6.0 GROUND-WATER QUALITY RESTORATION, SURFACE RECLAMATION, AND FACILITY DECOMMISSIONING

6.1 Plans and Schedules for Ground-Water Quality Restoration

In conducting these evaluations, the reviewer should consider the technical evaluations conducted by a state or another federal agency with authorities overlapping those of the NRC. The desired outcome is to identify any areas where duplicative NRC reviews may be reduced or eliminated. The NRC staff must make the necessary evaluations of compliance with applicable regulations for licensing the facility. However, the reviewer may, as appropriate, rely on the applicant's responses to inquiries made by a state or another federal agency to support the NRC evaluation of compliance. 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.

Some of the review methods and acceptance criteria in the following sections are more rigorous than those previously used by the NRC staff. They provide increased confidence in the adequacy of ground-water restoration plans and the sureties associated with them.

Technical assessment of the selected ground-water restoration methods, restoration time and pore volume displacements, and sureties may entail use of detailed, small-scale process models to large-scale, simplified models. Small-scale process models are generally used to evaluate potentially important complexities and mechanisms that govern the evolution of the contaminated areas, while large-scale, simplified models generally consider fewer complexities but may be suitable for evaluating average or effective processes for large areas. Model adequacy should be evaluated regardless of the level of complexity.

This review should be coordinated with the site hydrologic characteristics review conducted using Section 2.7 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.

6.1.1 Areas of Review

The staff should review the following aspects of the ground-water quality restoration program:

(1) Ground-water modeling used to estimate restoration time and the extent of uncertainties in processes and data. Specifically, the modeling review should include:

(a) Techniques used to collect data on the geology, hydrology, geochemistry, processes, plume geometry/extent

(b) Technical bases for evaluating effects of the geology, hydrology, geochemistry, processes, and physical phenomena on flow and transport pathways

(c) Consistency and adequacy of model assumptions

(d) Technical bases for the concentrations of contaminants

(e) Sufficiency of data and selection of model parameters and simplifications

(f) Evaluation of uncertainty associated with model parameters

(g) Model results compared to more detailed model results or site data (i.e., model validation)

(2) Estimates of the concentrations and lateral and vertical dispersion of those chemicals that may persist in leached-out well field production zones after termination of *in situ* leaching operations and before restoration activities.

(3) Descriptions of proposed methods and techniques to be used to restore ground-water quality, including identification of *in situ* chemical reactions that may hinder or enhance restoration.

(4) A schedule for sequential restoration of well fields.

(5) Descriptions of the expected post-reclamation conditions and quality of restored ground waters, compared with the pre-operational water quality characteristics, and any prior experience restoring ground water at the site.

(6) Adverse effects of the proposed water quality restoration operations on ground waters outside production zones.

(7) Procedures to be used for plugging, sealing, capping, and abandoning wells.

(8) Methods of effluent disposal, such as deep-well injection, discharge to surface water, and land application.

6.1.2 Review Procedures

The staff should review plans and schedules for ground-water quality restoration, and perform the following actions:

(1) If numerical ground-water flow or transport modeling is used to support or develop the ground-water restoration plans, examine the descriptions of features, physical phenomena, and the geological, hydrological, and geochemical aspects of the modeled aquifers. The staff should verify that the descriptions are adequate and that the conditions and assumptions used in the modeling are realistic or reasonably conservative and supported by the body of data presented in the descriptions.

Evaluate the sufficiency of data used to support model input parameter values. Data sources may include a combination of techniques such as laboratory experiments,

aquifer hydraulic testing and water level measurements in wells, geochemical analyses, or other site-specific field measurements.

Evaluate the technical bases for parameter ranges, probability distributions, or bounding values. The reviewer should determine whether the parameter values are derived from either site-specific data, or an analysis to show assumed parameter values bound data uncertainty in a manner that is not overly optimistic.

Evaluate whether there are aspects of the model where additional data could provide new information that could invalidate the modeling results and significantly affect the ground-water restoration plan. For example, if constant head boundary conditions are used in a numerical ground-water flow model, could additional wells or sampling during a different season result in a significantly different interpretation of model boundary conditions? If so, is a different interpretation of boundary conditions likely to significantly alter model results used to develop or support the restoration plan?

Examine the initial conditions and boundary conditions used in any numerical modeling for consistency with available data. The staff should also consider the potential importance of temporal and spatial variations in boundary conditions and source terms used to support the ground-water restoration plan.

Evaluate the applicant's assessment of uncertainty and variability in model parameters. The reviewer should determine whether uncertainty in both temporal and spatial parameter variability is incorporated into or bounded by parameter values.

Examine the technical bases for the identification of post-extraction changes to ground-water quality. The staff should examine how the evolution of water quality has been incorporated into estimates of restoration time or the number of pore volumes required to attain restoration goals.

Examine the assumptions used to develop any model of reactive transport that accounts for site geochemical processes, such as sorption or any other geochemical reaction, that reduce concentrations of, or retard, contaminants. The modeling should consider available data about the native ground-water downgradient of the production areas, the geochemical environment, hydraulic and transport properties, and the spatial variations of aquifer properties and ground-water volumetric fluxes along the flow paths.

Evaluate the estimated restoration time or required number of pore volume displacements for consistency with the output from any numerical model of ground-water restoration.

The reviewer should evaluate whether the applicant has appropriately reduced the dimensionality and complexity of models. The dimensionality of models, heterogeneity of aquifer parameters, and significant process couplings may be reduced if it is shown that the reduced and simplified dimension model bounds the prediction of the full dimension model. The staff should evaluate the acceptability of the sensitivity analyses

used to support the model of the ground-water restoration and the estimation of restoration time and pore volume displacements.

Where appropriate, the reviewer may use an alternative model to perform an independent technical assessment of ground-water restoration.

(2) Evaluate estimates of post-extraction ground-water quality by comparison to descriptions of lixiviant composition and host rock geochemistry. Ensure that methods for estimating the affected pore volume are consistent with the methods used at any research and development site or other sites upon which restoration estimates may be based.

(3) Compare descriptions of the proposed restoration methods with those methods that have been successfully applied at other *in situ* leaching facilities. Sources of information can include research and development and production sites that are located in similar hydrogeologic environments and have used similar restoration techniques. However, the applicant is not required to present operational experience from a research and development facility as part of an application. Ensure that the proposed restoration methods are appropriate for the host rock and lixiviant chemistry.

