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DRAFT
STANDARD REVIEW PLAN
for *In Situ* Uranium Mining License Applications

Revision 0

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards
Division of Waste Management

May 1997

Well Field is two words and not just one word.

426.1

General Comments

~~[illegible]~~

(1) Policy Statement on Environmental Justice (April, 1995) need to be looked at to determine if we need to include Environmental Justice in the SRP.

(2) The ~~[illegible]~~ SRP needs to provide procedures on what we can do to rely on State reviews.

(3) The SRP could reference Criterion 2, Criterion 6, Criterion 5F from 10CFR40.

(4) Put in Pyramid of Licensing & Inspection Functions

(5) Replace "License Application" with "Application"

Eliminate "Areas of Review" "Acceptance" "Evaluation Findings" & "References" Throughout

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INTRODUCTION

A Nuclear Regulatory Commission (NRC) source and byproduct material license is required under the provisions of Title 10 Code of Federal Regulations, Part 40 (10 CFR Part 40), Domestic Licensing of Source Material, to recover uranium by *in situ* solution mining techniques (*in situ* leaching or ISL). An applicant for a research and development or commercial-scale license, or for the renewal, or amendment of an existing license, is required to provide detailed information on the facilities, equipment, and procedures to be used and an environmental report (ER) that discusses the effect of proposed operations on the health and safety of the public and on the environment. This information is used by the Commission to determine whether the proposed activities will, among other things, result in undue risk to the health and safety of the public or adversely affect the environment. General guidance for filing an application and for producing an environmental report is provided in 10 CFR 40.31, Applications for Specific Licenses, and in 10 CFR Part 51, Licensing and Regulatory Policy and Procedures for Environmental Protection, respectively. The purpose of this guide is to provide the NRC staff specific guidance on the review of applications for *in situ* uranium solution mining facilities licenses. Applications for licenses authorizing research and development studies are treated in a similar but less comprehensive manner than commercial-scale operations because research and development activities are not considered to be major federal actions.

This standard review plan (SRP) is prepared for the guidance of staff reviewers in the Uranium Recovery Branch of the Division of Waste Management (DWM), Office of Nuclear Materials Safety and Safeguards (NMSS) in performing safety reviews of applications to develop ISL operations. It may be used for license applications (LAs), renewals, and amendments, and throughout the remainder of the SRP, LA is synonymous with application, renewal, or amendment. The principal purpose of the SRP is to assure the quality and uniformity of staff reviews and to present a well-defined base from which to evaluate proposed changes in the scope and requirements of reviews. The SRP is also intended to make information about regulatory matters widely available and to improve communication and understanding of the staff review process by interested members of the public and the uranium mining industry.

This guide is intended to provide instructive guidance. It should not be considered as a substitute for a careful evaluation of a program proposed by an applicant. Information not specifically discussed in this guide should be included in the application if it is a part of an applicant's proposed or existing operations that may effect health and safety or the environment. In some cases, information discussed in this guide may not be appropriate or necessary, depending on site-specific characteristics and circumstances. In those cases, the application should describe why the information is not necessary or appropriate. An incomplete application will result in processing delay and may result in the rejection of a LA.

Changes to existing licensed activities and conditions require the issuance of an appropriate license amendment. An application for such an amendment should describe the proposed changes in detail and should discuss the potential environmental and health and safety impacts, using the appropriate sections of this document for guidance.

Filing an Application

The National Environmental Policy Act (NEPA) of 1969 (83 Stat. 852), implemented by Executive Order 11514 and the Council on Environmental Quality regulations of July 30, 1979 (44 FR 55978), requires all agencies of the federal government to prepare detailed environmental impact statements (EIS) on

proposals for legislation and other major federal actions significantly affecting the quality of the human environment. The principal objective of NEPA is to build into agency decision making processes an appropriate and careful consideration of the environmental impacts of proposed actions. NRC licensing and regulatory policies and procedures for the preparation and processing of EISs and related documents, such as environmental impact appraisals, in accordance with NEPA, are set forth in 10 CFR Part 51.

The provisions of 10 CFR 40.31(f) and of 10 CFR 51.45 require the submittal of both a LA (Form NRC-2) and a separate ER for certain activities requiring an NRC source and byproduct material license, including ISL operations. In view of the nature of an ISL operation, where the major consideration of both an applicant submittal and the staff review is the assessment of the environmental impacts of the proposed activity, it is reasonable that an application and ER should consist of a single document (hereinafter referred to as the application or LA) containing the information discussed herein.

An application for a new commercial-scale license should be filed at least 12 mo prior to planned construction for the proposed operation. An application for a new research and development license should be filed at least 6 mo prior to planned construction for the proposed operation. An application for a renewal of an existing license should be filed at least 30 days prior to the expiration date of the existing license. An application for an amendment to an existing license should be filed with sufficient lead time to permit a detailed assessment by the NRC staff and issuance of the required authorization before the proposed modification is scheduled to be implemented. All applications must be accompanied by a remittance in the full amount of the fee specified in 10 CFR Part 170, Fees for Facilities and Materials Licenses and Other Regulatory Services Under the Atomic Energy Act of 1954, as Amended. Applications may be filed with the Director, Office of NMSS, U.S. Nuclear Regulatory Commission, Washington, DC 20555, or may be filed in person at the Commission offices at 1717 H Street NW., Washington, DC, or One White Flint North, 11555 Rockville Pike, Rockville, Maryland.

10 CFR 51.40 requires an applicant for a license authorizing commercial-scale mining to submit to the Director, Office of NMSS, 15 copies of the application described above. The applicant is also required to retain an additional 85 copies of the application for distribution to federal, state, and local authorities in accordance with written instructions issued by the Director, Office of NMSS. An applicant for a license authorizing research and development for ISL mining or for amendments or renewals for any ISL mining operation should submit 10 copies of the LA and/or ER to the Branch Chief, Uranium Recovery Branch, DWM.

ISL mining licenses are generally issued for 10-yr periods and are renewable over the life of the project. License renewal applications are processed in a manner similar to that used for new applications. Operational experience, site-specific data, and proposed continuing activities are the primary factors considered by the NRC staff in processing renewal applications.

Presentation of Information

The application should be clear and concise. Each subject should be treated in sufficient depth and with sufficient documentation[1] to permit the NRC to independently evaluate the information presented. An

[1]Documentation as used in this guide means presentation of information, supporting data, and statements and includes (1) references to published information, (2) citations from applicant experience, and (3) references to unpublished information developed by the applicant or consultants. Statements not supported by documentation may be acceptable provided the applicant identifies them as such or as expressions of belief or judgment.

INTRODUCTION

A Nuclear Regulatory Commission source and byproduct material license is required under the provision of Title 10 of the Code of Federal Regulations, Part 40 (10 CFR Part 40), Domestic Licensing of Source Material, to recover uranium by in situ solution mining techniques (in situ leaching or ISL). The licensing process for 10 CFR Part 40 licenses is pictured in Figure 1. An applicant for a new operating license, or for the renewal or amendment of an existing license, is required to provide detailed information on the facilities, equipment, and procedures to be used and an Environmental Report (ER) that discusses the effect of proposed operations on public health and safety and the impact on the environment. This information is used by NRC staff to determine whether the proposed activities will protective of public health and safety, and be environmentally acceptable. General guidance for filing an application and for producing an environmental report is provided in 10 CFR 40.31, Applications for Specific Licenses, and in 10 CFR Part 51, Licensing and Regulatory Policy and Procedures for Environmental Protection, respectively.

The purpose of this standard review plan (SRP) is to provide the staff in the Office of Nuclear Material Safety and Safeguards (NMSS) with specific guidance on the review of applications for ISL mining facilities. The SRP will be used by the NMSS staff in the review of license applications (LAs) for new facilities, renewals, and amendments. Throughout the remainder of this SRP, LA is synonymous with application, renewal, or amendment. The principal purpose of the SRP is to ensure a consistent quality and uniformity in the NRC staff reviews. Each section in this SRP provides guidance on the technical discipline who performs the review, what is to be reviewed, the basis for the review, how the staff review is to be accomplished, what the staff will find acceptable in a demonstration of compliance with the regulations, and the conclusions that are sought regarding the applicable sections in 10 CFR.

Application of this SRP is intended to cover only those aspect of the NRC regulatory mission related to the licensing of a facility. As such, the SRP is helping focus the NRC staff review on determining if a facility can be constructed and operated in compliance with the applicable NRC regulations. A licensing review is not intend to be a detailed evaluation of how exactly the facility will be operated. Specific information about implement of the program outlined in an LA is accomplished through the NRC review of procedures and operations done as part of the inspection function. A breakdown of the difference between licensing reviews and inspections is provided in Figure 2. The SRP is also intended to make information about regulatory matters widely available and to improve communications and understanding of the staff review process by interested members of the public and the uranium recovery industry.

The SRP is written so as to cover a variety of site conditions and plant designs. Each section provides the complete procedure and acceptance criteria for all of the areas of review pertinent to that section. For any given application, the staff reviewer may select and emphasize particular aspects of each SRP section as appropriate for the application. Because of this, the staff may not carry out in detail all of the review steps listed in each SRP section in the review of every application.

Changes to existing licensed activities and conditions require the issuance of an appropriate license amendment. An application for such an amendment should describe the proposed changes in detail, and should discuss the potential environmental and health and safety impacts, using the appropriate sections of this document for guidance. For amendments, the focus of the review should be on just the changes proposed in the amendment. Reviewers should not review other previously accepted actions if not part of the amendment unless the review of the amendment package identifies problems with other aspects of

facility operation.

For renewals, the licensee need only submit information showing changes from the currently accepted license. Like amendments, staff reviews should focus on those aspects of facility operation that are different from what is in the accepted application. The licensee need not resubmit a complete application covering all aspects of facility operation. Reviewers should analyze the inspection history of the site to see if any major operational problems have been identified over the course of the license term, and review changes to operations from those currently found acceptable. If these are found acceptable, then the license is acceptable for renewal.

The products that will be prepared by the NRC staff as a result of its review will be a Technical Evaluation Report, and, if appropriate an EA with a Finding of No Significant Impact. Preparation of an EA is required under the provisions of 10 CFR 51.20 unless: 1) the staff finds based on the EA that it needs to prepare an Environmental Impact Statement (EIS); 2) an EIS is needed by another Federal agency also involved in the action as a cooperating agency; 3) an EIS would be needed because of the controversy at the site; or 4) the action is categorically excluded by 10 CFR 51.22.

It is important to note that the acceptance criteria laid out in this SRP are for the guidance of NMSS staff responsible for the review of applications to operate ISL facilities. Review plans are not substitutes for the Commission's regulations and compliance with a particular review plan is not required. Methods and solutions different from those set out in the SRP will be acceptable if they provide a basis for the findings requisite to the issuance or continuance of a license by the NRC.

evaluation of information or data should clearly state the conclusions of the evaluation and should present the analyses and supporting data in sufficient detail to permit an independent reviewer to verify the result. Tables, line drawings, and photographs should be used wherever they contribute to the clarity and brevity of the application. The number of significant figures stated in numerical data should reflect the accuracy of the data. Descriptive and narrative passages should be brief and concise. In cases where test results to support conclusions are presented, the procedures, techniques, and identification of equipment used to obtain the test data should be included. When computer codes have been used, the code name, version number, and date should be provided. Input and output data should be documented and the user manual should be referenced.

Information previously submitted to the NRC may be incorporated into the application by reference. Each reference should be clear and specific. That is, the reference should indicate by document, date, page, and paragraph the information the applicant wishes to reference and provide a discussion of the relevance of such information.

Pertinent published information relating to a proposed site or facility and its surroundings should be referenced. Where published information or assumptions may be essential to evaluate specific aspects of the proposed activities, this information should be included in summary or verbatim form or as an appendix to the application.[2]

An ISL mining operation may include one or more ore bodies or wellfields in the same general area plus an associated processing plant. An applicant should address all projected activities over the anticipated lifetime of operations to the extent possible. If the proposed operation is at the site of other licensed uranium recovery activities, an applicant should consider the cumulative or synergistic effects of directly associated activities.

All pages of the application should be numbered and dated. Any changes to the original LA or environmental report made prior to issuance of a source material license should be submitted to the NRC in the form of replacement pages, figures, charts, graphs, or tables. The date of the change should be included on each page of replacement material. The applicant should review the entire application and related documents to eliminate any contradictory statements or proposals that may result from changes to a particular chapter or section.

Contents of an Application

The application should contain the information specified in items 1 through 8 of Form NRC-2. The information required in items 9 through 14 of Form NRC-2 should be incorporated into the various items identified in the chapters of the Regulatory Guide 3.46, Standard Format and Content of License Applications Including Environmental Reports for *In-Situ* Uranium Solution Mining (SFCG) that primarily address processing, in-plant radiation safety, and environmental considerations. Particular attention should be given to the information requested in Chapter 5, Operations, of the SFCG. Compliance with the specifications delineated in chapter 5 is normally made a specific condition of the NRC operating license.

[2]The distinction between pertinent and essential hinges on the effect that the information may have on the review of potential impacts to public health and safety and the environment. Useful information that is not likely to impact public health and safety or the environment is pertinent, whereas information that may reasonably be necessary for the review to ensure protection of public health and safety and the environment is essential.

The written specifications to be presented in the application in accordance with chapter 5 [these written specifications are required by 10 CFR 40.31(h)] are related to information in other chapters. Accordingly, chapter 5 of the SFCG should be reviewed in connection with other information throughout the review. The following environmental concerns must also be addressed in these chapters:

(1) The environmental impact of the proposed action

(2) Any adverse environmental effects that could not be avoided if the proposal were implemented

(3) Alternatives to the proposed action

(4) The relationship between local short-term uses of the environment (e.g., uranium recovery activities) and the maintenance and enhancement of long-term productivity

(5) Irreversible and irretrievable commitments of resources associated with the proposed operations

General guidance for filing a LA is provided in 10 CFR 40.31. General guidance regarding the requirements that must be met prior to the issuance of a specific license is provided in 10 CFR 40.32. The specific information required by the staff to support evaluation of an LA is identified in the SFCG. The SRP sections correspond to the SFCG sections, and are numbered in a matching manner. The NRC must determine whether the proposed activities will result in undue risk to the health and safety of the public or will adversely affect the environment.

Although the NRC has no regulations specifically addressing ISL operations, the requirements of 10 CFR Part 40, appendix A and 10 CFR Part 20 are generally applicable and provide the basis for many acceptance criteria and review procedures in this SRP. Material from a variety of NRC regulatory guides and technical positions has also been incorporated.

General Review Procedure

The general licensing process is outlined in the flow diagram provided in figure 1. The steps of the LA review process are described in the following paragraphs.

Acceptance Review

The staff will conduct an acceptance review of the LA to determine the completeness of the information submitted. This review requires a comparison of the submitted information to the information identified in the SFCG. The application will be considered ~~acceptable~~ if the information provided is complete, reflects an adequate reconnaissance and physical examination of the regional and site conditions, and provides appropriate analyses and design information to demonstrate that the applicable acceptance criteria will be met. ~~The reviewer should request additional information as appropriate from the~~ applicant, ~~keeping in mind that the time spent in obtaining a~~ complete application will speed the detailed review of ~~the application, preparation of the safety evaluation report (SER), and development of an environmental assessment (EA) or EIS.~~ The ~~reviewer~~ should complete the acceptance review and transmit the results to the applicant within 30 days of receipt of the application.

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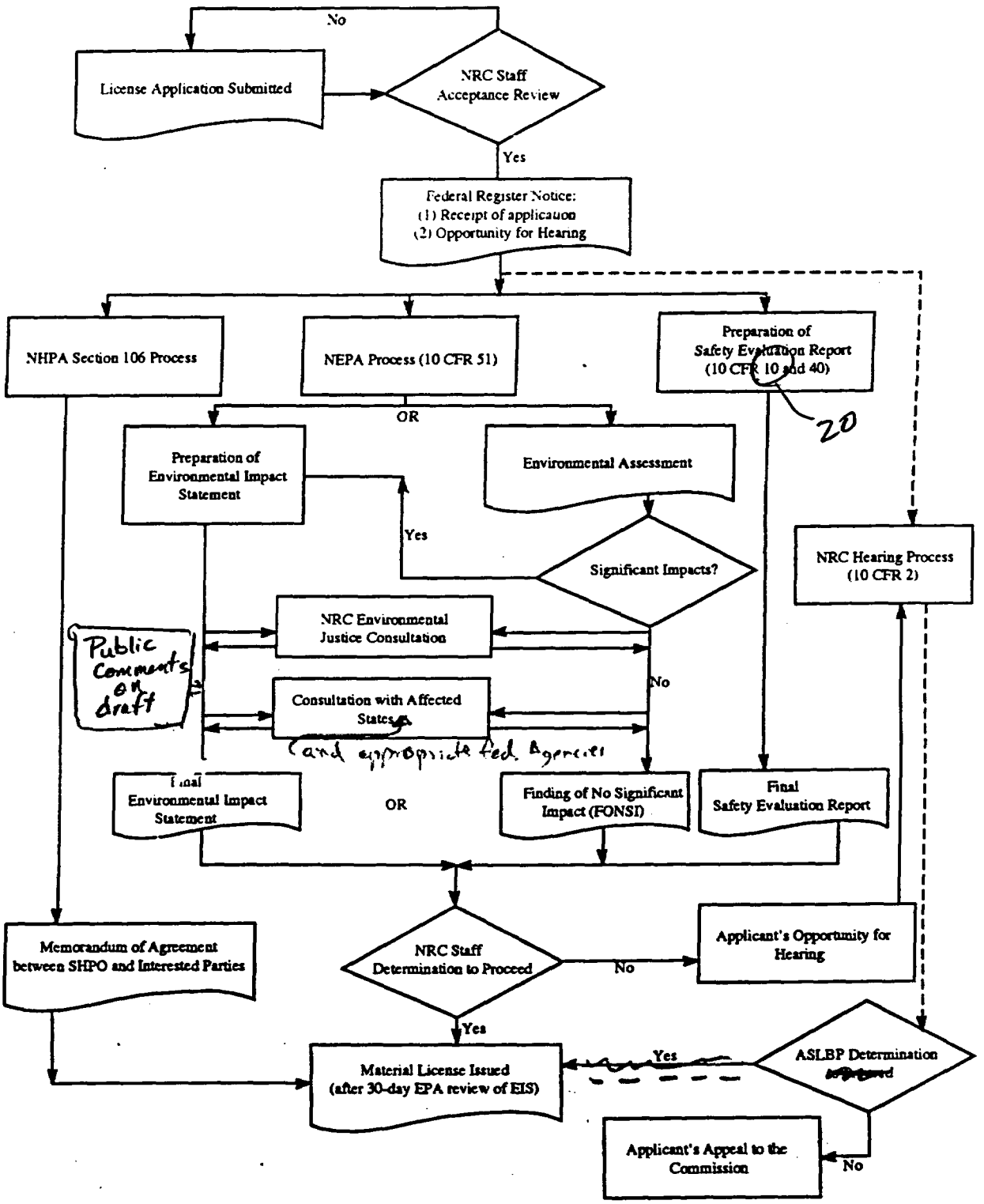

Figure 1. Licensing process for 10 CFR Part 40 licenses

Detailed Review

Following completion of the acceptance review, the staff will conduct a detailed technical review of the application. The results of this review and the basis for concurrence in or rejection of the requested licensing action are documented by the NRC in an SER and either an EA (10 CFR 51.30) if there is a finding of no significant impact, or an EIS (10 CFR 50.31) if the review indicates that the licensed activity would have a significant impact on the health and safety of the public or on the environment. The detailed review should evaluate the environmental, economic, and technical evidence provided by the applicant to support the ability of the proposed facility to meet applicable regulatory requirements.

The Standard Review Plan

The SRP is written to address a variety of site conditions, facilities, effluent controls, operations, environmental monitoring, groundwater restoration, reclamation activities, and decommissioning activities. Each SRP section provides the review procedures and acceptance criteria for the areas of review pertinent to that section and addresses the matters to be reviewed, the bases for the review, how to accomplish the review, and the conclusions that are sought. However, for any specific LA, the staff reviewers may select and emphasize particular aspects of each SRP section as appropriate. In some cases the features of an LA may be sufficiently similar to earlier submittals that a complete review is not needed. For these and other similar reasons, the staff may decide not to carry out all of the review steps listed in each SRP section in detail. Each SRP section is organized into five subsections described in the following paragraphs.

I. Areas of Review

This subsection describes the scope of the review (i.e., what is being reviewed). It contains a brief description of the specific technical information and analyses in the LA that must be reviewed by each technical reviewer.

II. Review Procedures

This subsection discusses the appropriate review technique. It is generally a step-by-step procedure that the reviewer uses to determine whether the acceptance criteria have been met.

III. Acceptance Criteria

This subsection identifies the applicable NRC regulatory requirements and delineates criteria that can be applied by the reviewer to determine the acceptability of the applicant compliance demonstration. The technical bases for these criteria have been derived from 10 CFR Parts 40 and 20, NRC regulatory guides, general design criteria, codes and standards, branch technical positions, standard testing methods [e.g., American Society for Testing and Materials (ASTM) standards], technical papers, and other similar sources. These sources typically include solutions and approaches previously determined to be acceptable by the staff for making compliance determinations for the specific area of review. These acceptance criteria have been defined so that staff reviewers can use consistent and well-documented approaches for review of all LAs. Applicants may take approaches to demonstrating compliance that are not consistent with the review procedures and acceptance criteria in this SRP. However, applicants should recognize that, as is the case for regulatory guides, substantial staff time and effort have gone into the development of these procedures and criteria, and a corresponding amount of time and effort may be required to

review and accept new or different solutions and approaches. Thus, applicants proposing solutions and approaches to safety problems or safety-related design areas other than those described in this SRP may expect longer review times and NRC request for more extensive supporting information. The staff is willing to consider proposals for other solutions and approaches on a generic basis, apart from a specific LA, to avoid the impact of the additional review time for individual cases.

IV. Evaluation Findings

This subsection presents general conclusions and findings of the staff that result from review of each area of the LA. Conclusions and findings for a specific LA and review area are dependent on the site and type of licensing action being considered. For each SRP section, a conclusion is included in the SER in which results of the review are published. The SER contains a description of the review; ~~an identification~~ of ~~matters modified by the applicant~~, including aspects of the review selected or emphasized; ~~which areas require additional information, will be resolved in the future, or remain unresolved;~~ where the facility design or the applicant programs deviate from the criteria stated in the SRP; and the ~~bases for any exemptions from the regulations~~.

V. References

This subsection lists any applicable references.

SRP Updates

The SRP will be revised and updated periodically as the need arises to clarify the content or correct errors and to incorporate modifications approved by NRC management. A revision number and publication date are printed at a lower corner of each page of the SRP. Since individual sections will be revised as needed, the revision numbers and dates may not be the same for all sections. Corresponding changes to the SFCG will be made as required.

1.0 PROPOSED ACTIVITIES

This chapter of the application should summarize the overall proposed activities for which a license is requested in sufficient detail to permit the reviewer to obtain a basic understanding of the proposed activities and potential environmental impact. Review of the subsequent chapers can then be accomplished with a better perspective and with recognition of their relative importance to the overall operations.

1.1 AREAS OF REVIEW

The reviewer will examine the summary of the proposed activities for which a license is requested to gain a basic understanding of those proposed activities and their potential for causing an environmental impact. For the purposes of license renewals or amendments and to gain an understanding of facility history since the previous license issuance, the reviewer should also examine the record of amendments and inspection results and the summary of changes to operating activities, if any, that are proposed in the license application (LA).

The staff should review the corporate entities involved; the location of the proposed activities; land ownership; ore-body locations and estimated U_3O_8 content; proposed solution mining method and recovery processes; operating plans, design throughput and anticipated annual U_3O_8 production; estimated schedules for construction, startup, and duration of operation; plans for project waste management and disposal; plans for groundwater quality restoration, decommissioning, and land reclamation; and surety arrangements covering eventual facility decommissioning, groundwater quality restoration, and site reclamation. Applications for licenses authorizing commercial-scale operations should rely heavily on results from research and development operations as a basis for the proposed processes, operating plans (including plans for groundwater quality restoration), and assessment of potential environmental impact.

1.2 REVIEW PROCEDURES

Selection and emphasis of various aspects of the areas covered by this standard review plan (SRP) section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should determine whether the LA provides a sufficiently comprehensive summary of the nature of the facilities, equipment, and procedures to be used in the proposed *in situ* leach (ISL) activity. For a renewal of an existing license, the reviewer should examine the summary of proposed changes since the license was last granted to provide a basis for determining the potential health, safety, and environmental effects of these changes.

1.3 ACCEPTANCE CRITERIA

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.41 gives the Nuclear Regulatory Commission (NRC) authority to require an applicant to submit such information as may be useful in aiding the NRC to comply with section 102(2) of the National Environmental Policy Act (NEPA).

The description of the proposed activities is acceptable if

(1) The LA summary of proposed activities ~~should~~ includes descriptions of the following items that are sufficient to provide a basic understanding of the proposed activities and their potential health, safety, and environmental impact. The content of the introduction is outlined in the Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG) (Nuclear Regulatory Commission, 1992).

(a) Corporate entities involved

(b) The location of the proposed facilities

(c) Land ownership

(d) Ore-body locations and estimated U_3O_8 content

(e) Proposed solution mining method and recovery process

(f) Operating plans, design throughput, and annual U_3O_8 production

(g) Estimated schedules for construction, startup, and duration of operations

(h) Plans for project waste management and disposal

(i) Plans for groundwater quality restoration, decommissioning, and land reclamation

(j) Surety arrangements covering eventual facility decommissioning, groundwater quality restoration, and site reclamation

(k) For license renewals; a summary of proposed changes, a record of amendments since the last license issuance, and documentation of inspection results

(2) Applications for commercial-scale operations include results from research and development operations or previous operating experience as a basis for the proposed processes, operating plans, groundwater quality restoration, and assessment of potential environmental impact.

~~(3) For license renewals, previous submittals are referenced so long as these references are readily available.~~

1.4 EVALUATION FINDINGS

No specific evaluation finding will be made for the Proposed Activities section. The reviewer should use the summary in this section of the LA to gain a basic understanding of the proposed activities and their potential health, safety, and environmental impact. The reviewer should determine whether the summary is sufficient to support the review of the LA and should document any inadequacies in the sufficiency of the summary.

The reviewer should keep in mind that this section is meant to be a summary of the proposed activities and that detailed information is provided in other sections of the LA. A lack of sufficient detail in the introduction may slow the review process, but should not be used as justification for rejecting the LA.

1.5 REFERENCES

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46.* Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

Rewritten using information from 40.31
NRC staff will provide info.

2.0 SITE CHARACTERIZATION

This section of the LA should present the basic relevant information concerning those physical, ecological, demographic, and social characteristics of the environs that might be affected by the proposed operations. To the extent possible, the information presented should reflect observations and measurements made over a sufficient period of time to allow defensible conclusions to be reached.

2.1 SITE LOCATION AND LAYOUT

2.1.1 Areas of Review

The staff should review geographic maps, topographic maps, and drawings that identify the site and its location relative to federal, state, county, and other political subdivisions. These should include maps provided to show the location and layout of the proposed facilities, wellfields, and all principal structures such as waste ponds, evaporation ponds, deep injection wells, recovery plant buildings, exclusion area boundaries and fences, applicant property and leases, and adjacent properties.

The regional location and site layout for the proposed ISL operations should be reviewed using maps that show the relationship of the site to local water bodies (lakes and streams), geographic features (highlands, forests), geologic features (faults, folds, outcrops), transportation links (roads, rails, airports, waterways), political subdivisions (counties, townships) and nonapplicant property (farms, settlements). A contour map of the site showing a plan layout of constructions, significant topographic variations of the site environs, and drainage gradients should be evaluated.

2.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should establish the validity and completeness of the basic data in order to determine that the site location and layout proposed in the LA are complete and accurate, and the site information is sufficient to evaluate the location of the proposed facilities relative to key features and activities.

The staff should examine maps and drawings provided in the LA and associated environmental reports to determine whether they provide sufficient detail to locate the site regionally relative to local political subdivisions and natural features and that the maps allow the staff to determine the proposed layout within the existing topography at the site. On a regional scale, the reviewer should examine the location of the facility and all federal, state, county, and local political subdivisions that have a bearing on estimating the environmental impact of the proposed operations. The staff should verify that the total acreage that is owned or leased by the applicant and the portion of that real estate or any adjacent properties likely to be affected by site activities have been identified. The reviewer should examine a contour map to determine that the contour intervals and information included on the map are sufficient to show any significant variations in site environs and important drainage gradients. The staff should also

For new applications, renewals, and significant amendments, the reviewer should conduct a site visit of the facility, after becoming familiar with the submitted materials, in order to provide adequate orientation for review and verify the general aspects of the submitted materials

determine that the relationship between the site and surface drainage is readily apparent from the provided maps. Likewise, it should be possible to ascertain the likely areas and effects of site activities on local flora and fauna from the location maps. Staff should determine that the scale and clarity of the maps are adequate to conduct the ~~required~~ environmental ~~impact assessment~~. necessary & safety reviews

2.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 40.31 requires the submission of both a LA and an environmental report (ER) that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve as an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG (Nuclear Regulatory Commission, 1982) has been prepared by the NRC to aid applicants in the development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

The description of the site location and layout is acceptable if

(1) Maps are provided that show geologic features, wellfields, and all planned principal structures such as waste ponds, evaporation ponds, monitoring wells, deep injection wells, and recovery plant buildings.

(2) Maps are provided to show exclusion area boundaries and fences.

(3) Maps are provided that show the applicant property and leases and adjacent properties, including water bodies, forests, and farms and all federal, state, county and local political subdivisions.

(4) Maps are provided that show nearby population centers and transportation links such as railroads, highways, and waterways.

(5) A topographic map is provided with elevation contours that show the locations of drainage basins and variations in the drainage gradient in the vicinity of the proposed ISL facility.

(6) The proposed ISL facility is clearly labeled at a scale appropriate to the area being covered (regional and local) and with sufficient clarity and detail to allow identification and evaluation of the proposed ISL facility. Maps are at an appropriate scale and are clear and readable.

(7) Data sources are documented. in reports such as USGS open files or existing published maps.

(8) Maps include designation of scale, orientation (e.g., North arrow), and geographic coordinates.

It data is generated by 2-2 the applicant, The data documenting should include a description of the investigation and data reduction techniques.

(9) If the LA is for a renewal, legible maps from earlier submittals can be used, with proposed changes highlighted. In addition to maps, the applicant may provide tabular locations of facilities using universal transverse mercator (UTM) coordinates with appropriate Northing and Easting in meters.

2.1.4 Evaluation Findings

The staff should determine, based upon a review of the descriptions of site location and layout whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the site location and layout. If the staff determines that the description of the site location and layout is sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.1.3, then the following findings will be made:

(1) The description of the site location and layout is adequate to allow an assessment of the relationship of the site to surrounding features and activities in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(2) The description of the site location and layout is adequate to allow evaluation of the potential impact of the facility on the surrounding area in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.1.5 References

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46*, Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

2.2 USES OF ADJACENT LANDS AND WATERS

2.2.1 Areas of Review

The staff shall review descriptions of the nature and extent of present and projected land use (e.g., agriculture, sanctuaries, hunting, grazing, industry, recreation, roads), any recent trends or changes in population or industrial patterns, and any other nuclear fuel cycle facilities located or proposed within an 80 km (50 mi) radius of the site.

The staff shall also review tables showing, for each of the 22 1/2-degree sectors centered on each of the 16 compass points (i.e., north, north-northeast, etc.) the distances [to a distance of 3.3 km (2 mi)] from the center of the site to the nearest resident and to the nearest site boundary.

The staff review shall include the location, nature, and amounts of present and projected surface and groundwater use (e.g., water supplies, irrigation, reservoirs, recreation, and transportation) within 3.3 km (2 mi) of the site boundary [0.8 km (0.5 mi) for research and development operations] and the present and projected population associated with each use point.

Tabulated data on both present and projected future water use will be evaluated including location, distances, withdrawal rate, return rates, type of water use, source and projection of water use estimates, and abandoned well locations.

2.2.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should determine whether the application provides sufficient information on the use of the lands and waters within a 3.3 km (2 mi) ~~radius~~ surrounding the proposed facilities [0.8 km (0.5 mi) for research and development operations] to assess the potential impacts of ISL mining on adjacent properties. distance from site boundary

The staff should determine that the LA contains the location of residence and groundwater supply-wells as well as surface water reservoirs and the estimated use of water in the lands surrounding the site of the proposed facility. Data sources should be referenced. This information should be evaluated to determine whether it delineates the likely impact(s) of the facility, under both normal operating conditions and accidents, on the groundwater, surface water, and population (both human and animal) near the site. The reviewer should determine that within a 3.3 km (2 mi) radius, the nature and extent of present and projected water and land use and any other trends or changes in population or industrial patterns have been reported. Any other nuclear fuel cycle facilities located or proposed within an 80 km (50 mi) radius of the site should be identified. from the site boundary

For license renewals, particular attention should be paid to changes in land and water use patterns. Earlier submittals can be incorporated by reference, but the application should provide the most recent land and water use statistics so that the reviewer can assess the current and future impact of the facility.

2.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both a LA and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve as an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG has been prepared by the NRC to aid applicants in the development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

Information on uses of adjacent lands and waters is acceptable if

(1) Information is presented in detail sufficient for understanding the surrounding land and water uses, such that the risks imposed by ISL mining operations can be adequately assessed.

Although the specific requirements may vary from site to site, the general purpose of determining land and water use patterns is to provide supporting data for exposure calculations and cost-benefit analyses. NRC has historically found that a 2 mi radius from the center of the proposed mining site is an acceptable area for which land and water use data should be collected. One acceptable method of presenting this data is for the applicant to provide the information requested in the SFCG (Nuclear Regulatory Commission, 1982), section 2.2. The information presented should include

(a) Maps showing the locations of nearest residences, groundwater supply wells, and abandoned wells.

(b) Types of present and projected water use (e.g., municipal, domestic, agriculture, livestock), and descriptions of the methodology and sources used to develop projections.

(c) Present and projected water use estimates by type for both groundwater and surface water, including present and projected withdrawal, and descriptions of the methodology and sources used to develop projections.

(d) Present and projected return rates, if appropriate, and descriptions of the methodology and sources used to develop projections.

(e) For groundwater wells: well depth, groundwater elevations, flow rates, drawdown, and a description of the producing aquifer(s).

(f) The locations of abandoned wells and drill holes, including the depth, type of use, condition of closing, plugging procedure used, and date of completion for each well or drill hole within the site area and within 0.4 km (.25 mi) of the wellfield boundary.

(g) Descriptions of the nature and extent of projected land use (e.g., agriculture, recreation, industry, and grazing) and descriptions of the methodology and sources used to develop projections.

(h) For commercial facilities, the location of any other nuclear fuel cycle facilities located or proposed within an 80 km (50 mi) radius of the site.

(2) For each of the 22.5-degree sectors centered on the 16 cardinal compass points, the information identified in section 2.2.3 of the SFCG (Nuclear Regulatory Commission, 1982) concerning human residences, nearest site boundary(ies) to residences, surface and groundwater use, and projected water use is provided. As described in section 2.2 of the SFCG (Nuclear Regulatory Commission, 1982), appropriate presentation of the data

should include mapped data as appropriate, and a tabular summary for each of the 22.5 degree sectors centered on the 16 cardinal compass points, and for each the distance from the center of the site to the site boundary and the nearest residence.

