the radiation safety training program, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the radiation safety training program at the _____*in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.5.2 and the acceptance criteria outlined in standard review plan Section 5.5.3.

The radiation safety training program at the _____*in situ* leach site is consistent with the guidance contained in NRC Regulatory Guides 8.31 (NRC, 2002), 8.13 (NRC, 1999), and 8.29 (NRC, 1996). The content of the training material, testing, on-the-job training, and the extent and frequency of retraining are acceptable. Radiation safety instructions for employees are acceptable.

Operations

Based on the information provided in the application and the detailed review conducted of the radiation safety training program for the _____ *in situ* leach facility, the staff concludes that the radiation safety training program is acceptable and is in compliance with 10 CFR 20.1101, which defines radiation protection program requirements, and 10 CFR 40.32(b), as it relates to applicant qualifications through training.

5.5.5 References

NRC. Regulatory Guide 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Mills Will Be As Low As Is Reasonably Achievable." Rev. 1. Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002.

———. Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure." Revision 3. Washington, DC: NRC, Office of Standards Development. 1999.

———. Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure." Revision 1." Washington, DC: NRC, Office of Standards Development. 1996.

5.6 Security

5.6.1 Areas of Review

The staff should review the security measures proposed to prevent unauthorized entry into the controlled area.

5.6.2 Review Procedures

The staff should determine whether the proposed security measures are sufficient to prevent unauthorized entry into the controlled area in accordance with regulatory requirements in 10 CFR Part 20, Subpart I.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.6.3 Acceptance Criteria

The security program is acceptable if the applicant has acceptable passive controls, such as fencing for well fields, and active controls, such as daily inspections and locks for plant buildings.

5.6.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the security measures, the following conclusions may be presented in the technical evaluation report and environmental assessment.

NRC has completed its review of the security measures at the _____*in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.6.2 and the acceptance criteria outlined in standard review plan Section 5.6.3.

The security measures at the _____ *in situ* leach site demonstrate that the applicant has acceptable active and passive constraints on entry to the licensed and restricted areas. The applicant has identified acceptable passive controls, for example, barbed wire fencing, locked gates, and warning signage for site control and active security systems for buildings.

Based on the information provided in the application and the detailed review conducted of the security measures for the _____ *in situ* leach facility, the staff concludes that the security measures are acceptable and are in compliance with 10 CFR Part 20, Subpart I, which provides requirements for the security of stored material and control of material not in storage.

5.6.5 References

None.

5.7 Radiation Safety Controls And Monitoring

5.7.1 Effluent Control Techniques

5.7.1.1 Areas of Review

The staff should review descriptions of the effluent control techniques (e.g., ventilation, confinement, filtration) designed to minimize in-plant and environmental emissions at each step of the process where releases might occur. Major airborne radioactive effluents include radioactive particulates (from drying and packaging areas) and radon gas emanating from production solutions. Radon gas mobilization can occur from recovery solutions at process locations where systems allow venting. The staff should evaluate effluent control techniques for uranium particulate emissions located in drying and packaging areas and in any other areas where release of significant quantities of uranium particulate is a concern. Closed systems can eliminate releases of uranium particulates and radon gas. For example, the use of vacuum packaging equipment has been shown to eliminate uranium releases from packaging operations.

Common liquid effluent sources are process bleed, process solutions (e.g., backwash, resin transfer waters), and wash-down water. The staff should review the facility design for containment of contamination from spills resulting from normal operations and probable accidents (e.g., tank, valve, or pipe joint failure). For surface impoundments used in the management of 11e.(2) byproduct material, the staff should also review engineering design to ensure proper containment performance, and evaluate leak detection and monitoring systems for surface impoundments containing contaminated effluents.

Operations

The staff reviews should include minimum performance specifications such as filtration or scrubber efficiency and ventilation airflow at their reasonably expected best performance and the frequency of tests and inspections to ensure that these specifications are being met.

The staff should review contingency plans and notification requirements to be implemented in the event of equipment failures, spills, or excursions.

5.7.1.2 Review Procedures

The staff should determine whether the proposed effluent control techniques are sufficient to limit radiation exposures and radioactive releases to as low as is reasonably achievable and to ensure conformance with regulatory requirements identified in 10 CFR Part 20.

In general, the reviewer should be familiar with 10 CFR Part 40, Appendix A, Criterion 8 and Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable" (NRC, 1977). Additional guidance is found in Regulatory Guide 8.37, "ALARA Levels for Effluent from Materials Facilities" (NRC, 1993); Regulatory Guide 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mill Will Be As Low As Is Reasonably Achievable" (NRC, 2002); and Regulatory Guide 3.56, "General Guidance for Designing, Testing, Operating, and Maintaining Emission Control Devices at Uranium Mills" (NRC, 1986). The staff should determine whether the proposed effluent control techniques (e.g., ventilation, confinement, filtration) are acceptably described and sufficient to control in-plant and environmental emissions at each step of the process where releases might occur. The staff should ensure that minimum performance specifications for ventilation, filtration, and confinement systems throughout the recovery plant and laboratories are provided and are consistent with assumptions made in exposure estimates for areas of the facility where the systems are operating. The staff should also check that the frequencies of equipment tests and inspections are consistent with manufacturers' recommendations to ensure that these specifications are being met. Engineering design should be adequate to meet the performance specifications. Contingencies for equipment failures, maintenance shutdowns, and spills should be reviewed to ensure procedures are in place to maintain exposures as low as is reasonably achievable.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.7.1.3 Acceptance Criteria

The effluent control techniques are acceptable if they meet the following criteria:

(1) Radon gas from processing tanks within enclosed buildings is properly controlled.

Effective control of radon gas can be achieved by using a pressurized processing tank system that eliminates venting in process buildings, or by using appropriate ventilation systems in buildings where radon gas venting is expected.

(2) Emissions from yellowcake drying operations are properly controlled.

Acceptable control of yellowcake emissions from the dryer is achieved by meeting the criteria of 10 CFR Part 40, Appendix A, Criterion 8 and Regulatory Guide 3.56, Section 1 (NRC, 1986).

(3) Release of liquids into surface waters must comply with the public dose limits in 10 CFR 20.1301, which may be demonstrated by one of the following methods:

(a) The licensee demonstrates compliance with 10 CFR Part 20, Appendix B, by one of the following methods and shows that if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 0.02 mSv/hr [2 mrem/hr] or 0.5 mSv/yr [50 mrem/yr]:

(i) Showing that the discharge of effluent from any surface impoundment is within 10 CFR Part 20, Appendix B, limits at the point of discharge.

(ii) Monitoring the incoming process water to demonstrate compliance with the effluent discharge requirements of 10 CFR Part 20, Appendix B, for process water.

(b) The licensee demonstrates that the total effective dose equivalent to the individual likely to receive the highest dose from the facility does not exceed the annual dose limit for the public.

(4) The applicant describes minimum performance specifications for the operation of the effluent controls and the frequencies of tests and inspections to ensure proper performance to specifications. Details of acceptable excursion control techniques are found in Section 5.7.8.3 of this standard review plan.

Acceptable methods for testing, maintenance, and inspection of effluent controls are given in Regulatory Guide 3.56, Section 1 (NRC, 1986).

(5) Record keeping for the effluent control techniques is sufficient to meet requirements in 10 CFR 20.2103(b)(4).

(6) The applicant describes emergency procedures in the event of equipment failures or spills, references existing emergency procedures, or commits to the development of emergency procedures.

For license renewal applications, the historical effluent control program summary is included through the most recent reporting period preceding the submittal of the application.

The effectiveness of the historical program should be discussed with regard to all applicable 10 CFR Part 20 regulatory requirements identified in the preceding

paragraphs. Long-term trends should be discussed, and any short-term deviations from the long-term trend should be explained.

(7) The effluent control techniques are designed to keep exposures to members of the public as low as is reasonably achievable as described in Regulatory Guide 8.37, Section 2 (NRC, 1993).

(8) The effluent control techniques are designed to limit exposures to members of the public from emissions to air (excluding Radon-222 and progeny) to no greater than 0.1 mSv [10 mrem/yr].

5.7.1.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the effluent control techniques, the following conclusions may be presented in the technical evaluation report and environmental assessment.

NRC has completed its review of the effluent control techniques at the _____*in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.7.1.2 and the acceptance criteria outlined in standard review plan Section 5.7.1.3.

The applicant has acceptable effluent control techniques at the _____ *in situ* leach site and has demonstrated that important effluent streams are controlled and monitored. The applicant has used an acceptable pressurized processing tank system or appropriate ventilation systems in buildings where radon gas is vented. Acceptable control of the yellowcake dryer system is evidenced by a vacuum dryer or other appropriate particulate scrubber equipment on the dryer stack. The applicant has shown that the discharge of process water is within the dose limits of 10 CFR 20.1301. The applicant has demonstrated acceptable effluent control techniques and associated test and inspection frequencies to ensure specified performance. Record keeping and monitoring procedures are acceptable. Acceptable emergency procedures for managing equipment failures or spills are described by the applicant.