(4) Assess whether the applicant has provided a reasonable standard for the determination of restoration success and a realistic assessment of the expected post-restoration water quality by comparing standards with previous restoration work at the research and development site or other previously restored *in situ* leaching facilities.

(5) Evaluate the ability of the post-reclamation stability monitoring program to verify successful restoration.

(6) Consider whether the proposed restoration program adequately addresses water quality cleanup because of well field flare (undetected spread of extraction solutions between the well field and monitor wells of the production zone), and whether the quantity of water pumped during restoration will adversely affect off-site ground-water uses.

(7) Assess whether plans for plugging and abandoning wells before license termination are consistent with generally accepted techniques.

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.

6.1.3 Acceptance Criteria

The primary purpose of restoring the ground-water quality in a well field after the completion of uranium extraction operations is to assure the protection of public health and the environment. NRC shares the regulatory oversight of ground-water restoration with the EPA under its

Underground Injection Control Program (40 CFR Part 144) and those underground injection control programs administered by EPA Authorized States. In addition to the NRC license, the EPA Authorized States issue underground injection control permits for *in situ* leaching operations, after the EPA grants an exemption from ground-water protection provisions for the portion of the aquifer undergoing uranium extraction (the exploited ore zone in an aquifer). The EPA aquifer exemption effectively removes that portion of the aquifer from any future consideration for ground-water protection; however, the ground-water protection provisions are still in effect for the aquifer adjacent to the exempted area. The EPA Authorized State may impose ground-water restoration requirements that are more stringent than the delegated federal program. Ground-water restoration requirements may vary from state to state. The reviewer is advised to closely coordinate the NRC licensing review activities with the underground injection control permitting programs of EPA Authorized States to avoid unnecessary duplication of effort. The following acceptance criteria should serve as the minimum requirements for demonstrating acceptability for the NRC licensing review.

The plans and schedules for ground-water quality restoration are acceptable if they meet the following criteria:

(1) The application includes estimates of the volume and quality of extraction solutions that need to be cleaned up during ground-water restoration. Generally, these estimates may be based on either experience with previous *in situ* leach operations or research and development investigations in similar host rock. Documentation of such prior experience should be included or referenced in the application. The applicant may also use numerical or analytical ground-water flow and transport modeling to support development of the ground-water restoration plan. When flow and transport modeling is used, the applicant must provide data and model justification to demonstrate that conclusions used to develop the restoration plan are reasonable. Data and model justification must meet the following criteria.

Important design features, physical phenomena, and consistent and appropriate assumptions are identified and described sufficiently for incorporation into the modeling that supports the ground-water restoration plan.

The applicant provides sufficient data to justify the selection of models used to develop the ground-water restoration plan and to adequately define model parameters, initial and boundary conditions, and any simplifying assumptions.

Parameter values, assumed ranges, probability distributions, and/or bounding assumptions used in modeling ground-water restoration are technically defensible and reasonably account for uncertainties and variabilities. The technical bases for each parameter value, ranges of values, or probability distributions used in the modeling ground-water restoration are provided.

In the case of sparse data and/or low confidence in the quality of available data or parameter estimates, the applicant demonstrates by sensitivity analyses or other

methods that the proposed ground-water restoration approach is appropriate, and the contingency built into the surety is consistent with the uncertainties.

For reactive transport models, adequate site geochemical data are provided to support the ground-water restoration plans and models. Water chemistry data are needed to develop an understanding of geochemical evolution as ground water is restored in the subsurface. The important geochemical parameters that should be delineated include pH, Eh, dissolved oxygen, temperature, major cation and anion concentrations, concentrations of potential contaminants, and host-rock mineralogy.

Reactive transport models incorporate thermodynamic data on solid phases and aqueous species, allowing the mass action calculations that determine estimated aqueous concentrations and solid phase evolution. Thermodynamic parameters constitute a major source of uncertainty in geochemical modeling, with potentially large effects on predicted aqueous ion concentrations. Therefore, geochemical modeling supporting ground-water restorations should include sensitivity analyses that provide assurance that contaminant concentrations will not be underestimated. Likewise, any kinetic models employed are subjected to critical analysis because of the large influence of kinetic effects at low temperatures. Additionally, consideration of geochemical model limitations and their effects on uncertainty is an important component of the review by the NRC. Such limitations include: the assumption of local equilibrium, neglect of porosity changes caused by precipitation or dissolution of the solid phase, omitting colloidal transport; neglect of density effects due to varying total dissolved solids, simplifying the mineralogical suite, and neglecting surface reactions such as ion exchange.

The applicant documents how the model output is validated in relation to site characteristics.

(2) The applicant describes the method used for estimating well field *pore volume*[1] and the associated horizontal and vertical *flare.*[2]

A pore volume is an indirect measurement of a unit volume of aquifer water affected by *in situ* leach extraction. It represents the volume of water that fills the void space inside a certain volume of rock or sediment. Typically, a pore volume is calculated by

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[1]*Pore volume* is a term of convenience used by the *in situ* leach industry to describe the quantity of free water in the pores of a given volume of aquifer material. It provides a unit reference that an operator can use to describe the amount of lixiviant circulation needed to leach an ore body, or describe the unit number of treated water circulations needed to flow through a depleted ore body to achieve restoration. A pore volume provides a way for an operator to use relatively small-scale studies and scale the results to field-level pilot tests or to commercial well field scales.

[2]*Flare* is a proportionality factor designed to estimate the amount of aquifer water outside of the pore volume that has been impacted by lixiviant flow during the extraction phase. The flare is usually expressed as a horizontal and vertical component to account for differences between the horizontal and vertical hydraulic conductivity of an aquifer material.

multiplying the surficial area of a well field (the area covered by injection and recovery wells) by the thickness of the production zone being exploited and the estimated or measured porosity of the aquifer material. The horizontal and vertical flares are usually expressed as additional percentages that are multiplied to the calculated pore volume. Specific flare factors approved in the past vary from 20 to 80 percent and are typically based on experience from research and development pilot demonstrations. The pore volume and flare factors provide a means of comparing the level of effort required to restore ground water regardless of the scale of the test. In general, the more pore volumes of water it takes to restore ground-water quality, the more effort it will cost to achieve restoration.

(3) The application includes well field restoration plans.