Generic change

(3) Data sources are documented.

(4) Maps include designation of scale, orientation (e.g., North arrow), and geographic coordinates.

2.2.4 Evaluation Findings

The staff should determine, based upon a review of the descriptions of the uses of adjacent lands and waters, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding uses of adjacent land and waters. If the staff determines that the description of the uses of adjacent land and waters is sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.2.3, then the following findings will be made:

(1) The description of the uses of adjacent land and waters is ~~adequate~~ acceptable to allow an assessment of the effects of the proposed ISL operations on land use and water supplies in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(2) The description of the uses of adjacent land and waters is ~~sufficient~~ acceptable to support the site description and any conceptual and numerical models used in the LA in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.2.5 References

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46,* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

2.3 POPULATION DISTRIBUTION

2.3.1 Areas of Review

The staff should review population data based on the most recent census, including maps that identify places of significant population grouping such as cities and towns within an 80 km (50 mi) radius [3.2 km (2 mi) for research and development operations] from the approximate center of projected activities in the format specified in the SFCG (Nuclear Regulatory Commission, 1982). The staff will review the basis for population projections.

In addition, for commercial-scale operations, the staff will review descriptive material giving significant population and visitor statistics of neighboring schools, plants, hospitals, sports facilities, residential areas, parks, etc., within 3.3 km (2 mi) of the ISL operations. The review will include appropriate available food production data in kg/yr for vegetables (by type and totals), meat (all types),

and milk and any available future predictions for this production by local governmental, industrial, or institutional organizations within 3.3 km (2 mi) of the site boundary.

2.3.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should determine that data has been tabulated and presented in pie segments as described in section 2.3 of the SFCG (Nuclear Regulatory Commission, 1982). The basis for population projections should be described. Recent agricultural production data should be included for vegetables, meat, milk, and other foodstuffs, in addition to predictions for future production by government, industry, or institutions for land within 3.3 km (2 mi) of the site. It is important to ascertain that the most recent census data has been used and that the data presented will support subsequent exposure-dose calculations and risk assessments.

2.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both a LA, and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve as an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG (Nuclear Regulatory Commission, 1982) has been prepared by the NRC to aid applicants in the development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill of the requirements of 10 CFR 51.45.

(A) The description of the population distribution is acceptable if

(1) Population data ~~from the latest census are provided~~ based on generally accepted sources such as the U.S. Census Bureau, and state and local agencies.

(2) A map of suitable scale is provided that identifies significant population centers within an 80 km radius (50 mi) [3.2 km (2 mi) for research and development operations] from the approximate center of the projected activities.

(3) A map of suitable scale is provided centered on the proposed ISL operation marked with concentric circles at 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, 70, and 80 km divided into 22 1/2 degree sectors centered on one of the 16 compass points. A table keyed to this map showing separate and cumulative population totals for each sector and annular ring. The distance to the nearest residence is noted for each sector.

(4) Descriptions of significant population and visitor statistics of neighboring schools, plants, hospitals, sports facilities, residential areas, parks, and forests within 3.3 km (2 mi) of the proposed ISL facility based on generally accepted sources such as U.S. Census Bureau, and state and local agencies are provided, with identification of data sources.

(5) Food production data (kg/yr) for vegetables, meat, and milk based on generally accepted sources such as U.S. Department of Agriculture, Farm Bureau, and state and local agriculture services are provided, with identification of data sources.

(6) Projections are included of population, visitor, and food production data over the expected life of the ISL facility (typically tens of years).

(7) Descriptions of the methodology and sources used to develop projections are provided.

(8) Data sources are documented.

2.3.4 Evaluation Findings

The staff should determine, based upon a review of the description of the population distribution near the site whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the description of the population distribution. If the staff determines that the description of the population distribution is sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.3.3, then the following findings will be made.

(1) The description of the population distribution in the region of the proposed ISL operations is adequate to allow an assessment of the potential impact of the facility on the surrounding population in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(2) The description of the population distribution is sufficient to support the site description and any conceptual and numerical models used in the LA in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.3.5 References

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46*, Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

2.4 REGIONAL HISTORIC, ARCHEOLOGICAL, ARCHITECTURAL, SCENIC, CULTURAL, AND NATURAL LANDMARKS

2.4.1 Areas of Review

The staff will review discussions of the historic, scenic, archeological, architectural, cultural, and natural significance, if any, of the proposed site and nearby areas, with specific attention to the site

and nearby areas listed in the National Registry of Natural Landmarks and properties included in or eligible for inclusion in the National Register of Historic Places.

The staff will review identifications of those properties included in or eligible for inclusion in the National Register of Historic Places located within the area of the proposed project and evidence of contact with the appropriate state historic preservation officer (SHPO), including a copy of the SHPO comments concerning the effect of the facility on historic, archeological, architectural, and cultural resources.

The review will include information on whether new roads, pipelines, and utilities for the proposed activity will pass through or near any area or location of known historic, scenic, cultural, natural, archeological, or architectural significance.

2.4.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine that the applicant has used the appropriate databases and records to identify historic, archaeologic, scenic, cultural, or natural landmarks that are found within the study region. The staff should determine that the locations and descriptions of the features are adequate to allow an evaluation of any potential impacts of the proposed facilities on the landmarks. Of particular interest are features included in the national Registry of Natural Landmarks and/or the National Register of Historic Places. Means to consider and treat such data are discussed in the SFCG (Nuclear Regulatory Commission, 1982). The data presented should support the determination of estimates of long-term costs in terms of potential impairment of the aesthetic or recreational values of such landmarks. It is important that the application document evidence of contact with knowledgeable sources when no landmarks are identified by the applicant within the study area. The likely impact of the presence of new roads, pipelines, or other utilities on areas and locations of known historic, scenic, cultural, natural, archaeologic, or architectural significance should be reported. The applicant should provide evidence of conferring with the SHPO and that the information provided is in concurrence with the National Historic Preservation Act (NHPA), section 106.

2.4.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both a LA, and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG (Nuclear Regulatory Commission, 1982) has been prepared by the Commission to aid applicants in the

(8) A letter of _____ must also be received from the SHPO for [illegible] site (cultural resources).

development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

The description of regional historic, archeological, scenic, cultural, and natural landmarks is acceptable if

(1) A listing of all areas included in or eligible to be included in the National Registry of Historic Landmarks is provided.

(2) A listing for all of properties included in or eligible for inclusion in the National Register of Historic Places is provided.

(3) A map is included showing all identified historic landmarks and historic places with respect to the location of facilities such as buildings, new roads, wellfields, pipelines, evaporation ponds, and utilities that might affect these areas.

(4) Discussions are incorporated of the treatment of areas of historic, archeological, architectural, scenic, and cultural significance that follow guidance equivalent to that provided by the National Park Service Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archeological, Architectural) Resources, August 1973 (National Park Service, 1973). Where appropriate, tribal authorities have been consulted for possible impact on Native American cultural resources.

(5) Evidence is provided of contact with the appropriate SHPO and tribal authorities. This evidence includes a copy of the SHPO and tribal authority comments concerning the effects of the proposed facility on historic, archeological, architectural, and cultural resources.

(6) The applicant presents a memorandum of agreement between the SHPO, tribal authorities, and other interested parties regarding their satisfaction with regard to the protection of historic, archeological, architectural, and cultural resources during site construction and operations. ~~The NRC should not enforce the conditions of the NHPA~~.

(7) The aesthetic and scenic quality of the site is rated in accordance with the U.S. Bureau of Land Management (BLM) Visual Resource Inventory and Evaluation System (U.S. Bureau of Land Management, 1978).

If the rating is below 19 (scale of 0 to 33), no special management is required. If the rating is 19 or above, the LA provides a management plan for minimizing the impact of the proposed facility.

~~(8) Data sources are documented.~~

2.4.4 Evaluation Findings

The staff should determine, based upon a review of the descriptions of regional historic, archeological, architectural, scenic, cultural and natural landmarks near the site, whether the information

(9) A letter from the State SHPO must be obtained the describe if the there are any problems with site on the State or federal register and any sites eligible for inclusion on the State & federal register

is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the regional historic, archeological, architectural, scenic, cultural and natural landmarks near the site. If the staff determines that the descriptions of regional historic, archeological, architectural, scenic, cultural, and natural landmarks near the site are sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.4.3, then the following findings will be made.

The staff should conclude that the applicant to

(1) The ~~description of the~~ regional historic, archeological, architectural, scenic, cultural, and natural landmarks in ~~the Region of the~~ proposed ISL operations ~~is adequate to allow~~ an ~~assessment of the potential impact of the facility on these site in accordance with~~ the requirements of 10 CFR 40.31 and 10 CFR 51.45.

meets the

(2) The applicant has consulted with and obtained necessary concurrences from the appropriate federal, state, and tribal authorities with respect to the management of the regional historic, archeological, architectural, scenic, cultural, and natural landmarks in the region of the proposed ISL operations in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.4.5 References

National Park Service. 1973. *Preparation of Environmental Statements: Guidelines for Discussion of Cultural (Historic, Archeological, Architectural) Resources*. Washington, DC: National Park Service.

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

U.S. Bureau of Land Management. 1978. *Upland Visual Resource Inventory and Evaluation*. BLM Manual Section 8411. Washington, DC: U.S. Department of the Interior.

2.5 METEOROLOGY

2.5.1 Areas of Review

The staff should review descriptions of the atmospheric diffusion characteristics of the site and its surrounding area based on data collected onsite or at nearby meteorological stations. The data to be reviewed include

(1) National Weather Service (NWS) station data including locations of all NWS stations within an 80 km (50 mi) radius, available joint frequency distribution data by wind direction, wind speed, stability class, period of record, and height of data measurement.

(2) Onsite meteorological data including locations and heights of instrumentation, descriptions of instrumentation, and a minimum of one full year of onsite joint frequency distribution data.

(3) Miscellaneous data including annual average mixing layer heights, a description of the regional climatology, and total precipitation and evaporation by month.

The staff should also review a discussion of the general climatology including existing levels of air pollution, the relationship of the regional meteorological data to the local data, the impact of the local terrain and large lakes and other bodies of water, and the occurrence of severe weather in the area and its effects. This review will also include data on averages of temperature and humidity.

2.5.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the application includes sufficient local and regional scale meteorological information to support estimates of the potential for airborne radionuclide transport from the proposed ISL operation to the surrounding area and for determination of airborne pathway inputs to risk assessment models. This information may include NWS data and onsite monitoring data, or data from local meteorological stations, and any maps or tables that describe meteorological conditions at the site and surrounding area. Section 2.5 of the SFCG (Nuclear Regulatory Commission, 1982) contains a list of the minimum meteorological data requirements. The reviewer should verify that meteorological data are summarized in a discussion that includes

(1) Assessment of extreme weather conditions that may be encountered and their potential effect on ISL operations. This should include, but is not limited to, potential effects of freezing, wind loading on structures, wind-driven projectiles, and flooding.

(2) A summary of meteorological inputs used in radiological risk models such as MILDOS-Area.

2.5.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both an LA and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG has been prepared by the NRC to aid applicants in the development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

The description of meteorology is acceptable if

(1) A description of the general climate of the region and local meteorological conditions is based on appropriate data from NWS, military, or other stations recognized as standard installations is provided.

These data include precipitation, evaporation, and joint frequency distribution data by wind direction, wind speed, stability class, period of record, and height of data measurement. The average inversion height should also be identified. Data should also be provided on diurnal and monthly averages of temperature and humidity. The locations of all stations used in the data analysis and the height of the data measurement should be included. Data periods should be defined by month and year and cover a sufficient time period to constrain long-term trends.

(2) Data from local meteorological weather stations supplemented by data from an onsite monitoring program are provided.

The onsite program should be designed in accordance with Regulatory Guide 1.23, Onsite Meteorological Programs (Nuclear Regulatory Commission, 1972), and Regulatory Guide 3.63, Onsite Meteorological Measurement Program for Uranium Recovery Facilities - Data Acquisition and Reporting (Nuclear Regulatory Commission, 1988).

(3) Consideration of relationships between regional weather patterns and local meteorological conditions based on weather station data and the onsite monitoring program is included. The impacts of terrain and nearby bodies of water on local meteorology are assessed, and the occurrence of locally severe weather is described and its impact considered.

(4) The application contains a description of existing levels of air pollution.

Information on potential for air pollution is based on U.S. Environmental Protection Agency (EPA) studies. Affected counties within 80 km (50 mi) of the facility are classified according to the National Ambient Air Quality Standards (NAAQS) as being in attainment (below NAAQS) or nonattainment (above NAAQS) status.

(5) A minimum of one full year of joint frequency data presented with a joint data recovery of 90 percent or more is provided.

(6) The sources of all meteorological and air quality data are documented.

2.5.4 Evaluation Findings

The staff should determine, based upon a review of the descriptions of the meteorological characteristics of the site, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the descriptions of the meteorological characteristics of the site. If the staff determines that the

descriptions of the meteorological characteristics or the site are sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.5.3, then the following findings will be made:

(1) The description of the meteorological characteristics of the site is adequate to allow an assessment of the potential impact of the site on the surrounding area, particularly with respect to the spread of airborne contamination in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(2) The description of the meteorological characteristics of the site is sufficient to support the site description and any conceptual and numerical models used in the LA in accordance with the requirements to 10 CFR 40.31 and 10 CFR 51.45.

2.5.5 References

Nuclear Regulatory Commission. 1972. Onsite Meteorological Programs (Safety Guide 23). *Regulatory Guide 1.23*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG), June. *Regulatory Guide 3.46*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1988. Onsite Meteorological Measurement Program for Uranium Recovery Facilities - Data Acquisition and Reporting. *Regulatory Guide 3.63*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

2.6 GEOLOGY AND SEISMOLOGY

2.6.1 Areas of Review

The reviewer should examine information on the geologic aspects of the site acquired through standard geologic analyses, including a survey of pertinent literature and field investigations. This will include regional seismicity and seismic history, local stratigraphy, petrology or lithology of rock units, tectonic features (faulting, folding, fracturing), and the continuity of the geologic strata at the site and in nearby regions.

Geologic, structural, and stratigraphic maps and cross sections including representative core and geophysical well-log data of the site and its environs should be reviewed. An isopach map of the intended zone of injection or production and associated confining beds will be evaluated. All conclusions regarding the lateral continuity and vertical thickness of the ore zone(s), surrounding lithologic units, and confining zones as based on lithologic logs from core and drill cuttings, geophysical data, remote-sensing measurements, and the results of other appropriate investigations will be reviewed.

The staff will review the information presented on any economically important minerals and energy-related deposits in addition to the uranium ore, including the potential impact of production of such related deposits on the uranium leach facility.

Data on the geochemistry of the ore zone and the geologic zones immediately surrounding the ore zone that will or could be affected by injected lixiviant should be evaluated. Information on unique minerals (including those that might be affected by fluid movement associated with the proposed project, such as bentonite) or paleontologic deposits of particular scientific interest should also be reviewed. The staff will examine descriptions of any effects that planned operations at the site might have on the future availability of other mineral resources.

2.6.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff shall review the LA to determine whether a thorough evaluation of the geologic setting for the proposed ISL activity has been presented along with the basic data supporting all conclusions. In addition to a description of the basic geology, both at the surface and at the depths of interest, the establishment of the continuity of the geologic strata at the site should be reviewed for applicability, correctness, inclusivity, and likely ability of the aforementioned strata to isolate mining fluids. The reviewer should focus particular attention on fractures or faults, permeable stratigraphic units, and lateral facies changes that might preclude the applicant-identified geologic barriers to fluid migration from performing adequately.

The reviewer should determine that the LA contains viable geologic maps, isopach maps of the ore-bearing strata and of the confining layers, geologic cross sections at places critical to a thorough understanding of the selected site~~, to meet the isolation requirements of the law~~, representative supportive ~~core samples~~ and geophysical and lithologic logs, ~~and other data required~~ for a ~~thorough~~ understanding of the pertinent geology at the site and its environs. The reviewer should determine that regional stratigraphic and geologic information is discussed in sufficient detail to give clear perspective and orientation to the site-specific material presented. The discussion of regional geology and stratigraphy is assessed to determine if it is adequately referenced and is illustrated by regional surface and subsurface geologic maps, stratigraphic columns, and cross sections. ~~Proprietary data, when provided, should be so designated and kept separate from the remainder of the application.~~

2.6.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both an LA and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve as an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG (Nuclear Regulatory Commission, 1982) has been prepared by the NRC to aid applicants in the development of

application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

The descriptions of geology and seismology are acceptable if

(1) They include a description of the local and regional stratigraphy based on techniques such as

(a) Surface sampling and descriptions

(b) Cuttings and core logging reports

(c) Wireline geophysical logs, such as electrical resistivity, neutron density, and gamma

(d) Geologic interpretations of surface geology and balanced cross sections

These interpretations may be based either on original work submitted by the applicant, or on an appropriate evaluation of previous work in the region performed by state or federal agencies (e.g., U.S. Geological Survey, U.S. Bureau of Land Reclamation, U.S. Bureau of Mines), universities, mining companies, or oil and gas exploration companies. The description should be accompanied by

(i) Maps such as geologic, topographic, and isopach maps that show surface and subsurface geology and locations for all wells used in defining the stratigraphy

(ii) Cross sections through the ore deposit roughly perpendicular and parallel to the principal ore trend

(iii) Fence diagrams showing stratigraphic correlations between wells

(2) All maps and cross sections are at suffi.. ..t scale and resolution to clearly show the intended geologic information. Maps show the locations of all site explorations such as borings, trenches, seismic lines, piezometer readings, and geologic cross sections.

(3) In the local stratigraphic section, all ore horizons, confining units, and other important units such as drinking water aquifers and deep well injection zones are clearly shown with their depths from the surface clearly indicated. Isopach maps are prepared showing the variations in thickness of the mineralized zone and the confining units over the proposed mining area.

(4) A geologic and geochemical description of the ore zone and the geologic units immediately surrounding the ore zone is provided.

(5) An inventory of economically significant mineral and energy related deposits in addition to the uranium ore is provided. Locations of all known wells, surface and underground

mine workings, and surface impoundments that may have an effect on the proposed operations are provided.

These items should be located on a map of sufficient scale and clarity to identify their relationship to the proposed facility. For existing wells, the depth should be shown, if possible. To allow evaluation of connections between the ore zone and underground sources of drinking water, plugging and abandonment records provided from state, federal, and local records, as appropriate, should be provided. The applicant should provide evidence that action has been undertaken to properly plug and abandon all wells that cannot be documented in this manner.

(5) A description of the local and regional geologic structure, including folds and faults is provided.

These can be shown on the geologic maps used to describe the stratigraphy. Major and minor faults traversing the proposed site should be evaluated for potential future effects of faulting on the uranium production activities and on the ability of the strata to contain lixiviant should fault motion occur. Geologic structures that are preferential pathways or barriers to fluid flow must be described and the basis for likely effects on flow given.

(6) A discussion of the seismicity and the seismic history of the region is included.

Historical seismicity based on data from universities and state and local agencies should be summarized on a regional earthquake epicenter map, including magnitude, location, and date of all known seismic events. Where possible, seismic events should be associated with the tectonic features described in the geologic structures.

(7) A generalized stratigraphic column including the thicknesses of rock units, representation of lithologies, and ore horizon definition is presented.

Generic response

(8) The sources of all geological and seismological data are documented.

(9) Maps have designation of scale, orientation (e.g., North arrow), and geographic coordinates.

The staff also may perform an independent analysis of the data provided to assess whether reasonable and conservative alternative interpretations are indicated.

The geologic characterization is considered acceptable if the information provided is adequate to determine that the design coupled with the site characteristics provides reasonable assurance of meeting the requirements of 10 CFR Part 40, appendix A. Although geologic site characterization provides data pertinent to the reviews under other major chapters of this SRP (Water Resources, Radon Attenuation, Site Clean-up, and Erosion Protection), this section discusses only the needs for assessment of geologic conditions.

Put in seismic stability - Reg Guide 3.11 } perhaps By Gen 11.29
criteria

(1) A good description 2-17 of the soils should be included to include environmental impacts of construction, operation,

(2) A more detailed soil description needed for land applic.

2.6.4 Evaluation Findings

The staff should determine, based upon a review of the descriptions of geology and seismology of the site whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the descriptions of the geology and seismology of the site. If the staff determines that the descriptions of the geology and seismology of the site are sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.6.3, then the following findings will be made:

Joe's Vision

(1) The descriptions of the geology and seismology of the site are adequate to allow an assessment of the potential impact of these features on the safety of operations proposed for the site in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(2) The descriptions of the geology and seismology of the site are sufficient to support the site description and any conceptual and numerical models used in the LA in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.6.5 References

Nuclear Regulatory Commission. 1982. *Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). Regulatory Guide 3.46.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

2.7 HYDROLOGY

2.7.1 Areas of Review

The hydrology portion of the site characterization should elucidate the effects of well construction and wellfield operation on adjacent surface water and groundwater including

(1) The control and monitoring of subsurface process fluids

(2) The quantitative physical, chemical, biological, radiological, and hydrological characteristics of the groundwater

(3) Typical seasonal ranges and averages, and the historical extremes for levels of surface water bodies and aquifers

(4) Water quality data in and in close proximity to proposed wellfields

(5) Information on past, current, and anticipated future water use

The staff should also review the regional groundwater setting including average thickness, lateral extent, general flow direction, average yield, and premining potentiometric maps of the regional aquifer, the ore zone aquifer, and potentially affected surrounding aquifers.

The review of local the groundwater system should include

(1) identification of aquifers that may be affected by the proposed ISL operations

(2) Ore zone aquifer properties including thickness, potentiometric or water table elevations, hydraulic gradients, flow velocities, conductivities, transmissivities, storage coefficients, and porosities

(3) Descriptions of confining beds or other lithologic units separating the ore zone from other aquifers

(4) Estimated conductivities, thickness, and lateral extent of aquitards, and other information relative to the control and prevention of excursions

(5) Soil types

(6) Conclusions concerning the local groundwater flow system based on well borings, cores, pumping tests, laboratory tests, soil surveys and other methods

(7) Descriptions of local groundwater wells including locations, uses, amounts used, depths, screened intervals, yield, static water level, and water quality

(8) Descriptions of project-related wells including locations, elevations, depths, screened intervals, static water levels, and preoperational water quality

(9) The preoperational water quality of all aquifers that might be affected by the proposed operations as well as the changes expected in quality due to the operations

Insert A

A description of the surface water hydrology should be reviewed including the size, shape, and hydrologic characteristics and uses of surface water bodies near the site; river control structures; topographic maps of hydrologic features; water quality analysis and flow rates from U.S. Geologic Survey (USGS) survey stations; site-related drainage water courses; and stream cross sections where necessary to show the vertical and horizontal relationships of channels and pond embankments.

2.7.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

At a minimum, the reviewer should evaluate whether the applicant has developed a sufficient conceptual model of the site hydrology, and whether the conceptual model is adequately supported by the data presented in the site characterization. To this end, the reviewer should

(1) Select ~~one or two potentiometric~~ a limited number of or water table surface elevation measurements, ~~and verify that they correspond to elevations shown on~~ from data calculations maps.

(2) Compare hydrogeologic cross sections with randomly selected wells and borehole logs to verify accuracy and ensure that cross sections are based on an adequate number of wells and boreholes.

(3) Examine both groundwater and surface water baseline water quality data to verify whether an adequate list of constituents has been identified, that the number of samples collected is sufficient to provide meaningful statistics, and that samples are spaced in time sufficiently to capture temporal variations.

(4) Examine pump tests, analyses, and/or other measurement techniques used to determine the hydrologic properties of the local aquifers and aquitards that affect or may be affected by the proposed solution mining activities.

(5) Review surface water data, including maps that identify nearby lakes, rivers, surface drainage areas, or other surface water bodies; stream flow data; and applicant assessment of the potential for surface water contamination due to mining operations.

(6) Review the modeling results used for the impact analysis, and the conclusions drawn from those results.

2.7.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both an LA and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both of these documents. Inasmuch as the LA may serve as an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG (Nuclear Regulatory Commission, 1982) has been prepared by the NRC to aid applicants in the development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

The hydrologic characterization should establish a hydrologic conceptual model for the mine site and surrounding region. The conceptual model will provide a framework for the applicant to make decisions on the optimal methods for extracting uranium from the ore zone, and how best to minimize environmental and safety concerns caused by mining operations. Hydrologic characterizations that accomplish this objective are considered acceptable.

The description of hydrology will be acceptable if

(1) The applicant has described ~~determined whether aquifers are generally continuous and horizontal or discontinuous and steeply dipping. For the case of horizontal and continuous aquifers, the applicant has estimated the~~ local and regional hydraulic gradients. Potentiometric surface maps are the recommended means for presenting this data.

These maps should include two levels of detail: regional and local. The regional map should represent the ore zone aquifer and should encompass the nearest populated area any potentially affected

Insert A

Table 2.7-1. Typical baseline water quality indicators to be determined during premining data collection

A. Trace and Minor Elements		
Aluminum	Copper	Nickel
Arsenic	Fluoride	Radium-226
Barium	Iron	Selenium
Boron	Lead	Thorium-230
Cadmium	Manganese	Uranium
Chromium	Mercury	Vanadium
Cobalt	Molybdenum	Zinc
B. Common Constituents		
Ammonia	Chloride	Sodium
Bicarbonate	Magnesium	Sulfate
Calcium	Nitrate	
Carbonate	Potassium	
C. Physical Indicators		
Specific Conductivity*		Total Dissolved Solids#
Temperature		Appearance, color, odor†
pH*		

*Field and Laboratory determination
†Field only.
#Laboratory only.

CAWRA will check Wyoming

For determining baseline water quality conditions, at least four sets of samples should be collected and analyzed for each listed constituent. Some samples should be split, and sent to different laboratories as part of a quality assurance program. Sets of samples should be taken within a week or two of each other unless natural conditions are such that the water quality of the aquifers changes significantly with time. If natural groundwater flow rates and recharge conditions vary considerably (the premise that they do not should be documented by the applicant), additional sampling to establish the natural cyclical fluctuations of the water quality is necessary. ~~For example, if mining is planned in an aquifer system that is essentially unconfined, seasonal water quality changes can be expected, and a more intensive sample collection program would be necessary~~. Where perennial surface water sources are present, surface water quality measurements should be taken on a seasonal basis for a minimum of one year prior to implementation of

downgradient from the site, or, if there are no nearby populated areas, the entire basin within which the ore zone occurs. The site scale map should encompass the entire license boundary. If overlying and underlying aquifers exist, local scale potentiometric or water surface elevation maps of these aquifers should also be included. These maps should indicate the locations, depths, and screened intervals of the wells used to determine the potentiometric surface elevations; alternatively, this information can be provided in separate maps and/or tables. The appropriate contour interval will vary from site to site; however, contour intervals should be sufficient to make clear the groundwater flow direction. The number of water table elevation measurements used in the construction of each map should be in proportion to the contour interval chosen (e.g., a ratio of one well per contour line or greater should be adequate for a large number of randomly spaced wells). In order to construct a regional potentiometric map, a reasonable effort should be made to consider as many existing wells as possible. For discontinuous and steeply dipping aquifers, a more complex numerical model may be required for estimation of flow velocities.

(2) The applicant has considered hydro-stratigraphy at an appropriate scale. Hydrogeologic cross sections are recommended. These cross sections should be constructed for the area within the license boundary. For very large or irregularly shaped mine areas, more than one cross section may be necessary. Cross sections must be based on borehole data from driller's logs collected during well installation or exploratory drilling. All significant borehole data should be included in an appendix. Staff should verify that, where hydrogeologic units are shown to be continuous, an adequate number of boreholes is used to support this assertion. However, because of the high cost of collecting borehole data, it is often the case that a spacing of kilometers between boreholes is used to infer continuity of layers that are only meters in thickness. When this is the case, the applicant is required to establish operational procedures for verifying the hydraulic isolation of the ore zone aquifer from upper and/or lower aquifers on a wellfield by wellfield basis. Review of operational procedures is covered in section 5 of this SRP.

(3) Reasonably comprehensive chemical and radiochemical analyses of water samples, obtained within the ore body and at locations away from the ore body, should be made to determine premining baseline conditions. Baseline water quality should be determined for the ore zone and surrounding aquifers. This data should include not only common constituents of natural waters, but also minor constituents, particularly trace and heavy metals, whose concentrations are likely to change as a result of chemical reactions initiated during ISL mining. A list of suggested water quality indicators to be measured to define baseline water quality is contained in table 2.7-1; this list is based on evaluation of uranium ore body mineralogy, EPA drinking water standards, water quality standards for agricultural uses, and uranium leaching processes (lixiviants used). Applicants may propose lists of constituents based on the host-rock geochemistry and mining solutions used at a particular site.

mining operations. Surface water samples can be obtained by grab sampling and should be taken at the same location each time.

Average water quality for each aquifer zone and the range of each indicator in the zone has been tabulated and evaluated. If zones of distinct water quality characteristics are identified, they are delineated and referenced on a topographic map. For example, since uranium roll-front deposits are formed at the interface between chemically oxidizing and reducing environments, water quality characteristics may differ significantly across the roll front.

(4) The applicant should describe all hydraulic parameters used to determine expected operational and restoration performance. Aquifer and aquitard hydraulic properties may be determined using aquifer pump tests for parameters such as hydraulic conductivity, transmissivity, and specific storage. Any of a number of commonly used aquifer pump tests may be used including single-well drawdown and recovery tests, drawdown versus time in a single observation well, and drawdown versus distance pump tests using multiple observation wells. The methods or standards used to analyze pump test data should be described and referenced; acceptable methods of analysis include use of curve fitting techniques for drawdown or recovery curves that are referenced to peer reviewed journal publications, texts, or American Society for Testing and Materials (ASTM) Standards. Driscoll (1989) provides examples for conducting and analyzing aquifer pump test data. It is important for the reviewer to ensure that where fitted curves deviate from measured drawdown, the applicant explains the probable cause of the deviation (e.g., leaky aquitards, delayed yield effects, boundary effects, etc.)

For estimates of porosity, the NRC has found it acceptable to use laboratory analysis of core samples, borehole geophysical methods, and analysis of barometric efficiency of the aquifer (e.g., Lohman, 1979). The applicant should distinguish between total porosity estimated from borehole geophysical methods and effective porosity that determines transport of chemical constituents.

(5) Surface water characterization in the mining zone and surrounding areas should be addressed. Maps provided in the application should identify the location, size, shape, hydrologic characteristics, and uses of surface water bodies near the proposed site, including potential surface drainage areas near the proposed facilities. An acceptable application should also identify the zones of interchange between surface water and groundwater.

(6) The applicant should evaluate the impact that ISL operations are likely to have on surrounding water users. An acceptable impact analysis should be based on results of numerical or analytical modeling calculations that are used to estimate groundwater travel times from the proposed mine areas to the nearby points of groundwater or surface water usage, estimate the amount of process bleed necessary to prevent migration of lixiviant out of the wellfield, and demonstrate the ability to recover lixiviant excursions. Modeling efforts should be kept simple to the extent possible, favoring conservative assumptions

move to page 3-4 where it becomes (g)

over complicated parameter estimation. An acceptable impact analysis should elucidate the following:

(a) The ability to control the migration of lixiviant from the ore zones to the surrounding environs

(b) Groundwater and surface water pathways that might transport mining solutions offsite in the event of an uncontrolled excursion or incomplete restoration

(c) The impact of ISL mining on groundwater flow patterns and aquifer levels

(d) The expected postmining impact on geochemical properties and water quality

2.7.4 Evaluation Findings

The staff should determine, based upon a review of the descriptions of the hydrologic characteristics of the site, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the description of the hydrologic characteristics of the site. If the staff determines that the description of the hydrologic characteristics of the site is sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.7.3, then the following findings will be made:

(1) The description of the hydrologic characteristics of the site is adequate to allow an assessment of the potential impact of the hydrology on the safety of operations proposed for the site in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(2) The description of the hydrologic characteristics of the site is sufficient to support the site description and any conceptual and numerical models used in the LA in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(3) The hydrologic characteristics of the site, coupled with the facility design, provide reasonable assurance that the proposed operations at the site can be conducted in a manner that will protect public health and safety and the environment in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.7.5 References

Driscoll, F.G. 1989. *Groundwater and Wells*. Third Edition. City, State: Johnson Filtration Systems, Inc.

Lohman, S.W. 1979. *Groundwater Hydraulics*. Geological Survey Professional Paper 708. City, State: Company.

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

2.8 ECOLOGY

2.8.1 Areas of Review

The staff should review descriptions of the flora and fauna in the vicinity of the site, their habitats, and their distribution. The review should include identification of important species that are (1) commercially or recreationally valuable, (2) threatened or endangered, (3) affect the well-being of some important species within criterion (1) or (2), or (4) critical to the structure and function of the ecological system or are a biological indicator of radionuclides or chemical pollutants in the environment.

The review should include the inventory of the majority of the terrestrial and aquatic organisms on or near the site and their relative (qualitative) abundance, the quantitative abundance of the important species, and species that migrate through the area or use it for breeding grounds. The staff should review discussions of the relative importance of the proposed site environs to the total regional area for the living resources (potential or exploited).

For commercial-scale operations and for research and development operations involving drying of yellowcake, the staff should examine data on the count and distribution of important domestic fauna, in particular, cattle, sheep, and other meat animals that may be involved in the exposure of man to radionuclides. Important game animals should receive similar treatment. A map showing the distribution of the principal plant communities should be reviewed.

The staff should also review the discussion of specie-environment relationships including descriptions of area usage (e.g., habitat, breeding) for important species; life histories of important regional animals and aquatic organisms, normal seasonal population fluctuations, and habitat requirements; and identification of food chains and other interspecies relationships, particularly when these contribute to prediction or evaluation of the impact of the facility on the regional biota.

The staff should examine any information presented on definable pre-existing environmental stresses from sources such as pollutants, as well as pertinent ecological conditions suggestive of such stresses, and the status of ecological succession.

As appropriate, the staff should review a list of pertinent published material dealing with the ecology of the region and ecological or biological studies of the site or its environs currently in progress or planned.

2.8.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should review the descriptions and inventory of the flora and fauna in the vicinity of the site including habitats and distribution. The review should include terrestrial and aquatic organisms on or near the site and their relative (qualitative) abundance should be established. Particular attention

should be given to species based on their relative importance to the community. The reviewer should determine that all important species have been identified. Important species include those (1) commercially or recreationally valuable, (2) threatened or endangered, (3) any species that affects the well-being of another important species within (1) or (2), and (4) organism(s) that are critical to the structure and function of the ecological system or area biological indicators of radionuclides or chemical pollutants in the environment. Important species should be a part of the larger inventory of species. If important species are determined to be present, the staff should evaluate possible detrimental effects on the organism by the proposed facility.

The reviewer should determine that information on the various species is presented in two separate subsections: Terrestrial Ecology and Aquatic Ecology. The reviewer should also determine that the discussion of the species-environment relationships includes descriptions of area usage (e.g. habitat, breeding) for important species; discussions of life histories of important regional animals and aquatic organisms including normal seasonal population fluctuations and their habitat requirements. Food chains and other interspecies relationships should be examined particularly when these may bear upon predictions or evaluations of the impact of the proposed facility on the stability of regional biota. The reviewer should also examine documentation provided for any preexisting environmental stresses from sources such as pollutants as well as pertinent ecological indicators suggestive of such stresses. A discussion of the status of ecological succession should be evaluated.