Based on the information provided in the application and the detailed review conducted of the effluent control techniques at the _____ *in situ* leach facility, the staff concludes that this program is acceptable and is in compliance with 10 CFR 20.1301, which provides dose limits for members of the public; 10 CFR 20.1101, which defines radiation protection program and as low as is reasonably achievable requirements; 10 CFR 20.1201(a), which provides occupational dose limits; and 10 CFR Part 20, Subpart M, which defines requirements for reports. In addition, the staff concludes that the effluent control techniques meet the requirements of 10 CFR 40.32(b) to protect health and minimize danger to life and property, and 10 CFR Part 40, Appendix A, Criterion 8, which specifies standards for yellowcake dryer operations.

5.7.1.5 References

NRC. Regulatory Guide 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills Will Be As Low As Is Reasonably Achievable." Rev. 1. Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002.

———. Regulatory Guide 8.37, "ALARA Levels for Effluent from Materials Facilities." Washington, DC: NRC, Office of Standards Development. 1993.

———. Regulatory Guide 3.56, "General Guidance for Designing, Testing, Operating, and Maintaining Emission Control Devices at Uranium Mills." Washington, DC: NRC, Office of Standards Development. 1986.

———. Regulatory Guide 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures as low as is Reasonably Achievable." Revision 1–R. Washington, DC: NRC, Office of Standards Development. 1977.

5.7.2 External Radiation Exposure Monitoring Program

5.7.2.1 Areas of Review

The staff should review survey methods, instrumentation, and equipment for determining exposures of employees to external radiation during routine and non-routine operations, maintenance, and cleanup activities. This review should include the types of surveys conducted, criteria for determining survey locations, frequency of surveys, action levels, management audits, and corrective action requirements. Staff should also review the program for personnel exposure monitoring, the criteria for including workers in the program, the sensitivity and range of devices used, and calibration frequency and methods.

5.7.2.2 Review Procedures

The staff should determine whether proposed monitoring methods, instrumentation, and equipment are sufficient to meet the regulatory requirements for determining the exposures of employees to external radiation in 10 CFR 20.1203. In conducting its review, the staff should ensure that the applicant has provided one or more charts that identify the facility layout and the location of monitors for external radiation as well as providing acceptable criteria for determining the sampling locations. The staff should ensure all monitoring equipment will be identified by type with additional specification of the range, sensitivity, calibration methods and frequency, availability, and planned use. Staff should ensure that the proposed monitoring program is sufficient to adequately protect workers from hazards of beta radiation (skin, extremity, lens of eye) resulting from the decay products of U-238 when effective shielding is not present (e.g., maintenance operations). The staff should also ensure that the monitoring program is acceptable to detect and control gamma radiation from uranium decay products in areas where large volumes of uranium may be present (e.g., processing tanks, yellowcake storage areas).

Operations

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.7.2.3 Acceptance Criteria

The external radiation exposure monitoring program is acceptable if it meets the following criteria:

(1) The application contains one or more drawings that depict the facility layout and the location of monitors for external radiation. Criteria for determining the external radiation monitor locations, are consistent with Regulatory Guide 4.14, Sections 1.1.5 and 2.1.6 (NRC, 1980).

(2) The application provides criteria to be used in establishing which employees are to receive external exposure monitoring. These criteria are consistent with Regulatory Guide 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses,” Section C (NRC, 1992a).

(3) Monitoring equipment is identified by type, sensitivity, calibration methods and frequency, availability, and planned use to protect health and safety. The ranges of sensitivity for the proposed external radiation monitors are consistent with those appropriate to the facility operation.

(4) All monitoring equipment has a lower limit of detection that allows measurement of 10 percent of the applicable limits. Planned surveys of external radiation are consistent with the guidance in Regulatory Guide 8.30, “Health Physics Surveys in Uranium Mills,” Section 1 (NRC, 2002a).

(5) Plans for documentation of radiation exposures are consistent with the approach in Regulatory Guide 8.7, “Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1" (NRC, 1992b).

(6) The application presents radiation dose levels for corrective action that are consistent with the 10 CFR Part 20 regulatory requirements.

(7) Radiation doses will be kept as low as is reasonably achievable by following Regulatory Guide 8.10 (NRC, 1977) and Regulatory Guide 8.31 (NRC, 2002b).

(8) The applicant monitoring program is adequate to protect workers from hazards of beta radiation (skin, extremity, lens of eye) resulting from the decay products of uranium-238 when effective shielding is not present (e.g., maintenance operations) and is consistent with Regulatory Guide 8.30 (NRC, 2002a).

(9) The monitoring program is sufficient to detect and control gamma radiation from uranium decay products in areas where large volumes of uranium may be present

(e.g., processing tanks, yellowcake storage areas) and is consistent with Regulatory Guide 8.30 (NRC, 2002a).

(10) The program for external exposure monitoring and determining doses from external exposure is consistent with Regulatory Guide 8.34, Section C (NRC, 1992a).

5.7.2.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the external radiation exposure monitoring program, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the external radiation exposure monitoring program at the _____ *in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.7.2.2 and the acceptance criteria outlined in standard review plan Section 5.7.2.3.

The applicant has proposed an acceptable external radiation exposure monitoring program at the _____ *in situ* leach site. The applicant has provided an acceptable drawing(s) that depicts the facility layout and the location of external radiation monitors. The external radiation monitors are acceptably placed. The applicant has established appropriate criteria to determine which employees should receive external radiation monitoring. The applicant has demonstrated that the range, sensitivity, and calibration of external radiation monitors will protect health and safety of employees during the full scope of facility operations. Planned radiation surveys are adequate. Planned documentation of radiation exposures is acceptable. The applicant's monitoring program is acceptable to protect workers from beta and gamma radiation.

Based on the information provided in the application and the detailed review conducted of the external radiation exposure monitoring program at the _____ *in situ* leach facility, the staff concludes that the external radiation exposure monitoring program is acceptable and is in compliance with 10 CFR 20.1101, which defines a radiation protection program and as low as is reasonably achievable requirements; 10 CFR 20.1201(a), which defines occupational dose limits; 10 CFR 20.1501, which provides requirements of surveying and radiation monitoring; 10 CFR 20.1502, which defines conditions requiring individual monitoring of external dose; 10 CFR Part 20, Subpart L, which specifies record keeping requirements; and 10 CFR Part 20, Subpart M, which defines reporting requirements.

5.7.2.5 References

NRC. Regulatory Guide 8.30, "Health Physics Surveys in Uranium Recovery Facilities." Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002a.

———. Regulatory Guide 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be As Low As Is Reasonably Achievable." Rev. 1. Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002b.

Operations

———. Regulatory Guide 8.34, “Monitoring Criteria and Methods to Calculate Occupational Radiation Doses.” Washington, DC: NRC, Office of Standards Development. 1992a.

———. Regulatory Guide 8.7, “Instructions for Recording and Reporting Occupational Radiation Exposure Data.” Revision 1. Washington, DC: NRC, Office of Standards Development. 1992b.

———. Regulatory Guide 4.14, “Radiological Effluent and Environmental Monitoring at Uranium Mills.” Washington, DC: NRC, Office of Standards Development. 1980.

———. Regulatory Guide 8.10, “Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable.” Washington, DC: NRC, Office of Standards Development. 1977.

5.7.3 Airborne Radiation Monitoring Program

5.7.3.1 Areas of Review

The staff should review the proposed airborne radiation monitoring program to determine concentrations of airborne radioactive materials (including radon) during routine and non-routine operations, maintenance, and cleanup. This review should include criteria for determining airborne radiation monitoring locations and sampling frequency with respect to process operations and personnel occupancy, as well as analytical procedures and sensitivity and instrument calibration requirements. Action levels, audits, and corrective action requirements should also be evaluated.

5.7.3.2 Review Procedures

The staff should determine whether the airborne radiation monitoring program proposed by the applicant is sufficient to limit airborne radiation exposures and airborne radioactive releases to as low as is reasonably achievable and is in conformance with regulatory requirements identified in 10 CFR Part 20. The staff should evaluate whether the proposed sampling program to determine concentrations of airborne radioactive materials (including radon) during routine and non-routine operations, maintenance, and cleanup is in conformance with the regulatory requirements identified in 10 CFR 20.1301; 20.1501; 20.1502; 20.1204; and the other applicable requirements listed in Section 5.7.3.3 of this standard review plan. The staff should determine whether action levels, audits, and corrective actions will be consistent with these requirements.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.7.3.3 Acceptance Criteria

The airborne radiation monitoring program is acceptable if it meets the following criteria:

(1) The applicant provides one or more drawings that depict the facility layout and the location of samplers for airborne radiation. Locations are based, in part, on a determination of airflow patterns in areas where monitoring is needed, and determination of monitoring locations is consistent with Regulatory Guide 8.30, "Health Physics Surveys in Uranium Recovery Facilities," (NRC, 2002a).

(2) Monitoring equipment is identified by type, sensitivity, calibration methods and frequency, availability, and planned use to accurately measure concentrations of airborne radioactive species. The application also demonstrates that the ranges of sensitivity are appropriate for the facility operation.

(3) Planned surveys of airborne radiation are consistent with the guidance in Regulatory Guide 8.30 (NRC, 2002a).

(4) The proposed monitoring program is sufficient to adequately protect workers from radon gas releases from venting of processing tanks and from yellowcake dust from drying operations, spills, and maintenance activities and is consistent with Regulatory Guide 4.14, Sections 1.1 and 2.1 (NRC, 1980). The air sampling program is consistent with Regulatory Guide 8.30 (NRC, 2002a).