Restoration plans contain descriptions of the process to be used for well field restoration and projected completion schedules. This description should include restoration flow circuits, treatment methods, methods for disposal or treatment of wastes and effluents, monitoring schedules, a discussion of chemical additives used in the restoration process, anticipated effects of chemical additives, and alternate techniques that may be employed in the event that primary plans are not effective. Typically, restoration is divided into distinct sequential phases in which different techniques are employed. Ground-water sweep is used to pump water from the ore zone without reinjecting, to recall lixiviant from the aquifer and draw in surrounding uncontaminated water. Reverse osmosis/permeate injection circulates water from the well field through a reverse osmosis treatment process and reinjects the permeate into the well field, typically at rates similar to those used during production. Ground-water recirculation is used to evenly distribute water throughout the restored well field, to dilute any pockets of remaining contamination. An additional acceptable restoration method is the injection of chemical reductants (usually hydrogen sulfide, sodium sulfide, or sodium bisulfide) into the well field. These reductants are used to immobilize metals that may have been dissolved by the oxidizing lixiviant; however, some general water quality parameters, such as total dissolved solids, may be adversely affected by reductants.

NRC allows flexibility and innovation in approaches to restoration. Therefore, applicants are not limited to one restoration method for all well fields. Rather, they should describe the sequential phases of restoration that may be used and the most likely restoration scenario, based on research and development results and restoration experience. Other restoration approaches, such as in-place biological remediation techniques, have been discussed by some applicants. These techniques show promise, but have not been tested or evaluated at commercial scale *in situ* leach operations. The application of other restoration techniques may necessitate some form of pilot demonstration to evaluate the potential for unanticipated impacts, such as clogging of aquifer pore spaces or potential health impacts from introduced compounds and organisms, before the techniques are applied to full-scale operations.

Restoration plans should also include a list of monitored constituents, a monitoring interval, and the sampling density (wells/acre). An acceptable constituent list should be

based on the chemistry of the production and restoration solutions used and on the host rock geochemistry. In the interest of minimizing expense, the applicant may propose a limited set of indicator constituents to monitor restoration progress and a sampling density that does not include all production and injection wells. The applicant may also propose monitoring composite samples from the restoration stream. However, all wells that were sampled for baseline conditions should be sampled for the full list of monitored constituents before a determination of restoration success is made.

The applicant should specify the criteria that will be used to determine restoration success. Generally, the acceptance criteria for restoration success are based on the ability to meet the predetermined numerical standards of the restoration program and the absence of a significant increasing trends of monitored indicator constituent concentrations during the stability monitoring period.

For purposes of surety bonding, restoration plans must include estimates of the level of effort (typically in terms of pore volume displacements) necessary to achieve the primary restoration target concentrations. These estimations may be based on historical results obtained from the research and development site or experience in other well fields having similar hydrologic and geochemical characteristics.

(4) Restoration standards are established in the application for each of the monitored constituents.

The applicant has the option of determining numerical restoration limits for each monitored constituent on a well-by-well basis, or as a statistical average applied over the entire well field. Restoration standards must be established for the production zone and for any overlying or underlying aquifers that have the potential to be affected by *in situ* leach solutions.

(a) Primary Restoration Standards—The primary goal of a restoration program is to return the water quality within the exploited production zone and any affected aquifers to pre-operational (baseline) water quality conditions. Recognizing that *in situ* leach operations fundamentally alter ground-water geochemistry, restoration activities are likely to return ground-water quality to the exact water quality that existed at every location prior to *in situ* leach operations. Still, as a primary restoration goal, licensees are required to attempt to return the concentrations of the monitored water quality indicator constituents to within the baseline range of statistical variability for each constituent. This standard requires licensees to identify the type of statistical analysis and criteria that will be used to determine whether concentrations of water quality parameters in the affected aquifers fall within an acceptable range of baseline variability. Statistical approaches for determining whether contamination persists in affected aquifers are found in American Society for Testing and Materials Standard D 6312 (American Society for Testing and Materials, 2001).

(b) Secondary Restoration Standards—*In situ* leach operations may cause permanent changes in water quality within the exploited production zone, because the *in situ* leach extraction process relies on changing the chemistry in the production zone to remove the uranium. The applicant may therefore propose returning the water quality to its pre-operational class of use (e.g., drinking water, livestock, agricultural, or limited use) as a secondary restoration standard. Applications should state the principal goal of the restoration program and that secondary standards will not be applied so long as restoration continues to result in significant improvement in ground-water quality. The applicant must first attempt to return ground-water quality to primary restoration standards before falling back on secondary restoration standards. License conditions should be set up such that a license amendment is necessary before the applicant can revert to secondary goals. The applicant must commit to use reasonable efforts to reach primary restoration standards.

It is acceptable to establish secondary restoration standards on a constituent-by-constituent basis, with the numerical limits established to ensure state or EPA primary or secondary drinking water standards will not be exceeded in any potential source of drinking water. For radionuclides not included in the drinking water standards, it is acceptable to determine, on a constituent-by-constituent basis, secondary standards from the concentrations for unrestricted release to the public in water, from Table 2 of 10 CFR Part 20, Appendix B.

(c) If a constituent cannot technically or economically be restored to its secondary standard within the exploited production zone, an applicant must demonstrate that leaving the constituent at the higher concentration would not be a threat to public health and safety or the environment or produce an unacceptable degradation to the water use of adjacent ground-water resources. This situation might arise with respect to general water quality parameters such as the total dissolved solids, sulfate, chloride, iron, and others which do not typically present a health risk. However, not all the major constituents have a primary or secondary drinking water standard (e.g., bicarbonate, carbonate, calcium, magnesium, and potassium). Consequently, ground-water restoration may achieve the secondary standard for total dissolved solids, but may not achieve a secondary standard for individual major ions that contribute to total dissolved solids. If such a situation occurred, the applicant must show that leaving the individual constituent at a concentration higher than secondary standard would not be a threat to public health and safety nor the environment or produce an unacceptable degradation to the water use of adjacent ground-water resources. Such proposed alternatives must be evaluated on a case-by-case basis as a license amendment request only after restoration to the primary or secondary standard is shown not to be technically or economically achievable. This approach is consistent with the as low as is reasonably achievable philosophy that is used broadly within NRC.

(5) The post-restoration stability monitoring program is described in the application.