For any operation involving the drying of yellowcake, the staff should review data on the number and distribution of locally significant domestic flora and fauna; in particular cattle, sheep, commercial fish, and other meat animals, and commercial crops that may be part of the food chain delivering radiation exposure to man. Important game animals should be treated similarly. A map showing the distribution and estimates of numbers of commercially significant species should be examined.

2.8.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both an LA and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve as an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG (Nuclear Regulatory Commission, 1982) has been prepared by the NRC to aid applicants in the development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

The description of ecology is acceptable if

(1) Inventories of terrestrial and aquatic species are compiled by the applicant based on reports or databases of state or federal agencies (e.g, U.S. Fish and Wildlife Service, EPA).

Historical sitings of important species as defined in the SFCG (Nuclear Regulatory Commission, 1982) should be included in the inventory. If such reports do not exist, inventories should be prepared by the applicant based on a survey of an area surrounding the proposed facility (80 km radius). Documentation should be provided that inventories were prepared in consultation with appropriate local, state, and federal agencies to confirm the presence or absence of important species (especially threatened or endangered species). Inventories may be based on historical data, but should be updated to within two years of the time of application to establish current baselines.

(2) Inventories of locally significant domestic flora and fauna; in particular cattle, sheep, commercial fish, and other meat animals and commercial crops are based on recent production figures from local, state, and federal agencies (e.g., U.S. Department of Agriculture).

The statistics should cover at least 3 yr and to within 2 yr of the date of the LA to establish reasonable baselines. Important game animals should be treated similarly. A map showing the distribution and estimates of numbers of commercially significant species should be provided and may be combined with land use maps presented in section 2.2.

(3) The important species are discussed in sufficient detail to estimate both their current and historical abundance.

Terminology defining endangered or threatened with endangerment can be found in Public Law 93-205, 87 Stat. 884. Any discussion should include non-permanent inhabitants migrating through the area or using it for breeding grounds. The preservation of habitat, particularly for important species, should be a prime consideration of the reviewer. The reviewer should determine that a map of the principal floral and faunal communities has been provided.

(4) If no important species are identified within 80 km of the facility, the LA should plainly state so, and no additional review is necessary.

(5) If important species have been identified within 80 km of the facility, the LA provides a thorough description of the species-environment relationships for each important species identified.

The LA should take these relationships into account in providing a discussion of possible detrimental effects that operation of the site will have on the species through changes in habitat, pollution, and aspects of the operations that may place stress on the species-environment relationship. Finally, the LA should provide information regarding steps that will be taken to minimize the effect of operating the facility on the species-environment relationship.

generic (6) All sources of information are identified.

A list of pertinent published material dealing with the ecology of the region should be included. Any ecological or biological study of the site or its environs either in progress or planned should be described and referenced.

2.8.4 Evaluation Findings

The staff should determine, based upon a review of the description of the ecology of the site, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the description of the ecology of the site. If the staff determines that the description of the ecology of the site is sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.8.3, then the following findings will be made:

(1) The description of the ecology of the site is adequate to allow an assessment of the potential impact of the proposed operations on the ecology in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(2) The description of the ecology of the site is sufficient to support the site description and any conceptual and numerical models used in the LA in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.8.5 References

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

2.9 BACKGROUND RADIOLOGICAL CHARACTERISTICS

2.9.1 Areas of Review

The reviewer should examine site-specific radiological data provided in the LA including the results of measurements of radioactive materials occurring in important species, soil, air, and in surface and groundwaters that could be affected by the proposed operation. The reviewer should examine the design of the preoperational monitoring program, including which radionuclides were analyzed, sampling locations, sample type, sampling frequency, location and density of monitoring stations and the detection limits. ~~The reviewer should be familiar with NRC staff technical position paper WM-8102 (Nuclear Regulatory Commission, 1981) in connection with background surface and groundwater quality monitoring programs.~~

incorporate into SRP

2.9.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the

LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should examine data from the preoperational monitoring program with particular attention paid to the design of the monitoring program, the radionuclides monitored, the results, and the detection limits reported for each radionuclide in each sample medium. The reviewer should compare and contrast the preoperational monitoring program as implemented against the guidance provided in Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980).

2.9.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both an LA and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve as an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG (Nuclear Regulatory Commission, 1982) has been prepared by the NRC to aid applicants in the development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

The description of background radiological characteristics is acceptable if

(1) Monitoring programs to establish background radiological characteristics, including sampling frequency, sampling methods, and sampling location and density are set up in accordance with preoperational monitoring guidance provided in Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills. Air monitoring stations are located in a manner consistent with the principle wind directions provided in section 2.5 of the LA.

(2) The time period covered by the preoperational monitoring program is sufficient to establish baseline levels including at least 12 consecutive months of sampling to adequately characterize seasonal variations in radiological background.

(3) Radionuclides monitored include

(a) For air particulate samples: Natural uranium, Th-230, Ra-226, Pb-210

(b) For air samples: Rn-222

(c) For groundwater samples: Natural uranium, Th-230, Ra-226, Po-210, and Pb-210. (Samples are analyzed separately for dissolved and suspended radionuclides.)

(2) i. Soil Sampling should be collected at both a 5 cm depth as described in Reg Guide 4.14 2-29 and at 15 cm depth for background decommissioning data.

(d) For surface water samples: Natural uranium, Th-230, Ra-226, Po-210, and Pb-210. (Samples are analyzed separately for dissolved and suspended radionuclides.)

(e) For vegetation, food, and fish: Natural uranium, Th-230, Ra-226, Po-210, and Pb-210

(f) For soil samples: Natural uranium, Th-230, Ra-226, and Pb-210

(g) For sediment samples: Natural uranium, Th-230, Ra-226, and Po-210

Direct gamma radiation surveys should also be provided to establish background gamma exposure. Additional guidance on sampling is provided in Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills.

(4) Detection limits for analyses meet at least those levels established in Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills as delineated in table 2.9-1.

(5) Data are gathered from preoperational surveillance.

Data from other sources may be used, but these data should be collected in a manner consistent with Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980). In all cases, data sources should be documented.

Table 2.9-1. Lower limits of detection for radionuclides at uranium mills from Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills

Radionuclide(s)	Sample Medium	Detection Limit
U-natural, Th-230, Ra-226	Air particulates	1×10^{-16} μCi/mL
Pb-210	Air particulates	2×10^{-15} μCi/mL
Rn-222	Air	2×10^{-10} μCi/mL
U-natural, Th-230, Ra-226	Water	2×10^{-10} μCi/mL
Po-210, Pb-210	Water	1×10^{-9} μCi/mL
U-natural, Th-230, Ra-226, Pb-210	Soil, sediment	2×10^{-7} μCi/g
U-natural, Th-230	Vegetation, food, fish (wet)	2×10^{-7} μCi/kg
Ra-226	Vegetation, food, fish (wet)	5×10^{-8} μCi/kg
Po-210, Pb-210	Vegetation, food, fish (wet)	1×10^{-6} μCi/kg

If the LA is for the renewal of an existing source material license, the application should include information for the preoperational monitoring period, and updated operational monitoring data. Data for operational monitoring should be collected in a manner consistent with the guidance provided in Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980), and may be incorporated by reference to sections 4.0 and 5.1.7 of the LA.

2.9.4 Evaluation Findings

The staff should determine, based upon a review of the description of background radiological characteristics of the site, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the description of the background radiological characteristics of the site. If the staff determines that the description of the background radiological characteristics of the site is sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.9.3, then the following findings will be made.

(1) The monitoring and sampling program established to define the background radiological characteristics of the site complies with regulatory requirements and guidance in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(2) The description of the background radiological characteristics of the site is adequate to allow an assessment of the potential impact of proposed operations on the radiological characteristics of the site in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(3) The description of the background radiological characteristics of the site is sufficient to support the site description and any conceptual and numerical models used in the LA in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.9.5 References

Nuclear Regulatory Commission. 1980. Radiological Effluent and Environmental Monitoring at Uranium Mills. *Regulatory Guide 4.14, Revision 1.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1981. *Technical Position Paper: Groundwater Monitoring Uranium at In-Situ Solution Mines.* WM-810. Washington, DC: Nuclear Regulatory Commission.

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

2.10 BACKGROUND NONRADIOLOGICAL CHARACTERISTICS

2.10.1 Areas of Review

The staff should review information in the LA on site-specific nonradiological characteristics, particularly those that are related to expected site-related effluents. Data to be examined should include

The description of the background radiological characteristics is acceptable to support values (background radionuclide concentrations) that will be used in assessing compliance with public dose limits (10 CFR 20.1301 and 10 CFR 20.1302) and decommissioning criteria (10 CFR 40, App A crit 6(6)).

such indicators as heavy metals and other potentially toxic substances in surface and groundwaters, atmospheric pollutants, dusts, etc., that could affect water or air quality. Other regional sources of these same materials should be examined along with any discussion of the possible incremental contribution to the existing levels found at the site. ~~The reviewer should be familiar with the NRC staff Technical Position Paper WM-8102 on background surface and groundwater quality monitoring programs~~.

2.10.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should examine data from the preoperational monitoring program with particular attention paid to the design of the monitoring program, contaminants analyzed, and the results and the detection limits reported for each contaminant in each sample medium. Maps should be examined to determine sampling locations and identify relationships to the proposed facility and the surrounding areas. Other local and regional potential sources of the same materials should be identified.

2.10.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both an LA and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve as an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG (Nuclear Regulatory Commission, 1982) has been prepared by the NRC to aid applicants in the development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

The description of background nonradiological characteristics is acceptable if

(1) A listing of expected site-related effluents is provided. This listing should be used to identify those ~~potential pollutants~~ constituents for which preoperational baseline values should be established.

(2) Atmospheric samples are taken to establish baseline conditions on ~~pollutants~~ constituents identified in the National Ambient Air Quality Standards (NAAQS).

Special attention should be paid to those ~~pollutants~~ constituents that may be produced during operation of the proposed facility. These data can be gathered as part of the meteorological information gathered in section 2.5.

(3) Background concentrations for soil ~~contaminants are~~ established.

Sampling locations should be clearly shown, and samples should be collected near areas that are likely to be disturbed during construction and operation of the facility. Soil and sediment sampling should also be conducted near and in drainage areas and surface water bodies that might be affected in the event of spills. Soil and sediment sampling locations may be the same for both radiological and nonradiological sampling.

(4) Groundwater and surface water background conditions are established in accordance with specific acceptance criteria identified in section 2.7.3.

(5) Data is gathered from a either a preoperational surveillance program or from previous reports from other sources such as local, state, and federal agencies or universities. In all cases, data sources are documented and substantiated.

If the LA is for the renewal of an existing source material license, the application should include information for the preoperational monitoring period and updated operational monitoring data.

2.10.4 Evaluation Findings

The staff should determine, based upon a review of the description of background non-radiological characteristics of the site, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the description of the background nonradiological characteristics of the site. If the staff determines that the description of the background nonradiological characteristics of the site is sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.10.3, then the following findings will be made:

(1) The monitoring and sampling program established to define the background nonradiological characteristics of the site complies with regulatory requirements and guidance in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(2) The description of the background nonradiological characteristics of the site is sufficient to support the site description and any conceptual and numerical models used in the LA in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

(3) The description of the background nonradiological characteristics of the site is adequate to allow an assessment of the potential impact of proposed operations on the nonradiological characteristics of the site in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.10.5 References

Nuclear Regulatory Commission. 1981. *Technical Position Paper: Groundwater Monitoring at Uranium In-Situ Solution Mines*. WM-8102. Washington, DC: Nuclear Regulatory Commission.

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

2.11 OTHER ENVIRONMENTAL FEATURES

2.11.1 Areas of Review

This subsection should include environmental site characterization information that does not clearly fall into any of the other subsections in section 2. These will typically be site-specific, and may be used by the applicant to mitigate unfavorable conditions, or provide additional information in support of the proposed facility. Information that the applicant believes is important to establish the value of the site and site environs to important segments of the population is appropriately included in this subsection.

2.11.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should consider environmental information provided in this section as auxiliary information to support a LA for a given facility. The information should be considered in a site-specific context and should be consistent with the information provided in the preceding subsections.

2.11.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.31 requires the submission of both an LA and an ER that meets the requirements of 10 CFR 51.45 for source material licenses. The Commission has adopted a policy of allowing a single LA package to meet the requirements of both these documents. Inasmuch as the LA may serve as an ER, it is necessary for the application to contain a description of site characteristics that adequately portrays the premining environment and the anticipated effects of mining operations. The SFCG (Nuclear Regulatory Commission, 1982) has been prepared by the NRC to aid applicants in the development of application packages that meet the requirements of 10 CFR 40.31 and 10 CFR 51.45. A thorough site characterization will partially fulfill the requirements of 10 CFR 51.45.

A description of other environmental features is acceptable if

(1) It is consistent with information provided in previous subsections.

(2) Information is provided in a manner consistent with good scientific practice, is supported by objective data to the extent possible, and is relevant to the site under consideration.

(3) Information supports a determination that the ISL facility can be operated in a manner that will protect public health and safety and the environment.

2.11.4 Evaluation Findings

The staff should determine, based upon a review of the description of other environmental features of the site, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the description of other environmental features of the site. If the staff determines that the description of the other environmental features of the site is sufficient to meet the regulatory requirements and acceptance criteria identified in section 2.11.3, then the following finding will be made.

The description of other environmental features of the site is consistent with other features of the site and adequately supports an assessment of the potential impact of the proposed operations on public health and safety and the environment in accordance with the requirements of 10 CFR 40.31 and 10 CFR 51.45.

2.11.5 References

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (SFCG). *Regulatory Guide 3.46.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

3.0 DESCRIPTION OF PROPOSED FACILITY

The *in situ* uranium solution mining operation should be reviewed using this section. Since environmental effects are of primary concern, the combined effects of mining effluents and related systems that interact with the environment should be evaluated in sufficient detail to permit an independent evaluation by the NRC of the proposed project.

3.1 SOLUTION MINING PROCESS AND EQUIPMENT

3.1.1 Areas of Review

The staff should review the *in situ* mining process as described in the LA. This review should include, but not be limited to

(1) Description of ore bodies and feasibility of processing defined well-field areas.

(2) Well construction techniques and integrity testing procedures to ensure well installations will not result in hydraulic communication between production zones and adjacent aquifers.

(3) Process description including: injection/production rates and pressures; plant material balances and flow rates; lixiviant makeup; recovery efficiency; gaseous, liquid, and solid wastes and effluents that will be generated.

(4) Proposed operating plans and schedules that include timetables and sequences for wellfield operation, surface reclamation, and groundwater restoration.

(5) Evaporation and storage pond construction techniques.

The review should also include maps showing the facilities layout, descriptions of the process and/or circuit, water and material balances, and the chemical recycling system.

3.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the description of the *in situ* mining process provided in the LA is sufficient to permit evaluation of the operations and processes involved in conformance with the regulatory requirements identified in section 3.1.3. Staff should ensure the following are included in this section: a map or maps showing the proposed sequence and schedules for the in situ uranium solution mining wellfield areas(s) and wellfield groundwater quality restoration operations; a flow diagram of the process and/or circuit; a material balance diagram; a description of any chemical recycle systems; a water

balance diagram for the entire system; and a map or maps showing the proposed sequence and schedules for land reclamation of the wellfield areas.

Well completion techniques should be described in sufficient detail to give the reviewer a clear picture of how recovery, injection, and monitor wells are drilled; how their location and spacing are selected; and what materials and methods are used in construction, casing, and abandonment. The reviewer should pay particular attention to the techniques employed to prevent hydraulic communication between overlying or underlying aquifers through well boreholes. These techniques include proper use of packers and cements to seal bottoms of boreholes and the space between the casing and borehole walls. Additionally, the applicant should describe methods for well abandonment. The reviewer should ensure that the well casing material used is appropriate for the depths to which the wells are drilled. Generally, polyvinyl chloride (PVC) is the preferred casing material for in-situ uranium solution mines; however, PVC may be susceptible to failure under high pressures encountered at depths greater than about 500 ft. Where PVC is installed at greater than 500 ft, the applicant should include the design specifications of the casing material used. The reviewer should examine a description of the procedures used to test well integrity. Part IX of WM-8102 (Nuclear Regulatory Commission, 1981) provides NRC guidelines for well design, testing, construction, and abandonment. The reviewer may also wish to refer to a well handbook (e.g., Driscoll, 1989) to verify the appropriateness and expected performance of well installation and abandonment methods.

3.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

A facility to recover uranium by in-situ solution mining is licensed under provisions of an NRC (10 CFR Part 40) source and byproduct material license. 10 CFR 20.1002 requires that such a license is subject to the radiation protection requirements of 10 CFR Part 20. Compliance with dose limits, and requirements for radiation surveys, monitoring, control of exposures, and respiratory protection in 10 CFR Part 20 will require use of equipment and instrumentation that is part of the facility. This equipment and instrumentation should be described and located (where applicable) on facility drawings. Additional radiation protection equipment that is not part of the facility will be described in Chapters 4.0, Effluent Control Systems and 5.0, Operations.

The description of the solution mining process and equipment is acceptable if

(1) The description of the ore body is sufficiently detailed to identify the mineralized zone, its areal distribution and its approximate thickness.

If more than one ore zone is to be mined, each ore zone should be defined separately. The estimated ore grade should be specified.

(2) The LA provides detailed discussion of well installation and testing techniques and indicates whether applicable ASTM standards (specific standard numbers must be cited), have been complied with. The following discussion reflects practices that NRC has historically found to be acceptable for ISL uranium mining.

(a) Well Design and Construction. Injection and recovery wells should be constructed from materials that are inert to lixiviants and are strong enough to withstand injection pressures. PVC, fiberglass, or acrylonilrile butadiene styrene (ABS) plastic casings are generally used in wells less than 500 ft deep. Wells deeper than 500 ft, or those subjected to high pressure cementing techniques, are subject to collapse. In these instances, steel or fiberglass casing is generally necessary. In all wells (including monitor wells), the annular space between the side of the borehole and the casing should be back-filled with a sealant from the bottom of the casing to the surface in one continuous operation. Proper back-filling isolates the screened formation against vertical migration of water from the surface or from other formations, and also provides support for the casing. Cement or cement-bentonite grout is generally acceptable as a sealant.

Material normally used for monitor-well casing is either metal or plastic. The possibility that chemical reactions may take place between the casing and the mineral constituents in the water affects the choice of casing material used for monitor wells. For example, iron oxide in steel-cased wells will adsorb trace and heavy metals dissolved in the groundwater; therefore, a baseline water sampling program should be used to determine concentrations of trace metals. The applicant should use casing that is inert to these metals, such as PVC or fiberglass. When any well is completed, it should be flushed until production of essentially sediment-free water is assured for the life of the well. One acceptable flushing method is to use a swab in the well to create a vacuum on the upstroke and positive pressure on the down-stroke.

(b) Well Integrity Testing. Injection and recovery wells should be tested for mechanical integrity. One acceptable method is to pressurize the casing with water to the maximum expected injection pressure. The valve on the line connecting the well to the pressurizing packer equipment should be closed, and the pressure inside the well casing monitored for 10 min. If the pressure does not drop 10 percent below the maximum pressure which was applied during the test, the casing is deemed acceptable for solution mining. The results of this test, including starting and ending pressures, should be recorded on a form signed by the wellfield engineer and facilities manager, and should be filed at the mine site and included in the LA.

(3) The description of the ISL process includes the following information and demonstrations:

(a) Projected downhole injection pressures with the hydrostatic pressure of the fluid column should be demonstrated to be maintained below formation fracture pressures to avoid hydrofracturing the aquifer and promoting leakage into the overlying units.

(b) Production rates should be ~~lower~~ higher than injection rates. ~~The production bleed should be large enough to keep the injected lixiviant in the wellfield. The LA should demonstrate the validity of the proposed production bleed through~~ either

research and development (R&D) or commercial operating experience at the site or appropriate computer flow models.

(c) Proposed plant material balances and flow rates should be supported by models that demonstrate that the public health and safety is not compromised.

(d) Lixiviant makeup should be described so that the staff can evaluate its impact on groundwater quality and the prospects for long-term groundwater restoration. The lixiviant should not incorporate toxic chemicals or organic materials that are known to degrade water quality. Oxidants such as gaseous oxygen and hydrogen peroxide and carbonates such as sodium bicarbonate or carbon dioxide gas have been demonstrated in a number of ISL facilities to be suitable lixiviants.

(e) Recovery efficiency should be demonstrated through documented mass balance calculations.

(f) The description should include an estimate of gaseous, liquid, and solid wastes and effluents that will be generated. Effluent monitoring and control measures are discussed in section 4.0.

(4) Proposed operating plans and schedules include timetables for wellfield operation, surface reclamation, and groundwater restoration. Water balance calculations should be provided that demonstrate that the liquid waste disposal facilities (evaporation ponds, land application, deep well injection) are adequate to handle the proposed production and restoration efforts at any time.

(5) The design, installation, and operation of evaporation and storage ponds at the site equals or exceeds guidance criteria provided in Regulatory Guide 3.11, Design, Construction, and Inspection of Embankment Retention Systems for Uranium Mills (Nuclear Regulatory Commission, 1977). The ponds should have sufficient capacity that the entire contents of one pond can be transferred to the other ponds in the event of a leak.

(6) Results from R&D operations are used to support the description of the solution mining process where appropriate.

3.1.4 Evaluation Findings

The staff should determine, based upon a review of the description of the solution mining process and equipment, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the description of the solution mining process and equipment. If the staff determines that the description of the solution mining process and equipment is sufficient to meet the regulatory requirements and acceptance criteria identified in section 3.1.3, then the following finding will be made.

The staff concludes that the description of the solution mining process and equipment is sufficient to permit evaluation of the operations and processes to assess compliance with the requirements of 10 CFR 20.1002.

3.1.5 References

Driscoll, F.G. 1989. *Groundwater and Wells*. Johnson Filtration Systems, Inc.

Nuclear Regulatory Commission. 1977. Design, Construction, and Inspection of Embankment Retention Systems for Uranium Mills. *Regulatory Guide 3.11*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1981. *Groundwater Monitoring at Uranium In Situ Solution Mines, Staff Technical Position Paper*. No. WM-8102, December. Washington, DC: Nuclear Regulatory Commission.

3.2 RECOVERY PLANT EQUIPMENT

3.2.1 Areas of Review

The staff should review the physical descriptions and reported operating characteristics for the major equipment items of the processing cycle. The staff should also review descriptions of the proposed process information and control systems relevant to safety, as well as radiation sampling and monitoring ~~instrumentation~~ equipment. A diagram should be provided that indicates the plant layout and locations where dusts, fumes, or gases would be generated; and locations of all ventilation, filtration, confinement, and dust collection systems and radiation monitoring devices.

3.2.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the physical descriptions and reported operating characteristics for the major equipment items of the processing cycle and the proposed control systems and safety/radiation instrumentation are sufficient to evaluate the performance of the proposed mining facility. Staff should ensure that the application identifies all areas where releases of radioactive and hazardous materials (such as radon gas and uranium dust) can occur and that locations of control equipment (e.g., ventilation and exhaust systems) and instrumentation are provided.

3.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

A facility to recover uranium by ISL mining is licensed under provisions of an NRC (10 CFR Part 40) source and byproduct material license. 10 CFR 20.1002 requires that such a license is subject to the radiation protection requirements of 10 CFR Part 20. Compliance with dose limits, and requirements for radiation surveys, monitoring, control of exposures, and respiratory protection in

10 CFR Part 20 will require use of equipment and instrumentation that is part of the facility. This equipment and instrumentation must be described and located (where applicable) on facility drawings. Additional radiation protection equipment that is not part of the facility will be described in Chapters 4.0, Effluent Control Systems and 5.0, Operations.

10 CFR 20.1701 requires that the licensee shall use, to the extent practical, process or other engineering controls (e.g., containment or ventilation) to limit the concentrations of radioactive material in air.

10 CFR 20.1501(b) requires the licensee to ensure that instruments and equipment used for quantitative radiation measurements (e.g., dose rate and effluent monitoring) are calibrated periodically for the radiation measured.

The discussion of recovery plant equipment is acceptable if

(1) The LA provides a diagram of the proposed (or existing) plant layout. Areas where dusts, fumes, or gases would be generated are clearly identified. All ventilation, filtration, confinement, and dust collection systems, as well as the locations of the radiation monitoring equipment, are clearly identified.

(2) The recovery plant equipment is of sufficient capacity to process the amount of ore described in section 3.1. Manufacturer specifications for major components of the processing circuit are specified.

3.2.4 Evaluation Findings

The staff should determine, based upon a review of the description of the recovery plant equipment, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the description of the recovery plant equipment. If the staff determines that the description of the recovery plant equipment is sufficient to meet the regulatory requirements and acceptance criteria identified in section 3.2.3, then the following finding will be made.

The staff concludes that the description of the recovery plant equipment is sufficient to permit evaluation of the operations and processes to assess compliance with the requirements of 10 CFR 20.1002, 20.1501(b), and 20.1701.

3.2.5 References

None.

3.3 INSTRUMENTATION

3.3.1 Areas of Review

The staff should review descriptions of the proposed process instrumentation and control systems relevant to safety and radiation safety sampling and monitoring instrumentation, including their minimum

specifications and operating characteristics. This should include wellfield process control equipment for monitoring injection pressures, injection rates, and production rates.

3.3.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should review the descriptions provided in the LA to determine whether they are sufficient to evaluate the interrelationship between the proposed instrumentation systems and the operations or processes to be controlled or monitored. The staff should also determine whether the proposed instrumentation systems are sufficient to control and monitor operations and processes identified in the description of the proposed facility. Particular attention should be focussed on whether proposed monitoring and control instrumentation is adequate to quickly identify and remedy mining and processing problems that can increase exposures to radiological and chemical hazards. Areas of concern include monitoring and ventilation systems designed to detect and control elevated releases of yellowcake dust from drying and storage operations and radon gas buildup in buildings. Instrumentation to detect and control liquid releases from wellfield and processing pipe failures, impoundment leaks, and chemical tank valve failures should also be considered in the staff review.

3.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

A facility to recover uranium by in-situ solution mining is licensed under provisions of an NRC (10 CFR Part 40) source and byproduct material license. 10 CFR 20.1002 requires that such a license is subject to the radiation protection requirements of 10 CFR Part 20. Compliance with dose limits, and requirements for radiation surveys, monitoring, control of exposures, and respiratory protection in 10 CFR Part 20 will require use of equipment and instrumentation that is part of the facility. This equipment and instrumentation must be described and located (where applicable) on facility drawings. Additional radiation protection equipment that is not part of the facility will be described in Chapters 4.0, Effluent Control Systems and 5.0, Operations.

10 CFR 20.1701 requires that the licensee shall use, to the extent practical, process or other engineering controls (e.g., containment or ventilation) to limit the concentrations of radioactive material in air.

10 CFR 20.1501(b) requires the licensee to ensure that instruments and equipment used for quantitative radiation measurements (e.g., dose rate and effluent monitoring) are calibrated periodically for the radiation measured.

U.S. 32 (c) and (d) ← In compliance with

The ~~discussion of~~ instrumentation is acceptable if

(1) Instrumentation has been described for the various components of the processing facility, including wellfields, wellfield houses, trunklines, the production circuit, evaporation ponds, and deep injection disposal wells.

(2) Instrumentation is designed to allow the plant operator to continuously monitor and control a variety of systems and parameters, including total flow into the plant, total waste flow leaving the plant, tank levels, and the yellowcake drier. Instrumentation includes alarms in the event of a failure.

(3) Critical components of the systems are equipped with backup systems that activate in the event of a power failure.

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3.3.4 Evaluation Findings

The staff should determine, based upon a review of the description of the process instrumentation and control systems, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the process instrumentation and control systems. If the staff determines that the description of the process instrumentation and control systems is sufficient to meet the regulatory requirements and acceptance criteria identified in section 3.3.3, then the following finding will be made.

The staff concludes that the description of the process instrumentation and control systems is sufficient to permit evaluation of the operations and processes to assess compliance with the requirements of 10 CFR 20.1002, 20.1501(b), and 20.1701.

3.3.5 References

None.

4.0 EFFLUENT CONTROL SYSTEMS

The design and operation of the effluent control systems will be reviewed to support evaluations of the radiological safety of the proposed operations. The NRC staff must make an independent assessment of this safety.

4.1 GASEOUS AND AIRBORNE PARTICULATES

4.1.1 Areas of Review

The staff should review descriptions of the proposed ventilation, filtration, and confinement systems that are to be used during operations to control the release of radioactive materials to the atmosphere. The staff should also review analyses of equipment as designed and operated to prevent radiation exposures and to limit exposures and releases to as low as reasonably achievable (ALARA). A review will also be conducted of a physical description of discharge stacks, types and estimated composition and flow rates of atmospheric effluents, and proposed methods for controlling such releases.

4.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should review descriptions, designs, and operational modes to determine whether the proposed ventilation, filtration, and confinement systems and equipment described in the LA are sufficient to control the release of radioactive materials to the atmosphere to meet regulatory requirements identified in section 4.1.3.

4.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

Radiation protection requirements in 10 CFR Part 20 establish dose limits for workers and the public from facility operations. Facility effluent control systems must be described in sufficient detail to provide assurance that exposure limits will be met and that exposures will be ALARA.

10 CFR 20.1201(a) requires that a licensee shall control the occupational dose to individual adults to the following dose limits.

(1) An annual limit, which is the more limiting of the total effective dose equivalent being equal to 5 rems (0.05 Sv); or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin, and to the extremities, which are: An eye dose equivalent of 15 rems (0.15 Sv), and a shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.

10 CFR 20.1302(a) requires that the licensee shall survey radiation levels, as appropriate, in unrestricted and controlled areas and in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits in 10 CFR 20.1301 for individual members of the public.

10 CFR 20.1302(b) requires that a licensee shall show compliance with the annual dose limit in 10 CFR 20.1301 by demonstrating by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit; or demonstrating that the annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B to 10 CFR Part 20; and if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 mSv) in an hour and 0.05 rem (0.5 mSv) in a year.

The description of the gaseous and airborne particulate effluent control system is acceptable if

(1) Monitoring and control systems for the facility are located to optimize their intended function. Monitors used to assess worker exposures are placed in locations of maximum concentration based upon determination of airflow patterns.

(2) Monitoring and control systems for the facility are appropriate for the types of effluents generated. The intended purpose of measurement devices are clearly stated and criteria for monitoring are provided.

(3) The LA provides a demonstration that adequate ventilation systems are planned for process buildings to avoid radon gas buildup.

The review emphasis should be on (i) radon gas mobilization from recovery solutions entering the plant, (ii) the extraction process (where tanks are vented), and (iii) uranium particulate emissions resulting from drying and packaging operations and spills. For facilities using an open air design for processing (i.e., processing equipment is not enclosed by a building), ventilation will be less of a safety concern. Aspects of design that can significantly limit airborne releases include closed production systems (i.e., no venting) and the use of vacuum dryers that eliminate airborne uranium particulate releases from drying operations.

(4) The LA demonstrates that the effluent control systems will limit exposures under both normal and accident conditions. The LA also provides information on the health and safety impacts of system failures and identifies contingencies for such occurrences.

4.1.4 Evaluation Findings

The staff should determine, based upon a review of the description of the gaseous and airborne particulate effluent control systems, whether the information is sufficient to support the evaluation of the

facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the gaseous and airborne particulate effluent control systems. If the staff determines that the description of the gaseous and airborne particulate effluent control systems is sufficient to meet the regulatory requirements and acceptance criteria identified in section 4.1.3, then the following finding will be made.

The staff concludes that the sources of all gaseous and airborne particulate effluents have been identified and that appropriate effluent control systems have been implemented to limit radiation exposures to workers and the public in accordance with ALARA and other radiation protection requirements of 10 CFR 20.1101, 20.1201, 20.1301, and 20.1302.

4.1.5 References

None.

4.2 LIQUIDS AND SOLIDS

4.2.1 Areas of Review

The staff should review estimates of quantities and compositions of waste residues expected during construction and operation, and the procedures proposed for their management. The staff should also review design specifications for effluent control systems for liquids and solids to ensure that the intended function of each system is clearly stated and consistent with reported operating tolerances and efficiencies. Staff should review the design specifications of any retention systems such as ponds to ensure that liner and leak detection systems are included. If effluents are to be released into surface waters or injected into disposal wells, the staff should also review the plans to obtain any water quality certifications and discharge permits that may be necessary.

Areas to be reviewed include

(1) Information related to lined evaporation pond design, monitoring programs, freeboard requirements, and leak reporting procedures

(2) Liquid effluent disposal plans

(3) Contingency plans for dealing with leaks and spills

(4) Contaminated solid waste generation and disposal plans

(5) Noncontaminated solid waste generation and disposal plans

4.2.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the

LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

Staff should ensure that facility descriptions include discussion of how design features serve to contain contamination from spills resulting from normal operations and potential accidents (e.g, valve and tank failures, leaks in pond liners). Staff should perform the following assessments:

(1) Verify that evaporation ponds rely on standard engineering design to ensure proper containment performance, including appropriate leak detection systems. Staff must also ensure that appropriate freeboard requirements are established, and that appropriate monitoring programs and reporting procedures are in place.

(2) If liquid effluents are to be released into surface waters, applied to land surfaces, or injected into disposal wells, determine whether the appropriate water quality certifications and discharge permits have been applied for or issued,

(3) Ensure that contingency plans are in place for dealing with spills of process fluids from valve, pipe, or tank failures that would result in large spills.

(4) Ensure that an agreement is in place for disposal of 11.e(2) byproduct material in an NRC licensed disposal facility or a licensed mill tailings facility.

(5) Ensure that all noncontaminated solid waste is collected and disposed of in accordance with state and local requirements regarding landfill disposal.

4.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

Radiation protection requirements in 10 CFR Part 20 establish dose limits for workers and the public from facility operations. Facility effluent control systems must be described in sufficient detail to provide assurance that exposure limits will be met and exposures will be ALARA.

10 CFR 20.1201(a) requires that a licensee shall control the occupational dose to individual adults to the following dose limits.

(1) An annual limit, which is the more limiting of the total effective dose equivalent being equal to 5 rems (0.05 Sv); or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin, and to the extremities, which are: An eye dose equivalent of 15 rems (0.15 Sv), and a shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.

10 CFR 20.1302(a) requires that the licensee shall survey radiation levels in unrestricted and controlled areas and in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits in 10 CFR 20.1301 for individual members of the public.

10 CFR 20.1302(b) requires that a licensee shall show compliance with the annual dose limit in 10 CFR 20.1301 by demonstrating through measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit; or demonstrating that the annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B to 10 CFR Part 20; and if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 mSv) in an hour and 0.05 rem (0.5 mSv) in a year.

The ~~description of the~~ liquids and solids effluent control systems are acceptable if

(1) Common liquid effluents generated from the process bleed, process solutions (e.g., backwash, resin transfer waters). wash-down water, well development water, and restoration waters are properly controlled.

Acceptable control methods include: diversion of liquid wastes to evaporation ponds, deep well injection, and land application/irrigation. Solid effluents can be considered either as contaminated or as noncontaminated. Contaminated solid effluent that can be decontaminated and released for unrestricted use is discussed in detail in section 4.3.

(2) In accordance with 10 CFR Part 40, appendix A, onsite evaporation systems are designed and operated in a manner that prevents migration of waste from the evaporation system to the subsurface. Applications contain enough detail to allow the reviewer to determine the appropriateness of the pond design, monitoring system, freeboard requirements, corrective action plans, and reporting procedures. Engineering plans and drawings are helpful in this regard.