(5) Plans for documentation of radiation exposures are consistent with the requirements in 10 CFR 20.2102, 20.2103, 20.2106, and 20.2110.

(6) The applicant demonstrates that respirators will routinely be used for operations within drying and packaging areas and identifies the criteria for determining when respirators will be required for special jobs or emergency situations. The respiratory protection program should be consistent with guidance in Regulatory Guide 8.15, Revision 1, "Acceptable Programs for Respiratory Protection" (NRC, 1999) and Regulatory Guide 8.31, Section 2.7 (NRC, 2002b).

(7) For license renewal applications, the historical results summary of the airborne radiation monitoring program is included through the most recent reporting period preceding the submittal of the application. The effectiveness of the historical program is discussed with regard to all applicable 10 CFR Part 20 regulatory requirements identified in the preceding paragraphs. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.

5.7.3.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the airborne radiation monitoring program, the following conclusions may be presented in the technical evaluation report.

Operations

NRC has completed its review of the airborne radiation monitoring program at the _____ *in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.7.3.2 and the acceptance criteria outlined in standard review plan Section 5.7.3.3.

The applicant has an acceptable airborne radiation monitoring program at the _____ *in situ* leach site. The applicant has provided an acceptable drawing(s) that depicts the facility layout and the locations of airborne radiation monitors. The airborne radiation monitors are acceptably placed. The applicant demonstrated that the range, sensitivity, and calibration of monitors of airborne radiation will enable accurate determinations of the concentrations of airborne radioactive species so as to protect the health and safety of employees during facility operations. The workers are acceptably protected from radon gas releases from venting of processing tanks and from yellowcake dust from drying operations, spills, and maintenance activities. Planned radiation surveys are acceptable. Planned documentation of radiation exposures is consistent with the requirements. The applicant's respiratory protection program is acceptable. The applicant program for monitoring uranium and sampling of radon or its daughters is acceptable. Employee internal exposure calculations will be performed in accordance with 10 CFR 20.1204(a).

Based on the information provided in the application and the detailed review conducted of the airborne radiation monitoring program at the _____ *in situ* leach facility, the staff has concluded that the airborne radiation monitoring program is acceptable and is in compliance with 10 CFR 20.1101, which defines radiation protection program and as low as is reasonably achievable requirements; 10 CFR 20.1201(a), which provides individual occupational dose limits; 10 CFR 20.1201(e), which specifies allowed intake of soluble uranium; 10 CFR 20.1202, which describes the means of compliance when summing internal and external doses; 10 CFR 20.1203, for determination of dose from airborne external radiation; 10 CFR 20.1208, which specifies the exposure limits to a fetus during pregnancy; 10 CFR 20.1301 which identifies public dose limits; 10 CFR 20.1702, which allows employees to limit dose to individuals by controlling access, limiting exposure times, prescribing use of respiratory equipment, or use of other controls; 10 CFR Part 20, Subpart L, which specifies record keeping requirements; 10 CFR Part 20, Subpart M, which provides requirements for reports and notification; and 10 CFR Part 40, Appendix A, Criterion 8, which provides requirements for control of airborne effluents.

5.7.3.5 References

NRC. Regulatory Guide 8.30, "Health Physics Surveys in Uranium Recovery Facilities." Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002a.

———. Regulatory Guide 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills Will Be As Low As Reasonably Achievable." Rev. 1. Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002b.

———. Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection." Revision 1. Washington, DC: NRC, Office of Standards Development. 1999.

———. Regulatory Guide 4.14, “Radiological Effluent and Environmental Monitoring at Uranium Mills.” Washington, DC: NRC, Office of Standards Development. 1980.

5.7.4 Exposure Calculations

5.7.4.1 Areas of Review

The staff should review the methodologies proposed to calculate the exposures to radioactive materials by personnel in work areas where airborne radioactive materials could exist. This review should include methods to determine exposures during routine and non-routine operations, maintenance, and cleanup activities.

5.7.4.2 Review Procedures

The staff should evaluate whether the methodologies proposed to calculate the intake of radioactive materials by personnel in work areas where airborne radioactive materials could exist are in accordance with 10 CFR 20.1204 and 20.1201. The review should also place emphasis on the parameters used in exposure calculations to ensure they are representative of conditions at the site. Estimation of airborne uranium concentrations should take into account the maximum production capacity requested in the application and the anticipated efficiencies of airborne particulate control systems reviewed using Section 5.7.1 of this standard review plan.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.7.4.3 Acceptance Criteria

The methodologies are acceptable if they meet the following criteria:

(1) The methodologies proposed to determine the intake of radioactive materials by personnel in work areas where airborne radioactive materials could exist are in accordance with 10 CFR 20.1204 and 20.1201.

(2) Exposure calculations for natural uranium are consistent with Regulatory Guide 8.30, Section 3 (NRC, 2002).

(3) For airborne radon daughter exposure (working levels), calculations are consistent with Regulatory Guide 8.30 (NRC, 2002) and Regulatory Guide 8.34, Section C (NRC, 1992a).

(4) Calculations and guidance for prenatal and fetal radiation exposure are consistent with Regulatory Guide 8.36, “Radiation Dose to the Embryo/Fetus” (NRC, 1992b) and Regulatory Guide 8.13, “Instruction Concerning Prenatal Radiation Exposure” (NRC, 1999).

Operations

(5) Exposure calculations are presented for routine operations, non-routine operations, maintenance, and cleanup activities and are consistent with Draft Regulatory Guide 8.30 (NRC, 2002) and Regulatory Guide 8.34, Section C (NRC, 1992a).

(6) Parameters used in exposure calculations are representative of conditions at the site and include the time-weighted exposure that incorporates occupancy time and average airborne concentrations.

For example, the time of exposure may be arbitrarily set at 40 hours per week; however, workers at some facilities may regularly work longer shifts. Both full-time and part-time employees should be considered in these calculations.

(7) Estimation of airborne uranium concentrations takes into account the maximum production capacity requested in the application and the anticipated efficiencies of airborne particulate control systems reviewed using in Sections 4.1 and 5.7.1 of this standard review plan.

(8) All reporting and record keeping of worker doses is done in conformance with Regulatory Guide 8.7 (NRC, 1982) and 10 CFR 20.2103.

(9) For license renewal applications, the historical results of radiation exposure calculations are included through the most recent reporting period preceding the submittal of the application. The effectiveness of historical radiation exposure calculations is discussed with regard to applicable 10 CFR Part 20 regulatory requirements. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.

5.7.4.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the exposure calculations, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the exposure calculations at the _____ *in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.7.4.2 and the acceptance criteria outlined in standard review plan Section 5.7.4.3.

The applicant has provided acceptable techniques for exposure calculations at the _____ *in situ* leach site. The applicant has techniques to determine intake of radioactive materials by personnel in work areas. The applicant exposure calculations for natural uranium and airborne radon daughter exposure are acceptable and are in conformance with the guidance in Regulatory Guide 8.30 (NRC, 2002) and Regulatory Guide 8.34 (NRC, 1992a). The applicant has acceptable methods to calculate prenatal and fetal radiation exposures consistent with Regulatory Guides 8.13 (NRC, 1999) and 8.36 (NRC, 1992b). All exposure calculation methods for routine operations, non-routine operations, maintenance, and cleanup activities are acceptable and are consistent with Regulatory Guide 8.30 (NRC, 2002) and Regulatory Guide 8.34 (NRC, 1992a). The applicant has used parameters that are representative of the site, such as using both full- and part-time workers in exposure

calculations. The applicant has considered maximum production capacity and anticipated efficiencies of airborne particulate control systems in exposure calculations. All reporting and record keeping is in conformance with Regulatory Guide 8.7 (NRC, 1982).

Based on the information provided in the application and the detailed review conducted of the exposure calculations at the _____ *in situ* leach facility, the staff has concluded that the exposure calculations are acceptable and are in compliance with 10 CFR 20.1101, which defines radiation protection program requirements; 10 CFR 20.1201(a), which specifies individual occupational dose limits; 10 CFR 20.1201(e), which defines allowed intake of soluble uranium; 10 CFR 20.1202, which describes the means of compliance when summing internal and external doses; 10 CFR 20.1203, for determination of dose from airborne external radiation; 10 CFR 20.1204, which provides requirements for determination of internal exposure; and 10 CFR 20.1208, which specifies the exposure limits for a fetus.

5.7.4.5 References

NRC. Regulatory Guide 8.30, “Health Physics Surveys in Uranium Recovery Facilities.” Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002.

———. Regulatory Guide 8.13, “Instruction Concerning Prenatal Radiation Exposure.” Revision 3. Washington, DC: NRC, Office of Standards Development. 1999.

———. Regulatory Guide 8.34, “Monitoring Criteria and Methods To Calculate Occupational Radiation Doses.” Washington, DC: NRC, Office of Standards Development. 1992a.

———. Regulatory Guide 8.36, “Radiation Dose to the Embryo/Fetus.” Washington, DC: NRC, Office of Standards Development. 1992b.

———. Regulatory Guide 8.7, “Instructions for Recording and Reporting Occupational Radiation Exposure Data.” Revision 1. Washington, DC: NRC, Office of Standards Development. 1982.

5.7.5 Bioassay Program

5.7.5.1 Areas of Review

The staff should review descriptions of the bioassay program and how the bioassay results will be used to confirm results derived from the airborne radiation monitoring program (standard review plan Section 5.7.3) and the exposure calculations (standard review plan Section 5.7.4). The staff should review the criteria for including workers in the bioassay program, the types and frequencies of bioassays performed, and action levels applied to the results.