The purpose of a stability monitoring program is to ensure that chemical species of concern do not increase in concentration subsequent to restoration. The applicant should specify the length of time that stability monitoring will be conducted, the number of wells to be monitored, the chemical indicators to be monitored, and the monitoring frequency. These requirements will vary based on site-specific post-extraction water quality and geohydrologic and geochemical characteristics. Before final well field decommissioning is completed, all designated monitor wells must be sampled for all monitored constituents. Well fields may be decommissioned when all constituent concentrations meet approved restoration standards and no post-restoration degradation in ground-water quality occurs outside of the aquifer exemption boundary.

(6) The application includes a discussion of the likely external effects of ground-water restoration.

Ground-water restoration operations, and the expected post-reclamation ground-water quality, must not adversely affect ground-water use outside the exploited production zone. Water users from nearby municipal or domestic wells that were in use before *in situ* leach operations should be provided reasonable assurance that their water quality will not be impacted. Impacts are not limited to chemical constituent concentrations, but also include changes in color, odor, hardness, and taste of the water. The water quality outside the exploited production zone should not, as a result of *in situ* leach operations, exceed EPA primary or secondary drinking water standards for ground water. Ground-water quality should not exceed the appropriate state water-use standards for aquifers that cannot support a drinking water use.

(7) Methods for abandoning wells are included in the application.

The basic purpose for sealing abandoned wells and bore holes is to restore the well field to pre-operational hydrogeologic conditions. Any well or bore hole to be permanently abandoned should be completely filled in such a manner that vertical movement of water along the borehole is prevented. *In situ* leach operators usually rely on a drilling contractor to perform well abandonment. The application should specify the methods and materials to be used to plug holes, and that records documenting the well abandonment will be maintained by the licensee. Abandonment procedures that: (i) conform to American Society for Testing and Materials Standard D 5299 (1992); (ii) are from the State Engineer's Office; or (iii) are codified in state regulations or rules are considered acceptable. An applicant may propose other generally accepted standards for abandoning wells and boreholes. References for these standards should be specified in the application and copies should be kept on file by the applicant. Techniques proposed by the applicant that are not considered to be generally accepted abandonment practices should be described in detail and may require additional time for review.

(8) Descriptions of water consumption impacts.

During *in situ* leach operations, water quality impacts usually are more of a concern than water consumption impacts. This is because water consumption during *in situ* leach operations is relatively small. However, when restoration activities begin, water consumption may significantly increase. The amount of increase will depend on the restoration techniques applied. Techniques that clean up the aquifer by pumping water from the aquifer, cleaning the water, and reinjecting the clean water consume the least amount of water. Water consumption impacts will result in water loss from the aquifer and water level declines. The impacts of water consumption on local wells and water users should be evaluated. Water level declines can result in increased pumping costs or inability to obtain water from the aquifer in local wells. Water loss from the aquifer may mean that less water could be available to down gradient ground-water and surface-water users.

(9) The applicant may propose alternatives to restoring an exploited production zone to primary or secondary ground-water restoration standards in lieu of the above criteria. These alternatives must be evaluated on a case-by-case basis and must assure protection of human health and the environment and assure no unacceptable degradation to adjacent ground-water resources. As an example, if an applicant proposes no ground-water restoration activities within the exploited production zone, the applicant would be required to show that adequate institutional control provisions are in place to assure potential water supplies adjacent to the exploited production zone would not be accessed for a use that would harm human health or the environment. If predictive computer modeling is used to support this alternative, the model must be validated by comparing the modeling results to ground-water monitoring for an appropriate period of time after *in situ* leach operations cease in a well field. The applicant must maintain a financial surety to cover potential restoration costs in the event that monitoring results are contrary to model predictions and ground-water restoration must be initiated.

6.1.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the plans and schedules for ground-water quality restoration, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the plans and schedules for ground-water quality restoration proposed for use at the _____ *in situ* leach facility. This review included an evaluation of the methods that will be used to develop the ground-water restoration program and schedules using the review procedures in standard review plan Section 6.1.2 and the acceptance criteria outlined in standard review plan Section 6.1.3.

The applicant has committed to adopt well field ground-water restoration standards that are representative of the pre-operational baseline ground-water conditions. As a secondary

restoration goal, the applicant has identified and committed to ensure federal or state drinking water standards will not be exceeded outside of the aquifer exemption boundary as a result of operations.

The applicant's method for estimating well field pore volume is acceptable, taking into account the estimated effective porosity of the contaminated region and the lateral and vertical extent of contamination. With respect to the methodology for undertaking restoration, the applicant provided an acceptable approach that includes a mix of ground-water sweep, reverse osmosis, and ground-water recirculation. The well-field-specific mix of these approaches will be determined as part of the ground-water restoration plan for each individual well field. In addition, the applicant has proposed an acceptable method for determining the extent of well field flare and for ensuring acceptable restoration of the flare. The applicant has committed to an acceptable schedule for complete restoration for any well field after ore extraction ceases.

The applicant has presented an acceptable list of indicator constituents to be monitored and has specified acceptable criteria to determine the success of restoration either on a well-by-well or well field average basis. The number of pore volume replacements necessary to achieve the primary restoration targets has been provided and is acceptable. The applicant has adopted a primary restoration program that will return the water quality of the production zone and affected aquifers to pre-extraction (baseline) water quality, that any secondary restoration standards proposed by the applicant are acceptable, or that final water quality will protect public health and safety and the environment in compliance with as low as is reasonably achievable principles. The applicant's post-restoration stability monitoring program is acceptable.

The methods proposed for abandoning wells and sealing them to restore the well field to pre-extraction hydrologic conditions are acceptable. The applicant has evaluated the consumptive water impacts of the *in situ* leach facility using acceptable methods.

Based on the information provided in the application and the detailed review conducted of the plans and schedules for ground-water quality restoration for the _____ *in situ* leach facility, the staff concludes that the proposed plans and schedules for ground-water quality restoration are acceptable and are in compliance with 10 CFR 40.32(c), requiring 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), requiring that the issuance of the license will not be adverse to the common defense and security or to the health and safety of the public; and 10 CFR 51.45(c), which requires the applicant to provide sufficient data for the Commission to conduct an independent analysis. The related reviews of the 10 CFR Part 51 environmental protection regulations for domestic licensing and related regulatory functions for plans and schedules for ground-water restoration in accordance with standard review plan Sections 5.0, "Operations;" and 7.0, "Environmental Effects;" are addressed elsewhere in this technical evaluation report.