The reviewer may wish to consult WM-8101 (Nuclear Regulatory Commission, 1981) for additional information regarding the use of synthetic liners in evaporation ponds. The following discussion provides guidelines for an acceptable LA section dealing with evaporation ponds.

The monitoring and inspection program consists of documented daily checks of pond freeboard and the leak detection system. Because small amounts of condensation can accumulate in leak detection sumps, chemical samples are not commonly collected until water levels greater than a specified amount are detected. ~~For this reason, applicants should propose the level or volume of fluid that, when exceeded in the leak detection system standpipes, would be analyzed for selected chemical constituents.~~ When significant water levels are detected, the water in the standpipes must be sampled for indicator parameters to confirm that the water in the detection system is from the pond. The applicant should specify and provide the basis for selecting the indicator parameter(s) used to verify leaks.

Corrective actions should commence upon leak confirmation and should consist of transferring the solution to another pond so that liner repairs can be made. Thus, sufficient freeboard capacity should be maintained in the evaporation pond system that any one pond could be transferred to the remaining ponds in the event of a leak. An additional freeboard requirement is that water levels should be kept far enough below the top of the pond to prevent waves from overtopping during high wind conditions.

Actions to be taken in the event that evaporation pond standpipe water analyses indicate pond leakage include (i) notify the NRC by telephone within 48 hr of verification, (ii) analyze standpipe water quality samples for leak parameters once every 7 days during the leak period and once every 7 days for at least 14 days following repairs, and (iii) file a written report with the NRC within 30 days of first notifying the NRC that a leak existed. (This report would include analytical data and describe the mitigative action and the results of that action.)

(3) Acceptance criteria for other methods of effluent disposal, such as deep well injection, surface discharge, and land application are found in the NRC Staff Technical Position on Effluent Disposal at Licensed Uranium Recovery Facilities (Nuclear Regulatory Commission, 1995). Such disposal practices are generally strictly regulated by the EPA and state agencies, and the applicant is responsible for ensuring such disposal methods are in compliance with applicable directives.

Bring evidence in in compliance Suit reference

(4) Plans and procedures are provided that address contingencies for all reasonably expected system failures, such as well/pipe leaks, to demonstrate confidence that the applicant is prepared to respond to such events.

Processing plants should have sump capacity sufficient to contain the volume of the largest tank in the plant that contains hazardous material. Wellfield flow circuits should be equipped with alarms to notify the operator in the event of loss of pressure or excess pressure anywhere within the production circuit. The applicant should maintain a log of all significant solution spills. The NRC should be notified by telephone within 48 hr of any failure that might have a radiological impact on the environment. The notification would be followed, within 7 days, by a written report detailing the conditions leading to the failure or potential failure, corrective actions taken, and results achieved. This should be done in addition to the requirements of 10 CFR Part 20, and 10 CFR 40.60 and nonradiological

(5) The LA contains a description of the methods to be used for disposing of contaminated solid wastes that are generated during operation of the facility.

5.7.6

Equipment that can be decontaminated and released for unrestricted use is discussed in section 5.7.6. The storage of byproduct material that either cannot or will not be decontaminated and released for unrestricted use ~~should be described~~. The LA should provide an estimate of the amount of contaminated material that will be generated and objective evidence of an agreement for disposal of these materials either in a licensed waste disposal site or at a licensed mill tailings facility.

managed to insure compliance with occupational dose limits in 10CFR20, Subpart C. Detailed reviews of occupational dose will be accomplished as described in 5.7.6

(6) Noncontaminated solid waste will be gathered periodically and disposed in a sanitary landfill in accordance with state and local regulations. Regulation of this disposal is not part of the NRC licensing responsibility.

(7) Water quality certification and discharge permits have been obtained, or plans are in place to obtain them.

4.2.4 Evaluation Findings

The staff should determine, based upon a review of the description of the liquids and solids effluent control systems, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the liquids and solids effluent control systems. If the staff determines that the description of the liquids and solids effluent control systems is sufficient to meet the regulatory requirements and acceptance criteria identified in section 4.2.3, then the following finding will be made.

The staff concludes that the sources of all liquid and solid effluents have been identified and that appropriate effluent control systems have been implemented to limit radiation exposures to workers and the public in accordance with ALARA and other radiation protection requirements of 10 CFR 20.1101, 20.1201, 20.1301, and 20.1302.

4.2.5 References

Nuclear Regulatory Commission. 1995. *Staff Technical Position of Effluent Disposal at Licensed Uranium Recovery Facilities, Revision 0*. Washington, DC: Nuclear Regulatory Commission.

Nuclear Regulatory Commission. 1980. Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1. *Regulatory Guide 4.14*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

4.3 CONTAMINATED EQUIPMENT

The review in this area will be moved to 5.7.6 where it is more appropriate

4.3.1 Areas of Review

The staff should review descriptions of methods proposed ~~for the disposal or release of~~ contaminated ~~equipment that may be produced in the ura~~ in recovery process. to ensure that the licensee eliminates residual prior to release for unrestricted use.

4.3.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the proposed methods for the disposal of contaminated waste solids and equipment that are generated in the uranium recovery process are sufficient to meet the regulatory requirements identified in section 4.3.3. Staff should ensure that the licensee intends to make a reasonable effort to eliminate residual contamination on equipment and materials prior to disposal or release for unrestricted use.

4.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 20.1302(a) requires that the licensee shall survey radiation levels, as appropriate, in unrestricted and controlled areas and in effluents released to unrestricted and controlled areas to demonstrate compliance with the dose limits for individual members of the public in 10 CFR 20.1301.

10 CFR 20.1302(b) requires that a licensee shall show compliance with the annual dose limit in 10 CFR 20.1301 by demonstrating through measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit; or demonstrating that the annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the values specified in table 2 of appendix B to part 20; and if an individual were continuously present in an unrestricted area, the dose from external sources would not exceed 0.002 rem (0.02 mSv) in an hour and 0.05 rem (0.5 mSv) in a year.

The ~~description~~ of methods proposed for disposal or release of contaminated equipment is acceptable if

(1) ~~The licensee makes a reasonable effort to eliminate residual contamination~~ The licensee will

(2) ~~Procedures are in place to~~ 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 4.3-1 prior to applying the covering. A reasonable effort is made to minimize the contamination prior to use of any covering.

(3) The radioactivity on the interior surfaces of pipes, drain lines, or ductwork 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 ductwork.

Surfaces of premises, equipment, or scrap which 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) ~~If requested, the Commission has authorized a~~ licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with material in excess of the limits specified. ~~This may include,~~ but would not be limited to, special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status. Such requests should

(a) Provide detailed information describing the premises, equipment or scrap, the radioactive contaminants, and the nature, extent, and degree of residual surface contamination.

the applicant should meet the following criteria.

Move to 5.7.4

Table 4.3-1. Acceptable surface contamination levels*

Nuclides[a]	Average[b,c,f]	Maximum[b,d,f]	Removable[b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm/100 cm² Alpha dpm	15,000 dpm/100 cm² Alpha dpm	1,000 dpm/100 cm² Alpha dpm
Transuranics, Ra-226, Ra-228, Th-230, Th-118, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm²	300 dpm/100 cm²	20 dpm/100 cm²
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm²	3,000 dpm/100 cm²	200 dpm/100 cm²
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90, and others noted above	5,000 dpm/100 cm²	15,000 dpm/100 cm²	1,000 dpm/100 cm²

[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 detector for background, efficiency, and geometric factors associated with the instrumentation.
[c]Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.
[d]The maximum contamination level applies to an area of not more than 100 cm².
[e]The amount of removable radioactive material per 100 cm² 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.
[f]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 milligrams per square centimeter of total absorber.

*Source: Nuclear Regulatory Commission, "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials," Revision IV, Uranium Recovery Field Office, 1984.

Insert from page 4-8

(b) 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 premises, equipment, or scrap, are unlikely to result in an unreasonable risk to the health and safety of the public.

(5) Prior to release of premises for unrestricted use, the licensee has made a comprehensive radiation survey that establishes that contamination is within the limits specified in table 4.3-1. ~~A copy of the survey report shall be filed with the NRC, Division of~~ NMSS, Uranium Recovery Branch. The survey report should

~~(a)~~ Identify the premises

~~(b)~~ Show that reasonable effort has been made to eliminate residual contamination

~~(c)~~ Describe the scope of the survey and general procedures followed

~~(d)~~ State the findings of the survey in units specified in table 4.3-1

~~Following the review of the report,~~ the staff should consider visiting the facilities to confirm the survey. The licensee shall not release the premises for unrestricted use without the written approval of the NRC staff.

Incorporate from guidance

The NRC Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Material (Nuclear Regulatory Commission, 1984) provides radiation exposure rate limits that licensees should use in accomplishing/verifying the decontamination and survey of the surfaces of buildings and equipment prior to their release for unrestricted use. Note that these guidelines do not address the potential for internal contamination in porous material such as wood, concrete, and insulation.

4.3.4 Evaluation Findings

The staff should determine, based upon a review of the description of the methods proposed for disposal or release of contaminated equipment, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the methods for disposal or release of contaminated equipment. If the staff determines that the description of the methods for disposal or release of contaminated equipment are sufficient to meet the regulatory requirements and acceptance criteria identified in section 4.3.3, then the following finding will be made.

The staff concludes that the program for controlling exposures from contaminated equipment, including the procedures for decontamination and release of contaminated equipment, are adequate to protect health and safety in accordance with ALARA and other radiation protection requirements of 10 CFR 20.1101, 20.1201, 20.1301, and 20.1302.

4.3.5 References

Nuclear Regulatory Commission. Radiological Effluent and Environmental Monitoring at Uranium Mills Revision. *Regulatory Guide 4.14*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Global search to remove performance based licensing

5.0 OPERATIONS

The operations to be reviewed in this section should be considered as specific commitments on the part of the applicant for conducting operations, radiological protection programs, and monitoring programs. The material in this portion of the LA should be complete in itself, insofar as possible, without references to other submittals. With the advent of performance-based licensing, which allows the licensee to make certain changes without NRC approval, the reviewer should pay particular attention to the procedures that are to be followed by the applicant to make any changes to the ISL facility (e.g., opening a new wellfield, or changing flow rates).

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 groundwater monitoring programs, quality assurance programs, routine and nonroutine maintenance activities, and changes to any of these. In addition, for ~~performance-based licensing~~, the reviewer should examine the plans proposed by the applicant for establishing a Safety and Environmental Review Panel (SERP) and the proposed composition and responsibilities of the SERP.

5.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should review areas outlined in Regulatory Guide 3.46, Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining (Nuclear Regulatory Commission, 1982). Specifically, the reviewer should determine whether the proposed organization and administrative procedures are defined in sufficient detail to evaluate the performance of persons in positions responsible for developing, reviewing, approving, implementing, and enforcing the proposed programs related to radiological safety, environmental safety, and groundwater protection. In addition, ~~for performance-based licensing~~, the reviewer should examine the plans proposed by the applicant for establishing a SERP and the proposed composition and responsibilities of the SERP.

5.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and the requirements of 10 CFR Part 40, appendix A provide criteria for disposition of wastes. Applicants are

required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also, that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and subpart M provides reporting and notification requirements.

10 CFR Part 40, appendix A, establishes a regulatory requirement for source material license holders to protect groundwater resources from contamination caused during operations.

The discussion of corporate organization and administrative procedures is acceptable if

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

(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.

(3) ~~For performance-based licensing,~~ the applicant will be required to establish a SERP. ~~An acceptable plan for the makeup of a SERP is as follows~~

~~The SERP~~ will consist of at least three individuals. One member of the SERP will have expertise in management and will be responsible for managerial and financial approval changes; one member will have expertise in operations and/or construction and will have responsibility for implementing any operational changes; and one member will be the corporate radiation safety officer (CRSO), or equivalent, with the responsibility for assuring that changes conform to radiation safety and environmental requirements. Additional members may be included in the SERP as appropriate to address specific technical issues such as health physics, groundwater hydrology, surface water hydrology, and specific earth sciences or other technical disciplines. Temporary members may include consultants.

(4) To the extent possible, proposed administrative procedures conform with Regulatory Guide 8.2, Guide for Administrative Practices in Radiation Monitoring (Nuclear Regulatory Commission, 1973).

5.1.4 Evaluation Findings

The staff should determine, based upon a review of the proposed corporate organization and administrative procedures, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the proposed corporate structure or administrative procedures. If the staff determines that the proposed corporate structure and administrative procedures are sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.1.3, then the following finding will be made.

The staff concludes that the proposed corporate structure and administrative procedures are adequate to ensure that the organizational control program will be effective and that the proposed operations can be conducted in a manner that protects health and safety and the environment in accordance with the requirements of 10 CFR Part 20 subparts B, C, L, and M, and 10 CFR Part 40, appendix A, criterion 5 in particular.

5.1.5 References

Nuclear Regulatory Commission. 1973. Guide for Administrative Practices in Radiation Monitoring. *Regulatory Guide 8.2.* Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1982. Standard Format and Content of License Applications, Including Environmental Reports, for In Situ Uranium Solution Mining. *Regulatory Guide 3.46.* Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

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 and safety are conducted in accordance with written standard operating procedures (SOP). For performance-based licensing, the reviewer should evaluate the management control and decision bases to be used by the SERP in deciding when it is necessary to apply for a license amendment. Procedures governing nonroutine work or maintenance that is not covered by an SOP should be reviewed.

5.2.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should determine that the proposed management control program and administrative procedures are sufficient to assure that all proposed activities potentially affecting health and safety can be conducted in accordance with written operating procedures. The review should include

determining the existence of SOPs for routine work, and the review and approval process to be used by the radiation safety staff when appropriate. Methods for review and approval of nonroutine work or maintenance activity by the radiation safety staff should be examined. ~~In addition, for performance-based licensing~~, the reviewer should examine the plans proposed by the applicant for establishing a SERP and the proposed composition and responsibilities of the SERP.

5.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and the requirements of 10 CFR Part 40, appendix A provide criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and subpart M provides reporting and notification requirements.

10 CFR Part 40, appendix A, establishes a regulatory requirement for source material license holders to protect groundwater resources from contamination caused during operations.

The description of the management control system is acceptable if

(1) The proposed management control program and administrative procedures are sufficient to assure that all proposed activities can be conducted in accordance with written operating procedures. For SOP refer to eg. guide 8.31 and protection

(2) ~~SOPs either exist and are referenced, are incorporated in the LA, as~~ the applicant provides ~~assurance that~~ operating procedures will be developed for routine work. the process that will be used to prepare There should be a mechanism for the development, approval, and periodic review of all SOPs by the radiation safety staff on an annual basis. Subsequent inspections will ensure that SOPs are adequate and applied correctly.

Should be expanded to all areas and posted, other ones such as well fields maintenance workers especially in radiation ovals.

(3) The applicant presents methods for review and approval of nonroutine work ~~or~~ maintenance activity by the radiation safety staff. The methods should include the issuance of radiation work permits for activities were standard work permits do not apply.

(4) For the purposes of performance-based licensing, the applicant defines changes the SERP can make in the construction and/or operation of the proposed facility. Acceptable guidance regarding the authority of the SERP to make changes is that the SERP may

(a) Make changes in the facility or process, as presented in the application

(b) Make changes in the procedures presented in the application

(c) Conduct tests or experiments not presented in the application

(5) For the purposes of performance-based licensing, the applicant acknowledges those conditions under which the SERP can make changes, tests, or experiments without applying for a license amendment. A license amendment is necessary unless all the following conditions are satisfied:

(a) The change, test, or experiment does not conflict with any requirement specifically stated in the license, or impair the licensee's ability to meet all applicable NRC regulations;

(b) There is no degradation in the essential safety or environmental commitments in the approved LA;

(c) The change, test, or experiment is consistent with the conclusions of actions analyzed and selected in the EA.

5.2.4 Evaluation Findings

The staff should determine, based upon a review of the proposed management control program, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the proposed management control program. If the staff determines that the proposed management control program is sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.2.3, then the following findings will be made:

(1) The staff concludes that the proposed management control program is adequate to ensure that all routine activities are conducted in accordance with written operating procedures that will be approved and reviewed at specified frequencies by the applicant radiation safety staff in accordance with the requirements of 10 CFR Part 20 subparts L and M.

(2) The staff concludes that the proposed management control program is adequate to ensure that any nonroutine work or maintenance not covered by an effective operating procedure will be conducted in accordance with a special work permit reviewed and approved by the applicant radiation safety staff in accordance with 10 CFR Part 20 subparts L and M.

5.2.5 References

None.

5.3 MANAGEMENT AUDIT AND INSPECTION PROGRAM

5.3.1 Areas of Review

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

Spill Notification

5.3.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should determine whether the proposed management audit and internal inspection programs are sufficient to ensure the implementation of the proposed management control program and to ensure that employee exposures and effluent releases are ALARA.

5.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

Criterion (2)

10 CFR Part 20 provides the regulatory standards for protection against radiation and 10 CFR Part 40, appendix A provide criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR 20.1501 requires each licensee to conduct surveys that may be necessary to comply with the standards in 10 CFR Part 20. These surveys include those necessary to evaluate radiation levels, concentrations and quantities of radioactive material, and potential radiation hazards that may be present. It also requires regular calibration of survey instruments and appropriate processing of dosimeter results

by National Voluntary Laboratory Accreditation Program accredited staff who have been approved to process results for the type of radiation survey conducted.

10 CFR 20.1204 requires the licensee to take suitable and timely measurements of concentrations of radioactive materials in air in work areas, quantities of radioactive materials in the body, or quantities of radioactive material excreted from the body when measurement of intake of radioactive material is required under 10 CFR 20.1502.

10 CFR 20.1702 states that when it is not practical to apply process or other engineering controls to limit radioactive material concentrations in air to below the levels for an airborne radioactivity area, the licensee may limit intakes by control of access, limitation of exposure times, use of respiratory protection equipment, or other controls.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and subpart M provides reporting and notification requirements.

Criterion 2 requires ISL by product disposal at larger tailings disposal sites to avoid

The description of the management audit and inspection program is acceptable if

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

make 2 pgh"

(a) refers to embankment

(b) refers to ALARA

(a) Acceptable programs for quarterly inspection of embankment retention systems and annual ALARA audits are described in Regulatory Guides 3.11, Design, Construction, and Inspection of Embankment Retention Systems for Uranium Mills (Nuclear Regulatory

(b) Commission, 1977) and 8.31, Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills Will be as low as is Reasonably Achievable (Nuclear Regulatory Commission, 1983), respectively.

(2) The applicant has described the anticipated content of ALARA audit reports. An acceptable ALARA audit report discusses trends in personal exposures and proper use, maintenance, and inspection of equipment for exposure control. Data summarized in the report should include

(a) Employee exposure records

(b) Bioassay results

(c) Inspection log entries and summary reports of mine and process inspections

(d) Documented training program entries

(e) Applicable safety meeting reports

(f) Radiological survey and sampling data

(g) Reports on any overexposure of workers

proliferation of small disposal cells. A commitment to secure and maintain a contractural agreement for the disposal of ISL by product material at an NRC licensed facility. Continued yellow-cake production is contingent on a valid agreement.

~~(b) Operating procedures reviewed during the year~~

(3) The applicant has established record control procedures to assure maintenance of all records until license termination.

(4) All reporting and recordkeeping conforms to Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1 (Nuclear Regulatory Commission, 1982).

(5) ~~For a performance-based license, the LA contains the reporting requirements for the SERP for any changes made~~

The SERP

~~These~~ records will include written safety and environmental evaluations made by the SERP that provide the basis for determining whether changes were made in accordance with the bases described in section 5.2.3. The applicant has made provisions to furnish an annual report to NRC that includes a description of these changes, tests, or experiments, and a summary of the safety and environmental evaluation for each. In addition, the licensee has made provisions to annually submit change pages to the NRC for the approved application and/or the approved operations plan and reclamation plan.

5.3.4 Evaluation Findings

The staff should determine, based upon a review of the proposed management audit and inspection program, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the proposed management audit and control program. If the staff determines that the proposed management audit and control program is sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.3.3, then the following findings will be made.

(1) The staff concludes that the proposed management audit and inspection program is adequate to identify the person responsible for each phase of the audit and inspection program in accordance with the requirements of 10 CFR 20.1101, 20.1702, and 20 CFR Part 20 subparts L and M.

(2) The staff concludes that the proposed management audit and inspection program is adequate to ensure that employee exposures to airborne and external radiation and effluent releases are ALARA in accordance with the requirements of 10 CFR 20.1101, 20.1501, 20.1204, and 20.1702.

5.3.5 References

Nuclear Regulatory Commission. 1977. Design, Construction, and Inspection of Embankment Retention Systems for Uranium Mills. *Regulatory Guide 3.11.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1983. Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills will be as low as is Reasonably Achievable. *Regulatory Guide 8.31.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

5.4 QUALIFICATIONS

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. ~~For performance-based licenses, it is not necessary for the staff to review the qualifications of specific persons so long as the procedures for selecting those persons~~ are adequate.

5.4.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

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 regulatory requirements identified in section 5.4.3. The staff should also determine that the qualifications of people specifically proposed for these positions are consistent with the minimum qualifications and experience levels.

5.4.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and the requirements of 10 CFR Part 40, appendix A provide criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

The ~~description of~~ qualifications of rad safety personnel is acceptable if:

(1) The applicant specifies minimum qualifications and experience for radiation safety staff that are consistent with Regulatory Guide 8.31, Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills will be ALARA (Nuclear Regulatory Commission, 1983). The emphasis of this guidance is for uranium mills; however, the training requirements apply equally to ISL facilities. ~~Therefore, qualifications for ISL facility personnel consistent with Regulatory Guide 8.31 (Nuclear Regulatory Commission, 1983) should specify that the radiation safety officer has the~~ following ~~education, training, and~~ experience:

(a) Education: A bachelor's degree in the physical sciences, industrial hygiene, or engineering from an accredited college or university or an equivalent combination of training and relevant experience in uranium mill radiation protection. Two years of relevant experience are generally considered equivalent to 1 year of academic study.

(b) Health Physics Experience: At least 1 yr of work experience relevant to uranium mill operation in applied health physics, radiation protection, industrial hygiene, or similar work. This experience should involve actually working with radiation detection and measurement equipment, not strictly administrative or "desk" work.

(c) Specialized Training: At least 1 wk of specialized classroom training in health physics specifically applicable to ISL facility operations. In addition, the radiation safety officer should attend refresher training on ISL facility health physics every 2 yr.

(d) Specialized Knowledge: A thorough knowledge of the proper application and use of all health physics equipment used in the ISL facility, the chemical and analytical procedures used for radiological sampling and monitoring, methodologies used to calculate personnel exposure to uranium and its daughters, and a thorough understanding of the uranium extraction process and equipment used in the ISL facility and how hazards are generated and controlled during the extraction process.

Similarly, the following education, training, and experience requirements apply to health physics technicians:

(a) Education: An associate degree or 2 or more years of study in the physical sciences, engineering, or a health-related field.

(b) Training: A total of at least 4 wk generalized training (up to 2 wk may be on-the-job training) in radiation health protection applicable to ISL facilities.

(c) Experience: One year of work experience using sampling and analytical laboratory procedures that involve health physics, industrial hygiene, or industrial safety measures to be applied in a uranium mill

or

(d) Education: A high school diploma

(e) Training: A total of at least 3 mo specialized training (up to one month may be on-the-job training) in radiation health protection relevant to ISL facilities

(f) Experience: Two years relevant work experience in applied radiation protection; the health physics technician should demonstrate a working knowledge of the proper operation of health physics instruments used in the ISL facility, surveying and sampling techniques, and personnel dosimetry requirements.

(2) The LA includes the qualifications for radiation safety positions or a statement that the qualifications meet the minimum qualifications described in section 5.4.3. This information may be presented in an appendix. Subsequent NRC inspections will check the qualifications of existing staff to verify that minimum requirements are being met.

5.4.4 Evaluation Findings

The staff should determine, based upon a review of the qualifications proposed for personnel holding positions in the applicant organizational structure, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the qualifications proposed for personnel holding positions in the applicant organizational structure. If the staff determines that the qualifications proposed for personnel holding positions in the applicant organizational structure are sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.4.3, then the following finding will be made.

The staff concludes that the qualifications proposed for personnel holding positions in the applicant organizational structure are sufficient for administering the radiation safety program in accordance with the requirements of 10 CFR 20.1101.

5.4.5 References

Nuclear Regulatory Commission. 1983. Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills will be as low as is Reasonably Achievable. *Regulatory Guide 8.31*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

5.5 TRAINING

5.5.1 Areas of Review

The staff should review the proposed employee radiological protection training program, including the content of the initial training or indoctrination, testing, on-the-job training, and the extent and frequency of retraining. This material will most likely be presented as an appendix to the LA. The staff should also review the proposed written radiological safety instructions that will be provided to employees to include personal hygiene, contamination surveying prior to eating or leaving the operating area, requirements for personal monitoring devices and respirators, housekeeping requirements, spill cleanup procedures, and emergency actions.

5.5.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the applicant has procedures for an employee radiological protection training program that are adequate to provide radiological safety instructions to the employees. The staff should also determine whether the proposed written radiological safety instructions that will be provided to employees are sufficiently detailed to meet acceptance criteria identified in section 5.5.3.

5.5.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and 10 CFR Part 40, appendix A provides criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

An appendix addressing compliance with 10 CFR 19.12 should be provided that contains a copy of the proposed radiological safety instructions to be provided to employees.

The description of the training program is acceptable if

(1) Training requirements have been clearly defined for employees.

For the training of permanent employees, the staff should review the training programs against the acceptable approach described in Regulatory Guide 8.31, Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Mills Will be as low as is Reasonably Achievable (Nuclear Regulatory Commission, 1983). 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. Other guidance pertinent to this course is found in Regulatory Guide 8.13, Instruction Concerning Prenatal Radiation Exposure (Nuclear Regulatory Commission, 1987), and Regulatory Guide 8.29, Instruction Concerning Risks from Occupational Radiation Exposure (Nuclear Regulatory Commission, 1981). This course of instruction should include the following topics:

(a) Fundamentals of Health Protection

(i) The radiologic and toxic hazards of exposure to uranium and its daughters

(ii) How uranium and its daughters enter the body (inhalation, ingestion, and skin penetration)

(iii) Why exposures to uranium and its daughters should be kept ALARA.

(b) Personal Hygiene at Uranium Mills

(i) Wearing protective clothing

(ii) Using respirators correctly

(iii) Eating, drinking, and smoking only in designated areas

(iv) Using proper methods for decontamination (i.e., showers)

(c) Facility-Provided Protection

(i) Ventilation systems and effluent controls

(ii) Cleanliness of the work place

(iii) Features designated for radiation safety for process equipment

(iv) Standard operating procedures

(v) Security and access control for designated areas

(d) Health Protection Measurements

(i) Measurement of airborne radioactive materials

(ii) Bioassay to detect uranium (urinalysis and in vivo counting)

(iii) Surveys to detect contamination of personnel and equipment

(iv) Personnel dosimetry

(e) Radiation Protection Regulations

(i) Regulatory Authority of NRC, MSHA, and the state

(ii) Employee rights in 10 CFR Part 19

(iii) Radiation protection requirements in 10 CFR Part 20

(iv) Mill emergency procedures

(2) The LA includes specific procedures to ensure that the training program includes tests and that results of tests will be kept on file.

Permanent workers must be provided an abbreviated retraining course annually, with records maintained on file. New workers must be given specialized, on-the-job health physics training for the areas related to their work. Supervisors should be given specialized training in areas they are expected to oversee. All employees should sign a statement that indicates they have received the radiation safety training. Monthly or bimonthly safety meetings should be attended by all workers to provide a means to discuss radiation safety issues at the facility. Contractors who work onsite should be given the same training as similarly employed regular workers.

(3) Plans are in place requiring all visitors to the site to receive safety training, or requiring escorts for all accessible areas posing a potential radiation exposure hazard.

5.5.4 Evaluation Findings

The staff should determine, based upon a review of the training proposed for applicant employees, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the training proposed for applicant employees. If the staff determines that the training proposed for applicant employees is sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.5.3, then the following finding will be made.

The staff concludes that the training proposed for applicant employees is sufficient for administering the radiation safety program in accordance with the requirements of 10 CFR 20.1101.

5.5.5 References

Nuclear Regulatory Commission. 1981. Instruction Concerning Risks from Occupational Radiation Exposure. *Regulatory Guide 8.29*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1983. Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Mills Will be as low as is Reasonably Achievable. *Regulatory Guide 8.31*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1987. Instruction Concerning Prenatal Radiation Exposure, Revision 2. *Regulatory Guide 8.13*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

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

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

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, subparts H and I.

5.6.3 Acceptance Criteria

Security controls will be acceptable if the license has acceptable

~~Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.~~ possible controls such as fencing the well field and active controls for plant buildings.

10 CFR Part 20 provides the regulatory standards for protection against radiation and 10 CFR Part 40, appendix A provides criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures for security that serve to control worker and public access to hazardous areas of the facility and maintain exposures ALARA.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR 20.1702(a) requires the licensee to control access to restricted areas as a means of achieving ALARA.

10 CFR subpart I contains requirements for security of stored licensed materials that are in controlled or unrestricted access, and control of licensed material that is not in storage.

The description of security requirements will be acceptable if

(1) The applicant has demonstrated that all licensed material will be properly stored and access to it will be restricted to authorized personnel only.

(2) All visitors to restricted areas are required to sign in and will not admitted to the restricted area without appropriate access. Inexperienced visitors should be escorted inside the plant or wellfield areas.

(3) Plans are presented for posting signs to clearly identify restricted areas.

(4) Procedures are in place to establish security protocols at the site in accordance with 10 CFR Part 20 requirements.

(5) The applicant identifies local law enforcement agencies that have jurisdiction over the proposed facility.

5.6.4 Evaluation Findings

The staff should determine, based upon a review of the proposed facility security program, whether the information is sufficient to ensure safe operation of the facilities. The staff should also document any concerns regarding the proposed facility security program. If the staff determines that the proposed facility security program is sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.6.3, then the following finding will be made.

The staff concludes that the proposed facility security program is sufficient for administering the radiation safety program in accordance with the requirements of 10 CFR 20.1101, 20.1702, and 10 CFR Part 20 subpart I.

5.6.5 References

None.

5.7 RADIATION SAFETY CONTROLS AND MONITORING

The staff should review safety controls and monitoring procedures proposed by the applicant to limit radiation exposures and radioactive releases to levels ALARA. Staff should ensure that procedures applicable to operating, maintaining, and keeping adequate records of control systems are reviewed for ALARA requirements.

5.7.1 Effluent Control Techniques

5.7.1.1 Areas of Review

The staff should review descriptions of the systems and procedures (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 particulate (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. Staff should evaluate effluent control systems 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 washdown water. 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). Staff should also review evaporation pond engineering design to ensure proper containment performance, and evaluate leak detection and monitoring systems for ponds containing contaminated effluents.

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 to be implemented in the event of equipment failures or spills. or ground water excursions. an notification requirment

5.7.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the proposed safety controls and monitoring procedures are sufficient to limit radiation exposures and radioactive releases to ALARA and are in conformance with regulatory requirements identified in 10 CFR Part 20.

In general, the staff should be familiar with Regulatory Guide 8.10, Operating Philosophy for Maintaining Occupational Radiation Exposures as low as is Reasonably Achievable (Nuclear Regulatory Commission, 1977). Additional guidance is found in Draft Regulatory Guide ~~DG-8~~013, ALARA Levels for Effluent from Materials Facilities (Nuclear Regulatory Commission, 1992), and Regulatory Guide 8.31, Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Mills will be as low as is Reasonably Achievable (Nuclear Regulatory Commission, 1983). The staff should determine whether the proposed systems and procedures (e.g., ventilation, confinement, filtration) are adequately described ~~and sufficient to minimize~~ to minimize in-plant and environmental emissions at each step of the process where releases might occur. 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. Staff should also check that the frequencies of equipment tests and inspections are consistent with manufacturer's recommendations to ensure that these specifications are being met. Contingencies for equipment failures, maintenance shutdowns, and spills should be reviewed to ensure procedures are in place to maintain exposures ALARA.

5.7.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR 20.1201(a) requires that a licensee shall control the occupational dose to individual adults to the following dose limits.

(1) An annual limit, which is the more limiting of the total effective dose equivalent of 5 rems (0.05 Sv); or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye at 50 rems (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin, and to the extremities, which are: an eye dose equivalent of 15 rems (0.15 Sv), and a shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.

10 CFR 20.1302 requires the licensee to survey, as appropriate, radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with public dose limits in 10 CFR 20.1301. Effluent control techniques are necessary to ensure that a facility complies with these dose limits.

10 CFR 20.1702 states that when it is not practical to apply process or other engineering controls to limit radioactive material concentrations in air to below the levels for an airborne radioactivity area, the licensee may limit intakes by control of access, limitation of exposure times, use of respiratory protection equipment, or other controls.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and subpart M provides reporting and notification requirements.

The description of radiation safety controls and monitoring is acceptable if

(1) Important effluent streams include radon gas venting from processing tanks within enclosed buildings and yellowcake dusts from drying operations.

Effective control of radon gas can be achieved by use of 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. Acceptable methods for implementation of radon gas control are given in Regulatory Guide 3.56, General Guidance for Designing, Testing, Operating, and Maintaining Emission Control Devices at Uranium Mills (Nuclear Regulatory Commission, 1986).

(2) Acceptable control of yellowcake emissions from the dryer is achieved by implementation of a vacuum dryer system that eliminates particulate emissions or by use of appropriate *particulate scrubber equipment on the dryer stack (e.g., wet impingement or venturi* scrubbers are generally used).

Acceptable methods for implementation of yellowcake dust control are given in Regulatory Guide 3.56, General Guidance for Designing, Testing, Operating, and Maintaining Emission Control Devices at Uranium Mills (Nuclear Regulatory Commission, 1986).

(3) The applicant describes minimum performance specifications for the operation of the different effluent control systems and the frequencies of tests and inspections to ensure proper performance to specifications.

Acceptable methods for testing, maintenance, and inspection of effluent control systems are given in Regulatory Guide 3.56, General Guidance for Designing, Testing, Operating, and Maintaining Emission Control Devices at Uranium Mills (Nuclear Regulatory Commission, 1986).

(4) Recordkeeping for the effluent control system is sufficient to meet requirements in 10 CFR 20.2102.

See Janet Lambert

Acceptable recordkeeping techniques are described in Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1 (Nuclear Regulatory Commission, 1982).

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

Acceptable emergency procedures are outlined in Regulatory Guide 3.56, General Guidance for Designing, Testing, Operating, and Maintaining Emission Control Devices at Uranium Mills (Nuclear Regulatory Commission, 1986).

Adequate monitoring well sampling and verification of potential exceedances. Commitment to verify or control excursion within 60 days. Details are described in 5.7.8.3

(6) For license renewal applications, the historical effluent control program results are 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.

5.7.1.4 Evaluation Findings

The staff should determine, based upon a review of the proposed effluent control techniques, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed effluent control techniques. If the staff determines that the proposed effluent control techniques are sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.1.3, then the following finding will be made.

The staff concludes that the proposed effluent control techniques are sufficient to maintain environmental emissions from the facility ALARA taking into account the site specific pathways in accordance with the requirements of 10 CFR 20.1101, 20.1201(a), and 10 CFR Part 20 subparts L and M.