5.7.5.2 Review Procedures

The staff should determine whether the bioassay program is adequate to confirm results determined in the airborne radiation monitoring program (standard review plan Section 5.7.3) and the exposure calculations (standard review plan Section 5.7.4). The staff should review the

bioassay program to ensure that it is consistent with applicable sections of Regulatory Guide 8.22, “Bioassay at Uranium Mills” (NRC, 1988). The staff review should check to ensure that all workers who are routinely exposed to yellowcake dust are included in the bioassay program and that sampling and analysis frequencies are sufficient to detect and take corrective action against high intakes of uranium in the workplace. Primarily, the program should involve workers stationed in yellowcake drying areas and those who conduct regular maintenance on drying and ventilation/filtration equipment.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.7.5.3 Acceptance Criteria

The bioassay program is acceptable if it meets the following criteria:

(1) It is consistent with applicable sections of Regulatory Guide 8.22 (NRC, 1988) and Regulatory Guide 8.31 (NRC, 2002) including as low as is reasonably achievable requirements. The bioassay program is adequate to confirm results determined from the airborne radiation monitoring program (standard review plan Section 5.7.3) and the exposure calculations (standard review plan Section 5.7.4).

(2) The determination of which workers will be monitored in the bioassay program is consistent with Regulatory Guide 8.22, Section 2 (NRC, 1988).

(3) Sampling and analysis frequencies include baseline urinalyses for all new employees and exit bioassays on termination of employment and are consistent with Regulatory Guide 8.22, Section 4 (NRC, 1988) and Regulatory Guide 8.9, Revision 1, “Acceptable Concepts, Equations, and Assumptions for a Bioassay Program” (NRC, 1993).

(4) Action levels for bioassay monitoring are set in accordance with Regulatory Guide 8.22, Section 5 (NRC, 1988).

(5) All reporting and record keeping are done in conformance with the requirements of 10 CFR Part 20, Subpart L and Subpart M.

(6) For license renewal applications, the historical bioassay program results are included through the most recent reporting period preceding the submittal of the application. The effectiveness of the historical program is discussed with regard to all applicable 10 CFR Part 20 regulatory requirements. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.

5.7.5.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the bioassay program, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the bioassay program at the _____*in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.7.5.2 and the acceptance criteria outlined in standard review plan Section 5.7.5.3.

The applicant has established an acceptable bioassay program at the _____ *in situ* leach site that is consistent with Regulatory Guide 8.22 (NRC, 1988). An acceptable program for baseline urinalysis and exit bioassay is in place. Individuals routinely exposed to yellowcake dust are a part of the bioassay program. An acceptable action program to curtail uranium intake is established, and appropriate actions levels are set. The applicant has established reporting and record keeping protocols in conformance with the requirements of 10 CFR Part 20, Subpart L.

Based on the information provided in the application and the detailed review conducted of the bioassay program at the _____ *in situ* leach facility, the staff concludes that the bioassay program is acceptable and is in compliance with 10 CFR 20.1204, which provides requirements for the determination of internal exposure; and 10 CFR Part 20, Subpart L, which establishes record keeping requirements.

5.7.5.5 References

NRC. Regulatory Guide 8.31, "Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills Will Be As Low As Reasonably Achievable." Rev. 1. Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002.

———. Regulatory Guide 8.9, "Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program." Revision 1. Washington, DC: NRC, Office of Standards Development. 1993.

———. Regulatory Guide 8.22, "Bioassay at Uranium Mills." Revision 1. Washington, DC: NRC, Office of Standards Development. 1988.

5.7.6 Contamination Control Program

5.7.6.1 Areas of Review

The staff should review the contamination control program proposed to prevent employees from entering clean areas or from leaving the site while contaminated with radioactive materials. Levels of radioactive contamination will be monitored by means of a radiation survey program. Review areas include methods for surveying occupational radiation levels, housekeeping and cleanup requirements; specifications in process areas to control contamination; frequency of surveys of clean areas; survey methods; and minimum sensitivity, range, and calibration

frequency of survey equipment. Proposed contamination criteria or action levels for clean areas and for the release of materials, equipment, and work clothes from clean areas or from the site should be evaluated. The staff should also review the methods proposed to ensure that the licensee reduces residual contamination below limits before authorizing release of equipment for unrestricted use.

5.7.6.2 Review Procedures

The staff should determine whether the contamination control program proposed to prevent contaminated employees from entering clean areas or from leaving the site is in conformance with regulatory requirements in Regulatory Guide 8.30 (NRC,2002). Requirements for a contamination control program (e.g., maintaining change areas and personal alpha radiation monitoring before leaving radiation areas) should be included in standard operating procedures and discussed in the application. The staff should confirm that the license applicant has a contamination control program consistent with the guidance on conducting surveys for contamination of skin and personal clothing provided in Regulatory Guide 8.30 (NRC, 2002). The staff should ensure that the licensee eliminates residual contamination on equipment and materials to within acceptable release limits before release of the equipment for unrestricted use.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.7.6.3 Acceptance Criteria

The contamination control program is acceptable if it meets the following criteria:

(1) Radiation surveys of workers will be conducted to prevent contaminated employees from entering clean areas or from leaving the site in conformance with guidance in Regulatory Guide 8.30 (NRC, 2002).

The proposed contamination control program is consistent with the guidance on conducting surveys for contamination of skin and personal clothing provided in Regulatory Guide 8.30 (NRC, 2002).

(2) Requirements for a contamination control program (e.g., maintaining change areas and personal alpha radiation monitoring before leaving radiation areas) are included in standard operating procedures or are discussed in the application.

These procedures should be consistent with the guidance on conducting surveys for contamination of skin and personal clothing provided in Regulatory Guide 8.30 (NRC, 2002).

(3) Action levels for surface contamination are set in accordance with Regulatory Guide 8.30, Section 4 (NRC, 2002).

(4) Monitoring equipment by type, specification of the range, sensitivity, calibration methods and frequency, availability, and planned use is adequately described. The application demonstrates that the ranges of sensitivity for monitoring equipment will be appropriate to expected facility operation.

(5) All reporting and record keeping is done in conformance with the requirements of 10 CFR Part 20, Subpart L and Subpart M.

(6) The licensee will ensure that radioactivity on equipment or surfaces is not covered by paint, plating, or other covering material unless contamination levels, as determined by a survey and documented, are below the limits specified in Table 5.7.6.3-1 of this standard review plan before application of the covering. A reasonable effort will be made to minimize the contamination before the use of any covering.

(7) The radioactivity of the interior surfaces of pipes, drain lines, or duct work will be determined by making measurements at all traps and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior of the pipes, drain lines, or duct work.

(8) The licensee will make a comprehensive radiation survey, in conformance with Regulatory Guide 8.30, Section 1 (NRC, 2002) and NUREG–1575, Revision 1 (NRC, 2000) “Multi-Agency Survey and Site Investigation Manual (MARSSIM)” that establishes that contamination is within the limits specified in Table 5.7.6.3-1 and is as low as is reasonably achievable before release of equipment or scrap for unrestricted use.

(9) Appropriate criteria are established to relinquish possession or control of equipment or scrap having surfaces contaminated with material in excess of the limits specified in Table 5.7.6.3-1:

(a) The applicant will provide detailed information describing the equipment, or scrap; the radioactive contaminants; and the nature, extent, and degree of residual surface contamination.

(b) The applicant will provide a detailed health and safety analysis that reflects that the residual amounts of contaminated materials on surface areas, together with other considerations such as prospective use of the equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

(c) The applicant includes materials created by special circumstances including, but not limited to, the razing of buildings, transfer of structures or equipment, or conversion of facilities to a long-term storage facility or to standby status.

Table 5.7.6.3-1. Acceptable Surface Contamination Levels (U.S. Atomic Energy Commission, 1974)

Nuclides[a]	Average[b,c,d]	Maximum[b,d,e]	Removable[b,d,f]
Natural Uranium, Uranium-235, -238, and associated decay products	5,000 α dpm/100 cm^2	15,000 α dpm/100 cm^2	1,000 α dpm/100 cm^2
Transuranics, Radium-226, Radium-228, Thorium-230, Thorium-118, Protactinium-231, Actinium-227, Iodine-125, Iodine-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Natural Thorium, Thorium-232, Strontium-90, Radium-223, -224, Uranium-232, Iodine-126, Iodine-131, Iodine-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Strontium-90, and others noted above	5,000 dpm/100 cm^2	15,000 dpm/100 cm^2	1,000 dpm/100 cm^2

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.
[b]As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate factor for background, efficiency, and geometric factors associated with the instrumentation.
[c]Measurements of average contamination should not be averaged over more than 1 m^2. For objects of less surface area, the average should be derived for each such object.
[d]The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 mg/cm^2 of total absorber.
[e]The maximum contamination level applies to an area of not more than 100 cm^2.
[f]The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.
Reference: U.S. Atomic Energy Commission. Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors." Washington, DC: U.S. Atomic Energy Commission. June 1974.

5.7.6.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the contamination control program, the following conclusions may be presented in the technical evaluation report and environmental assessment.