6.1.5 References

American Society for Testing and Materials. "Standard Guide for Developing Appropriate Statistical Approaches for Ground-Water Detection Monitoring Programs, Designation: D6312." West Conshohocken, Pennsylvania: American Society for Testing and Materials. 2001.

———. "Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, and Other Devices for Environmental Activities, Designation: D 5299." West Conshohocken, Pennsylvania: American Society for Testing and Materials. 1992.

6.2 Plans For Reclaiming Disturbed Lands

6.2.1 Areas of Review

Prior to commencement of reclamation, the licensee will provide the NRC with maps and data that document the post-operational condition. The staff should also review plans for (i) reclaiming temporary diversion ditches and impoundments, (ii) reestablishing surface drainage patterns disrupted by the proposed activities, and (iii) returning the ground surface and structures for post-operational use (i.e., license termination), in accordance with the criteria in Section 6.4 of the standard review plan.

Staff should review the pre-remediation radiological survey program that will identify areas of the site that need to be cleaned up to comply with NRC concentration limits. The staff should evaluate measurement techniques and sampling procedures proposed for determining the radionuclide concentrations and the extent of contamination of structures and soils. In addition, the review should confirm that the licensee will have an approved decommissioning radiation protection program in place before the start of reclamation and cleanup work and that an acceptable agreement is in place for off-site disposal of 11e.(2) byproduct material.

6.2.2 Review Procedures

The staff should determine whether the described approaches for reclaiming temporary diversion ditches and impoundments, reestablishing surface drainage patterns disrupted by the proposed activities, and returning the ground surface and structures for post-operational use are consistent with regulatory guidance and are sufficient to satisfy the requirements of 10 CFR Part 40, Appendix A, Criterion 6(6), and 10 CFR 40.42. The staff should ensure that the licensee intends to restore topography and vegetation to a state that is similar to pre-operational conditions. The staff should review the pre-reclamation survey plan to ensure that it provides adequate coverage to designate contaminated areas for cleanup. Particular attention should be focused on sampling temporary diversion ditches and surface impoundments, well field surfaces, process and storage areas, transportation routes, and operational air monitoring locations. These areas are expected to have higher levels of contamination than surrounding areas. The staff should also ensure that plans exist for the disposal of contaminated soils at an existing licensed byproduct material disposal facility, consistent with 10 CFR Part 40, Appendix A, Criterion 2. The staff should confirm that the

licensee has an approved radiological protection program to ensure worker safety during decommissioning, reclamation, and cleanup activities. Prior to commencement of reclamation, the NRC should review licensee commitments and any changes the licensee has proposed. The program for radiation protection is addressed in Section 5.7 of the standard review plan but additional review is needed to ensure any hazards specific to decommissioning are addressed (e.g., yellowcake dryer demolition). The staff should review the compliance history for the radiation safety program to identify any deficient areas that may require special consideration before the start of work.

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.

6.2.3 Acceptance Criteria

The plans for reclaiming disturbed lands are acceptable if they meet the following criteria:

(1) Appropriate cleanup criteria will be used in conducting the pre-reclamation surveys and planned cleanup activities. Acceptable cleanup criteria are discussed in standard review plan Sections 6.3 (for structures) and 6.4 (for soils).

(2) The pre-reclamation radiological survey program for buildings and soils identifies instruments and techniques similar to those used in the pre-operational survey program to determine baseline site conditions (e.g., background radioactivity) but also takes into account current technology (acceptable sensitivity), results from operational monitoring, and other information that provide insights to areas of expected contamination.

    Survey areas should include diversion ditches, surface impoundments, well field surfaces and structures in process and storage areas, on-site transportation routes for contaminated material and equipment, and other areas likely to be contaminated. A sampling grid of 100 m^2 (for soil) should be used and a statistical basis for sample size should be provided. Acceptable methods for sampling are provided in NUREG–1575, “Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)” (NRC, 2000).

(3) The licensee provides the procedures for interpretation of the pre-reclamation survey results and describes how they will be used to identify candidate areas for cleanup operations. Acceptable survey methods are discussed in standard review plan Section 6.4, “Procedures for Conducting Post-Reclamation and Decommissioning Radiological Surveys.”

(4) The discussion of surface restoration includes a pre-construction surface contour map, a description of any significant disruptions to surface features during facility construction and operation, and a description of planned activities for surface restoration that identifies any important features that cannot be restored to the pre-operations condition.

(5) Any changes to the existing NRC-approved radiation safety program that are needed for decommissioning and reclamation work are identified with appropriate justification to assure continued safety for workers and the public. Acceptable approaches for the radiation safety program are evaluated in accordance with Section 5.7 of this standard review plan, "Radiation Safety Controls and Monitoring."

(6) The applicant has an approved waste disposal agreement for 11e.(2) byproduct material disposal at an NRC or NRC Agreement State licensed disposal facility. This agreement is maintained on site. The applicant has committed to notify NRC in writing within 7 days if this agreement expires or is terminated and to submit a new agreement for NRC approval within 90 days of the expiration or termination. Failure to comply with this license condition will result in a prohibition from further lixiviant injection.

(7) The applicant commits to providing final (detailed) reclamation plans for land (soil) to the NRC for review and approval at least 12 months before the planned commencement of reclamation of a well field or licensed area. The final decommissioning plan includes a description of the areas to be reclaimed, a description of planned reclamation activities, a description of methods to be used to ensure protection of workers and the environment against radiation hazards.

(8) The decommissioning plan addresses the non-radiological hazardous constituents associated with the wastes according to 10 CFR Part 40, Appendix A, Criterion 6(7). Any unusual or extenuating circumstances related to such constituents should be discussed in the reclamation plan or decommissioning plan in relation to protection of public health and the environment and should be evaluated by staff.

(9) The quality assurance and quality control programs address all aspects of decommissioning. The programs should indicate a confidence interval or that one will be specified before collection of samples. The data to be used to demonstrate compliance and the quality assurance procedures to confirm that compliance data are precise and accurate are identified. Management will ensure that approved procedures are followed.

6.2.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the plans for reclaiming disturbed lands, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the plans for reclaiming disturbed lands proposed for use at the _____ *in situ* leach facility. This review included an evaluation of the methods that will be used to develop the reclamation of disturbed lands program using the review procedures in standard review plan Section 6.2.2 and the acceptance criteria outlined in standard review plan Section 6.2.3.