5.7.1.5 References

Nuclear Regulatory Commission. 1977. Operating Philosophy for Maintaining Occupational Radiation Exposures as low as is Reasonably Achievable, Revision 1-R. *Regulatory Guide 8.10.* Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1983. Information Relevant to Ensuring that Occupational Radiation Exposures at Uranium Mills will be as low as is Reasonably Achievable. *Regulatory Guide 8.31.* Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

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

Nuclear Regulatory Commission. 1992. *Draft Regulatory Guide DG-8013, ALARA Levels for Effluent from Materials Facilities.* Washington, DC: Nuclear Regulatory Commission.

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 nonroutine operations, maintenance, and cleanup activities. This 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 personal monitoring (using film badges) including 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

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the proposed safety controls and monitoring procedures proposed by the applicant are sufficient to limit radiation exposures and radioactive releases to ALARA and are in conformance with regulatory requirements identified in 10 CFR Part 20. The staff's review should focus on the following aspects of the radiation safety program.

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 (10 CFR 20.1203). In conducting their 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. All monitoring equipment should be identified by type with additional specification of the range, sensitivity, calibration methods and frequency, availability, and planned use. Staff should ensure that planned surveys for external radiation are consistent with the guidance in Regulatory Guide 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983). Plans for documentation of radiation exposures should be consistent with the approach in Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data (Nuclear Regulatory Commission, 1982). Staff should confirm that the recordkeeping program includes files for contractors. Staff shall 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 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).

5.7.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and 10 CFR Part 40, appendix A provides criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR 20.1501 requires each licensee to conduct surveys which may be necessary to comply with the standards in 10 CFR Part 20. These surveys include those necessary to evaluate radiation levels, concentrations and quantities of radioactive material, and potential radiation hazards that may be present. This section also requires regular calibration of survey instruments and appropriate processing of dosimeter results by National Voluntary Laboratory Accreditation Program accredited staff who have been approved to process results for the type of radiation survey conducted.

10 CFR 20.1502 requires monitoring radiation exposures to comply with the standards in 10 CFR Part 20 and provides criteria for when personal monitoring devices are required. Workers who are likely to receive more than 10 percent of the annual limits in 10 CFR 20.1201(a) are required to wear individual monitoring devices. Occupational intake of radioactive material shall be monitored for those workers likely to receive more than 10 percent of the applicable annual limit on intake (ALI) (see 10 CFR Part 20, appendix B).

10 CFR 20.1201(a) requires that a licensee shall control the occupational dose to individual adults to the following dose limits:

(1) An annual limit, which is the more limiting of the total effective dose equivalent of 5 rems (0.05 Sv); or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye at 50 rems (0.50 Sv).

(2) The annual limits to the lens of the eye, to the skin, and to the extremities, which are: an eye dose equivalent of 15 rems (0.15 Sv), and a shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.

10 CFR 20.1202 provides methods for determining compliance with the dose limits in 10 CFR 20.1201 when it is necessary to sum external and internal doses.

10 CFR 20.1203 requires licensees to include the determination of the deep dose equivalent, eye dose equivalent, and shallow dose equivalent when determining the airborne external dose from exposure to a radioactive cloud.

10 CFR 20.1207 limits the annual occupational dose for minors to 10 percent of the annual dose limits specified for adult workers.

10 CFR 20.1208 specifies limits on the exposure for an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman. The limit is set at 0.5 rem (0.005 Sv).

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and subpart M provides reporting and notification requirements.

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 (10 CFR 20.1203).

The external radiation exposure monitoring program is acceptable if

(1) The LA contains one or more charts that identify the facility layout and the location of monitors for external radiation and provide acceptable criteria for determining the sampling locations.

(2) The LA indicates criteria to be used in establishing which employees are to receive external exposure monitoring. These criteria are consistent with the 10 CFR Part 20 regulatory requirements identified in the preceding paragraphs.

(3) All monitoring equipment is identified by type with specification of the range, sensitivity, calibration methods and frequency, availability, and planned use.

(4) Planned surveys of external radiation are consistent with the guidance in Regulatory Guide 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

(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 (Nuclear Regulatory Commission, 1982).

(6) The LA presents levels for which corrective action(s) will be implemented that are consistent the 10 CFR Part 20 regulatory requirements identified in the preceding paragraphs in this section.

(7) The applicant 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) and is consistent with Regulatory Guide 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

(8) 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, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

develop A Appendix with evaluation section

(9) For license renewal applications, the historical results of the external radiation exposure monitoring program are included for 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.

5.7.2.4 Evaluation Findings

The staff should determine, based upon a review of the proposed external radiation exposure monitoring program, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed external radiation exposure monitoring program. If the staff determines that the proposed external radiation exposure monitoring program is sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.2.3, then the following finding will be made.

The staff concludes that the proposed external radiation exposure monitoring program procedures, instrumentation, and equipment adequately protect workers from the hazards of external radiation in accordance with the requirements of 10 CFR 20.1101, 20.1201(a), 20.1203, 20.1501, 20.1502, and 10 CFR Part 20 subparts L and M.

5.7.2.5 References

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1983. Health Physics Surveys in Uranium Mills. *Regulatory Guide 8.30.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

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 nonroutine operations, maintenance, and cleanup. This review should include criteria for determining sampling locations and sampling frequency with respect to process operations and personnel occupancy, as well as analytical procedures and sensitivity and instrument calibration. Action levels, audits, and corrective action requirements should also be evaluated. This information may be presented in an appendix to the LA.

5.7.3.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an

inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the proposed safety controls and monitoring procedures proposed by the applicant are sufficient to limit radiation exposures and radioactive releases to ALARA and are 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 nonroutine operations, maintenance, and cleanup is in conformance with the regulatory requirements identified in 10 CFR 20.1501, 10 CFR 20.1502, 10 CFR 20.1204 and the other applicable requirements listed in Section 5.7.3.3.

5.7.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and the requirements of 10 CFR Part 40, appendix A provides criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR 20.1501 requires each licensee to conduct surveys that may be necessary to comply with the standards in 10 CFR Part 20. These surveys include those necessary to evaluate radiation levels, concentrations and quantities of radioactive material, and potential radiation hazards that may be present. This section also requires regular calibration of survey instruments and appropriate processing of dosimeter results by National Voluntary Laboratory Accreditation Program accredited staff who have been approved to process results for the type of radiation survey conducted.

10 CFR 20.1502 requires monitoring of radiation exposures to comply with the standards in 10 CFR Part 20 and provides criteria for when personal monitoring devices are required. Workers who are likely to receive more than 10 percent of the annual limits in 10 CFR 20.1201(a) are required to wear individual monitoring devices. Occupational intake of radioactive material shall be monitored for those workers likely to receive more than 10 percent of the applicable ALI (see 10 CFR Part 20, appendix B).

10 CFR 20.1201(a) requires that a licensee shall control the occupational dose to individual adults to the following dose limits:

(1) An annual limit, which is the more limiting of the total effective dose equivalent of 5 rems (0.05 Sv); or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye of 50 rems (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin, and to the extremities, which are: an eye dose equivalent of 15 rems (0.15 Sv), and a shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.

10 CFR 20.1201(e) specifies a limit for the intake of soluble uranium by an individual to 10 mg/wk to protect against chemical toxicity. This limit is more limiting than the occupational derived air concentration (DAC) listed in appendix B of 10 CFR Part 20 for inhalation class D and W materials.

10 CFR 20.1202 provides methods for determining compliance with the dose limits in 10 CFR 20.1201 when it is necessary to sum external and internal doses.

10 CFR 20.1204 requires the licensee to take suitable and timely measurements of concentrations of radioactive materials in air in work areas, quantities of radioactive materials in the body, or quantities of radioactive material excreted from the body when measurement of intake of radioactive material is required under 10 CFR 20.1502.

10 CFR 20.1207 limits the annual occupational dose for minors to 10 percent of the annual dose limits specified for adult workers.

10 CFR 20.1208 specifies limits on the exposure for an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman. The limit is set at 0.5 rem (0.005 Sv).

10 CFR 20.1702 states that when it is not practical to apply process or other engineering controls to limit radioactive material concentrations in air to below the levels for an airborne radioactivity area, the licensee may limit intakes by control of access, limitation of exposure times, use of respiratory protection equipment, or other controls.

10 CFR 20.1703, pursuant to section 1702, provides standards for the use of respiratory protection equipment. Respiratory equipment must be tested and certified by the National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA) or the licensee must apply for authorization. This section also requires the licensee to implement a respiratory protection program involving air sampling, surveys, and bioassay as appropriate to evaluate individual intakes, regular testing of respirators, and written procedures for the respiratory protection program including a written policy statement. The licensee may take credit for respirators when determining occupational exposures provided certain specified conditions are met.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and subpart M provides reporting and notification requirements.

The airborne radiation monitoring program is acceptable if

(1) The applicant provides one or more charts that identify 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 8.25, Air Sampling in the Workplace (Nuclear Regulatory Commission, 1992).

Duane? (2) All monitoring equipment is identified by type with additional specification of the range, sensitivity, calibration methods, availability, and planned use.

(3) Planned surveys of airborne radiation are consistent with the guidance in Regulatory Guide 8.25, Air Sampling in the Workplace (Nuclear Regulatory Commission, 1992) and Regulatory Guide 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

(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. The air sampling program is consistent with Regulatory Guide 8.25, Air Sampling in the Workplace (Nuclear Regulatory Commission, 1992) and Regulatory Guide 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

(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 (Nuclear Regulatory Commission, 1982).

(6) The respiratory protection program is consistent with guidance in Regulatory Guide 8.15, Acceptable Programs for Respiratory Protection (Nuclear Regulatory Commission, 1976).

move to Appendix A

(7) ~~For license renewal applications, the historical results of the airborne radiation monitoring program 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 identified in the preceding paragraphs. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.~~

(8) ~~Sample analysis and instrument calibration procedures are provided as an appendix to the~~ LA.

5.7.3.4 Evaluation Findings

The staff should determine, based upon a review of the proposed airborne radiation monitoring program, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed airborne radiation monitoring program. If the staff determines that the proposed airborne radiation monitoring program is sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.3.3, then the following finding will be made.

The staff concludes that the proposed airborne radiation monitoring program to determine concentrations of airborne radioactive materials (including radon) in work areas during operations adequately protects workers in accordance with the requirements of 10 CFR 20.1101, 20.1201(a), 20.1201(e), 20.1202, 20.1204, 20.1501, 20.1502, 20.1702, 20.1703, and 10 CFR Part 20 subparts L and M.

5.7.3.5 References

Nuclear Regulatory Commission. 1976. Acceptable Programs for Respiratory Protection. *Regulatory Guide 8.15*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7*. Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1983. Health Physics Surveys in Uranium Mills. *Regulatory Guide 8.30*. Washington, DC: U.S. Nuclear Regulatory Commission, Office Standards Development.

Nuclear Regulatory Commission. 1992. Air Sampling in the Workplace, Revision 1. *Regulatory Guide 8.25*. Washington, DC: U.S. Nuclear Regulatory Commission, Office of Standards Development.

5.7.4 Exposure Calculations

5.7.4.1 Areas of Review

The staff should review the procedures proposed to determine the intake of radioactive materials by personnel in wo[illegible]as where airborne radioactive materials could exist. This review should include procedures for determining exposures during routine and nonroutine operations, maintenance, and cleanup activities.

5.7.4.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the safety controls and monitoring procedures proposed by the applicant are sufficient to limit radiation exposures and radioactive releases to ALARA and are in conformance with regulatory requirements identified in 10 CFR Part 20. The staff's review should focus on the following aspects of the radiation safety program.

The staff should evaluate whether the procedures 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. In reviewing exposure calculations staff should take note that for natural uranium, the 10mg/wk limit for protection against kidney toxicity from 10 CFR 20.1201(e) is more limiting than the DACs provided in 10 CFR Part 20, appendix B for solubility classes D and W. Unless an applicant provides justification to the contrary, the most conservative solubility class (Y) should be used in the absence of site specific solubility characterization results. The review should also place emphasis on the parameters used in exposure calculation to ensure they are representative of conditions at the site. For example, the time of exposure may be arbitrarily set at 40 hr per week; however, workers at some facilities may regularly work longer shifts. 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 described in section 5.7.1.

5.7.4.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and 10 CFR Part 40, appendix A provides criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during [redacted] ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR 20 1501 requires each licensee to conduct surveys that may be necessary to comply with the standards in 10 CFR Part 20. These surveys include those necessary to evaluate radiation levels, concentrations and quantities of radioactive material, and potential radiation hazards that may be present. This section also requires regular calibration of survey instruments and appropriate processing of dosimeter results by National Voluntary Laboratory Accreditation Program accredited staff who have been approved to process results for the type of radiation survey conducted.

10 CFR 20.1201(a) requires that a licensee shall control the occupational dose to individual adults to the following dose limits.

(1) An annual limit, which is the more limiting of the total effective dose equivalent of 5 rems (0.05 Sv); or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye at 50 rems (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin, and to the extremities, which are: an eye dose equivalent of 15 rems (0.15 Sv), and a shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.

10 CFR 20.1201(e) specifies a limit for the intake of soluble uranium by an individual to 10 mg/wk to protect against chemical toxicity. This limit is more limiting than the occupational DAC listed in appendix B of Part 20 for inhalation class D and W materials.

10 CFR 20.1202 provides methods for determining compliance with the dose limits in 10 CFR 20.1201 when it is necessary to sum external and internal doses.

10 CFR 20.1207 limits the annual occupational dose for minors to 10 percent of the annual dose limits specified for adult workers.

10 CFR 20.1208 specifies limits on the exposure for an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman. The limit is set at 0.5 rem (0.005 Sv).

10 CFR 20.1702 states that when it is not practical to apply process or other engineering controls to limit radioactive material concentration in air to below the levels for an airborne radioactivity area, the licensee may limit intakes by control of access, limitation of exposure times, use of respiratory protection equipment, or other controls.

10 CFR 20.1703, pursuant to section 1702, provides standards for the use of respiratory protection equipment. Respiratory equipment must be tested and certified by the NIOSH/MSHA, or the licensee must apply for authorization. This section also requires the licensee to implement a respiratory protection program involving air sampling, surveys, and bioassay as appropriate to evaluate individual intakes, regular testing of respirators, and written procedures for the respiratory protection program, including a written policy statement. The licensee may take credit for respirators when determining occupational exposures, provided certain specified conditions are met.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and subpart M provides reporting and notification requirements.

The exposure calculations are acceptable if

(1) The procedures 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, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

For natural uranium the 10mg/wk limit for protection against kidney toxicity from 10 CFR 20.1201(e) is more limiting than the DACs provided in 10 CFR Part 20, appendix B for solubility classes D and W. The most conservative solubility class (Y) should be used in the absence of site specific solubility characterization results.

(3) For airborne radon daughter exposure, calculations are consistent with Regulatory Guide 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

(4) Calculations for prenatal and fetal radiation exposure are consistent with Regulatory Guide 8.13, Instruction Concerning Prenatal Radiation Exposure, Revision 2 (Nuclear Regulatory Commission, 1987) and Regulatory Guide 8.36, Radiation Dose to the Embryo/Fetus (Nuclear Regulatory Commission, 1992).

(5) Exposure calculations are presented for routine operations, nonroutine operations, maintenance, and cleanup activities and are consistent with Regulatory Guide 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

(6) Parameters used in exposure calculations are representative of conditions at the site.

For example, the time of exposure may be arbitrarily set at 40 hr 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 described in section 5.7.3.

(8) All reporting and recordkeeping is done in conformance with Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1 (Nuclear Regulatory Commission, 1982).

(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 identified in the preceding paragraphs. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.

5.7.4.4 Evaluation Findings

The staff should determine, based upon a review of the proposed methods to calculate exposures whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed methods to calculate exposures. If the staff determines that the proposed methods to calculate exposures are sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.4.3, then the following finding will be made.

The staff concludes that the proposed methods for calculating exposures to personnel in work areas where airborne radioactive materials could exist provide adequate protection in accordance with the requirements in 10 CFR 20.1101, 20.1204 and 20.1201(a), 20.1201(e), 20.1202, 20.1501, 20.1702, 20.1703, and 10 CFR Part 20 subparts L and M.

5.7.4.5 References

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1983. Health Physics Surveys in Uranium Mills. *Regulatory Guide 8.30.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1987. Instruction Concerning Prenatal Radiation Exposure, Revision 2. *Regulatory Guide 8.13.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1992. Radiation Dose to the Embryo/Fetus. *Regulatory Guide 8.36.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

5.7.5 Bioassay Program

5.7.5.1 Areas of Review

The staff should review descriptions of the bioassay program proposed to confirm results derived from the Airborne Radiation Monitoring Program (Section 5.7.3) and the Exposure Calculations (Section 5.7.4). 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

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the bioassay program proposed to confirm results determined in the Airborne Radiation Monitoring Program (Section 5.1.7.3) and the Exposure Calculations (Section 5.1.7.4) is in conformance with 10 CFR 20.1204, 10 CFR 20.1202, 10 CFR 20.1201, and 10 CFR Part 20, appendix B. Staff should review the bioassay program to ensure that it is consistent with applicable sections of Regulatory Guide 8.22, Bioassay at Uranium Mills (Nuclear Regulatory Commission, 1988) or that an acceptable justification has been provided for selecting an alternative approach. 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 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.

5.7.5.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and 10 CFR Part 40, appendix A provides criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR 20.1501 requires each licensee to conduct surveys that may be necessary to comply with the standards in 10 CFR Part 20. These surveys include those necessary to evaluate radiation levels, concentrations and quantities of radioactive material, and potential radiation hazards that may be present. This section also requires regular calibration of survey instruments and appropriate processing of dosimeter results by National Voluntary Laboratory Accreditation Program accredited staff who have been approved to process results for the type of radiation survey conducted.

10 CFR 20.1502 requires monitoring of radiation exposures to comply with the standards in 10 CFR Part 20 and provides criteria for when personal monitoring devices are required. Workers who are likely to receive more than 10 percent of the annual limits in 10 CFR 20.1201(a) are required to wear individual monitoring devices. Occupational intake of radioactive material shall be monitored for those workers likely to receive more than 10 percent of the applicable ALI (see 10 CFR Part 20, appendix B).

10 CFR 20.1204 requires the licensee to take suitable and timely measurements of concentration of radioactive materials in air in work areas, quantities of radioactive materials in the body, or quantities of radioactive natural excreted from the body when measurement of intake of radioactive material is required under 10 CFR 20.1502.

10 CFR 20.1201(a) requires that a licensee shall control the occupational dose to individual adults to the following dose limits:

(1) An annual limit, that is the more limiting of the total effective dose equivalent of 5 rems (0.05 Sv); or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye at 50 rems (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin, and to the extremities, which are: an eye dose equivalent of 15 rems (0.15 Sv), and a shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.

10 CFR 20.1201(e) specifies a limit for the intake of soluble uranium by an individual to 10mg/wk to protect against chemical toxicity. This limit is more limiting than the occupational DAC listed in appendix B of 10 CFR Part 20 for inhalation class D and W materials.

10 CFR 20.1202 provides methods for determining compliance with the dose limits in 10 CFR 20.1201 when it is necessary to sum external and internal doses.

10 CFR 20.1208 requires the licensee to ensure the occupational dose to an embryo/fetus during an entire pregnancy is pr ..ted from occupational exposures to the pregnant woman. The ...it is set at 0.5 rem (0.005 Sv).

10 CFR 20.1702 states that when it is not practical to apply process or other engineering controls to limit radioactive material concentrations in air to below the levels for an airborne radioactivity area, the licensee may limit intakes by control of access, limitation of exposure times, use of respiratory protection equipment or other controls.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and subpart M provides reporting and notification requirements.

The bioassay program is acceptable if

(1) The proposed bioassay program is consistent with applicable sections of Regulatory Guide 8.22, Bioassay at Uranium Mills (Nuclear Regulatory Commission, 1988). The bioassay program proposed to confirm results determined from the Airborne Radiation Monitoring Program (Section 5.1.7.3) and the Exposure Calculations (Section 5.1.7.4) is in conformance with 10 CFR 20.1204, 10 CFR 20.1202, 10 CFR 20.1201, and 10 CFR Part 20, appendix B.

(2) The program makes provisions for establishing a baseline urinalysis for all new employees prior to assignment to the facility. Provisions are made for an exit bioassay on termination of employment.

(3) Provisions are made for checking that all workers who are routinely exposed to yellowcake dust are included in the bioassay program.

Sampling and analysis frequencies are sufficient to detect and take action against high intakes of uranium in the workplace. At a minimum, the program involves workers stationed in yellowcake drying areas and those who conduct regular maintenance on drying and ventilation/filtration equipment.

(4) Action levels are set in accordance with Regulatory Guide 8.22, Bioassay at Uranium Mills (Nuclear Regulatory Commission, 1988) and Regulatory Guide 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

(5) All reporting and recordkeeping are done in conformance with Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data (Nuclear Regulatory Commission, 1982).

(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 identified in the preceding paragraphs. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.

5.7.5.4 Evaluation Findings

The staff should determine, based upon a review of the proposed bioassay program whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed bioassay program. If the staff determines that the proposed bioassay program is sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.5.3, then the following finding will be made.

The staff concludes that the proposed bioassay program is sufficient to ensure worker safety in accordance with the requirements of 10 CFR 20.1101, 20.1201(a), 20.1201(e), 20.1202, 20.1208, 20.1501, 20.1502, 20.1702, and 10 CFR Part 20 subparts L and M.

5.7.5.5 References

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1983. Health Physics Surveys in Uranium Mills. *Regulatory Guide 8.30.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1988. Bioassay at Uranium Mills, Revision 1. *Regulatory Guide 8.22.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

5.7.6 Contamination Control Program

5.7.6.1 Areas of Review

The staff should review the occupational radiation survey program proposed to prevent employees from entering clean areas or leaving the site while contaminated with radioactive materials. Review areas include proposed housekeeping and cleanup requirements and 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. Related procedures should be provided as an appendix to the LA.

5.7.6.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the proposed safety controls and monitoring procedures proposed by the applicant are sufficient to limit radiation exposures and radioactive releases to ALARA and are in conformance with regulatory requirements identified in 10 CFR Part 20.

The staff should determine whether the occupational radiation survey program proposed to prevent contaminated employees from entering clean areas or leaving the site is in conformance with regulatory requirements in 10 CFR 20.1702 and relevant guidance. Requirements for a contamination control program (e.g., maintaining change areas and personal alpha radiation monitoring prior to leaving radiation areas) should be included in standard operating procedures or discussed in the LA. 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, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

5.7.6.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and 10 CFR Part 40, appendix A provides criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR 20.1207 limits the annual occupational dose for minors to 10 percent of the annual dose limits specified for adult workers.

10 CFR 20.1501 requires each licensee to conduct surveys that may be necessary to comply with the standards in 10 CFR Part 20. These surveys include those necessary to evaluate radiation levels, concentrations and quantities of radioactive material, and potential radiation hazards that may be present. This section also requires regular calibration of survey instruments and appropriate processing of

dosimeter results by National Voluntary Laboratory Program accredited staff who have been approved to process results for the type of radiation survey conducted.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and subpart M provides reporting and notification requirements.

The contamination control program is acceptable if

(1) The occupational radiation survey program proposed to prevent contaminated employees from entering clean areas or leaving the site is in conformance with regulatory requirements in 10 CFR 20.1702 and relevant guidance.

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, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

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

These plans are consistent with the guidance on conducting surveys for contamination of skin and personal clothing provided in Regulatory Guide, 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

(3) Action levels are set in accordance with Regulatory Guide 8.30, Health Physics Surveys in Uranium Mills (Nuclear Regulatory Commission, 1983).

(4) All items removed from the restricted area are surveyed by the radiation safety staff and meet release limits for contaminated materials that are consistent with the guidelines established in Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Material (Nuclear Regulatory Commission, 1984).

Duane (5) Survey instruments are identified by type and manufacturer and should be calibrated and checked in accordance with manufacturer recommendations.

(6) All reporting and recordkeeping is done in conformance with Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1 (Nuclear Regulatory Commission, 1982).

Appendix B (7) For license renewal applications, the historical contamination control 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 identified in the preceding paragraphs. Long-term trends are discussed, and any short-term deviations from the long-term trend are explained.

5.7.6.4 Evaluation Findings

The staff should determine, based upon a review of the proposed contamination control program, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed contamination control program. If the staff determines that the proposed contamination control program is sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.6.3, then the following finding will be made.

The staff concludes that the proposed contamination control program is sufficient to ensure that employees entering clean areas or leaving the site are not contaminated with radioactive materials to comply with the requirements of 10 CFR 20.1101, 20.1501, 20.1702, and 10 CFR Part 20 subparts L and M.

5.7.6.5 References

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1983. Health Physics Surveys in Uranium Mills. *Regulatory Guide 8.30.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1984. *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Material,* September. Arlington, TX: Nuclear Regulatory Commission, Uranium Regional Field Office. Region IV.

5.7.7 Airborne Effluent and Environmental Monitoring Programs

5.7.7.1 Areas of Review

The staff should review the operational airborne effluent and environmental monitoring programs proposed for measuring concentrations and quantities of both radioactive and nonradioactive materials released to and in the environment surrounding the facility, ~~as described in a site characterization in section 2.0~~. The staff should review the technical bases proposed for determining environmental concentrations for demonstrating compliance to 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, and the minimum number and criteria for locating effluent and environmental monitoring stations. The staff should review the topographic map of the site and the surrounding area showing monitoring locations.

5.7.7.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the

LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should be familiar with the requirements of 10 CFR Part 20 which provides the regulatory standards for protection against radiation. Applicants are required to demonstrate not only that public exposure to radiation is below allowable dose limits as specified in subparts D and F, but also, in accordance with Subpart B, that radiation exposure during mine operations is ALARA.

The staff should determine whether the proposed airborne effluent and environmental monitoring programs are sufficient to limit exposures and releases of radioactive and nonradioactive materials to ALARA and are in conformance with regulatory requirements identified in 10 CFR Part 20.

The staff should determine whether the effluent and environmental monitoring programs proposed for measuring concentrations and quantities of both radioactive and nonradioactive materials released to and in the environment around the proposed facility as described in the site characterization in section 2.0 are in accordance with the regulatory requirements described in 10 CFR Part 20 subparts D and F (10 CFR 20.1302 and 10 CFR 20.1501, in particular).

Staff should ensure that the license applicant has adequately considered site-specific aspects of climate and topography in determining locations of offsite airborne monitoring stations and environmental sampling areas such that they are capable of detecting maximum offsite concentrations of effluents in the environment. In conducting their review, staff should refer to guidance in Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980) which contains information on determining sampling locations, types, methods, frequencies and analyses which are sufficient to comply with the applicable requirements for protection of the public from offsite exposures in 10 CFR Part 20, subparts D and F.

5.7.7.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR 20.1302 requires the licensee to survey, as appropriate, radioactive materials in effluents released to unrestricted and controlled areas to demonstrate compliance with public dose limits in 10 CFR 20.1301. Airborne effluent and environmental monitoring programs are necessary to ensure that a facility complies with these dose limits.

10 CFR 20.1501 requires each licensee to conduct surveys that may be necessary to comply with the standards in 10 CFR Part 20. These surveys include those necessary to evaluate radiation levels, concentrations and quantities of radioactive material, and potential radiation hazards that may be present. This section also requires regular calibration of survey instruments and appropriate processing of

dosimeter results by National Voluntary Laboratory Accreditation Program accredited staff who have been approved to process results for the type of radiation survey conducted.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and Subpart M provides reporting and notification requirements.

The airborne effluent and environmental monitoring programs are acceptable if

(1) The proposed airborne effluent and environmental monitoring program is consistent with the guidance in Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980).

(2) The proposed locations of the air monitoring stations are consistent with guidance in Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980).

The license applicant adequately considers site-specific aspects of climate and topography, as described in the site characterization provided in section 2.0, in determining the number and locations of offsite airborne monitoring stations and environmental sampling areas such that they are capable of detecting maximum offsite concentrations of effluents in the environment. 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 programs should sample radon, air particulates, surface soils, subsurface soils, vegetation, direct radiation, and sediment in accordance with Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980).

Preoperational baselines should be established for each of these using statistically valid methods prior to startup of the facility.

(4) The proposed sampling methods are consistent with guidance in Regulatory Guide 4.14, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980).

(5) All reporting and recordkeeping are done in conformance with Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data (Nuclear Regulatory Commission, 1982).

(6) 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 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.

Append A

5.7.7.4 Evaluation Findings

The staff should determine, based upon a review of the proposed airborne effluent and environmental monitoring programs whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed airborne effluent and environmental monitoring programs. If the staff determines that the proposed airborne effluent and environmental monitoring programs are sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.7.3, then the following finding will be made.

The staff concludes that the proposed airborne effluent and environmental monitoring programs are adequate to ensure that concentrations and quantities of radioactive and nonradioactive materials released to the environment surrounding the facility will be in accordance with the requirements of 10 CFR 20.1101, 20.1302 and 20.1501, and 10 CFR Part 20 subparts L and M.

5.7.7.5 References

Nuclear Regulatory Commission. 1980. Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1. *Regulatory Guide 4.14, Revision 1.* Washington, DC: Nuclear Regulatory Commission.

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7.* Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

5.7.8 Groundwater and Surface Water Monitoring Programs

5.7.8.1 Areas of Review

There are three distinct phases of groundwater and surface water monitoring: premining, operational, and restoration. Premining monitoring is conducted as a part of site characterization, and review procedures are covered in section 2 of this SRP. Restoration monitoring is conducted during the groundwater restoration phase of operations, and review procedures are discussed in section 6. This SRP section deals specifically with monitoring of groundwater and surface water quality during the production phase of ISL operation.

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

(1) Wellfield (mine unit) baseline water quality monitoring programs (groundwater and surface water).

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

(3) The placement of excursion monitoring wells.

(4) Wellfield testing to verify horizontal continuity between the ore zone and perimeter wells, and vertical isolation between the ore zone and vertical excursion monitor wells.

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

(6) Surface water monitoring program.

Procedures for sample collection and analysis should be presented in an appendix.

5.7.8.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

For approval of a performance-based license, the reviewer should determine that the objectives of the operational monitoring program have been established. To this end, the reviewer will

(1) Verify that procedures for collecting all water quality data result in sets of samples that are adequate to evaluate natural spatial and temporal variations in water quality.

(2) Ensure that excursion indicator upper concentration limits (UCLs) are suitable to detect migration of lixiviant away from the ore zone.

(3) Ensure that the applicant uses an appropriate technical basis for determining monitor well spacing.

(4) Evaluate whether wellfield testing is sufficient to establish horizontal connectivity between the ore zone and outer monitor wells, and vertical isolation between the ore zone and vertical excursion monitor wells.

(5) Evaluate whether the excursion monitoring program will result in timely detection and reporting of lixiviant migration from the ore zone.

(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.

(7) Evaluate whether actions to be taken in the event an excursion is detected are consistent with the acceptance criteria.

5.7.8.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and the requirements of 10 CFR Part 40, appendix A provides criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

The ~~description~~ of groundwater and surface water monitoring programs is acceptable if

The monitoring program is sufficient to ensure that, during day to day operations, groundwater and surface water will be monitored such that early detection and timely restoration of excursions will be achieved. The following criteria must be met by ISL uranium mining operational monitoring programs:

(1) For each new wellfield, the applicant establishes baseline water quality data sufficient to (i) establish the primary restoration goal of returning each wellfield to its premining water quality conditions, and (ii) provide a standard for determining when an excursion has occurred.

Baseline sampling programs should provide enough data to adequately evaluate natural spatial and temporal variations in premining water quality. At least four independent sets of samples should be collected. There should be adequate time between sets to detect premining temporal variations (2 wk recommended; longer if seasonal variations occur). A set of samples is defined to be a group of at least one sample for each of the designated baseline monitor wells within the unit being characterized, taken to represent the water quality conditions of the sampled aquifer at a specific point in time. An acceptable set of samples should include all mining unit perimeter monitor wells, all upper and lower aquifer monitor wells, and at least one production/injection well per acre in each wellfield. For large wellfields, it may not be practical to sample one production/injection well per acre; if fewer than one per acre are sampled, enough production/injection wells to provide an adequate statistical population must be sampled. As a general guideline, for normally and log-normally distributed populations, at least six samples are required to achieve ninety 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 four acres.

The applicant should identify the list of constituents to be sampled for baseline concentrations. The list of constituents in table 2.7-1 has generally been accepted by the NRC for ISL uranium mines. Alternatively, applicants may propose a list of constituents that is tailored to a particular location. In such cases, sufficient technical bases must be provided for the selected constituent list. For example, many licensees have decided not to sample for thorium-230; thorium-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 groundwater 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 ISL mines. This example concerning thorium-230 has been found to be an acceptable technical basis for excluding thorium-230 from the list of sampled constituents. For all constituents that are sampled, copies of laboratory reports documenting the measurements should be maintained by the applicant.

Removal of outliers from sample sets should be done using proper statistical methods. An outlier is a single value that lies far above or below the rest of the sample values for a single well. The outlier may represent a sampling, analytical, or other unknown source of error. 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. It is often necessary to perform log-transformations on data in order to better approximate a normal distribution. When an outlier has been discarded, it may be necessary to take another sample to replace the one discarded. A conservative method for dealing with suspected outliers is to accept any suspicious data that cannot be positively linked to sampling or analytical error. Another acceptable method is to accept any value within three standard deviations of the mean. For a normally distributed set of values, three standard deviations encompass 99.7 percent of variation in the population. The standard deviation should be calculated without using the suspected outliers. Other documented and technically justified methods used by applicants will be considered in the evaluation of outliers (U.S. Evironental Protection Agency, 1989).

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(2) The applicant selects excursion indicator sets and upper control limits. A minimum of three excursion indicators must be proposed. The choice of excursion indicators must be based on lixiviant content and host rock geochemistry. Staff must ensure that selected excursion indicators are measurable parameters that are found in significantly higher concentrations during solution mining than in the natural waters. At most uranium ISL 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 ISL mining. Conductivity, which is correlated to total dissolved solids (TDS), is also a commonly used excursion indicator. Total alkalinity (carbonate plus bicarbonate plus hydroxide) is an excellent indicator at mine units where sodium bicarbonate or carbon dioxide are used in the lixiviant. If conductivity is used to estimate TDS, it must be clearly stated that measurements will be normalized to a reference temperature, usually 25° C., due to the temperature dependence of conductivity. The use of cations (e.g., Ca^{2+}, Na^{+}) as excursion indicators is generally not appropriate, because they are subject to ion exchange processes in the presence of clay minerals. The applicant may choose to add a nonreactive, conservative tracer to mining solutions to act as an excursion indicator. The applicant is required to provide the technical bases for the selection of all excursion indicators.

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UCLs must be calculated such that the presence of two or more excursion indicators in a monitoring well at concentrations greater than the UCL for the respective indicator will be an indication that a lixiviant excursion has occurred. The value of the UCL for each excursion indicator must be less than the lowest concentration at which the indicator could reasonably be expected to occur in the mining lixiviant while the wellfield is in operation. Each UCL must also be greater than the baseline concentration for its

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respective excursion indicator. Applicant site-specific experience is often valuable in determining appropriate UCLs that provide timely detection and avoid false alarms. One commonly accepted UCL is the baseline mean value plus five standard deviations.