NRC has completed its review of the contamination control program at the _____ *in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.7.6.2 and the acceptance criteria outlined in standard review plan Section 5.7.6.3.

The applicant has established an acceptable contamination control program at the _____ *in situ* leach site. Acceptable controls are in place to prevent contaminated employees from entering clean areas or from leaving the site. The standard operating procedures will include provisions for contamination control, such as maintaining changing areas and personal alpha radiation monitoring before leaving radiation areas. Acceptable action levels have been set in accordance with Regulatory Guide 8.30 (NRC, 2002), and plans for surveys are in place for skin and personal clothing contamination. The applicant has established that all items removed from the restricted area are surveyed by the radiation safety staff and meet release limits. All reporting and record keeping is done in conformance with protocols established in Regulatory Guide 8.7 (NRC, 1982). The applicant has demonstrated that the range, sensitivity, and calibration of monitoring equipment will protect the health and safety of employees during the full scope of facility operations. The licensee has demonstrated that contaminated surfaces will not be covered unless, before covering, a survey documents that the contamination level is below the limits specified in Table 5.7.6.3-1. The applicant will determine the radioactivity on the interior surfaces of pipes, drain lines, or duct work by making measurements at appropriate access points that will have been shown to be representative of the interior contamination. The applicant has committed to establishing that contamination on equipment, or scrap will be within the limits in Table 5.7.6.3-1 before unrestricted release. To relinquish possession or control of equipment, or scrap with material in excess of the limits specified in Table 5.7.6.3-1, the applicant will provide detailed information on the contaminated material, provide a detailed health and safety analysis that shows that the release of the contaminated material will not result in an unreasonable risk to the health and safety of the public, and obtain NRC staff approval.

Based on the information provided in the application and the detailed review conducted of the contamination control program at the _____ *in situ* leach facility, the staff concludes that the contamination control program is acceptable and is in compliance with 10 CFR 20.1101, which defines radiation protection program and as low as is reasonably achievable requirements; 10 CFR 20.1501, which provides survey and monitoring requirements; and 10 CFR 20.1702, which allows employees to limit dose to individuals by controlling access, limiting exposure times, prescribing use of respiratory equipment, or other controls.

Operations

5.7.6.5 References

NRC. Regulatory Guide 8.30, “Health Physics Surveys in Uranium Recovery Facilities.” Washington, DC: NRC, Office of Nuclear Regulatory Research. 2002.

———. NUREG–1575, “Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM).” Revision 1. Washington, DC: NRC. 2000.

———. Regulatory Guide 8.7, “Instructions for Recording and Reporting Occupational Radiation Exposure Data.” Revision 1. Washington, DC: NRC, Office of Standards Development. 1982.

5.7.7 Airborne Effluent and Environmental Monitoring Program

5.7.7.1 Areas of Review

The staff should review the airborne effluent and environmental monitoring programs proposed for measuring concentrations and quantities of both radioactive and non-radioactive materials released to and in the environment surrounding the facility. The staff should review the technical bases proposed for determining environmental concentrations for demonstrating compliance with standards. The staff review should focus on the frequency of sampling and analysis, the types and sensitivity of analysis, action levels and corrective action requirements, the minimum number and criteria for locating effluent and environmental monitoring stations, and the commitments for semiannual effluent and environmental monitoring reporting. The staff should review a topographic map of the site and the surrounding area showing monitoring locations.

5.7.7.2 Review Procedures

The staff should determine whether the proposed environmental monitoring programs are sufficient to limit exposures and releases of radioactive and hazardous materials as required by 10 CFR 20.2007.

The staff should determine whether the airborne effluent and environmental monitoring programs proposed for measuring concentrations and quantities of both radioactive and hazardous materials released to and in the environment around the proposed facility are in accordance with the regulatory requirements.

The staff should ensure that the license applicant has adequately considered site-specific aspects of climate and topography in determining locations for off-site airborne effluent monitoring stations and environmental sampling areas such that they are capable of detecting maximum concentrations expected from facility operations in the environment. In conducting its review, the staff should refer to guidance in Regulatory Guide 4.14, Revision 1 (NRC, 1980) which contains information on determining sampling locations, types, methods, frequencies, and analyses that are sufficient to comply with the applicable requirements for protection of the public from off-site exposures.

The reviewer shall confirm that the applicant has committed to adequate semiannual airborne effluent and environmental monitoring reporting.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.7.7.3 Acceptance Criteria

The airborne effluent and environmental monitoring program is acceptable if it meets the following criteria:

(1) The proposed airborne effluent and environmental monitoring program is consistent with Regulatory Guide 4.14, Sections 1.1 and 2.1 (NRC, 1980) and as low as is reasonably achievable requirements as described in Regulatory Guide 8.37, Section 3 (NRC, 1993).

(2) The proposed locations of the airborne effluent monitoring stations are consistent with guidance in Regulatory Guide 4.14, Sections 1.1.1 and 2.1.2 (NRC, 1980).

The license applicant adequately considers site-specific aspects of climate and topography in determining the number and locations of off-site airborne monitoring stations and environmental sampling areas. The criteria used in selecting sampling locations should be given. All sampling locations should be clearly shown relative to the proposed facility, nearest residences, and population centers on topographic maps of the appropriate scale.

(3) The proposed airborne effluent and environmental monitoring program should sample radon, air particulates, surface soils, subsurface soils, vegetation, direct radiation, and sediment in accordance with Regulatory Guide 4.14, Section 3 (NRC, 1980).

(4) The proposed sampling methods are consistent with guidance in Regulatory Guide 4.14, Section 3 (NRC, 1980).

(5) For license renewal applications, the historical airborne effluent and environmental monitoring program results are included through the most recent reporting period preceding the submittal of the application. The effectiveness of the historical program is discussed with regard to all applicable regulatory requirements. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.

(6) The applicant commits to semiannual airborne effluent and environmental monitoring reporting. These reports will be submitted to the appropriate NRC Regional Office with copies to the Chief, Fuel Cycle Facilities Branch and the project manager. The reports will specify the quantity of each of the principal radionuclides released to unrestricted areas in liquid and gaseous effluents during the previous 6 months, injection rates, recovery rates, injection manifold pressures, and injection trunk line pressures for each

satellite facility. The process rate and pressure data are to be reported as monthly averages. A license condition will be imposed to specify these reporting requirements.

5.7.7.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the airborne effluent and environmental monitoring programs, the following conclusions may be presented in the technical evaluation report and environmental assessment.

NRC has completed its review of the airborne effluent and environmental monitoring programs at the _____ *in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.7.7.2 and the acceptance criteria outlined in standard review plan Section 5.7.7.3.

The applicant has established acceptable airborne effluent and environmental monitoring programs at the _____ *in situ* leach site. The programs are consistent with guidance in Regulatory Guide 4.14 (NRC, 1980). The applicant will sample radon, air particulates, surface soils, subsurface soils, vegetation, direct radiation, and sediment. Locations of monitoring stations are consistent with Regulatory Guide 4.14 (NRC, 1980). Instrumentation is appropriate.

Based on the information provided in the application and the detailed review conducted of the airborne effluent and environmental monitoring programs at the _____ *in situ* leach facility, the staff concludes that the airborne effluent and environmental monitoring programs are acceptable and are in compliance with 10 CFR 20.1302, which requires effluent monitoring to determine dose to individual members of the public; 10 CFR 20.1501, which specifies survey and monitoring requirements; 10 CFR Part 20, Subpart L, which establishes record keeping requirements; and10 CFR 40.65, which specifies effluent and environmental monitoring requirements.

5.7.7.5 References

NRC. Regulatory Guide 8.37, “ALARA Levels for Effluent from Materials Facilities.” Washington, DC: NRC, Office of Standards Development. 1993.

———. Regulatory Guide 4.14, “Radiological Effluent and Environmental Monitoring at Uranium Mills.” Revision 1. Washington, DC: NRC, Office of Standards Development. 1980.

5.7.8 Ground-Water and Surface-Water Monitoring Programs

5.7.8.1 Areas of Review

There are three distinct phases of ground-water and surface-water monitoring: pre-operational, operational, and restoration. Pre-operational monitoring is conducted as a part of site characterization, and review procedures are in Section 2 of this standard review plan. Restoration monitoring is conducted during the ground-water restoration phase of operations,

and review procedures are in Section 6. This standard review plan section deals specifically with monitoring ground-water and surface-water quality during the production or operational phase of *in situ* leach activities.

The staff should review the technical bases and procedures for the following components of an effective ground-water and surface-water operational monitoring program:

(1) Well field baseline water quality monitoring programs (ground-water and surface-water)

(2) Selection of excursion indicators and their respective upper control limits

(3) The placement of excursion monitoring wells

(4) Well field testing to verify horizontal continuity between the production zone and perimeter wells and vertical isolation between the production zone and vertical excursion monitor wells

(5) The excursion monitoring program, including well sampling schedules, criteria for placing well fields on excursion status, and corrective actions to be taken in the event of an excursion

(6) The surface-water monitoring program

For all of the preceding aspects of ground-water and surface-water monitoring programs that involve analysis of water samples, procedures for sample collection and analysis should be reviewed.