The applicant has acceptable plans for a pre-reclamation radiation survey that use instrumentation and techniques similar to the pre-operational survey used to establish baseline site conditions, if these are still acceptable methods. The applicant has acceptably considered results from operational monitoring and other information relative to areas of expected contamination in its reclamation plans. Areas to be evaluated include diversion ditches, surface impoundments, well field surfaces, and structures in process and storage areas, on-site transportation routes, and other areas likely to be contaminated. The applicant has proposed acceptable methodology to determine areas to be resampled or sampled with higher than normal densities. The applicant has defined appropriate procedures for the pre-reclamation survey and the means used to identify areas for cleanup using the acquired data. Methods proposed for reclamation and an acceptable plan for surface restoration, including identification of any irreversible changes, have been provided. The applicant has assured NRC that any required changes to the radiation safety program identified as a result of the reclamation work will be implemented before commencing the work.

Based on the information provided in the application and the detailed review conducted of the plans for reclaiming disturbed lands for the _____ *in situ* leach facility, the staff concludes that the proposed plans are acceptable and are in compliance with 10 CFR 40.32(c), which requires applicant proposed equipment, facilities, and procedures to be adequate to protect health and minimize danger to life or property; 10 CFR 40.42(g)(4), which provides requirements for final decommissioning plans; 10 CFR 40.41(c), which requires the applicant to confine source or byproduct material to the locations and purposes authorized in the license; 10 CFR Part 40, Appendix A, Criterion 2, which requires that the applicant provide objective evidence of an agreement for disposal of 11e.(2) byproduct materials either in a licensed waste disposal site or at a licensed mill tailings facility to demonstrate non-proliferation of waste disposal sites; 10 CFR Part 40, Appendix A, Criterion 6(6), which identifies cleanup criteria requirements; and 10 CFR 51.45(c), which requires the applicant to provide sufficient data for the Commission to conduct an independent analysis.

The reclamation plan specifies the location of records of information important to the decommissioning as required by 10 CFR 40.36(f) and meets the criteria of 10 CFR 40.42(g)(4) and (5). The plan sufficiently demonstrates that the proposed reclamation activities will result in compliance with 10 CFR 40.42(j)(2) requirements to conduct a radiation survey. The plan complies with the 10 CFR 40.42(k)(1) and (2) requirements that source material be properly disposed of and reasonable effort be made to eliminate residual radioactive contamination. The plan demonstrates the proposed reclamation activities will result in compliance with 10 CFR Part 40, Appendix A, Criterion 6(7) requirements to prevent threats to human health and the environment from non-radiological hazards.

6.2.5 Reference

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

6.3 Removal and Disposal of Structures, Waste Materials, and Equipment

6.3.1 Areas of Review

The staff should review methodologies proposed for removal and disposal of contaminated structures and equipment used during *in situ* leach operations, as well as techniques for managing toxic and radioactive waste materials. The reviewers should also evaluate approaches for identifying radiological hazards before initiating dismantlement of structures and equipment and for detection and cleanup of removable contamination from such structures and equipment. The staff should also review plans for ensuring that all contaminated facilities and equipment are addressed and are either planned to be disposed of in a licensed facility, will meet the contamination levels for unrestricted use, or are designated for re-use at another *in situ* leach facility. The staff should also review provisions made for the removal and disposal of byproduct material to an existing uranium mill or licensed disposal site.

6.3.2 Review Procedures

The staff should determine whether the techniques proposed for removing and disposing of structures and equipment used during *in situ* leach operations and approaches for managing toxic and radioactive waste materials are consistent with regulatory guidance and sufficient to meet the applicable regulatory requirements in 10 CFR 40.42. Plans for structures and equipment to be released for unrestricted use should be reviewed using standard review plan Section 5.7.6, "Contamination Control Program." The staff should confirm that plans for dismantlement of structures and equipment include a preliminary assessment of anticipated hazards that should be considered before dismantlement. This should include the use of appropriate survey methods to determine the extent of contamination of equipment and structures before starting decommissioning and reclamation work. Particular attention should be focused on those parts of the processing system that are likely to have accumulated contamination over long time periods such as pipes, ventilation equipment, effluent control systems, and facilities and equipment used in or near the yellowcake dryer area. The staff should also review provisions made for the removal and disposal of byproduct material to an existing uranium mill or licensed disposal site to ensure that they meet requirements of 10 CFR Part 40, Appendix A, Criterion 2.

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.

6.3.3 Acceptance Criteria

The procedures for removing and disposing of structures, waste materials, and equipment are acceptable if they meet the following criteria:

(1) A program is in place to control residual contamination on structures and equipment.

(2) Measurements of radioactivity on the interior surfaces of pipes, drain lines, and 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, and ductwork.

(3) Surfaces of premises, equipment, or scrap that are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement are presumed to be contaminated in excess of the limits.

(4) Before release of structures for unrestricted use, the licensee makes a comprehensive radiation survey to establish that contamination is within the limits specified in standard review plan Section 5.7.6, “Contamination Control Program” and obtain NRC approval.

(5) A contract between the licensee and a waste disposal operator exists to dispose of 11e.(2) byproduct material.

(6) The applicant commits to providing final (detailed) decommissioning plans for structures and equipment to the NRC for review and approval at least 12 months before the planned commencement of decommissioning of such structures and equipment. The final decommissioning plan includes a description of structures and equipment to be decommissioned, a description of planned decommissioning activities, a description of methods to be used to ensure protection of workers and the environment against radiation hazards, a description of the planned final radiation survey, and an updated detailed cost estimate. A license condition will be established to this effect.

6.3.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the methodologies for removal and disposal of structures, waste materials, and equipment, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the methodologies for removal and disposal of structures and equipment used at the _____ *in situ* leach facility. This review included an evaluation of the methods that will be used to develop the procedures for removal and disposal of structures, waste materials, and equipment using the review procedures in standard review plan Section 6.3.2 and the acceptance criteria outlined in standard review plan Section 6.3.3.