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

(3) The applicant establishes criteria for determining monitor well locations. Ore zone perimeter monitor wells are used to detect horizontal excursions outside the wellfield boundary. They generally surround the entire wellfield and are screened over the entire ore zone hydrogeologic unit. Local groundwater gradients, velocity, and dispersion of the excursion indicators should be considered when choosing the location and spacing for these wells. A horizontal excursion may be more likely to occur down-gradient from the wellfield due to the background gradient of the groundwater. As an excursion migrates away from the wellfield, it will tend to spread laterally due to dispersive processes. Excursions may also occur upgradient or cross-gradient from the natural flow direction if the flow balance between production and injection well is incorrect, or if flow velocities away from the wellfield are low enough that dispersion is the dominant transport process. Perimeter monitor wells should be placed close enough to the wellfield to provide timely detection, yet they should be far enough away from the wellfield to avoid numerous false alarms; they must also be spaced close enough to one another so that, by the time an excursion reaches them, the expected width of the excursion plume is likely to encounter at least one monitor well.

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Upper and lower aquifer monitor wells should lie within the wellfield and be completed in the appropriate hydrogeologic unit. Their location within the wellfield should not be arbitrary, and the technical basis for their selection should be discussed in the application. The appropriate number of these monitor wells may vary from site to site. For example, if the site characterization demonstrates that the ore body is underlain by an effectively impermeable layer of significant thickness, it may be appropriate to exclude the requirement to monitor water quality in the underlying aquifer. Generally, an underlying aquitard must be on the order of hundreds of meters thick, of very low conductivity (e.g., less than 10^{-5} m/d), and essentially unfractured for this exclusion to be acceptable. In wellfields where the ore zone confining layers are particularly thin, or of questionable continuity, a greater number of monitor wells is appropriate. In general, consideration by the applicant should be given to locating these wells on the hydraulically downgradient side of a wellfield, in areas where ore 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).

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(4) The applicant establishes wellfield test procedures. Once a wellfield is installed, it should be tested to establish that the ore zone production and injection wells are hydraulically connected to the perimeter horizontal excursion monitor wells, and hydraulically isolated from the vertical excursion monitor wells. Such testing will serve to confirm the performance of the monitoring system, and verify the validity of the site conceptual

model reviewed in section 2. The reviewer should verify that wellfield test ~~procedures~~ have sound technical bases. Test procedures typically consist of a pump test that subjects the wellfield 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 one foot of drawdown in the perimeter monitor wells will verify hydraulic connection, but the amount may vary due to distance from the pumping wells, pumping rates, and hydraulic conductivity.

For the vertical excursion monitor wells, an acceptable criterion for establishing hydraulic isolation is that, during the same wellfield test performed to confirm hydraulic connectivity between ore zone and monitor wells, no drawdown should be observed that can be attributed only to hydraulic connection to the ore zone aquifer. The results should be interpreted carefully, as small amounts of drawdown may be observed due to fluctuations in barometric pressure, naturally occurring water level changes, or measurement variability. Additionally, stress relaxation in the ore zone due to decreased pressures has often been observed to cause an observable decline in water levels in adjacent aquifers: though this type of drawdown is caused by pumping in the ore zone, it is not caused by hydraulic communication.

(5) The applicant defines operational procedures 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. The NRC has determined that an acceptable excursion monitoring program should indicate that all monitor wells will be sampled for excursion indicators at least every two weeks during mining operations.

An excursion is deemed to have occurred if any two excursion indicators in any monitor well exceed their respective UCLs, or a single excursion indicator exceeds its UCL by 20 percent. A verification sample must be taken within 48 hr after results of the first analyses were received. If the second sample does not indicate that UCLs were exceeded, a third sample must be taken within 48 hr after the second set of sampling data was acquired. If neither the second nor the third sample indicate that UCLs are exceeded, the first sample is considered in error and the well is removed from excursion status. If either the second or third sample contain indicators above UCLs, 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 ISL mining 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 prior to and during operations. The reviewer should ensure that premining water quality sampling locations for applicable surface waters are indicated in the application. The premining data should be collected on a seasonal basis for a minimum of 1 yr prior to mining 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 groundwater to surface water occurs near the site (e.g., if surface water bodies are perched and ephemeral).

(6) The LA includes corrective action and motification plans in the event of an excursion. The NRC must be notified within 24 hr 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 when the report is submitted, the report must also contain a schedule for submittal of future reports to the NRC 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 ore-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 ISL mines, vertical excursions have persisted for years. In the event that an excursion is not corrected within 60 days of confirmation, applicants must either terminate injection of lixiviant into the wellfield 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 wellfield 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 wellfield and the monitor wells on excursion has been contaminated with lixiviant. It is also assumed that the width of the excursion is 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 above background is made. All estimates assume that the entire thickness of the upper 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 wellfield 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 groundwater should the licensee fail to do so.

An excursion is deemed to have been corrected when all control parameters are reduced to their UCLs or lower.

5.7.8.4 Evaluation Findings

The staff should determine, based upon a review of the proposed groundwater and surface water monitoring programs, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the proposed groundwater and surface water monitoring programs. If the staff determines that the proposed groundwater and surface water monitoring programs are sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.8.3, then the following finding will be made.

The staff concludes that the proposed groundwater and surface water monitoring programs are adequate to measure concentrations of radioactive and nonradioactive materials released to the environment of the facility and to ensure that these concentrations meet levels specified by license condition in accordance with requirements equivalent to those in ~~10 CFR Part 40, appendix A, criteria 5 and 7.~~

5.7.8.5 References

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

U.S. Environmental Protection Agency. 1989. *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: U.S. Environmental Protection Agency.

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 groundwater) monitoring programs.

5.7.9.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the proposed safety controls and monitoring procedures proposed by the applicant are sufficient to limit radiation exposures and radioactive releases to ALARA

and are 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 groundwater) monitoring are in accordance with Regulatory Guides 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment (Nuclear Regulatory Commission, 1979) and 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data (Nuclear Regulatory Commission, 1982).

5.7.9.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

The reviewer should be familiar with the requirements of 10 CFR Part 20 which provides the regulatory standards for protection against radiation.

10 CFR 20.1101 requires each licensee to develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with 10 CFR Part 20 requirements. This requirement further specifies that licensees shall use procedures and engineering controls based upon sound radiation protection principles to achieve occupational and public doses that are ALARA.

10 CFR Part 20, subpart L contains recordkeeping requirements for radiation protection programs, and Subpart M provides reporting and notification requirements.

The description of the quality assurance program is acceptable if

(1) The quality assurance plan 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, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980) and Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment (Nuclear Regulatory Commission, 1977).

(2) All reporting and recordkeeping will be done in conformance with Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data (Nuclear Regulatory Commission, 1982).

Note that under the existing 10 CFR Part 20 requirements, a licensee must retain survey and calibration records for 3 yr instead of the 2 mentioned in Regulatory Guide 4.15 (Nuclear Regulatory Commission, 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 the 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 are 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.

5.7.9.4 Evaluation Findings

The staff should determine, based upon a review of the proposed quality assurance programs whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed quality assurance programs. If the staff determines that the proposed quality assurance programs are sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.9.3, then the following finding will be made.

The staff concludes that the proposed quality assurance program is adequate to ensure that the proposed safety controls and monitoring procedures will limit radiation exposures and releases to the requirements of 10 CFR Part 20.1101 and subparts L and M.

5.7.9.5 References

Nuclear Regulatory Commission. 1979. Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, Revision 1. *Regulatory Guide 4.15*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1980. Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1. *Regulatory Guide 4.14, Revision 1*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

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5.7.9.4 Evaluation Findings

The staff should determine, based upon a review of the proposed quality assurance programs whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed quality assurance programs. If the staff determines that the proposed quality assurance programs are sufficient to meet the regulatory requirements and acceptance criteria identified in section 5.7.9.3, then the following finding will be made.

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5.7.9.5 References

Nuclear Regulatory Commission. 1979. Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, Revision 1. *Regulatory Guide 4.15*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1980. Radiological Effluent and Environmental Monitoring at Uranium Mills, Revision 1. *Regulatory Guide 4.14, Revision 1*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

Nuclear Regulatory Commission. 1982. Instructions for Recording and Reporting Occupational Radiation Exposure Data, Revision 1. *Regulatory Guide 8.7*. Washington, DC: Nuclear Regulatory Commission, Office of Standards Development.

and are 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 groundwater) monitoring are in accordance with Regulatory Guides 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment (Nuclear Regulatory Commission, 1979) and 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data (Nuclear Regulatory Commission, 1982).

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The description of the quality assurance program is acceptable if

(1) The quality assurance plan 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, Revision 1, Radiological Effluent and Environmental Monitoring at Uranium Mills (Nuclear Regulatory Commission, 1980) and Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment (Nuclear Regulatory Commission, 1977).

(2) All reporting and recordkeeping will be done in conformance with Regulatory Guide 8.7, Instructions for Recording and Reporting Occupational Radiation Exposure Data (Nuclear Regulatory Commission, 1982).

Note that under the existing 10 CFR Part 20 requirements, a licensee must retain survey and calibration records for 3 yr instead of the 2 mentioned in Regulatory Guide 4.15 (Nuclear Regulatory Commission, 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 the 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 are discussed with regard to all

6.0 GROUNDWATER QUALITY RESTORATION, SURFACE RECLAMATION, AND PLANT DECOMMISSIONING

6.1 PLANS AND SCHEDULES FOR GROUNDWATER QUALITY RESTORATION

6.1.1 Areas of Review

The staff shall review the following aspects of the groundwater quality restoration program:

(1) Estimates of the quantities, concentrations, and lateral and vertical extent of those chemicals that may persist in leached-out wellfield production zones after termination of *in situ* mining operations and prior to restoration activities must be provided.

(2) Descriptions of proposed methods and techniques to be used to achieve groundwater quality restoration, including identification of *in situ* chemical reactions that may hinder or enhance restoration. The staff should also review descriptions of fluids to be used during restoration and the hydraulic and geochemical properties of the receiving stratum. For commercial-scale operations, the staff should evaluate incorporation of results obtained from research and development operations, and a schedule for sequential restoration of mine units should be included.

Replace with Insert A

(3) Descriptions of the expected postreclamation conditions and quality of restored groundwaters, compared with the preoperational land and water quality characteristics if there is prior experience in restoring groundwater at the site.

(4) Assessments of the proposed water quality restoration operations with respect to their adverse effects on groundwaters outside production zones.

(5) Procedures to be used for plugging, sealing, capping, and abandoning wells associated with the ISL operations.

6.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

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

(1) Evaluate estimates of postmining contamination 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 the research and development (R&D) site or other site upon which restoration estimates are based.

(2) Compare descriptions of restoration methods to methods that have been used successfully at R&D sites for other ISL mines. Ensure that methods selected are appropriate for the host rock and lixiviant chemistry.

(3) Assess whether the applicant has provided a reasonable standard for the determination of restoration success and a realistic assessment of the expected postreclamation water quality by comparing standards to previous restoration work at the R&D site or other previously restored ISL mines.

(4) Evaluate the ability of the postreclamation stability monitoring program to verify successful restoration.

(5) Consider whether the proposed restoration program adequately addresses cleanup of contamination ~~due to~~ wellfield flare (undetected spread of contaminants outside of the production zone), and whether the quantity of water pumped during restoration will adversely affect offsite groundwater uses.

(6) Assess whether plans for plugging and abandoning wells prior to license termination are consistent with generally accepted techniques.

6.1.3 Acceptance Criteria

~~There are no specific regulatory requirements applicable to groundwater restoration at ISL facilities.~~

The description of plans and schedules for groundwater quality restoration, surface reclamation, and plant decommissioning is acceptable if

(1) The LA clearly demonstrates how the provisions of appendix A to 10 CFR Part 40 have been addressed.

Criterion 5 of appendix A provides basic groundwater protection standards. Groundwater monitoring to comply with these standards is required by criterion 7. Though the requirements of appendix A are directed toward achieving compliance at uranium mill tailings sites, they also provide a convenient framework for achieving compliance with EPA groundwater protection standards at ISL facilities.

(2) ~~The LA includes estimates of the extent of chemicals that might persist after mining.~~

~~Generally, these estimates are based on experience in ISL mining or R&D endeavors in similar host rock.~~

(3) The applicant describes in the LA the method used for estimating wellfield pore volume.

In order to normalize estimates of the extent of contamination so that the concept can be applied to wellfields of different sizes, the extent of contamination is usually expressed as a function of pore volumes of water required to conduct restoration. A pore volume should take into account the estimated effective porosity of the contaminated region and the lateral and vertical extent of contamination. Realistically, there is no way of knowing the true extent of contamination; however, if the same ISL process is used in all wellfields, and the same assumptions can be made concerning wellfield flare, then the number of pore volumes required to restore the R&D site can be used as a basis for an estimate to be applied to production-scale wellfields. For example, if it takes ten estimated pore volumes to restore an R&D site, then it is reasonable to assume that it will take ten pore volumes to restore a production site so long as the same mining processes and the same method of estimating pore volume are used at both sites.

(4) The LA includes wellfield restoration plans.

Restoration plans contain descriptions of the process to be used for wellfield restoration. 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. ~~Acceptable restoration plans should use the best available technology.~~ Typically, restoration is divided into distinct phases in which different techniques are employed. Groundwater sweep is used to pump water from the ore zone without reinjecting in order to recall lixiviant from the aquifer and draw in surrounding uncontaminated water. Reverse osmosis/permeate injection circulates water from the wellfield through a reverse osmosis (RO) treatment process and reinjects the permeate into the wellfield, typically at similar rates to those used during production. Groundwater recirculation is used to evenly distribute water throughout the restored wellfield in order to dilute any pockets of remaining contamination. An additional acceptable restoration method is the injection of chemical reductants (usually hydrogen sulfide) into the wellfield. These reductants are used to immobilize metals that may have been dissolved by the oxidizing lixiviant. When chemical reductants are added, the applicant should address any additional treatment necessary to remove the reductant from the aquifer after it has served its intended purpose. Typically, this will require additional RO/permeate injection.

The NRC promotes flexibility and innovation in approaches to restoration. Therefore, applicants should not be limited to one restoration method for all wellfields. Rather, they should describe the phases of restoration that may be used and the most likely restoration scenario, based on R&D results and restoration experience.

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 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 ~~wish to~~ monitor composite samples from the restoration stream. Prior to determination of restoration success, all

wells that were sampled for baseline conditions should be sampled for the full list of monitored constituents.

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 goals of the restoration program and the absence of a significant increasing trend during the stability monitoring period.

For purposes of surety bonding, restoration plans must include estimates of the level of effort, in terms of pore volume displacements, necessary to achieve ~~at least secondary restoration targets for each wellfield~~. These estimations must be based on historical results obtained from the R&D site or experience in other wellfields having similar hydrologic and geochemical characteristics.

(5) Restoration goals are established in the LA for each of the monitored constituents.

The applicant has the option of determining restoration goals for each constituent on a well-by-well basis, or on a wellfield average basis. Restoration goals should be established for the ore zone and for any overlying or underlying aquifer that remains affected by ISL mining solutions.

(a) Primary Restoration Standards—The primary goal for a restoration program is to return the water quality of the ore zone and affected aquifers to premining (baseline) water quality or better. Because baseline water quality is determined from randomly obtained samples, it is unlikely that this restoration target represents the exact baseline conditions of the aquifer. Therefore, it is acceptable for the applicant to propose that the baseline conditions for each chemical species be represented by a range of concentrations. For example, a confidence interval of 99 percent has been found acceptable in past licensing actions (i.e., there is only a one percent probability that the true baseline falls outside of the proposed range). The reviewer will ensure that statistical methods used to determine such confidence intervals are properly applied. The baseline average plus three standard deviations is another method for establishing primary restoration targets that has been found acceptable by the NRC.

(b) Secondary Restoration Standards—Because the ISL mining process requires changing the chemistry of the ore zone, it is reasonable to expect that ISL mining may cause permanent changes in water quality. For this reason, it is acceptable for the applicant to propose, as a secondary restoration standard, returning the water quality to its pre-mining class of use (e.g., drinking water, livestock, agricultural, or limited use). LAs should state that secondary standards will not be applied so long as restoration continues to result in significant improvement in groundwater quality.

Secondary goals have historically been determined on a constituent-by-constituent basis by applying the lower of the state or federal maximum concentration limits (MCLs) for drinking water. For example, if premining water quality is not suitable for drinking water only because of high radium concentrations, then

postmining restoration must return all constituents except for radium to drinking water standards. Some uranium ISL mine operators have asserted that if premining use is not suitable for drinking water because of one or more constituents, then it is not reasonable to require restoration to drinking water standards for all other constituents. However, NRC has maintained that if only a few constituents are above drinking water standards, then the water could reasonably be treated for use as drinking water. Thus, class of use should be considered on a constituent by constituent basis.

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(c) Tertiary Restoration Standards—ISL mine operators may propose a tertiary cleanup standard for constituents based on ALARA principles. NRC will consider granting ALARA exemptions if it can be shown that (1) a reasonable effort has been made to restore to premining use using best available technology; (2) benefits to be gained by additional restoration do not justify the expense; (3) the level of cleanup proposed is protective of human health and the environment; and (4) the proposed level of cleanup has been approved by the appropriate state agency. Such exemptions would normally require a separate application for an amendment to an existing license, once the applicant has attempted restoration to secondary standards. Such an amendment request would be similar in nature to the process used by UMTRCA mill tailings sites to apply for alternate concentration limits (ACLs).

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(6) The postrestoration stability monitoring program is described in the LA.

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. NRC has previously approved stability monitoring periods as short as nine months with samples taken from designated monitor wells every three months. These requirements will vary based on site-specific contamination and geohydrologic and geochemical characteristics. Prior to final wellfield decommissioning, all designated monitor wells must be sampled for all monitored constituents. Wellfields may be decommissioned when all constituent concentrations meet approved standards.

(7) The LA includes discussion of the potential external effects of groundwater restoration.

Groundwater restoration operations, and the expected postreclamation groundwater quality, must not adversely affect groundwater use outside the mining zones. Water users from nearby municipal or domestic wells that were in use prior to mining operations should be provided reasonable assurance that their water quality will not be degraded by mining operations. Degraded water quality includes changes in color, odor, and taste of water, in addition to changes in concentrations of chemical constituents. In cases where such threats exist, the use of secondary restoration targets may not be appropriate. In one such case the NRC has found it acceptable to allow the ISL operator to move municipal wells used by a nearby town to a location that would eliminate potential for degraded water quality due to ISL operations (Nuclear Regulatory Commission, 1997).

(8) Methods for abandoning wells are included in the LA.

The basic purpose for sealing abandoned wells and bore holes is to restore the wellfield to premining 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. ISL mine operators usually rely on a drilling contractor to perform well abandonment. The LA 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 conform to ASTM Standard D 5299 (American Society for Testing and Materials, 1992) are considered acceptable by the NRC. 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 that are not considered to be generally accepted abandonment practices should be described in detail and may require additional time for review.

Insert A

also [illegible] procedures [illegible] Environ Office.

6.1.4 Evaluation Findings

The staff should determine, based upon a review of the proposed plans and schedules for groundwater quality restoration, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed plans and schedules for groundwater quality restoration. If the staff determines that the proposed plans and schedules for groundwater quality restoration are sufficient to meet the regulatory requirements and acceptance criteria identified in section 6.1.3, then the following finding will be made.

The staff concludes that the proposed plans and schedules for groundwater quality restoration are sufficient to restore groundwater to premining conditions or to other approved restoration targets specified by license condition in accordance with requirements equivalent to those in 10 CFR Part 40, appendix A, criteria 5 and 7.

6.1.5 References

American Society for Testing and Materials. 1992. *Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, and Other Devices for Environmental Activities, Designation: D 5299.* Philadelphia, PA: American Society for Testing and Materials.

Nuclear Regulatory Commission. 1997. *Final Environmental Impact Statement to Construct and Operate the Crownpoint Uranium Solution Mining Project, Crownpoint, New Mexico.* NUREG-1508. Washington, DC: Nuclear Regulatory Commission.

6.2 PLANS AND SCHEDULES FOR RECLAIMING DISTURBED LANDS

6.2.1 Areas of Review

The staff should review all maps provided in the application showing the postreclamation conditions of affected lands and immediate surrounding areas. The staff should also review procedures for (i) reclaiming temporary diversion ditches and impoundments, (ii) re-establishing surface drainage

patterns disrupted by the proposed activities, (iii) mitigating or controlling the effects of subsidence, and (iv) preparing ground surface for postoperational use.

NRC staff should review the radiological survey program that will serve as a basis for determining compliance with NRC concentration limits that will identify areas of the site that need to be cleaned up. Staff should evaluate measurement techniques and sampling procedures proposed for determining the radium concentration in contaminated soils. In addition, the review should confirm that the licensee will have an approved radiation protection program in place prior to the start of reclamation and cleanup work.

6.2.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

Criterion (6) of 40.42

The staff should determine whether the described procedures for reclaiming temporary diversion ditches and impoundments, re-establishing surface drainage patterns disrupted by the proposed activities, mitigating or controlling the effects of subsidence, and preparing ground surface for postoperational use are consistent with regulatory guidance and sufficient to verify that requirements equivalent to 10 CFR Part 40, appendix A have been met. Staff should ensure that the licensee intends to restore topography and vegetation to a state that is similar to premining conditions. Staff should review the prereclamation sampling plan to ensure that it provides adequate coverage to designate contaminated areas for cleanup. Particular attention should be focussed on sampling temporary diversion ditches and impoundments (evaporation ponds), wellfield 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. Staff should also ensure that plans exist for the disposal of contaminated soils at an existing licensed byproduct material disposal facility. Staff should confirm that the licensee has an approved radiological protection program to ensure worker safety during decommissioning, reclamation, and cleanup activities and determine whether any changes have been proposed for this program. ~~Staff should review the compliance history for the radiation safety program to identify any deficient areas that may require special consideration prior to the start of work.~~

consistent Appx A criterion (2)

The program for rad protection is described in ——.

6.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.42 provides requirements for expiration and termination of licenses and decommissioning of sites, buildings, and outdoor areas. Following ~~expiration of a license~~, the license remains in effect for possession of ~~source~~ material until the Commission notifies the licensee in writing that the license is terminated. Actions during this period are limited to decommissioning and access control. 10 CFR 40.43 specifies conditions under which a decommissioning plan must be submitted. Such a decommissioning plan must include a description of the site, decommissioning activities, methods used

cessation of uranium extraction activities

11e2 byproduct material

to ensure worker protection against radiation hazards during decommissioning, plans for final radiation surveys, and a cost estimate.

The description of plans and schedules for reclaiming disturbed land is acceptable if

(1) The basic acceptance criteria pertinent to the radiological cleanup aspects of the processing site reclamation are equivalent to those in 10 CFR Part 40, appendix A, criterion 6.

This criterion provides the design requirements for longevity and control of radon releases that 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 square meters, which as a result of byproduct material, does not exceed the background level by more than:

(a) 5 picocuries per gram (pCi/g) of radium-226, or, in the case of thorium byproduct material, radium-228, averaged over the first 15 centimeters (cm) below the surface, and

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

(2) The prereclamation surface soil survey procedure identifies instruments and techniques similar to the preoperational survey program to determine baseline site conditions (e.g., background radioactivity) but also takes into account results from operational monitoring and other information that provides insight to areas of expected contamination.

Survey areas should include diversion ditches, evaporation ponds, wellfield surfaces, process and storage areas, and onsite transportation routes for contaminated material and equipment. A sampling grid should be used and a statistical basis for sample size should be provided. Acceptable methods for sampling are provided in NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination (Berger, 1992). To reduce the number of soil samples needed for measurement of Ra-226 concentrations, it is acceptable to correlate the Ra-226 concentration with measured gamma activity for a subset of sampling locations so that the correlation can be applied to grid sectors where only gamma surveys are then needed. Areas where concentrations are found to be elevated above the limits should be resurveyed using soil sample and analysis techniques and, as necessary, higher sampling densities for greater precision. Areas that remain above the limits should be cleaned up to satisfy the Ra-226 concentration limit. In some cases, it may be more cost effective to clean up first, then conduct soil sampling to demonstrate compliance with the limit.

(3) The licensee provides the procedures for interpretation of the prereclamation survey results and describes how they will be used to identify candidate areas for cleanup operations.

(4) The postreclamation survey procedure provides the survey methods and approach for complying with the requirements equivalent to 10 CFR Part 40, appendix A, criterion 6 limits discussed previously.

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

(6) Any changes to the existing NRC-approved 10 CFR Part 20-based radiation safety program that are needed to ensure safety to workers and the public are identified with appropriate justification prior to the start of decommissioning and reclamation work.

Review the procedures laid out in Chapter 5.7.

6.2.4 Evaluation Findings

The staff should determine, based upon a review of the proposed plans and schedules for reclaiming disturbed lands, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed plans and schedules for reclaiming disturbed lands. If the staff determines that the proposed plans and schedules for reclaiming disturbed lands are sufficient to meet the regulatory requirements and acceptance criteria identified in section 6.2.3, then the following finding will be made.

The staff concludes that the proposed plans and schedules for reclaiming disturbed lands are sufficient to restore lands to premining conditions or to meet the requirements of 10 CFR 40.42 and requirements equivalent to those in 10 CFR Part 40, appendix A, criterion 6.

6.2.5 References

Berger, J.D. 1992. *Manual for Conducting Radiological Surveys in Support of License Termination.* NUREG/CR-5849. Washington, DC: Nuclear Regulatory Commission.

6.3 PROCEDURES FOR REMOVING AND DISPOSING OF STRUCTURES AND EQUIPMENT

6.3.1 Areas of Review

The staff should review procedures for removing and disposing of contaminated structures and equipment used during ISL operations, as well as procedures for managing toxic and radioactive waste materials and for removal and disposal of structures. The reviewers shall also evaluate procedures that identify radiological hazards prior to initiating dismantlement of structures and for detection and cleanup of removable contamination from structures and equipment. Procedures and plans for ensuring that all contaminated facilities and equipment are addressed and are either planned to be disposed in a licensed facility, will meet the contamination levels for unrestricted use, or are designated for re-use at another ISL facility will be examined. 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

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the procedures for removing and disposing of structures used during mining operations and all procedures 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 against ~~the~~ guidance provided in Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials (Nuclear Regulatory Commission, 1984) which provides ~~limits for surface contamination~~ and procedures for ensuring that equipment meets these limits prior to release. Staff should confirm that plans for dismantlement of structures and equipment include a preliminary assessment of anticipated hazards that should be considered prior to 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 focussed 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 similar to those in 10 CFR Part 40, appendix A.

6.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 40.42 provides requirements for expiration and termination of licenses and decommissioning of sites, buildings and outdoor areas. Following ~~expiration of a license~~, the license remains in effect for possession of ~~source material~~ until the commission notifies the licensee in writing that the license is terminated. Actions during this period are limited to decommissioning and access control. 10 CFR 40.42 specifies conditions under which a decommissioning plan must be submitted. Such a decommissioning plan must include a description of the site, decommissioning activities, methods used to ensure worker protection against radiation hazards during decommissioning, plans for final radiation surveys, and a cost estimate.

The discussion of procedures for removing and disposing of structures and equipment is acceptable if

(1) ~~Procedures have been provided that will eliminate~~ residual contamination on structures and equipment.

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

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.

(3) If requested, the Commission has authorized a licensee to relinquish possession or control of premises, equipment, or scrap having surfaces contaminated with material in excess of the limits specified, including but not limited to special circumstances such as razing of buildings, transfer of premises to another organization continuing work with radioactive materials, or conversion of facilities to a long-term storage or standby status, such requests should

(a) Provide detailed, specific information describing the premises, equipment, or scrap, radioactive contaminants, and the extent and degree of residual surface contamination.

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

(4) Prior to release of premises for unrestricted use, the licensee plans to conduct a comprehensive radiation survey to establish that contamination is within the limits specified in table 1 of Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials (Nuclear Regulatory Commission, 1984). The licensee also plans to file a copy of the survey report with the NRC NMSS, Uranium Recovery Branch. The licensee has indicated that the content of this survey report will include:

(a) Identification of the premises

(b) Documentation that a reasonable effort has been made to eliminate residual contamination

(c) A description of the scope of the survey and general procedures

(5) The ~~findings~~ results of the survey ~~are~~ will be reported in units specified in table 1 of Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct or Source Materials (Nuclear Regulatory Commission, 1984).

6.3.4 Evaluation Findings

The staff should determine, based upon a review of the proposed procedures for removing and disposing of structures and equipment, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed procedures for removing and disposing of structures and equipment. If the staff determines that the proposed procedures for removing and disposing of structures and equipment are sufficient to meet the regulatory requirements and acceptance criteria identified in section 6.3.3, then the following finding will be made.

The staff concludes that the proposed procedures for removing and disposing of structures and equipment are sufficient to control the spread of contamination in accordance with the requirements of 10 CFR 40.42 and requirements equivalent to those in 10 CFR Part 40, appendix A, criterion 6.

6.3.5 References

Nuclear Regulatory Commission. 1984. *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material, Division of Fuel Cycle, Medical, Academic, and Commercial Use Safety*. Washington DC: Nuclear Regulatory C ...ission.

6.4 PROCEDURES FOR CONDUCTING POSTRECLAMATION AND DECOMMISSIONING RADIOLOGICAL SURVEYS

6.4.1 Areas of Review

The staff should review procedures for conducting postreclamation and decommissioning radiological surveys, including postoperational groundwater monitoring for decontamination and removal of structures and equipment.

6.4.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

criterion (3)

The staff should determine whether the procedures for conducting postreclamation and decommissioning radiological surveys, ~~including postoperational groundwater monitoring~~, are sufficient to verify that concentration limits similar to those in ~~10~~ CFR Part 40, appendix A are met. Staff should ensure that sampling frequencies and locations are adequate and representative of conditions at the site. Staff should consider the survey methods provided in NUREG/CR-5849 (Berger, 1992) along with the applicable site conditions to determine the acceptability of the licensee's proposed sampling program. Staff should confirm that the determination of background concentrations of radium-226 and thorium-230 (also similar to 10 CFR Part 40, appendix A) is based upon sampling in uncontaminated areas near the site. The presence of thorium-232 should also be determined if suspected to be present.

If elevated levels of ~~uranium~~ are expected to remain after the radium-226 criteria have been met, the reviewer will determine whether ~~appropriate criteria for cleanup are presented~~ in the reclamation plan.

6.4.3 Acceptance Criteria

~~There are no specific regulatory requirements~~ applicable to reclamation of ISL facilities.

The description of procedures for conducting postreclamation and decommissioning radiological surveys are acceptable if

(1) The basic requirements pertinent to the radiological cleanup aspects of the processing site as provided in 10 CFR Part 40, appendix A, criterion 6 - (6) are met.

This criterion states that the design requirements in criterion 6 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 square meters, 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 centimeters (cm) below the surface, and

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

(2) An acceptable cleanup standard for total uranium is 10 pCi/g in the top 15 cm of soil and 30 pCi/g in subsequent 15 cm layers.

This standard is based on the amount of uranium that would decay to radium levels meeting the cleanup standard in 10 CFR Part 40, appendix A.

(3) If areas that already meet the radium cleanup criteria still have elevated thorium levels, the reclamation plan contains criteria such that reclamation will continue until the amount of radium (residual and from thorium decay) that would be present in 1000 years meets the cleanup standard.

An acceptable alternate criteria for a deeply-buried thorium deposit would be to determine that the amount of radon that could exit into a 100 square meter structure built over that deposit would meet the EPA radon progeny standard for habitable structures.

(4) Verification surveys include analysis of a percentage of samples (at least 10 percent) for thorium. If habitable buildings are to remain onsite, the reviewer will ensure that the reclamation plan indicates that the radon daughter concentration will be measured after reclamation and evaluated against the EPA standard for radon progeny and that interior gamma levels will be demonstrated to meet the EPA standard.

(b) Survey methods for determining contamination on facilities and equipment destined for release to unrestricted use should be sufficient to show compliance with the limits in table 1 of NRC Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use for Termination of Licenses for Byproduct, Source, or Special Nuclear Material (Nuclear Regulatory Commission, 1984). Acceptable survey methods are provided in NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination (Berger, 1992).

6.4.4 Evaluation Findings

The staff should determine, based upon a review of the proposed procedures for conducting postreclamation and decommissioning radiological surveys, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed procedures for conducting postreclamation and decommissioning radiological surveys. If the staff determines that the proposed procedures for conducting postreclamation and decommissioning radiological surveys are sufficient to meet the regulatory requirements and acceptance criteria identified in section 6.4.3, then the following finding will be made.

(1) The staff concludes that the proposed procedures for conducting postreclamation and decommissioning radiological surveys are sufficient to verify that the decommissioning and radiological surveys will be successful in controlling material concentrations and radiation exposures in accordance with the requirements of 10 CFR 40.42 and requirements equivalent to those in 10 CFR Part 40, appendix A, criterion 6.

6.4.5 References

Berger, J.D. 1992. *Manual for Conducting Radiological Surveys in Support of License Termination.* NUREG/CR-5849. Washington, DC: Nuclear Regulatory Commission.

Nuclear Regulatory Commission. 1984. *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," Division of Fuel Cycle, Medical, Academic, and Commercial Use Safety.* Washington, DC: Nuclear Regulatory Commission.

6.5 FINANCIAL ASSESSMENT FOR GROUNDWATER RESTORATION, DECOMMISSIONING, RECLAMATION, WASTE DISPOSAL, AND MONITORING

6.5.1 Areas of Review

The staff should review financial assessments provided by the applicant for the costs of groundwater restoration (section 6.1); reclamation (section 6.2); and decommissioning, waste disposal, and monitoring (section 6.4). These assessments may be provided in the form of a narrative or as an appendix. The staff should review provisions for a financial surety similar to those contained in criterion 9 of 10 CFR Part 40, appendix A.

annually by NRC to assure that sufficient funds would be available for completion of the reclamation plan by an independent contractor.

(2) All activities included in the financial analysis are activities that are included either in the reclamation plan or in sections 6.1 through 6.4.

(3) All activities included either in the reclamation plan or in sections 6.1 through 6.4 are included in the financial analysis.

(4) The assumptions used for the financial surety analysis are consistent with what is known about the site (section 2.0) and the design and operations of the facility and its effluent control system (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, research and development at the site, or previous operating experience in the case of a license renewal.

(5) The values used in the financial surety analysis are based on current dollars (or adjusted for inflation) and reasonable values for the cost of various activities.

(6) The type of financial instrument proposed for the surety is consistent with the requirements of 10 CFR Part 40, appendix A, criterion 9. Accepted financial instruments include

(a) Surety bonds

(b) Cash Deposits

(c) Certificates of Deposit

(d) Deposits of government securities

(e) Irrevocable letters or lines of credit

(f) Combinations of the above that meet the total surety requirement

6.5.4 Evaluation Findings

The staff should determine, based upon a review of the proposed methods for financial assessment for groundwater restoration, decommissioning, reclamation, waste disposal, and monitoring, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed methods for financial assessment for groundwater restoration, decommissioning, reclamation, waste disposal and monitoring. If the staff determines that the proposed methods for financial assessment for groundwater restoration, decommissioning, reclamation, waste disposal, and monitoring are sufficient to meet the regulatory requirements and acceptance criteria identified in section 6.5.3, then the following finding will be made.

6.5 FINANCIAL ASSESSMENT FOR GROUNDWATER RESTORATION, DECOMMISSIONING, RECLAMATION, WASTE DISPOSAL, AND MONITORING

6.5.1 Areas of Review

The staff should review financial assessments provided by the applicant for the costs of groundwater restoration (section 6.1); reclamation (section 6.2); and decommissioning, waste disposal, and monitoring (section 6.4). These assessments may be provided in the form of a narrative or as an appendix. The staff should review provisions for a financial surety similar to those contained in criterion 9 of 10 CFR Part 40, appendix A.