5.7.8.2 Review Procedures

Well field hydrologic and water chemistry data are collected before *in situ* leach operations to establish a basis for comparing operational monitoring data. Hydrologic data are used to (i) evaluate whether the well field can be operated safely, (ii) confirm monitor wells have been located correctly, and (iii) design aquifer restoration activities. Water chemistry data are used to establish a set of water quality indicators, and the concentrations of these indicators in monitoring wells are used to determine whether the well field is being operated safely. Water chemistry data are also used to set the water quality standard for restoring the production zones and adjacent aquifers after *in situ* leach extraction ceases. The reviewer should determine whether these objectives of the operational monitoring program have been met. To this end, the reviewer should

(1) Verify that procedures for establishing baseline water quality include acceptable sample collection methods, a set of sampled parameters that is appropriate for the site and *in situ* leach extraction method, and collection of sample sets that are sufficient to represent any natural spatial and temporal variations in water quality.

(2) Review the applicant's selection (or procedure for selecting) the set of water quality parameters and their respective upper control limits that will be used as indicators to

ensure timely detection and reporting of unplanned lixiviant migration (excursions) from production zones.

(3) Review the applicant's technical basis or procedures for establishing the appropriate monitor well spacing for vertical and horizontal excursion monitoring.

(4) Evaluate whether well field testing is sufficient to show a horizontal hydraulic connection between the production zones and the perimeter monitor well network, and vertical hydraulic separation between the production zones and the shallow and deep monitor wells.

(5) Evaluate whether procedures describing the operational excursion monitoring program include sampling schedules, sampling and analytical procedures, criteria for placing well fields on excursion status, and corrective action and notification procedures to be followed if an excursion is detected.

(6) Evaluate whether a surface-water monitoring program is necessary at the site and, if so, whether the monitoring program will be effective to detect migration of contaminants into surface-water bodies.

In conducting these evaluations, the reviewer should consider the review of ground-water activities conducted by state and other federal agencies to identify any areas where dual reviews can be eliminated. Although the staff must make the necessary findings of compliance with applicable regulations, if a state or other federal agency asks questions in a particular area, the reviewer need not duplicate those questions. Instead, the reviewer can rely on the answers to the state or federal agency questions if they are acceptable, and if the applicant submits them as part of the NRC application. The reviewer should make every effort to coordinate the NRC technical review with the state or other federal agency with overlapping authority to avoid unnecessary duplication of effort.

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.7.8.3 Acceptance Criteria

The ground-water and surface-water monitoring program should ensure that an excursion is detected long before *in situ* leach solutions could seriously degrade the quality of ground-water outside the well field area. Early detection of excursions by a monitor well is influenced by the thickness of the aquifer monitored, the distance that monitor wells are placed from the well field and from each other, the frequency that the monitor wells are sampled, the water quality parameters that are sampled, and the concentrations of parameters that will be used to declare that an excursion has been detected.

The ground-water and surface-water monitoring programs are acceptable if they will allow the early detection and timely restoration of excursions. The following criteria must be met by *in situ* leach operational monitoring programs:

(1) For each new well field, the applicant's approach for establishing baseline water quality data is sufficient to (i) define the primary restoration goal of returning each well field to its pre-operational water quality conditions and (ii) provide a standard for determining when an excursion has occurred. The reviewer should verify that acceptable procedures were used to collect water samples, such as American Society for Testing and Materials D4448 (American Society for Testing and Materials, 1992). The reviewer should also ensure that acceptable statistical methods are used to meet these three objectives, such as American Society for Testing and Materials D6312 (American Society for Testing and Materials, 1998).

Baseline sampling programs should provide enough data to adequately evaluate natural spatial and temporal variations in pre-operational water quality. At least four independent sets of samples should be collected, with adequate time between sets to represent any pre-operational temporal variations. A set of samples is defined as a group of at least one sample at each of the designated baseline monitor wells and analyzed for the water quality conditions of the sampled aquifer at a specific time.

An acceptable set of samples should include all well field perimeter monitor wells, all upper and lower aquifer monitor wells, and at least one production/injection well per acre in each well field. For large well fields, it may not be practical to sample one production/injection well per acre. Consequently, enough production/injection wells must be sampled to provide an adequate statistical population if fewer than one well per acre is used. As a general guideline, for normally and log-normally distributed populations, at least six samples are required to achieve 90 percent confidence that any random sample will lie within two standard deviations from the sample mean. In no case should the baseline sampling density for production/injection wells be less than one per 4 acres.

The applicant should identify the list of constituents sampled for baseline concentrations. Table 2.7.3-1 provides a list of acceptable constituents for monitoring at *in situ* leach facilities. Alternatively, applicants may propose a list of constituents that is tailored to a particular location. In such cases, sufficient technical bases must be provided to demonstrate the acceptability of the selected constituent list. For example, many licensees have decided not to sample for Th-230; Th-230 is a daughter product from the decay of uranium-238, and studies have shown that it is mobilized by bicarbonate-laden leaching solutions. However, studies have also shown that after restoration, thorium in the ground-water will not remain in solution, because the chemistry of thorium causes it to precipitate and chemically react with the rock matrix (Hem, 1985). As a result of its low solubility in natural waters, thorium is found in only trace concentrations. Additionally, chemical tests for thorium are expensive, and are not commonly included in water analyses at *in situ* leach facilities. This example concerning Th-230 demonstrates an acceptable technical basis for excluding Th-230 from the list of sampled constituents. For all constituents that are sampled, laboratory reports documenting the measurements should be maintained by the applicant.

An outlier is a single non-repeating value that lies far above or below the rest of the sample values for a single well. Dealing with outliers in the sample sets should be done

using proper statistical methods. The outlier may represent a sampling, analytical, or other unknown source of error or an unidentified randomness in the data. Its inclusion within the sample could significantly change the baseline data, since the outlier is not typical of the bulk of the samples. All calculations, assumptions, and conclusions made by the applicant in evaluating outliers should be fully explained. When an outlier is suspected, perhaps the easiest solution is to take another sample from the source well; if the repeat sample yields the same results, then the outlier should not be discarded. If the repeat sample is more consistent with the statistical population, the outlier can be replaced with the new sample. Another acceptable method for dealing with potential outliers is to accept any value within three standard deviations of the mean (the standard deviation should be calculated without using the suspected outliers). It is often necessary to perform log transformations on data to better approximate a normal distribution before calculating sample statistics. Care should be taken not to exclude suspected outliers that ultimately may represent bimodal distributions. Methods in American Society for Testing and Materials E178 (American Society for Testing and Materials, 1994), NUREG/CR–4604 (NRC, 1988) and NUREG–1475 (NRC, 1994) are acceptable methods for outlier calculation. Other documented and technically justified methods used by applicants will be considered in the evaluation of outliers (e.g., EPA, 1989).

(2) The applicant selects excursion indicator constituents and upper control limits. Upper control limits are concentrations for excursion indicator constituents that provide early warning that leaching solutions are moving away from the well fields and that ground-water outside the monitor well ring may be threatened. Excursion indicator constituents should be parameters that are strong indicators of the *in situ* leach process and that are not significantly attenuated by geochemical reactions in the aquifers. If possible, the chosen parameters should be easily analyzed to allow timely data reporting. The upper control limit concentrations of the chosen excursion indicators should be set high enough that false positives (false alarms from natural fluctuations in water chemistry) are not a frequent problem, but not so high that significant ground-water quality degradation could occur by the time an excursion is identified. A minimum of three excursion indicators should be proposed. The choice of excursion indicators is based on lixiviant content and ground-water geochemistry. Ideal excursion indicators are measurable parameters that are found in significantly higher concentrations during *in situ* leach operations than in the natural waters. At most uranium *in situ* leach operations, chloride is an excellent excursion indicator because it acts as a conservative tracer, it is easily measured, and chloride concentrations are significantly increased during *in situ* leaching. Conductivity, which is correlated to total dissolved solids, is also considered to be a good excursion indicator (Staub, 1986; Deutsch, 1985). Total alkalinity (carbonate plus bicarbonate plus hydroxide) is an excellent indicator in well fields where sodium bicarbonate or carbon dioxide is used in the lixiviant. If conductivity is used to estimate total dissolved solids, measurements will be normalized to a reference temperature, usually 25 °C, because of the temperature dependence of conductivity.

Calcium, sodium, and sulfate are usually found at significantly higher levels in *in situ* solutions than in natural ground-water concentrations. The use of cations

(e.g., calcium^{2+}, sodium^{+}) as excursion indicators is generally not appropriate because they are subject to ion exchange with the host rock. The use of sulfate may give false alarms because of induced oxidation around a monitor well (Staub, 1986; Deutsch, 1985). However, this should only be a problem if upper control limit values are set too conservatively. Uranium is not considered a good excursion indicator because, although it is mobilized by *in situ* leaching, it may be retarded by reducing conditions in the aquifer. Although water level changes in artesian aquifers are quickly transmitted, water levels are generally not considered good indicators, because water levels tend to have significant natural variability. The applicant may choose to add a non-reactive, conservative tracer to *in situ* leach solutions to act as an excursion indicator. The applicant is required to provide the technical bases for the selection of excursion indicators.

Upper control limit concentrations must be set to easily identify excursions. An excursion is defined to occur whenever two or more excursion indicators in a monitoring well exceed their upper control limits. The upper control limit for each excursion indicator must generally be less than the lowest concentration that typically occurs in the lixiviant while the well field is in operation. Each upper control limit must also be greater than the baseline concentration for its respective excursion indicator. Applicant site-specific experience is often valuable in determining appropriate upper control limits that provide timely detection and avoid false alarms. Guidance for appropriate statistical methods that can be used to establish upper control limits can be found in American Society for Testing and Materials D6312 (American Society for Testing and Materials, 1998).