The applicant has established an acceptable program for the measurement and control of residual contamination on structures and equipment. The applicant has made acceptable plans for measurements of radioactivity on the interior surfaces of pipes, drain lines, and ductwork by making appropriate measurements at all traps and other access points where contamination is likely to be representative of system-wide contamination. All premises, equipment, or scrap likely to be contaminated but that cannot be measured, will be assumed by the applicant to be contaminated in excess of limits and will be treated accordingly. For all premises, equipment, or scrap contaminated in excess of specified limits, the applicant will provide detailed, specific information describing the premises, equipment, or scrap in terms of extent and degree of radiological contamination. The applicant will provide a detailed health and safety analysis that

reflects that the contamination and any use of the premises, equipment, or scrap will not result in an unacceptable risk to the health and safety of the public nor the environment. The applicant plans to conduct a comprehensive radiation survey to establish that any contamination is within limits specified before the release of the premises, equipment, or scrap. A contract exists between the licensee and a licensed waste disposal site operator to dispose 11e.(2) byproduct material.

Based on the information provided in the application and the detailed review conducted of the methodologies for removal and disposal of structures, waste materials, and equipment for the _____ *in situ* leach facility, the staff concludes that the methodologies are acceptable and are in compliance with 10 CFR 40.32(c), which provides requirements for final decommissioning plans; 10 CFR 40.42(g)(4), 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 40.41(c), which requires the applicant to confine source or byproduct material to the locations and purposes authorized in the license; and 10 CFR Part 40, Appendix A, Criterion 2, which requires that the applicant provide objective evidence of an agreement for disposal of 11e.(2) byproduct materials either in a licensed waste disposal site or at a licensed mill tailings facility to demonstrate non-proliferation of waste disposal sites.

6.3.5 References

None.

6.4 Methodologies for Conducting Post-Reclamation and Decommissioning Radiological Surveys

6.4.1 Areas of Review

The staff should review methodologies for conducting post-reclamation and decommissioning radiological surveys. The staff should review the radiological verification survey program that will serve as a basis for determining compliance with NRC concentration limits. The staff should evaluate the measurement techniques and sampling procedures proposed.

6.4.2 Review Procedures

The staff should determine whether the methodologies for conducting post-reclamation and decommissioning radiological surveys are acceptable to verify that concentration limits of 10 CFR Part 40, Appendix A, Criterion 6(6) are met. The staff should ensure that sampling and locations are acceptable and representative of conditions at the site. The staff should consider the survey methods provided in NUREG–1575 (NRC, 2000) along with the applicable site conditions to determine the acceptability of the licensee proposed sampling techniques. The staff should confirm that the determination of background concentrations of radium-226 and other radionuclides is based upon sampling in uncontaminated areas near the site. Other radionuclides that should be sampled if suspected to be present include thorium-230, thorium-232, uranium; and lead-210.

The radium benchmark dose applies for cleanup of residual radionuclides other than radium in soil and for surface activity on structures. If appropriate, the reviewer should refer to Appendix E of this standard review plan for guidance on the benchmark approach.

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

6.4.3 Acceptance Criteria

The procedures for conducting post-reclamation and decommissioning radiological surveys are acceptable if they meet the following criteria:

(1) The cleanup criteria for radium in soils are met as provided in 10 CFR Part 40, Appendix A, Criterion 6(6).

This criterion states that the design requirements for longevity and control of radon releases apply to any portion of a licensed and/or disposal site unless such portion contains a concentration of radium in land, averaged over areas of 100 m^2, which as a result of byproduct material, does not exceed the background level by more than

(i) 5 picocuries per gram (pCi/g) of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over the first 15 cm [5.9 in.] below the surface,

(ii) 15 pCi/g of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over 15-cm [5.9-in.] thick layers more than 15 cm [5.9 in.] below the surface

(2) Background radionuclide concentrations are determined using appropriate methods as described in Section 2.9, “Background Radiological Characteristics,” of this standard review plan. If there are large variations in the background radionuclide concentrations within a given site, the licensee may assign different background radionuclide concentrations to different areas of the site, provided that the licensee properly justifies the background concentrations selected for each area.

(3) Acceptable cleanup criteria for uranium in soil, such as those in Appendix E of this standard review plan, are proposed by the applicant. This is the radium benchmark dose approach of 10 CFR Part 40, Appendix A, Criterion 6(6).

(4) For areas that already meet the radium cleanup criteria, but that still have elevated thorium levels, the applicant proposes an acceptable cleanup criterion for thorium-230. One acceptable criterion is a concentration that, combined with the residual concentration of radium-226, would result in the radium concentration (residual and from thorium decay) that would be present in 1,000 years meeting the radium cleanup standard.

(5) The survey method for verification of soil cleanup is designed to provide 95-percent confidence that the survey units meet the cleanup guidelines. Appropriate statistical tests for analysis of survey data are described in NUREG–1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (NRC, 2000).

6.4.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the methodologies for conducting post-reclamation and decommissioning radiological surveys, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the methodologies for conducting post-reclamation and decommissioning radiological surveys proposed for use at the _____*in situ* leach facility. This review included an evaluation of the methods that will be used for the post-reclamation and decommissioning radiological surveys using the review procedures in standard review plan Section 6.4.2 and the acceptance criteria outlined in standard review plan Section 6.4.3.

The applicant has developed acceptable methodologies for verification of cleanup (final status survey plan) that demonstrate that the radium concentration in the upper 15 cm [5.9 in.] of soil will not exceed 5 pCi/g and in subsequent 15 cm [5.9 in.] layers will not exceed 15 pCi/g. Also, the cleanup of other residual radionuclides in soil will meet the criteria developed with the radium benchmark dose approach (Appendix E), including a demonstration of as low as is reasonably achievable and application of the unity test of 10 CFR Part 40, Appendix A, Criterion 6(6) where applicable. For cases in which the licensee has proposed an alternative to the requirements of Criterion 6(6) or the approved guidance, the staff determines that the resulting level of protection is equivalent to that required by this criterion.

Based on the information provided in the application and the detailed review conducted of the methodologies for conducting post-reclamation and decommissioning radiological surveys for the _____ *in situ* leach facility, the staff concludes that the methodologies 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; 10 CFR Part 40, Appendix A, Criterion 6(6), which provides standards for cleanup of radium; and 10 CFR 51.45(c), which requires the applicant to provide sufficient data in an environmental report for the Commission to conduct an independent analysis.

6.4.5 Reference

NRC. "Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)." Revision 1. Washington, DC: NRC. 2000.