6.5.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should review the financial surety assessment provided by the applicant to verify that the activities incorporated in the financial assessment are consistent with those proposed in sections 6.1 through 6.4 of the application. In addition, the reviewer should verify that the activities proposed in the sections 6.1 through 6.4 are included in the financial assessments. The purpose of the financial surety is to provide sufficient resources for completion of reclamation by an independent contractor if necessary.

The reviewer should determine whether the assumptions for the financial surety analysis are consistent with what is known about the site (section 2.0) and the design and operations of the facility and its effluent control system (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 proposed for the surety to ensure that it is consistent with the requirements of 10 CFR Part 40, appendix A, criterion 9.

6.5.3 Acceptance Criteria

There are no specific regulatory requirements applicable to financial assessments for ISL facilities.

The description of the financial assessment for groundwater restoration, decommissioning, reclamation, waste disposal, and monitoring is acceptable if

(1) The bases for establishing a financial surety are similar to those found in 10 CFR Part 40, appendix A, criterion 9. Once accepted, the surety will be reviewed

The staff concludes that the proposed methods for financial assessment for groundwater restoration, decommissioning, reclamation, waste disposal, and monitoring are sufficient to meet requirements equivalent to those in 10 CFR Part 40, Appendix A, criterion 9.

6.5.5 References

None.

7.0 ENVIRONMENTAL EFFECTS

The areas of review to be considered are descriptions in the LA of those aspects of facility construction, well drilling, and operations that may affect the environment.

7.1 SITE PREPARATION AND CONSTRUCTION

7.1.1 Areas of Review

The staff should review a description of how construction activities may disturb the existing terrain and wildlife habitats, including the effects of such activities as building temporary or permanent roads, bridges, or service lines; disposing of trash; excavating; and land filling. The staff should also review information on how much land will be disturbed and for how long and whether there will be dust or smoke problems. The staff shall review data indicating the proximity of human populations and identifying undesirable impacts on their environment arising from noise, disruption of stock grazing patterns, and inconvenience due to the movement of men, material, or machines, including activities associated with any provision of housing, transportation, and educational facilities for workers and their families. Descriptions of any expected changes in accessibility to historic and archeological sites in the region shall be assessed. Discussions of measures designed to mitigate or reverse undesirable effects such as erosion control, dust stabilization, landscape restoration, control of truck traffic, and restoration of affected habitats shall be reviewed. The staff shall also evaluate any discussion on the beneficial effects of site preparation construction activities.

The staff will review the impact of site preparation and construction activities on area water sources and the effects of these activities on fish and wildlife resources, water quality, water supply, esthetics, etc., as applicable. Reviewers will evaluate measures such as pollution control and other procedures for habitat improvement to mitigate undesirable effects.

7.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether descriptions in the application adequately address how site preparation and construction activities may disturb the existing terrain, wildlife habitats, and area water sources. The consequences of these activities to both human and wildlife populations should be considered. The descriptions should be adequately supported by site-specific data, well-documented calculations, and accepted modeling studies. The discussion should include those impacts that are unavoidable as well as those that are irreversible. Staff should ensure that the applicant provides information pertaining to how much land will be disturbed and for how long. Staff should confirm that the effects of the following activities and circumstances, where applicable, are addressed: the building of temporary or permanent roads, bridges, or service lines; disposing of trash; excavating and land filling; and the potential for dust and smoke problems. The proximity of site activities to nearby human populations should be addressed as well as anticipated impacts on their environment including noise;

disruption of grazing patterns; inconvenience due to movement of material and machines; effects arising from additional housing, transportation, and educational facilities for workers and families; and any disruption in access to historic or archeological sites. Staff should ensure that mitigation measures that are adequate to alleviate or significantly reduce environmental impacts are discussed. Examples of mitigation measures include erosion control, dust stabilization, landscape restoration, control of truck traffic, and restoration of affected habitats.

The staff should also evaluate any discussion of potential beneficial effects from site preparation and construction to the extent that such might counteract detrimental effects.

7.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.10 directs that policies, regulations, and public laws of the U.S. government be interpreted and administered in accordance with the policies set forth in NEPA.

10 CFR 51.60 describes the format and content of an environmental report for a materials license.

10 CFR 51.45 is referenced by 10 CFR 51.60, and contains a more detailed list of the contents of the environmental report.

The description of site preparation and construction is acceptable if

(1) All environmental impacts from construction activities are adequately described and supported with site specific data and, where applicable, modeling studies and calculations.

A thorough discussion of all construction activities should be provided with associated impacts including the generation and control of wastes; dusts; smoke; noise; traffic congestion; disruption of local public services, routines, and property; and aesthetic impacts.

(2) The applicant adequately describes all unavoidable and irreversible impacts to both the natural environment and nearby human populations.

(3) The applicant adequately describes the amount of land to be disturbed and the amount of time it will be disturbed.

(4) The applicant recommends reasonable mitigation measures for all significant impacts.

site can be returned to original characteristics.

7.1.4 Evaluation Findings

The staff should determine, based upon a review of the description of the proposed site preparation and construction activities, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of the proposed site

preparation and construction activities. If the staff determines that the description of the proposed site preparation and construction activities is sufficient to meet the regulatory requirements and acceptance criteria identified in section 7.1.3, then the following finding will be made.

(1) The staff concludes that the description of the proposed site preparation and construction activities and related mitigation measures are sufficient to provide assurance that the proposed activities will not cause significant injury to the environment in accordance with the requirements of 10 CFR 51.10, 51.60, and 51.45.

7.1.5 References

None.

7.2 EFFECTS OF OPERATIONS

7.2.1 Areas of Review

The staff should review discussions in the application that address the impact of facility operations on the environment, including surface water bodies, groundwater, air, land, land use, ecological systems, and important plants and animals as discussed in section 2.0.

7.2.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether discussions in the LA address the impact of facility operations on the environment, including surface water bodies, groundwater, air, land, land use, ecological systems, and important plants and animals. The staff should determine whether the supporting evidence is based on and supported by theoretical, laboratory, onsite, or field studies undertaken for this or for previous operations.

The staff should determine whether the proposed facility provides for the protection of groundwater from the environmental effects of operations. In conducting the review, the staff should consider the information on the (i) characteristics of the hydrological system provided in section 2.7 of the LA, (ii) effluent control system provided in sections 4.2 and 5.7.1, (iii) groundwater monitoring and surface water monitoring programs covered in section 5.7.8, and (iv) the groundwater restoration program described in section 6.1. This information should provide a strong basis for determining the overall effects of potential impacts to the groundwater system, such as lixiviant excursions, infiltration from spills, or ruptures of wells.

Staff should ensure that, if surface water exists onsite or is connected to offsite surface water systems, impacts of operations on surface water are assessed and mitigation measures are provided if a significant potential for impacts is identified. Potential impacts might include siltation from disruption of

surface ground cover or changes to surface drainage patterns. Staff should also determine whether the applicant has assessed the potential for decreased air quality resulting from dust loading due to truck traffic on dirt roads and exposure of disturbed surface soils to wind. Radiological impacts to air from operations are discussed in the following sections.

In conducting the review, the staff should consider the applicant's ecological information provided in section 3.0 to determine if any endangered or sensitive species of plants and animals exist on site. The level of concern for ecological impacts of operations will be affected by the presence of any such sensitive or endangered species. For most facilities, the ecological impacts are expected to be minimal during this period due to the lack of surface disruption during operations. The staff review should ensure that measures have been taken to restrict terrestrial animals from entering facility grounds by use of fencing and other means. In areas used by migrating waterfowl, additional measures may need to be taken to ensure that any evaporation ponds are not used by waterfowl. Local ecological conditions may be such that the facility grounds provide favorable habitat for local wildlife, and efforts to minimize contact between wildlife and contaminated areas should be considered. These efforts will serve to mitigate immediate impacts on local species, but will also serve to limit introduction of contamination into the food chain.

7.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.60 requires applicants for a material license under 10 CFR 40 to submit an environmental report with their application.

10 CFR 51.45 provides a list of the contents of the environmental report.

The description of the effects of operations is acceptable if

(1) The applicant describes all anticipated significant environmental impacts from facility operations and provides (i) mitigation measures for these impacts, (ii) justification for why impacts cannot be mitigated, or (iii) justification for why it is not necessary to mitigate these impacts to protect the local environment.

(2) The applicant discusses anticipated impacts to terrestrial ecology, air quality, surface and groundwater systems, and land use.

7.2.4 Evaluation Findings

The staff should determine, based upon a review of the description of the proposed effects of operations, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of the proposed effects of operations. If the staff determines that the description of the proposed effects of operations is sufficient to meet the regulatory requirements and acceptance criteria identified in section 7.2.3, then the following finding will be made.

The staff concludes that the description of the proposed effects of operations and related mitigation measures is sufficient to provide assurance that the applicant has sufficiently described anticipated environmental impacts to terrestrial ecology, air quality, surface and groundwater, and land use activities from facility operations and has provided mitigation measures or other information sufficient to provide reasonable assurance the facility operations will not significantly impact the environment in accordance with the requirements of 10 CFR 51.60 and 51.45.

7.2.5 References

None.

7.3 RADIOLOGICAL EFFECTS

The staff should review information on the radiological effects of operations on humans, including estimates of the radiological impacts from all exposure pathways.

7.3.1 Exposure Pathways

The staff should evaluate descriptions of the plant operations with special attention to potential pathways for radiation exposure of humans. Staff should review information on accumulation of radioactive material in specific compartments and should ensure that both internal and external doses are included in the analysis. This information can be tabulated using the outline provided in appendix A of the SFCG.

7.3.1.1 Exposures from Water Pathways

7.3.1.1.1 Areas of Review

The staff should review the estimates of annual average concentrations of radioactive nuclides in receiving water at the site boundary and at locations where water is consumed or is otherwise used by humans or where it is inhabited by biota of significance to human food chains. The review should include the data presented in support of these estimates, including details of models and assumptions used in supporting calculations of total annual whole body and organ doses to individuals in the offsite population from all receiving water exposure pathways as well as any dilution factors used in these calculations. Additionally, staff should review estimates of radionuclide concentration in aquatic and terrestrial food chains and associated bioaccumulation factors. Staff should evaluate calculations of internal and external doses. If there are no waterborne effluents from the facility, then these analyses are not needed. Details of models and assumptions used in calculations may be provided in an appendix to the LA.

7.3.1.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the concentration estimates at the site boundary meet the regulatory requirements in 10 CFR 20.1302(i) with regard to annual average concentrations of radioactive nuclides in liquid effluents. Staff should also check to ensure that calculations of concentrations have been done for receiving water at locations where water is consumed or is otherwise used by humans or where it is inhabited by biota of significance to human food chains to meet public dose limits in 40 CFR Part 190. If the liquid effluent dose is calculated separately from the air pathway dose, it is important that the staff ensures that the results can be summed with the air pathway dose for the total dose comparison to the limit in 40 CFR Part 190. The staff should also determine whether these estimates are supported by properly interpreted data, calculations, and model results using reasonable assumptions. Staff should review the parameter selections including the justifications provided for important parameters used in the dose calculation. Staff should check the input data for all modeling results to ensure the parameters discussed in the LA are the same as those used in the modeling. Code outputs should be spot checked to ensure that the results are correctly reported in the LA. For simple hand calculations, spot calculations can be done to verify that calculations were done correctly.

7.3.1.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 20.1301 provides dose limits for individual members of the public. These dose limits include an annual total effective dose equivalent (TEDE) no greater than 0.1 rem (1 mSv) exclusive of background, and a 0.002 rem (0.02 mSv) external dose for any hour. If special conditions exist, an applicant can propose to meet limits in excess of these.

10 CFR 20.1302 provides additional instructions for compliance with the limits in 10 CFR 20.1301. These instructions include a choice for demonstrating compliance by measurement or calculation of TEDE to the individual receiving the highest exposure, or by demonstrating that annual average concentrations of radioactive material released in gaseous and liquid effluents at the site boundary meet the limits specified in table 2 of appendix B in 10 CFR Part 20.

40 CFR 190 10 requires that operations be conducted to provide reasonable assurance that the annual dose equivalent to any member of the public does not exceed 25 mrem (0.25 mSv) to the whole body, 75 mrem (0.75 mSv) to the thyroid, and 25 mrem (0.25 mSv) to any other organ as the result of planned discharges (radon excepted).

The description of exposures from water pathways is acceptable if

(1) The estimates of individual exposure to radionuclides at the site boundary meet the regulatory requirements in 10 CFR 20.1302(a)(2)(i) with regard to annual average concentrations of radioactive nuclides in liquid effluents or the dose limit in 10 CFR 20.1302(a)(1).

(2) Calculations of concentrations of radionuclides in receiving water at locations where water is consumed or is otherwise used by humans or where it is inhabited by biota of significance to human food chains are included in the compliance demonstration for public dose limits in 40 CFR Part 190.

(3) For facilities that generate liquid effluents, the relevant exposure pathways are included in a pathway diagram provided by the applicant.

(4) The conceptual model used for calculating the source term and individual exposures (and/or concentrations of radionuclides) from liquid effluents at the facility boundary is representative of conditions described at the site as presented in section 2.0 of the LA.

(5) The parameters used to estimate the source term, environmental concentrations, and exposures are applicable to conditions at the site as presented in section 2.0 of the LA.

7.3.1.1.4 Evaluation Findings

The staff should determine, based upon a review of the description of expected exposures from water pathways, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of expected exposures from water pathways. If the staff determines that the description of expected exposures from water pathways is sufficient to meet the regulatory requirements and acceptance criteria identified in section 7.3.1.1.3, then the following finding will be made.

(1) The staff concludes that the description of expected exposures from water pathways is sufficient to provide reasonable assurance that the radiation exposure to an individual receiving the highest exposure at the site boundary or in populated areas will meet the requirements of 10 CFR 20.1301, 20.1302, and 40 CFR 190.10.

7.3.1.1.5 References

None.

7.3.1.2 Exposures from Air Pathways

7.3.1.2.1 Areas of Review

The staff should review estimated release rates of airborne radioactivity considering applicable meteorological data as presented in section 2.0. The staff should then review the estimates of annual total body and organ doses to individuals including (i) at the point of maximum ground level concentration offsite, (ii) at the site boundary in the direction of the prevailing wind, (iii) at the site boundary nearest the emission source, and (iv) at the nearest residence in the direction of the prevailing wind. The applicant can choose to show compliance with a concentration limit or with individual dose limits. Therefore, the staff should initially determine the method of compliance chosen by the applicant and focus the review accordingly. Regardless of which compliance method is chosen, the reviewer will also need to calculate an individual dose to the public to comply with the requirements in 40 CFR Part 190. The staff should review data, models, calculations, and assumptions used in support of these estimates. The review should consider both the source term and exposure pathway components of the calculation and should include deposition of radioactive material on food crops and pasture grass.

7.3.1.2.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the estimates of annual total body and organ doses to individuals at the point of maximum ground level concentrations off site, individuals exposed at the site boundary in the direction of prevailing wind, individuals exposed at the site boundary nearest to the sources of emissions, and individuals exposed at the nearest residence in the direction of the prevailing wind meet the regulatory requirements in 10 CFR 20.1301 and 40 CFR 190.10 . The staff should also determine whether these estimates are supported by properly interpreted data, calculations, and model results using reasonable assumptions.

An acceptable computer code that calculates offsite doses to individuals from airborne emissions from ISL facilities is MILDOS (Strenge and Bander, 1981). This code does not calculate the source term. Therefore, the applicant must provide documentation of the source term calculation that is used as input to MILDOS, if this code is used. Staff should review the source term equation to ensure that it is an accurate estimation of all significant airborne releases from the facility including, where applicable, yellowcake dust from the dryer stack and radon emissions from processing tank venting and wellfield releases. If a closed processing loop is used, then radon release from processing is expected to be negligible. If a vacuum dryer is used for yellowcake, then dust emissions from drying will also be assumed to be negligible. Staff should focus attention on the values used for the production flow and the fraction of this flow that is expected to be released during operations. A reasonable estimate of well field radon release is about 25 percent. Staff should also ensure that the source term calculation accounts for all material released during start up, production, and restoration activities.

The review of the MILDOS calculation should focus on the code output provided by the applicant. The applicant should have provided a list of the relevant parameter information that was used. The information from this list should be compared with the input from the code run to ensure that the correct values have been used. Dose results from the code output should be checked against the tabulated results in the LA to ensure that the values have been correctly reported. Staff should also evaluate warning messages that the code provides in the output to identify anomalies in the input data or problems with the run. If reported results appear anomalous, staff may conduct confirmatory analyses using MILDOS.

7.3.1.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 20.1301 provides dose limits for individual members of the public. These dose limits include an annual TEDE no greater than 0.1 rem (1 mSv) exclusive of background and a 0.002 rem (0.02 mSv) external dose for any hour. If special conditions exist, an applicant can propose to meet limits in excess of these.

10 CFR 20.1302 provides additional instructions for compliance with the limits in 10 CFR 20.1301. These instructions include a choice for demonstrating compliance by measurement or calculation of TEDE to the individual receiving the highest exposure, or by demonstrating that annual average concentrations of radioactive material released in gaseous and liquid effluents at the site boundary meet the limits specified in table 2 of appendix B in 10 CFR Part 20.

40 CFR 190.10 requires that operations be conducted to provide reasonable assurance that the annual dose equivalent to any member of the public does not exceed 25 mrem (0.25 mSv) to the whole body, 75 mrem (0.75 mSv) to the thyroid, and 25 mrem (0.25 mSv) to any other organ as the result of planned discharges (radon excepted).

The description of exposures from air pathways is acceptable if

(1) The estimates of individual exposure to radionuclides at the site boundary meet the regulatory requirements in 10 CFR 20.1302(a)(2)(i) with regard to annual average concentrations of radionuclides in airborne effluents or the dose limit in 10 CFR 20.1302(a)(1).

(2) Calculations of concentrations of radionuclides in air at locations downwind where residents live or where biota of significance to human food chains exist are included in the compliance demonstration for public dose limits in 40 CFR Part 190.

(3) Relevant airborne exposure pathways are included in the pathway diagram provided by the applicant.

(4) The conceptual model used for calculating the source term and individual exposures (and/or concentrations of radionuclides) from airborne effluents at the facility boundary is representative of conditions described at the site as presented in section 2.0 of the LA. The conceptual model for the MILDOS code (Strenge and Bander, 1981) is acceptable for these exposure calculations.

(5) The parameters used to estimate the source term, environmental concentrations, and exposures are applicable to conditions at the site as presented in section 2.0 of the LA.

7.3.1.2.4 Evaluation Findings

The staff should determine, based upon a review of the description of expected exposures from air pathways, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of expected exposures from air pathways. If the staff determines that the description of expected exposures from air pathways is sufficient to meet the regulatory requirements and acceptance criteria identified in section 7.3.1.2.3, then the following finding will be made.

(1) The staff concludes that the description of expected exposures from air pathways is sufficient to provide reasonable assurance that the radiation exposure to an individual receiving the highest exposure at the site boundary or in populated areas will meet the requirements of 10 CFR 20.1301, 20.1302, and 40 CFR 190.10.

7.3.1.2.5 Reference

Strenge, D.L., and T.J. Bander. 1981. *MILDOS - A Computer Program for Calculating Environmental Radiation Doses from Uranium Recovery Operations*. NUREG/CR-2011. Washington, DC: Nuclear Regulatory Commission.

7.3.1.3 Exposures from External Radiation

7.3.1.3.1 Areas of Review

The staff should review estimates of maximum annual external dose that would be received by an individual from direct radiation at the nearest site boundary and in offsite populations. The staff should also review data, models, calculations, and assumptions used in support of these estimates.

7.3.1.3.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment, and whether items of special safety significance are involved.

The staff should determine whether the estimates of maximum annual external dose that would be received by an individual from direct radiation at the nearest site boundary meet the limits specified in 10 CFR 20.1301(a)(2). The staff should also determine whether these estimates are supported by properly interpreted data, calculations, and model results using reasonable assumptions. An acceptable computer code for conducting these calculations is MILDOS (Strenge and Bander, 1981). Staff should confirm that the input parameters used for the external dose calculation are consistent with the information provided in the LA. The staff should also confirm that the selected parameter values are representative of conditions at the site as presented in section 2.0 of the LA. If MILDOS (Strenge and Bander, 1981) is used, a separate calculation for the source term will be needed. Staff should check the source term conceptual model and selected parameter values to ensure that they are appropriate for the site conditions described in the LA.

7.3.1.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirement

10 CFR 20.1301(a)(2) specifies that the dose from external sources in any unrestricted area shall not exceed 0.002 rem/hr (0.02 mSv/hr).

The description of exposures from external radiation is acceptable if

(1) The estimates of external radiation exposure at the site boundary meet the regulatory limits in 10 CFR 20.1301(a)(2).

(2) The applicant provides an exposure pathway diagram that includes the relevant external exposure pathways.

(3) The model(s) used for calculating the source term, environmental concentrations, and external exposures at the facility boundary are representative of site conditions described in section 2.0 of the LA. The conceptual model for the MILDOS code (Strenge and Bander, 1981) is acceptable for these exposure calculations.

(4) The parameters used to estimate the source term, environmental concentrations, and external exposure are applicable to site conditions described in section 2.0 of the LA.

7.3.1.3.4 Evaluation Findings

The staff should determine, based upon a review of the description of expected exposures from external radiation, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of expected exposures from external radiation. If the staff determines that the description of expected exposures from external radiation is sufficient to meet the regulatory requirements and acceptance criteria identified in section 7.3.1.3.3, then the following finding will be made.

(1) The staff concludes that the description of expected exposures from external radiation is sufficient to provide reasonable assurance that the radiation exposure to an individual receiving the highest exposure at the site boundary or in populated areas will meet the requirements of 10 CFR 20.1301(a)(2).

7.3.1.3.5 Reference

Strenge, D.L., and T.J. Bander. 1981. *MILDOS - A Computer Program for Calculating Environmental Radiation Doses from Uranium Recovery Operations.* NUREG/CR-2011. Washington, DC: Nuclear Regulatory Commission.

7.3.1.4 Total Human Exposures

7.3.1.4.1 Areas of Review

The staff should review estimates of the maximum annual dose that could be received via all pathways described above by an individual at the site boundary and at the nearest residence. For commercial-scale operations, the staff should also review estimates of radiation dose from all pathways to the regional population within 80 km of the facility including the total annual 100-yr environmental dose commitment to the population from all pathways. The staff should also review data, models, calculations, and assumptions used in support of these estimates. Much of this review will already have been completed for the pathway-specific calculations and the total dose will be the sum of these results.

7.3.1.4.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether estimates of the maximum annual dose that could be received via all pathways described above by an individual at the site boundary and at the nearest residence meet regulatory requirements in 10 CFR 20.1301 and 40 CFR 190.10. For commercial-scale operations, the staff should also review estimates of radiation dose from all pathways to the regional population within 80 km of the facility. These calculations can be effectively executed by the MILDOS code (Strenge and Bander, 1981). The staff should also determine whether these estimates are supported by properly interpreted data, calculations, and model results using reasonable assumptions. After the pathway-specific calculations have been reviewed, staff should check to ensure that the doses have been correctly summed to determine the total dose. Also, staff should ensure the population dose is compared with a meaningful reference dose, such as that which is expected for the exposure to the same population from background radiation sources.

7.3.1.4.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 20.1301 provides dose limits for individual members of the public. These dose limits include an annual TEDE no greater than 0.1 rem (1 mSv) exclusive of background and a 0.002 rem (0.02 mSv) external dose for any hour. If special conditions exist, an applicant can propose to meet limits in excess of these.

10 CFR 20.1302 provides additional instructions for how to comply with the limits in 10 CFR 20.1301. These instructions include a choice for demonstrating compliance by measurement or calculation of TEDE to the individual receiving the highest exposure, or by demonstrating that annual average concentrations of radioactive material released in gaseous and liquid effluents at the site boundary meet the limits specified in table 2 of appendix B in 10 CFR Part 20.

40 CFR 190.10 requires that operations be conducted to provide reasonable assurance that the annual dose equivalent to any member of the public does not exceed 25 mrem (0.25 mSv) to the whole body, 75 mrem (0.75 mSv) to the thyroid, and 25 mrem (0.25 mSv) to any other organ as the result of planned discharges (radon excepted).

The description of total human exposures is acceptable if

(1) The estimates of individual exposure to radionuclides at the site boundary meet the regulatory requirements in 10 CFR 20.1302(a)(2)(i) with regard to annual average concentrations of radioactive nuclides in airborne and liquid effluents or the dose limit in 10 CFR 20.1302(a)(1).

(2) Calculations of the maximum individual whole body and organ doses at the site boundary and for the nearest downwind resident and where biota of significance to human food chains exist are included in the compliance demonstration for public dose limits in 40 CFR Part 190.

(3) The exposure pathway diagram provided by the applicant includes pathways relevant to all effluents expected from facility operations.

(4) The models used for calculating the source terms and individual exposures (and/or concentrations of radionuclides) from all effluents at the facility boundary are representative of conditions described at the site as presented in section 2.0 of the LA. An acceptable model for calculating offsite doses to individuals and populations from airborne releases is MILDOS (Strenge and Bander, 1981).

(5) The parameters used to estimate source terms, concentrations, and exposures are representative of conditions described at the site as presented in section 2.0 of the LA.

7.3.1.4.4 Evaluation Findings

The staff should determine, based upon a review of the description of expected total human exposures, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of expected total human exposures. If the staff determines that the description of expected total human exposures is sufficient to meet the regulatory requirements and acceptance criteria identified in section 7.3.1.4.3, then the following finding will be made.

(1) The staff concludes that the description of expected total human exposures is sufficient to provide reasonable assurance that the radiation exposure to an individual receiving the highest exposure at the site boundary or in populated areas will meet the requirements of 10 CFR 20.1301, 20.1302, and 10 CFR 40 190.10.

7.3.1.4.5 References

Strenge, D.L., and T.J. Bander. 1981. *MILDOS - A Computer Program for Calculating Environmental Radiation Doses from Uranium Recovery Operations*. NUREG/CR-2011. Washington, DC: Nuclear Regulatory Commission.

7.3.1.5 Exposures to Flora and Fauna

7.3.1.5.1 Areas of Review

The staff should review estimates of maximum radionuclide concentrations that may be present in important local flora and local and migratory fauna. The staff should also review data, bioaccumulation factors, models, calculations, and assumptions used in support of these estimates.

7.3.1.5.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether estimates of maximum radionuclide concentrations that may be present in important local flora and local and migratory fauna are calculated such that environmental impacts from facility operations can be assessed to address the requirements of 10 CFR Part 51. The staff

should also determine whether these estimates are supported by properly interpreted data, reasonable bioaccumulation factors, approved calculations, and model results using reasonable assumptions. Detailed biosphere modeling is not necessary for these calculations. Output from MILDOS (Strenge and Bander, 1981) provides ground level concentrations of radionuclides that can be then converted to plant and animal concentrations by use of simple conversion equations that include deposition, uptake factors, plant interception fractions, and animal consumption rates obtained from the literature. Staff should spot check parameter values against known sources to ensure that they are within expected ranges. The tabulation of bioaccumulation factors and their sources can be presented in an appendix to the LA.

7.3.1.5.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.60 requires that an environmental report be completed that contains the information identified in 10 CFR 51.45. This requirement specifies that environmental effects should be quantified to the greatest extent possible. Therefore, an analysis of environmental concentrations from facility effluents is necessary.

The description of exposures to flora and fauna is acceptable if

(1) The model and parameter values used for calculation of concentrations of radionuclides in important local flora and fauna are consistent with generally accepted health physics practice and are applicable to the species identified at the site as described in section 2.0 of the LA.

7.3.1.5.4 Evaluation Findings

The staff should determine, based upon a review of the description of expected exposures to flora and fauna, whether the information is sufficient to support the evaluation of the facility. The staff should also document any concerns regarding the description of expected exposures to flora and fauna. If the staff determines that the description of expected exposures to flora and fauna is sufficient to meet the regulatory requirements and acceptance criteria identified in section 7.3.1.5.3, then the following finding will be made.

The staff concludes that the description of expected exposures to flora and fauna is sufficient to provide reasonable assurance that the concentrations of radionuclides that might be present in important local flora and fauna resulting from facility operations will meet the requirements of 10 CFR 51.60 and 51.45.

7.3.1.5.5 References

Strenge, D.L., and T.J. Bander. 1981. *MILDOS - A Computer Program for Calculating Environmental Radiation Doses from Uranium Recovery Operations*. NUREG/CR-2011. Washington, DC: Nuclear Regulatory Commission.

7.4 NONRADIOLOGICAL EFFECTS

7.4.1 Areas of Review

The staff should review estimates of concentrations of nonradioactive wastes in effluents at the points of discharge as compared with natural ambient concentrations without the discharge and with applicable standards. The review should include the projected effects of the effluents for both acute and chronic exposure of the biota (including any long-term buildup in soils and sediments and in the biota). The staff should evaluate discussions of dilution and mixing of discharge into the receiving environs, and estimates of concentrations at various distances from the point of discharge. The effects on terrestrial and aquatic environments from chemical wastes that contaminate groundwater should also be examined.

The staff should also review discussions of any potential effects of the proposed operation that do not clearly fall under any specific topic previously addressed. These may include changes in land and water use at the project site; sanitary and other recovery plant waste systems; interaction of the facility with other existing or projected neighboring facilities; effects of groundwater withdrawal on groundwater resources in the vicinity of the wellfield(s) and recovery plant(s); effects of construction and operation of roads, transmission corridors, railroads, etc.; effects of changes in surface water availability on biotic populations; and disposal of other solid and liquid wastes.

7.4.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether the specific estimated concentrations of nonradioactive wastes in effluents at the point of discharge and the projected effects for both acute and chronic exposure of the biota are adequately quantified in accordance with the NEPA requirements in 10 CFR 51.45. Where applicable, the staff should determine whether these estimates are supported by properly interpreted data, reasonable bioaccumulation factors, calculations, and model results using reasonable assumptions.

7.4.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.60 requires that an environmental report be completed that contains the information identified in 10 CFR 51.45. This requirement specifies that environmental effects should be quantified to the greatest extent possible. Therefore, an analysis of environmental concentrations from facility effluents is necessary.

The description of nonradiological effects is acceptable if

(1) The estimated concentrations of nonradioactive wastes in effluents at the point of discharge and the projected effects for both acute and chronic exposure of the biota are adequately quantified in accordance with the NEPA requirements in 10 CFR 51.45.

7.4.4 Evaluation Findings

The staff should determine, based upon a review of the description of nonradiological effects of proposed facility operations, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of nonradiological effects of proposed facility operations. If the staff determines that the description of nonradiological effects of proposed facility operations is sufficient to meet the regulatory requirements and acceptance criteria identified in section 7.4.3, then the following finding will be made.

(1) The staff concludes that the description of nonradiological effects of proposed facility operations is sufficient to provide reasonable assurance that the estimated effects of nonradioactive wastes in effluents at the point of discharge and the projected effects for both acute and chronic exposure of biota will meet the requirements of 10 CFR 51.45 and 51.60.

7.4.5 References

None.

7.5 EFFECTS OF ACCIDENTS

In this section of the LA, the applicant should discuss the environmental effects of possible accidents that may occur, whether or not those accidents may produce an impact on the site or its environs. Analyses should be based on relevant experience and accident statistics from similar operating facilities. Accidents due both to human causes and natural phenomena should be addressed. See 10 CFR 20.403 and 20.405 regarding reporting requirements.

7.5.1 Accidents Involving Radioactivity

7.5.1.1 Areas of Review

The staff should review analyses of accidents involving radioactivity for a spectrum of accidents that might occur ranging in severity from trivial (essentially no release of radioactivity to the environment) to large releases, including characterization of occurrence rate or probability and potential consequences. Examples of accidents resulting in large releases would be an undetected lixiviant excursion or the failure of a waste retention system resulting from an act of nature, faulty design, or misoperation. Examples of accidents resulting in small releases would be failure of a pumping circuit with ground surface lixiviant release or failure of the ventilation system serving the chemical makeup area. An example of a trivial accident would be the leakage of a vessel containing barren lixiviant solution. The staff should review measures to be taken to prevent accidents, and discussions of proposed contingency plans to be implemented in the event that accidents occur.

7.5.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether accident scenarios described in the application are reasonable based upon analysis of descriptions of the facility and operations provided in sections 3.0, 4.0, and 5.0 of the LA and are sufficiently complete to determine environmental impacts of operations pursuant to the NEPA requirements. The staff should determine whether these scenarios and estimates are supported by properly interpreted data, calculations, and model results using reasonable assumptions. If consequences cannot be quantified, then a qualitative description of impacts may be acceptable. Staff should ensure the applicant has procedures in place to detect and respond to all postulated accident conditions and to mitigate consequences.

7.5.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.60 requires an environmental report to be completed which contains the information identified in 10 CFR 51.45. This latter section specifies that environmental effects should be quantified to the greatest extent possible. Therefore, the analysis of the consequences of potential facility accidents is necessary to fulfill this requirement.

The ~~description of accidents~~ involving radioactivity is acceptable if

(1) The applicant has provided analyses of probable accident consequences that are consistent with the facility design and planned operations and are sufficient to identify possible environmental impacts from operations.

(2) Analyses of accident consequences include mitigation measures for postulated accidents.

(3) Analyses of accidents include results of operating experience at similar facilities.

7.5.1.4 Evaluation Findings

The staff should determine, based upon a review of the description of effects of accidents involving radioactivity, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of effects of accidents involving radioactivity. If the staff determines that the description of effects of accidents involving radioactivity is sufficient to meet the regulatory requirements and acceptance criteria identified in the acceptance criteria section, then the following finding will be made.

(1) The staff concludes that the description of effects of accidents involving radioactivity is sufficient to provide reasonable assurance that the probable accident consequences and

mitigation measures are consistent with the facility design and proposed operations and are sufficient to identify possible environmental effects of operations in accordance with the requirements to 10 CFR 51.45 and 51.60.

7.5.1.5 References

None.

7.5.2 Transportation Accidents

7.5.2.1 Areas of Review

The staff should review accident scenarios and estimated releases of radioactivity and nonradiological wastes as a result of transportation accidents. ISL facilities will need to address the potential for yellowcake and processing chemical shipment accidents. Yellowcake is classified by NRC in 10 CFR 71 as Low-Specific Activity material. The radiological health impacts of accidents are small and most spills can be remediated by a clean-up crew. Additional transportation activities can include shipments of wet yellowcake slurry and offsite waste disposal shipments. The staff should review data, models, calculations, and assumptions used in support of these estimates. Emergency response plans, mitigation measures, and experience from other similar facilities should also be reviewed to ensure the appropriate procedures are in place.

7.5.2.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether transportation accident scenarios described in the application are reasonable and complete and that the analyses are sufficient to assess the environmental impacts from transportation activities onsite and offsite pursuant to the NEPA requirements of 10 CFR Part 51. The review should consider the discussion of plant operations in section 5.0 and confirm that all significant transportation activities are included in the accident analyses. The staff will use its understanding of the past industry experience with transportation accidents to assess whether the analyses are complete in addressing possible accident conditions and consequences. Staff do not need to review all of the operational aspects of transportation activities as these will be addressed through inspections relevant to the general transportation license requirements. The staff should determine whether the scenarios and estimates are supported by properly interpreted data, calculations, and model results using reasonable assumptions.