Upper control limits for a specific excursion indicator should be determined on a statistical basis to account for likely spatial and temporal concentration variations within the mineralized zone. Statistical techniques, such as the student's t-test, are acceptable for setting upper control limits. In some cases, the use of a simple percentage increase above baseline values is acceptable. The staff has decided that in areas with good water quality (a total dissolved solids less than 500 mg/L), setting the upper control limit at a value of 5 standard deviations above the mean of the measured concentrations is an acceptable approach. However, in some aquifers of good water quality, low chloride concentrations have been found to have such a narrow statistical distribution that a specified concentration (e.g., 15 mg/L) above the mean or the mean plus 5 standard deviations approach, which ever is greater, has been used to establish the chloride upper control limit.

The same upper control limits may be assigned to all monitor wells within a particular hydrogeologic unit in a given well field if baseline data indicate little chemical heterogeneity. Alternatively, if individual monitor wells in a given unit exhibit unique baseline water quality, upper control limits may be assigned on a well-by-well basis. If upper control limits vary from well to well, a table should be included listing all monitor wells and their respective upper control limits.

(3) The applicant establishes criteria for determining monitor well locations. Production zone perimeter monitor wells are used to detect horizontal excursions outside the well

field boundary. They generally surround the entire well field and are screened over the entire production zone hydrogeologic unit. Perimeter monitor wells should be placed close enough to the well field to provide timely detection, yet they should be far enough away from the well field to avoid numerous false alarms. Previously approved *in situ* leach excursion monitoring systems used monitor wells as far as 180 m [600 ft] and as near as 75 m [250 ft] from the well field edge (NRC, 2001, Table 4-6). The licensee should be afforded some discretion in determining the appropriate distance of horizontal excursion monitor wells from the well field, but should provide justification for distances greater than about 150 m [500 ft]. For example, a rigorous modeling demonstration that a theoretical excursion can be controlled at the monitor well locations within 60 days of detection is an acceptable technical basis. The horizontal excursion monitor wells must be spaced close enough to one another so that the likelihood of missing an excursion plume is low. In determining the appropriate spacing between perimeter monitoring wells, the applicant must consider such factors as the distance of the monitoring wells from the edge of the well field, the minimum likely size of an excursion source zone, ground-water flow directions and velocities outside of the well field, and the potential for mixing and dispersion. Staff should consult NUREG/CR–6733 (NRC, 2001, Section 4.3.3) for an analysis and discussion of acceptable approaches for establishing the appropriate monitor well spacing.

NUREG/CR–6733 (NRC, 2001, Section 4.3.3) established that significant risks for vertical excursions may exist if monitor wells are randomly located, given the typical criteria for spacing of vertical excursion monitor wells at licensed *in situ* leach facilities {e.g., one well per 1.6 ha [4 acres] for overlying aquifers; one well per 3.2 ha [8 acres] for underlying aquifers}. Thus, location of vertical excursion monitor wells within the well field should be such that the likelihood of detecting a vertical excursion is maximized. The appropriate number of these monitor wells may vary from site to site. It may be appropriate to exclude the requirement to monitor water quality in the underlying aquifer if (i) the underlying aquifer is a poor producer of water, (ii) the underlying aquifer is of poor water quality, (iii) there is a large aquitard between the production zone and the underlying aquifer and few boreholes have penetrated the aquitard, or (iv) deep monitor wells would significantly increase the risk of a vertical excursion into the underlying aquifer. Monitor wells completed in aquifers above the first overlying aquifer may not be required when (i) the aquifers are separated from the production zone by thick aquitards, (ii) a high quality mechanical integrity well testing program will be implemented, or (iii) the aquifers are unsubstantial producers of water or of poor water quality. In well fields where the production zone confining layers are particularly thin, or of questionable continuity, a greater number of monitor wells is appropriate. In general, when the direction of ground-water flow in an upper or lower aquifer is well known, the applicant should consider locating these wells on the hydraulically down gradient side of a well field, in areas where production zone confining layers may be thin or incompetent, and in areas where injection pressure may be highest (i.e., closer to injection wells than to production wells).

The process for determining the screened interval of the monitor wells should be described. Fully screened monitor wells sample the entire thickness of the aquifer. Therefore, excursions could not pass above or below the well screens. However, the

concentration of the indicator parameters might be diluted and therefore may not provide timely warning that an excursion is occurring. Partially screened monitor wells only sample the zone of extraction within an aquifer. These wells might miss some excursions, but would suffer less from dilution effects than fully screened wells. For most situations the staff favors fully screened monitor wells. Fully screened monitor wells would assure that excursions will eventually be detected, have the advantage of more accurately representing the water quality that a ground-water user is likely to experience, and do not suffer from the uncertainty of predicting the completion intervals of injection and production wells that have not yet been drilled.

(4) The applicant establishes well field test procedures. Once a well field is installed, it should be tested to establish that the production and injection wells are hydraulically connected to the perimeter horizontal excursion monitor wells and are hydraulically isolated from the vertical excursion monitor wells. Such testing will serve to confirm the performance of the monitoring system and will verify the validity of the site conceptual model reviewed in Section 2 of this standard review plan. The reviewer should verify that well field test approaches have sound technical bases. Test approaches typically consist of a pumping test that subjects the well field to a sustained maximum withdrawal rate while monitoring the perimeter and vertical excursion wells for drawdown. The test should continue until the effects of pumping can be clearly seen via drawdown in the perimeter monitor wells. Typically, about 0.3 m [1 ft] of drawdown in the perimeter monitor wells will verify hydraulic connection, but the amount may vary because of the distance from the pumping wells, pumping rates, and hydraulic conductivity. To investigate vertical confinement or hydraulic isolation between the production zone and upper and lower aquifers, water levels in upper or lower aquifers may also be monitored during the pumping tests.

(5) The applicant defines operational approaches for the monitoring program. The monitoring program must indicate which wells will be monitored for excursion indicators, the monitoring frequency, and the criteria for determining when an excursion has occurred. An acceptable excursion monitoring program should indicate that all monitor wells will be sampled for excursion indicators at least every 2 weeks during *in situ* leach operations.

An excursion is deemed to have occurred if two or more excursion indicators in any monitor well exceed their upper control limits. A verification sample must be taken within 48 hours after results of the first analyses were received. If the second sample does not indicate that upper control limits were exceeded, a third sample must be taken within 48 hours after the second set of sampling data was acquired. If neither the second nor the third sample indicates that upper control limits are exceeded, the first sample is considered in error, and the well is removed from excursion status. If either the second or third sample contains indicators above upper control limits, an excursion is confirmed, the well is placed in excursion status, and corrective action must be initiated.

Generally, the risk of contamination to surface-water bodies from *in situ* leach operations is low when proper operational procedures are followed. Any surface-water

body that lies within the proposed license boundary should be sampled at upstream and downstream locations, both before and during operations. The reviewer should ensure that pre-operational water quality sampling locations for applicable surface-waters are indicated in the application. The pre-operational data should be collected on a seasonal basis for a minimum of 1 year before *in situ* leach operations. Procedures for monitoring surface-water quality during operations should be discussed in the application: this discussion must include a monitoring schedule, monitor locations, and a list of sampled constituents. The applicant may be exempted from monitoring during operations if the site characterization demonstrates that no significant flow of ground water to surface water occurs near the site (e.g., if surface-water bodies are perched and ephemeral).

The excursion monitoring operational procedures must also include corrective action and notification plans in the event of an excursion. NRC must be notified within 24 hours by telephone and within 7 days in writing from the time an excursion is verified. A written report describing the excursion event, corrective actions, and the corrective action results must be submitted to NRC within 60 days of the excursion confirmation. If wells are still on excursion status when the report is submitted, the report must also contain a schedule for submittal of future reports describing the excursion event, corrective actions taken, and results obtained. In the case of a vertical excursion, the report must contain a projected date when characterization of the extent of the vertical excursion would be completed.

Corrective action to retrieve horizontal excursions within the production-zone aquifer is generally accomplished by adjusting the flow rates of the pumping/injection wells to increase process bleed in the area of the excursion. Vertical excursions have proven more difficult to retrieve: at some *in situ* leach facilities, vertical excursions have persisted for years. If an excursion is not corrected within 60 days of confirmation, applicants must either terminate injection of lixiviant into the well field until the excursion is retrieved, or provide an increase to the reclamation surety in an amount that is agreeable to NRC and that would cover the expected full cost of correcting and cleaning up the excursion. The surety increase must remain in force until the excursion is corrected. The written 60-day excursion report should state and justify which course of action will be followed.

If wells are still on excursion status at the time the 60-day report is submitted to NRC, and the surety option is chosen, the well field restoration surety will be adjusted upward. To calculate the increase in surety for horizontal excursions, it is assumed that the entire thickness of the aquifer between the well field and the monitor wells on excursion has been contaminated with lixiviant. The width of the excursion is assumed to be the distance between the monitor wells on excursion status plus one monitor well spacing distance on either side of the excursion. When the excursion is corrected, the additional surety requirements resulting from the excursion will be removed.