6.5 Financial Assurance

6.5.1 Areas of Review

The staff should review financial assessments (cost estimates) provided by the applicant for the costs of ground-water restoration (standard review plan Section 6.1); reclamation (standard review plan Section 6.2); and decommissioning and waste disposal (standard review plan Section 6.3). These assessments may be provided as an appendix. The staff should review provisions for a financial surety that is consistent with Criteria 9 of 10 CFR Part 40, Appendix A, and the guidance in Appendix C of this standard review plan.

6.5.2 Review Procedures

The staff should review the proposed surety amount provided to ensure that it is sufficient to fund all decommissioning activities documented in the license application, that the methods used to establish the surety amount are acceptable, and that the forecast costs are reasonable. Activities to be covered by the surety include reclamation, off-site disposal of 11e.(2) byproduct material, ground-water restoration, structure and equipment removal, and closure. The purpose of the financial surety is to provide sufficient resources for completion of reclamation of the facility including building decommissioning and well field restoration and soil reclamation, by a third party, if necessary.

The reviewer should determine whether the assumptions for the financial surety analysis are consistent with what is known about the site (standard review plan Section 2.0) and the design and operations of the facility and its effluent control system (standard review plan Sections 3.0, 4.0, and 5.0). To the extent possible, the applicant should base these assumptions on experience from generally accepted industry practices, from research and development activities at the site, or from previous operating experience in the case of a license renewal. The values used in the analysis should be based on current dollars (or adjusted for inflation) and reasonable values for the costs of various activities. The reviewer should also examine the type of financial instrument(s) proposed for the surety to ensure that it is consistent with the requirements of 10 CFR Part 40, Appendix A, Criterion 9.

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.

6.5.3 Acceptance Criteria

The cost estimate for ground-water restoration, decommissioning, reclamation, and waste disposal is acceptable if it meets the following criteria:

(1) The bases for establishing a financial surety in 10 CFR Part 40, Appendix A, Criterion 9 are satisfied. The surety for well fields is usually established as they go into production. Once accepted, the surety will be reviewed annually by NRC to assure that sufficient

funds would be available for completion of the reclamation plan by a third party. Detailed guidance on reviewing financial assessments for *in situ* leach operations is found in Appendix C of this standard review plan .

The reviewer shall examine licensee commitments and proposed schedules for surety updates in response to facility changes, annual updates, and changes in closure or decommissioning plans. Additional guidance to reviewers is contained in NMSS Decommissioning Standard Review Plan, NUREG–1727 (NRC, 2000).

(2) All activities included in the cost estimate are activities that are included either in the reclamation plan or in the operations review completed using Sections 6.1 through 6.4 of this standard review plan.

(3) All activities included either in the reclamation plan or in Sections 6.1 through 6.4 of this standard review plan are included in the financial analysis.

(4) The assumptions used for the proposed surety are consistent with what is known about the site (standard review plan Section 2.0) and the design and operations of the facility and its effluent control system (standard review plan Sections 3.0, 4.0, and 5.0). To the extent possible, the applicant has based these assumptions on experience from generally accepted industry practices, any research and development at the site, or previous operating experience in the case of a license renewal.

(5) Surety values are based on current dollars (or are adjusted for inflation), and reasonable costs for the required reclamation activities are defined.

(6) The applicant commits to funding the approved financial surety through one of the mechanisms described in 10 CFR Part 40, Appendix A, Criterion 9, including a (i) surety bond, (ii) cash deposit, (iii) certificate of deposit, (iv) deposit of a government security, (v) irrevocable letters or lines of credit, or (vi) combinations of the above that meet the total surety requirements.

(7) The applicant commits to updating the surety value annually, in response to changes in closure or decommissioning plans, and as necessitated by changes in the facility and its operations. The annual update will be submitted ninety (90) days prior to the surety anniversary date each year.

(8) The applicant commits to extending the surety for an additional year if NRC has not approved a proposed revision thirty (30) days prior to the surety expiration date.

(9) The applicant commits to revising the surety arrangement within three (3) months of NRC approval of a revised closure (decommissioning) plan if estimated costs exceed the amount of the existing financial surety. This revised surety instrument will take effect within thirty (30) days of NRC written approval of the surety documents.

(10) Surety documentation includes a breakdown of costs; the basis for cost estimates with adjustments for inflation; a minimum 15-percent contingency; and changes in engineering plans, activities performed, and any other conditions affecting estimated costs for site closure.

(11) The licensee commits to submitting for NRC approval an updated surety to cover any planned expansion or operational change not included in the annual surety update at least ninety (90) days prior to beginning associated construction.

(12) The licensee commits to providing NRC with copies of surety-related correspondence submitted to a state, a copy of the state's surety review, and the final approved surety arrangement. The licensee also commits that, where the surety is authorized to be held by the state, the surety covers all appropriate costs

(13) Reclamation/decommissioning plan cost estimates, and annual updates should follow the outline in Appendix C to this standard review plan.

6.5.4 Evaluation Findings

If the staff review, as described in this section, results in the acceptance of the financial assurance cost estimate, the following conclusions may be presented in the technical evaluation report.

NRC has completed its review of the financial assurance cost estimate for the _____ *in situ* leach facility. This review included an evaluation of the methods that will be used to develop the procedures using the review procedures in standard review plan Section 6.5.2 and the acceptance criteria outlined in standard review plan Section 6.5.3.

The applicant has established an acceptable financial assurance cost estimate based on the requirements in 10 CFR Part 40, Appendix A, Criterion 9. The applicant has assured that sufficient funds would be available for completion of the reclamation plan by an independent contractor. The applicant has included in the financial analyses all the activities in the reclamation plan or in Sections 6.1–6.4 of the standard review plan. The applicant has based the assumptions for financial surety analysis on site conditions, including experiences with generally accepted industry practices, research and development at the site, and previous operating experience (in the case of a license renewal). The values used in the financial surety analysis are based on current dollars (or are adjusted for inflation) and reasonable costs for the required reclamation activities are defined. The financial instrument(s) proposed are acceptable to NRC and meet the total surety requirements (select appropriate description).

Based on the information provided in the application and the detailed review conducted of the financial assurance cost estimate for the _____ *in situ* leach facility, the staff concludes that the amount of the proposed financial surety and its methods of estimation are acceptable and are consistent with 10 CFR Part 40, Appendix A, Criterion 9, which that requires financial surety arrangements be established by each operator.

6.5.5 Reference

NRC. NUREG–1727, NMSS Decommissioning Standard Review Plan." Washington, DC: NRC. 2000.