To calculate the increase in surety for vertical excursions, an initial estimate of the area contaminated is made. All estimates assume that the entire thickness of the aquifer is contaminated. As characterization of the extent of contamination proceeds, the surety

may be increased or decreased, as appropriate. Once the extent of contamination is determined, the area contaminated above background is used to calculate the level of surety. When the vertical excursion is cleaned up, the additional surety requirements resulting from the excursion are removed.

In calculating the increase in surety bonding for horizontal and vertical excursions, the same formula used to calculate the number of pore volumes required to restore a well field is applied to the assumed areas of contamination. This approach is consistent with 10 CFR Part 40, Appendix A, Criterion 9. Increased surety provides assurance that cleanup will be accomplished in the event of licensee default, and surety can be adjusted downward once cleanup is complete. In calculating the area affected by an excursion and the volume of water required to effect restoration, a conservative estimate is taken to ensure that adequate funds are available to clean up the ground water should the licensee fail to do so.

Corrective action for vertical and horizontal excursions can be determined complete when all excursion indicators are below their respective upper control limits, or if only one excursion indicator exceeds its respective upper control limit by less than 20 percent. Stability in the excursion indicator concentrations must be demonstrated by measurements over a suitable time period before the corrective action measures can be discontinued.

(6) If an *in situ* leach facility is located adjacent to bodies of surface-water, the applicant must establish a surface-water monitoring program that will be effective to detect migration of contaminants into surface-water bodies . Alternatively, the applicant may demonstrate that the risk of contamination from *in situ* leach activities is negligible or that potential releases are within limits set by the Safe Drinking Water Act.

5.7.8.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the ground-water and surface-water monitoring programs, the following conclusions may be presented in the technical evaluation report and environmental assessment.

NRC has completed its review of the ground-water and surface-water monitoring programs at the _____ *in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.7.8.2 and the acceptance criteria outlined in standard review plan Section 5.7.8.3.

The applicant has established acceptable ground-water and surface-water monitoring programs at the _____ *in situ* leach site. The applicant has established acceptable well field baseline sampling programs including the number and timing of samples, constituents sampled, and appropriate statistical methods to remove outliers. The applicant has selected acceptable excursion indicator constituents and an approach for establishing upper control limits. Appropriate criteria are used to establish monitor well locations for all aquifers likely to be affected. Appropriate well field test procedures are established. The applicant has defined acceptable operational approaches for the ground-water and surface-water monitoring

programs, including identifying appropriate wells for monitoring for excursion indicators, monitoring frequency, and criteria for determining the presence of an excursion. The applicant has defined an acceptable sampling program for any surface-water body that lies within the facility boundary, including downstream sampling locations and standard approaches for monitoring with a schedule and a list of analyzed constituents. The applicant has prepared an acceptable ground-water and surface-water corrective action plan, including notification of NRC and subsequent reporting in the event of an excursion.

Based on the information provided in the application and the detailed review conducted of the ground-water and surface-water monitoring programs at the _____ *in situ* leach facility, the staff concludes that the ground-water and surface-water monitoring programs are acceptable and are in compliance with 10 CFR 40.32(c), which requires the applicant's proposed equipment, facilities, and procedures to be adequate to protect health and minimize danger to life or property; 10 CFR 40.32(d), which requires that the issuance of the license will not be inimical to the common defense and security or to the health and safety of the public; 10 CFR 40.41(c), which requires the applicant to confine source or byproduct material to the locations and purposes authorized in the license; and 10 CFR 40.31, which defines requirements for applications for specific licenses. The ground-water and surface-water monitoring programs are also in compliance with 10 CFR Part 40, Appendix A, Criteria 5B(1), 5B(5), and 5C, which provide concentration limits for contaminants; 10 CFR Part 40, Appendix A, Criterion 5D, which requires a ground-water corrective action program; and 10 CFR Part 40, Appendix A, Criteria 7 and 7A, which require ground-water monitoring programs.

Pre-operational monitoring is conducted as part of site characterization and is addressed in Section 2 of this technical evaluation report, whereas restoration monitoring is conducted during ground-water restoration and is addressed in Section 6 of this technical evaluation report.

5.7.8.5 References

American Society for Testing and Materials. "Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring." Designation D6312–98. West Conshohocken, Pennsylvania: American Society for Testing and Materials. 1998.

———. "Standard Practice for Dealing with Outlying Observations." Designation E178. West Conshohocken, Pennsylvania: American Society for Testing and Materials. 1994.

———. "Standard Guide for Sampling Groundwater Monitoring Wells." Designation D4448–85a. West Conshohocken, Pennsylvania: American Society for Testing and Materials. 1992.

Deutsch, W.J., et al. NUREG/CR–3709, "Method of Minimizing Ground-Water Contamination From *In Situ* Leach Uranium Mining." Washington, DC: NRC. 1985.

EPA. "Statistical Analysis of Ground-Water Monitoring Data at RCRA (Resource Conservation and Recovery Act) Facilities, Interim Final Guidance." EPA/530–SW–89–026. Washington, DC: EPA. 1989.

Hem, J.D. "Study and Interpretation of the Chemical Characteristics of Natural Water." USGS Water Supply Paper 2254. Third edition. Reston, Virginia: U.S. Geological Survey. 1985.

NRC. NUREG/CR–6733, "A Baseline Risk-Informed, Performance-Based Approach for *In Situ* Leach Uranium Extraction Licensees." Washington, DC: NRC. 2001.

———. NUREG–1475, "Applying Statistics." Washington, DC: NRC. 1994.

———. NUREG/CR–4604, "Statistical Methods for Nuclear Material Management." Washington, DC: NRC. 1988.

Staub, W.P., et al. NUREG/CR–3967, "An Analysis of Excursions at Selected *In Situ* Uranium Mines in Wyoming and Texas." Washington, DC: NRC. 1986.

5.7.9 Quality Assurance

5.7.9.1 Areas of Review

The staff should review the quality assurance programs proposed for all radiological, effluent, and environmental (including ground water) monitoring programs.

5.7.9.2 Review Procedures

The staff should determine whether the quality assurance program proposed by the applicant is sufficient to limit radiation exposures and radioactive releases to as low as is reasonably achievable and is in conformance with regulatory requirements identified in 10 CFR Part 20. The staff should determine if the quality assurance programs proposed for all radiological, effluent, and environmental (including ground water) monitoring are in accordance with Regulatory Guide 4.14, "Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1 (NRC, 1980) and Regulatory Guide 4.15, "Quality Assurance for Radiological Monitoring Programs (Normal Operations)—Effluent Streams and the Environment, Revision 1" (NRC, 1979).

For license renewals and amendment applications, Appendix A to this standard review plan provides guidance for examining facility operations and the approach that should be used in evaluating amendments and renewal applications.

5.7.9.3 Acceptance Criteria

The quality assurance program is acceptable if it meets the following criteria:

(1) The quality assurance program has been established and applied to all radiological, effluent, and environmental programs. The proposed quality assurance plan should be consistent with guidance provided in Regulatory Guide 4.14, Section 3 and 6 (NRC, 1980) and Regulatory Guide 4.15 (NRC, 1979).

Operations

(2) All reporting and record keeping will be done in conformance with the criteria presented in Section 5.3.2 of this standard review plan.

Note that under the existing 10 CFR Part 20 requirements, a licensee must retain survey and calibration records for 3 years instead of the 2 years mentioned in Regulatory Guide 4.15 (NRC, 1979). Furthermore, existing 10 CFR Part 20 requirements have been updated to include a requirement that all licensees maintain records used to demonstrate compliance and evaluate dose, intake, and releases to the environment until NRC terminates the license.

(3) For license renewal applications, the historical quality assurance program results are included through the most recent reporting period preceding the submittal of the application. The effectiveness of the historical program is discussed with regard to all applicable 10 CFR Part 20 regulatory requirements. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.

5.7.9.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the quality assurance program, the following conclusions may be presented in the technical evaluation report and environmental assessment.

NRC has completed its review of the quality assurance program at the _____ *in situ* leach facility. This review included an evaluation using the review procedures in standard review plan Section 5.7.9.2 and the acceptance criteria outlined in standard review plan Section 5.7.9.3.

The applicant has established an acceptable quality assurance program at the _____ *in situ* leach site. The quality assurance program has been applied to all radiological, effluent, and environmental programs consistent with Regulatory Guides 4.14 (NRC, 1980) and 4.15 (NRC, 1979). The applicant has agreed to retain survey and instrument calibration records for 3 years and to retain records to demonstrate compliance and evaluate dose, intake, and releases to the environment until NRC terminates the license.

Based on the information provided in the application and the detailed review conducted of the quality assurance program at the _____ *in situ* leach facility, NRC staff concludes that the quality assurance program is acceptable and is in compliance with 10 CFR 20.1101, which provides requirements for radiation protection programs; 10 CFR Part 20, Subpart L, which specifies record keeping requirements; and 10 CFR Part 20, Subpart M, which defines reporting and notification requirements.

5.7.9.5 References

NRC. Regulatory Guide 4.14, “Radiological Effluent and Environmental Monitoring at Uranium Mills.” Revision 1. Washington, DC: NRC, Office of Standards Development. 1980.

———. Regulatory Guide 4.15, “Quality Assurance for Radiological Monitoring Programs (Normal Operations)—Effluent Streams and the Environment.” Revision 1. Washington, DC: NRC, Office of Standards Development. 1979.