7.5.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.60 requires that an environmental report be completed that contains the information identified in 10 CFR 51.45. This latter section specifies that environmental effects should be quantified to the greatest extent possible. Therefore, the analysis of the consequences of possible transportation accidents is necessary to fulfill this requirement.

The description of transportation accidents is acceptable if

(1) The transportation accident analyses postulated scenarios cover the full extent of significant transportation activities discussed in section 5.0 of the LA.

(2) The accident scenarios and results are consistent with industry transportation experience and are considered reasonably likely to occur during the life of the facility.

(3) Procedures to respond to and mitigate or remediate the impacts of all forms of potential transportation accidents are referenced in the LA.

(4) Assessment of transportation impacts considers the local routing options and accident rates for these routes, and how these rates will be affected by the additional shipments.

7.5.2.4 Evaluation Findings

The staff should determine, based upon a review of the description of effects of transportation accidents, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of effects of transportation accidents. If the staff determines that the description of effects of transportation accidents is sufficient to meet the regulatory requirements and acceptance criteria identified in the acceptance criteria section, then the following finding will be made.

(1) The staff concludes that the description of effects of transportation accidents is sufficient to provide reasonable assurance that the probable accident consequences and mitigation measures are consistent with the facility design and proposed operations and is sufficient to identify possible environmental effects of operations in accordance with the requirements to 10 CFR 51.45 and 51.60.

7.5.2.5 References

None.

7.5.3 Other Accidents

7.5.3.1 Areas of Review

The staff should review information on other accidents that, although radioactive materials would not be involved, would have consequences that could affect the environment. Such accidents as chemical explosions or fires, steam boiler failures, and leakage or rupture of vessels containing toxic materials could have significant environmental impacts. The possible effects of these accidents should be evaluated.

7.5.3.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether accident scenarios described in the LA and their estimated consequences are reasonable and consistent with past industry experience. The review should emphasize the plant design and specific components that are prone to failure or known to have failed at other facilities. The staff should determine whether the scenarios and estimates are supported by properly interpreted data, calculations, and model results using reasonable assumptions. If consequences cannot be quantified, then a qualitative description of impacts may be acceptable. Staff should ensure the applicant has procedures in place to detect and respond to all postulated accident conditions and to mitigate consequences.

7.5.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.60 requires that an environmental report be completed that contains the information identified in 10 CFR 51.45. This section specifies that environmental effects should be quantified to the greatest extent possible. Therefore, the analysis of the consequences of possible accidents is necessary to fulfill this requirement.

The description of other accidents is acceptable if

(1) Analyses of accidents provide definition of probable accident consequences that are consistent with the facility design, industry experience, and planned operations, and are sufficient to identify possible environmental impacts from operations.

(2) The analyses of accident consequences include mitigation measures for postulated accidents.

7.5.3.4 Evaluation Findings

The staff should determine, based upon a review of the description of effects of other accidents, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the description of effects of other accidents. If the staff determines that the description of effects of other accidents is sufficient to meet the regulatory requirements and acceptance criteria identified in the acceptance criteria section, then the following finding will be made.

(1) The staff concludes that the description of effects of nonradiological accidents is sufficient to provide reasonable assurance that the probable accident consequences and mitigation measures are consistent with the facility design and proposed operations and are sufficient to identify possible environmental effects of operations in accordance with the requirements to 10 CFR 51.45 and 51.60.

7.5.3.5 References

None.

7.6 ECONOMIC AND SOCIAL EFFECTS OF CONSTRUCTION AND OPERATION

The staff should review descriptions in the application related to the potential economic and social effects of construction and operation of the proposed facility. These impacts should be discussed in separate sections covering benefits, costs, and resources committed.

7.6.1 Benefits

7.6.1.1 Areas of Review

The staff should review social and economic benefits from the proposed ISL operations that affect various political jurisdictions or public and private interests. Some of these reflect transfer payments or other values that may partially, if not fully, compensate for certain services as well as external or environmental costs, and this fact should be reflected in the designation of the benefit. Some examples of benefits to be reviewed include

(i) Tax revenues to be received by local, state, and federal governments

(ii) Temporary and permanent new jobs created and payroll (value-added concept)

(iii) Incremental increases in regional productivity

(iv) Enhancement of recreational values

(v) Environmental enhancement in support of the propagation or protection of wildlife and the improvement of wildlife habitats

(vi) Creation and improvement of local roads, waterways, or other transportation facilities

(vii) Increased knowledge of the environment as a consequence of ecological research and environmental monitoring activities associated with plant operation and technological improvements from the applicant research programs

The staff should also review discussions of significant benefits that may be realized from construction and operation of the proposed facility including expressions in monetary terms, discounted to present worth, of who is likely to be affected and for how long. In the case of aesthetic impacts that are difficult to quantify, the staff should review pictorial drawings of structures or environmental modifications visible to the public.

7.6.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether sufficient detail is presented to evaluate significant economic and social benefits that may be realized from construction, operation, restoration, reclamation, and decommissioning of the proposed facility. The staff should determine whether the likely benefits are reasonable and supported by properly interpreted data, calculations, and model results using reasonable assumptions. The staff should determine to what extent likely benefits can serve to offset adverse effects and costs of construction and operation of the facility. The SFCG provides a list of the types of benefits to be included in the LA.

7.6.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.45(c) requires the environmental report to include an analysis of the economic, technical, and other benefits and costs of the proposed action and alternatives.

The description of the economic and social effects of construction and operation is acceptable if

(1) The applicant's analysis of economic and social benefits that may be realized from construction, operation, restoration, reclamation, and decommissioning of the proposed facility are supported by properly interpreted data, calculations, and model results to comply with the requirements of 10 CFR 51.45(c).

(2) For each benefit identified, the applicant identifies who is affected and the duration of the impact.

7.6.1.4 Evaluation Findings

The staff should determine, based upon a review of the analysis of the benefits of proposed operations, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the analysis of the benefits of proposed operations. If the staff determines that the analysis of the benefits of proposed operations is sufficient to meet the regulatory requirements and acceptance criteria identified in the acceptance criteria section, then the following finding will be made.

(1) The staff concludes that the analysis of the economic and social benefits from the construction, operation, restoration, reclamation, and decommissioning of the proposed facility is supported by properly interpreted data, calculations, and model results and provides reasonable assurance that the requirements of 10 CFR 51.45(c) will be met.

7.6.1.5 References

None.

7.6.2 Costs

7.6.2.1 Areas of Review

The staff should review information presented concerning the primary corporate internal costs including (1) the capital costs of land acquisition and improvement; (2) the capital costs of facility construction; (3) other operating and maintenance costs, including license fees and taxes; (4) groundwater quality restoration, surface reclamation, and plant decommissioning; and (5) research and development costs, including postoperational monitoring requirements. As in the case of benefits, the applicant should discount these costs to present worth.

The staff should also review information on external costs including the probable number and location of the population group adversely affected, the estimated economic and social impact, and any special measures taken to alleviate the impact.

Temporary external costs should also be evaluated including housing shortages; inflationary rentals or prices, congestion of local streets and highways; noise and temporary aesthetic disturbances; overloading of water supply and sewage treatment facilities; crowding of local schools, hospitals, or other public facilities; overtaxing of community services; and disruption of people's lives or of the local community caused by acquisition of land for the proposed site.

Finally, the staff should review information regarding long-term external costs including impairment of recreational values (e.g., reduced availability of desired species of wildlife and sport animals, restrictions on access to land or water areas preferred for recreational use); deterioration of aesthetic and scenic values; restrictions on access to areas of scenic, historic, or cultural interest; degradation of areas having historic, cultural, natural, or archeological value; removal of land from present or contemplated alternative uses; reduction in quantities of regional products because of displacement of persons from the land proposed for the site; lost income from recreation or tourism that may be impaired by environmental disturbances; lost income attributable to environmental degradation; decrease in real estate values in areas adjacent to the proposed facility; and increased costs to local governments for the services required by the permanently employed workers and their families. In discussing these costs, the applicant should indicate, to the extent practical, who is likely to be affected, to what degree, and for how long.

7.6.2.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether sufficient detail is presented to evaluate significant economic and social internal and external costs that may be incurred during construction, operation, restoration, reclamation, and decommissioning of the proposed facility. The assessment of costs should be reviewed in the context of the information provided in earlier chapters of the LA to ensure consistency and completeness. The staff should review any data, models, calculations, and assumptions used in support of these projections. The staff should ensure the applicant has identified who it is that will bear the cost, the number of such people, the duration of the impacts, and what measures will be taken to mitigate the impacts.

7.6.2.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.45(c) requires the environmental report to include an analysis of the economic, technical, and other benefits and costs of the proposed action and alternatives.

The description of costs is acceptable if

(1) The analysis of economic and social costs that may be realized from construction, operation, restoration, reclamation, and decommissioning of the proposed facility are supported by properly interpreted data, calculations, and model results to comply with the requirements in 10 CFR 51.45(c).

(2) For each cost identified, the applicant identifies who is affected, the duration of impacts, and any mitigation measures necessary to alleviate or reduce impacts.

7.6.2.4 Evaluation Findings

The staff should determine, based upon a review of the analysis of the costs of proposed operations, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the analysis of the costs of proposed operations. If the staff determines that the analysis of the costs of proposed operations is sufficient to meet the regulatory requirements and acceptance criteria identified in the acceptance criteria section, then the following finding will be made.

(1) The staff concludes that the analysis of the economic and social costs from the construction, operation, restoration, reclamation and decommissioning of the proposed facility is supported by properly interpreted data, calculations, and model results and provides reasonable assurance that the requirements of 10 CFR 51.45(c) will be met.

7.6.2.5 References

None.

7.6.3 Resources Committed

7.6.3.1 Areas of Review

The staff should review irreversible and irretrievable commitments of resources due to the construction, operation, restoration, reclamation, and decommissioning of the proposed facility. This review should include both relative impacts and long-term net effects. Such resources should include permanent land withdrawal, irreversible or irretrievable commitments of mineral resources, water resource needs, permanent vegetation and wildlife losses (e.g., unique habitat, species), and consumption of material resources such as processing chemicals and power or energy needs. The staff should review information presented concerning the percentage terms in which the expected resource loss is related to the total resource in the immediate region and in which the immediate region is related to the surrounding regions in terms of affected areas and distances from the site.

7.6.3.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether sufficient detail is presented to evaluate irreversible and irretrievable commitments of resources due to the construction, operation, restoration, reclamation, and decommissioning of the proposed facility. The description of these commitments should be reviewed considering the facility description and operations discussed in earlier chapters to ensure consistency and completeness. Resource needs previously identified in existing environmental reports for similar facilities that are currently operating can be used in the staff's review for comparison.

7.6.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.45(b)(5) requires the environmental report to include a discussion of any irreversible or irretrievable commitments of resources that would be involved in the proposed action if implemented.

The description of resources committed is acceptable if

(1) The discussion of irreversible and irretrievable commitments of resources for the construction, operation, restoration, reclamation, and decommissioning of the proposed facility considers the following:

(a) Permanent land withdrawal

(b) Permanent commitment of mineral resources

(c) Permanent commitment of water resources

(d) Irreversible loss of surface vegetation

(e) Irreversible loss of wildlife

(f) Irreversible commitments of material resources including processing chemicals and energy needs.

7.6.3.4 Evaluation Findings

The staff should determine, based upon a review of the analysis of the irreversible and irretrievable resources to be committed to the proposed operations, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the analysis of the irreversible and irretrievable resources to be committed to the proposed operations. If the staff determines that the analysis of the irreversible and irretrievable resources to be committed to the proposed operations is sufficient to meet the regulatory requirements and acceptance criteria identified in the acceptance criteria section, then the following finding will be made.

(1) The staff concludes that the analysis of the irreversible and irretrievable resources to be committed to the construction, operation, restoration, reclamation and decommissioning of the proposed facility is supported by properly interpreted data, calculations, and model results and provides reasonable assurance that the requirements of 10 CFR 51.45(b)(5) will be met.

7.6.3.5 References

None.

8.0 ALTERNATIVES TO PROPOSED ACTION

8.1 AREAS OF REVIEW

The staff will review comparative evaluations of available alternatives to the selected ISL mining process including realistic alternatives for the various processing stages. The reviews will include descriptions of the groundwater quality restoration programs to be applied for each alternative. The staff will evaluate alternatives that may reduce or avoid significant adverse environmental, social, and economic effects expected to result from construction and operation of the proposed facility. The staff will also review the bases and rationales for the choices in regard to number, availability, suitability, and factors limiting the range of alternatives that might avoid some or all of the environmental effects identified in Section 7.0, Environmental Effects. For commercial-scale operations, the review will include the comparative evaluation of available alternatives using results obtained from R&D operations.

The staff will also review waste management alternatives considering siting, design, and operational performance objectives developed by the NRC staff in addition to the plans for final disposal discussed in section 6.0.

The review will include discussions regarding locating the liquid impoundment areas at sites where disruption and dispersion by natural forces are eliminated or reduced to the maximum extent reasonably achievable, and designing the impoundment areas so that seepage of toxic materials into the groundwater system would be eliminated or reduced to the maximum extent reasonably achievable.

8.2 REVIEW PROCEDURES

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application for renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine that the applicant has justified the choice of particular mining and recovery processes for the ore body by considering and choosing among techniques and processes that affect the environment in minimal ways. The justification should include a comparative evaluation of the available, practicable alternatives. Strengths and weaknesses associated with the likely effects of use of each technique or process including the groundwater quality restoration program should be presented. The staff should determine that the applicant has considered and chosen those alternatives which may reduce or avoid significant adverse environmental, social, and economic effects expected to result from the construction and operation of the proposed facility. The staff will evaluate the bases and rationales the applicant used for the consideration and rating of the alternatives. The staff should determine that, for commercial scale operations, the comparative evaluation of available alternatives includes results from research and development operations or similar production scale sites.

8.3 ACCEPTANCE CRITERIA

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

Sections 102(2)(C) and 102(2)(E) of NEPA require all agencies of the Federal Government to consider alternatives to proposed actions.

10 CFR 51.41 gives the NRC authority to require an applicant to submit such information as may be useful in aiding the NRC to comply with section 102(2) of NEPA.

10 CFR 40.32 describes the general requirements for the issuance of a specific license. Any alternatives should be evaluated compared to these requirements.

The description of alternatives to the proposed action is acceptable if

(1) The applicant considers mining alternatives to the proposed action. The applicant identifies alternatives to the operation of the proposed facility in the manner described in sections 3.0, 4.0, 5.0, and 6.0 that may mitigate adverse environmental, social, and economic effects identified in section 7.0. These alternatives may include, but are not limited to

(a) Alternative mining processes such as traditional open-pit and underground mining

(b) Alternative lixiviant chemistry

(c) Alternative groundwater restoration techniques

(d) Alternative waste management practices

(e) Uranium recovery process alternatives

(2) The alternatives are compared to the proposed actions pertaining to the site as described in section 2.0 and are consistent with existing mining standards and practices.

The rationale for selecting the proposed method should be provided, and the proposed action should be shown to be at least as effective as the considered alternatives in meeting all regulatory requirements. If the application is for a new commercial scale license, the consideration should be based on the results of the R&D site. If the LA is for a renewal of an existing license, the previous operating experience should be considered.

(3) The applicant considers the environmental, social, and economic effects of a no licensing alternative. Presumably, the applicant will provide information to demonstrate that the proposed action will provide social and economic benefits that outweigh the environmental impact of operating the facility.

8.4 EVALUATION FINDINGS

The staff should determine, based upon a review of an analysis of the alternatives to the proposed action, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the analysis of the alternatives to the proposed action. If the staff determines that the analysis of the alternatives to the proposed action is sufficient to meet the

regulatory requirements and acceptance criteria identified in section 8.3, then the following finding will be made.

(1) The staff concludes that the analysis of the alternatives to the proposed action has provided adequate consideration of those alternatives and adequate rationale for the alternatives selected in accordance with the requirements of sections 102(2)(C) and 102(2)(E) of NEPA, 10 CFR 51.41, and 10 CFR 40.32.

8.5 REFERENCES

None.

9.0 BENEFIT-COST ANALYSIS

9.1 AREAS OF REVIEW

The benefit-cost analysis proposed in this section is intended to be a summary of the benefits and costs of the proposed facility. The staff should review the discussion provided in the LA and any accompanying illustrations and tables that explain the important benefits and costs of the proposed facility and operations to determine that the issuance of a license is justified. It is important that both quantitative and qualitative justifications be supported with adequate data and appropriate rationale.

The review will include criteria for assessing and comparing benefits and costs where these are expressed in nonmonetary or qualitative terms and rationales for the selection of process alternatives as well as subsystem alternatives. The staff will also evaluate descriptions of the potential cumulative effects, and the rationale for omitting apparent benefits or costs.

9.2 REVIEW PROCEDURES

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should determine that the benefit-cost statement has been summarized in the form of a narrative and accompanying tables and charts. The important benefits and costs should be contrasted and discussed appropriately to justify the issuance of the license.

The reviewer should determine that the applicant has developed criteria for assessing and comparing benefits and costs where they are expressed in nonmonetary or qualitative terms: Among the criteria that should be considered are: (i) groundwater quality or quantity effects, (ii) radiological impact, and (iii) disturbance of the land. The applicant should present the rationales for the selection of process alternatives as well as subsystem alternatives. The reviewer should ascertain that potential cumulative and symbiotic effects have been detailed along with appropriate rationales for such tradeoffs. If any apparent benefits or costs have been omitted by the applicant, the reviewer should determine that the applicant has presented the rationale for such omissions. The staff should determine that the applicant has related all the terms used in the benefit-cost analysis to the relevant sections of the application. Overall, the benefit-cost section should demonstrate to the reviewer's satisfaction that the proposed project is a positive economic and social activity.

9.3 ACCEPTANCE CRITERIA

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

Section 102(2) of NEPA requires all agencies of the federal government to consider environmental costs and possible economic benefits of proposed actions.

10 CFR 51.41 gives the NRC authority to require an applicant to submit such information as may be useful in aiding the NRC to comply with section 102(2) of NEPA.

10 CFR 40.32 describes the general requirements for the issuance of a specific license. Any alternatives should be evaluated compared to these requirements.

The benefit-cost analysis is acceptable if

(1) The economic benefits of the construction and operation of the proposed facility are adequately summarized. These may include, but are not limited to:

(a) Tax revenues to be received by federal, state, and local governments

(b) Temporary and permanent jobs

(c) Incremental increases in regional product

(d) Enhancement of recreational values

(e) Environmental enhancement in support of the propagation or protection of wildlife and the improvement of wildlife habitats

(f) Creation and improvement of local roads, waterways, or other transportation facilities

(g) Increased knowledge of the environment as a consequence of ecological research and environmental monitoring activities associated with plant operation and technological improvements from the applicant's research program

(2) Economic benefits are estimated based on realistic assumptions and objective sources such as census data, tax information, and other site characteristics presented in section 2.0.

(3) The applicant provides a summary of internal costs, including capital costs of land acquisition and improvement, capital costs of facility construction, other operating and maintenance costs, plant decommissioning and site reclamation costs, and the costs of future improvements in the proposed facility. The costs of groundwater restoration, decommissioning, and reclamation are considered as presented in the financial assessment for surety in section 6.5.

(4) The applicant summarizes short-term external costs as they affect the interests of people outside of the owners and operators of the proposed facility. These may include, but are not limited to

(a) Housing shortages

(b) Local inflation

(c) Noise and congestion

are acceptable in accordance with the requirements of section (02/2) of NEPA, 10 CFR 40.32.

The staff concludes that the benefit-cost analysis of the proposed operations is complete and is adequate to demonstrate the acceptability of the proposed operations in accordance with the requirements of section 102(2) of NEPA, 10 CFR 51.41 and 10 CFR 40.32.

9.5 REFERENCES

None.

(d) Overloading of the water supply, water treatment facilities, and disposal landfills

(e) Crowding of schools, hospitals, recreational facilities or other public facilities

(f) Disruption of people's lives (e.g., ranching, farming) through the acquisition of land

(5) The applicant summarizes long-term external costs as they affect the interests of people outside of the owners and operators of the proposed facility. These may include, but are not limited to

(a) Impairment of recreational values through reduction in wildlife and sport animals

(b) Restrictions on access to land or water

(c) Aesthetic impacts

(d) Degradation or limited access to areas of historical, scenic, or cultural interests

(e) Lost income related to limitations on access to land and facilities

(f) Decreased real estate values

(g) Increased cost to provide government services for increased populations

(6) The applicant identifies who is most likely to be affected by the construction and operation of the proposed facility, and to the extent possible, identifies how long the disturbance is expected. This information should be consistent with the population information provided in section 2.3.

(7) If the LA is for a renewal, the applicant provides a summary of the actual economic benefits and costs of the facility since the last licensing action.

(8) A comparison of the benefits and costs is presented that adequately justifies proceeding with the ISL operations.

9.4 EVALUATION FINDINGS

The staff should determine, based upon a review of the benefit-cost analysis of the proposed operations, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the benefit-cost analysis of the proposed operations. If the staff determines that the benefit-cost analysis of the proposed operations is sufficient to meet the regulatory requirements and acceptance criteria identified in section 9.3, then the following finding will be made.

(1) The staff concludes that the benefit cost analysis provided by the applicant is adequate to demonstrate that the environment costs and economic benefits of the proposed actions

10.0 ENVIRONMENTAL APPROVALS AND CONSULTATIONS

10.1 AREAS OF REVIEW

The staff will review all licenses, permits, and other approvals of construction and operations required by federal, state, local, and regional authorities for the protection of the environment including a list of those federal and state approvals that have already been received, and the status of those pending approvals. The staff shall also review similar information regarding approvals, licenses, and contacts with tribal authorities. The staff will examine previously submitted environmental assessments or environmental impact statements, if appropriate.

The staff will evaluate discussions of the status of efforts to obtain a water quality certification under section 401 and discharge permits under section 402 of the Federal Water Pollution Control Act, as amended, if required including the rationale if certification is not required. The staff will also note the state, local, and regional planning authorities that have been contacted or consulted.

Finally, the staff will review descriptions of meetings held with environmental and other citizen groups with references to specific instances of the compliance with citizen group recommendations.

10.2 REVIEW PROCEDURES

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The reviewer should determine that the applicant has satisfied all license, permit, and other approvals of construction and operations which are required by federal, state, local, and regional authorities for the protection of the environment. Types of licenses or permits may include but are not limited to (i) source materials, (ii) underground injection, (iii) pond construction, (iv) surface discharge, (v) industrial groundwater, (vi) aquifer exemption, (vii) air quality, and (viii) disposal well. The federal and state approvals that have already been received should be listed, and those pending approval should be appropriately identified. The reviewer should determine that the applicant has presented the appropriate environmental assessment or full environmental impact assessment for the proposed mining site and surrounding area regardless of whether the assessments are pre-existing or prepared especially for this LA. This section is intended to cover licensing and permitting of the process as a whole or parts of the process, and does not require a listing of certifications that may be required for equipment or personnel. Copies of associated documentation may be provided as an appendix to the LA.

10.3 ACCEPTANCE CRITERIA

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

Sections 102(2)(C) and 102(2)(D) of NEPA require consultation with federal, state, and local agencies that are authorized to develop and enforce environmental standards and to discuss the responsibility and jurisdiction of state and local agencies.

10 CFR 51.41 gives the NRC authority to require an applicant to submit such information as may be useful in aiding the NRC to comply with section 102(2) of NEPA.

10 CFR 40.32 describes the general requirements for the issuance of a specific license. Any alternatives should be evaluated compared to these requirements.

The description of environmental approvals and consultations is acceptable if

(1) The applicant provides a summary of all permits or licenses obtained for the proposed facility. These should clearly identify

   (a) The type of permit or license

   (b) The granting authority (local, state, regional, tribal authorities, or federal)

   (c) The permit or license number (if appropriate)

   (d) The current status, with expiration date, if appropriate

(2) For permits not yet granted, the applicant provides a discussion of the current status of the application and objective evidence that the applicant has applied for, but has not yet received, the permit from the granting authority. Such evidence may include copies of documents such as letters from the granting authority or the permit application.

(3) For permits and licenses not yet granted, the applicant indicates when approval is expected. Consultations with the granting authority can be summarized.

(4) The granting authority is clearly defined and appropriate to the area being permitted or licensed. If permits are granted under agreement state status, this should be identified in the LA.

(5) The applicant summarizes meetings held with environmental and other citizens groups since the last licensing application, and responses to the concerns expressed at these meetings.

10.4 EVALUATION FINDINGS

The staff should determine, based upon a review of the environmental approvals and consultations required for the proposed operations, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the environmental approvals and consultations required for the proposed operations. If the staff determines that the environmental approvals and consultations required for the proposed operations are sufficient to meet the

regulatory requirements and acceptance criteria identified in section 10.3, then the following finding will be made.

(1) The staff concludes that the applicant has provided adequate evidence that all necessary environmental-related licenses, permits, consultations, and other approvals of construction and operation as required by federal, state, tribal, or other authorities have been obtained or applied for in accordance with the requirements of sections 102(2)(C) and 102(2)(D) of NEPA, 10 CFR 51.31, and 10 CFR 40.32.

10.5 REFERENCES

None.

Inserts

from the site, or, if there are no nearby populated areas, the entire basin within which the ore zone occurs. The site scale map should encompass the entire license boundary. If overlying and underlying aquifers exist, local scale potentiometric or water surface elevation maps of these aquifers should also be included. These maps should indicate the locations, depths, and screened intervals of the wells used to determine the potentiometric surface elevations; alternatively, this information can be provided in separate maps and/or tables. The appropriate contour interval will vary from site to site; however, contour intervals should be sufficient to make clear the groundwater flow direction. The number of water table elevation measurements used in the construction of each map should be in proportion to the contour interval chosen (e.g., a ratio of one well per contour line or greater should be adequate for a large number of randomly spaced wells). In order to construct a regional potentiometric map, a reasonable effort should be made to consider as many existing wells as possible. For discontinuous and steeply dipping aquifers, a more complex numerical model may be rquired for estimation of flow velocities.

(2) The applicant has considered hydro-stratigraphy at an appropriate scale. Hydrogeologic cross sections are recommended. These cross sections should be constructed for the area within the license boundary. For very large or irregularly shaped mine areas, more than one cross section may be necessary. Cross sections must be based on borehole data from driller's logs collected during well installation or exploratory drilling. All significant borehole data should be included in an appendix. Staff should verify that, where hydrogeologic units are shown to be continuous, an adequate number of boreholes is used to support this assertion. ~~However, because of the high cost of collecting borehole data, it is often the case that a spacing of kilometers between boreholes is used to infer continuity of layers that are only meters in thickness. When this is the case, the applicant is required to establish operational procedures for verifying the hydraulic isolation of the ore zone aquifer from upper and/or lower aquifers on a wellfield by wellfield basis. Review of operational procedures is covered in section 5 of this SRP.~~

(3) Reasonably comprehensive chemical and radiochemical analyses of water samples, obtained within the ore body and at locations away from the ore body, should be made to determine premining baseline conditions. Baseline water quality should be determined for the ore zone and surrounding aquifers. This data should include water quality parameters which are expected to increase in concentration as a result of solution mining activities and that are of concern to the water use of the aquifer (i.e., drinking water, etc.).

For example, ISL uranium solution mining is not expected to mobilize aluminum and unless an ammonia based lixiviant is used ammonia concentrations in the groundwater should not be increased as a result of *in-situ* minining. Therefore, little is gained by sampling these parameters. However, studies have shown that thorium-230 is mobilized by bicarbonate-laden leaching solutions. However, studies have also shown that after restoration, thorium in the groundwater 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 ISL mines.

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The applicant should identify the list of constituents to be sampled for baseline concentrations. The list of constituents in table 2.7-1 has generally been accepted by the NRC for ISL uranium mines. Alternatively, applicants may propose a list of constituents that is tailored to a particular location. In such cases, sufficient technical bases must be provided for the selected constituent list.

~~not only common constituents of natural waters, but also minor constituents, particularly trace and heavy metals, whose concentrations are likely to change as a result of chemical reactions initiated during ISL mining. A list of suggested water quality indicators to be measured to define baseline water quality is contained in table 2.7-1; this list is based on evaluation of uranium ore body mineralogy, EPA drinking water standards, water quality standards for agricultural uses, and uranium leaching processes (lixiviants used). Applicants may propose lists of constituents based on the host-rock geochemistry and mining solutions used at a particular site.~~

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Table 2.7-1. Typical baseline water quality indicators to be determined during premining data collection

A. Trace and Minor Elements		
~~Aluminum~~	Copper	Nickel
Arsenic	Fluoride	Radium-226 & 228
Barium	Iron	Selenium
Boron	Lead	~~Thorium-230~~ Silver
Cadmium	Manganese	Uranium
Chromium	Mercury	Vanadium
~~Cobalt~~	Molybdenum	Zinc
B. Common Constituents		
~~Ammonia~~ Alkalinity	Chloride	Sodium
Bicarbonate	Magnesium	Sulfate
Calcium	Nitrate	
Carbonate	Potassium	
C. Physical Indicators		
Specific Conductivity*		Total Dissolved Solids#
~~Temperature~~		~~Appearance, color, odor†~~
pH*		
D. RADIOLOGICAL PARAMETERS		
Gross Alpha	Gross Beta	

*Field and Laboratory determination.
~~†Field only.~~
#Laboratory only.

For determining baseline water quality conditions, at least four sets of samples should be collected and analyzed for each listed constituent. Some samples should be split, and sent to different laboratories as part of a quality assurance program. Sets of samples should be taken within a week or two of each other unless natural conditions are such that the water quality of the aquifers changes significantly with time. If natural groundwater flow rates and recharge conditions vary considerably (the premise that they do not should be documented by the applicant), additional sampling to establish the natural cyclical fluctuations of the water quality is necessary. For example, if mining is planned in an aquifer system that is essentially unconfined, seasonal water quality changes can be expected, and a more intensive

Insert A page 3-2

If wells are not properly completed, lixiviant can flow through casing breaks and into overlying aquifers. Casing breaks can occur if the well is damaged during well construction activities. Casing breaks can also occur if water injection pressures exceed the strength of the well materials. ~~Well completion techniques should be described in sufficient detail to give the reviewer a clear picture of~~ how recovery, injection, and monitor wells are drilled; how their location and spacing are selected; and what materials and methods are used in construction, casing, and abandonment. The reviewer should pay particular attention to the techniques employed to prevent hydraulic communication between overlying or underlying aquifers through well boreholes. These techniques include proper use of packers and cements to seal bottoms of boreholes and the space between the casing and borehole walls. Additionally, the applicant should describe methods for well abandonment. The reviewer should ensure that the well casing material used is appropriate for the depths to which the wells are drilled. Generally, polyvinyl chloride (PVC) is the preferred casing material for in-situ uranium solution mines; however, PVC may be susceptible to failure under high pressures encountered at depths greater than about 500 ft. Where PVC is installed at greater than 500 ft, the applicant should include the design specifications of the casing material used. The reviewer should examine a description of the procedures used to test well integrity. ~~Part IX of WM-8102 (Nuclear Regulatory Commission, 1981) provides NRC guidelines for well design, testing, construction, and abandonment~~. (Note to CNWRA. Any useful information from this reference should be directly included in this review plan so that we can eliminate this reference from our guidance) The reviewer may ~~also~~ wish to refer to a well handbook (e.g., Driscoll, 1989) to verify the appropriateness and expected performance of well installation and abandonment methods.

3.1.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

A facility to recover uranium by in-situ solution mining is licensed under provisions of an NRC (10 CFR Part 40) source and byproduct material license. 10 CFR 20.1002 requires that such a license is subject to the radiation protection requirements of 10 CFR Part 20. Compliance with dose limits, and requirements for radiation surveys, monitoring, control of exposures, and respiratory protection in 10 CFR Part 20 will require use of equipment and instrumentation that is part of the facility. This equipment and instrumentation should be described and located (where applicable) on facility drawings. Additional radiation protection equipment that is not part of the facility will be described in Chapters 4.0, Effluent Control Systems and 5.0, Operations.

The description of the solution mining process and equipment is acceptable if

(1) The description of the ore body is sufficiently detailed to identify the mineralized zone, its areal distribution and its approximate thickness.

If more than one ore zone is to be mined, each ore zone should be defined separately. The estimated ore grade should be specified.

(2) The LA provides detailed discussion of well installation and testing techniques and indicates whether applicable ASTM standards (specific standard numbers must be cited), have been complied with. The following discussion reflects practices that NRC has historically found to be acceptable for ISL uranium mining.

(a) Well Design and Construction. Injection and recovery wells should be constructed from materials that are inert to lixiviants and are strong enough to withstand injection pressures. PVC, fiberglass, or acrylonilrile butadiene styrene (ABS) plastic casings are generally used in wells less than 500 ft deep. Wells deeper than 500 ft, or those subjected to high pressure cementing techniques, are subject to collapse. In these instances, steel or fiberglass casing is generally necessary. In all wells (including monitor wells), the annular space between the side of the borehole and the casing should be back-filled with a sealant from the bottom of the casing to the surface in one continuous operation. Proper back-filling isolates the screened formation against vertical migration of water from the surface or from other formations, and also provides support for the casing. Cement or cement-bentonite grout is generally acceptable as a sealant.

Material normally used for monitor-well casing is either metal or plastic. The possibility that chemical reactions may take place between the casing and the mineral constituents in the water affects the choice of casing material used for monitor wells. For example, iron oxide in steel-cased wells will adsorb trace and heavy metals dissolved in the groundwater; therefore, a baseline water sampling program should be used to determine concentrations of trace metals. The applicant should use casing that is inert to these metals, such as PVC or fiberglass. When any well is completed, it should be flushed until production of essentially sediment-free water is assured for the life of the well. One acceptable flushing method is to use a swab in the well to create a vacuum on the upstroke and positive pressure on the down-stroke.

(b) Well Integrity Testing. Injection and recovery wells should be tested for mechanical integrity. One acceptable method is to pressurize the casing with water to the maximum expected injection pressure. The valve on the line connecting the well to the pressurizing packer equipment should be closed, and the pressure inside the well casing monitored for 10 min. If the pressure does not drop 10 percent below the maximum pressure which was applied during the test, the casing is deemed acceptable for solution mining. The results of this test, including starting and ending pressures, should be recorded on a form signed by the wellfield engineer and facilities manager, and should be filed at the mine site and included in the LA.

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In the past the NRC staff has found the following well integrity testing procedures acceptable. To inspect for casing leaks after a well had been completed and opened to the aquifer, a packer would be set above the well screen, and each well casing would be filled with water. At the surface, the well would then be pressurized up with either air or water to 25 percent above the expected operating. A well would be considered to have passed the test if a pressure drop of less than 10 percent occurred over 1 hr. Operating pressure would vary with the depth of the well and would be less

Insert A
page 3-3
continued

than formation fracture pressure. Well integrity tests would be performed on each injection and production well before the wells are utilized and on wells that have been serviced with equipment or procedures that could damage well casing. Additionally, each well has to be retested at least once each 5 years it is in use.

(3) The description of the ISL process includes the following information and demonstrations:

(a) Projected downhole injection pressures with the hydrostatic pressure of the fluid column should be demonstrated to be maintained below casing (casing and cement) presssures and formation fracture pressures to avoid hydrofracturing the aquifer and promoting leakage into the overlying units.

(b) Production rates should be lower than injection rates. The production bleed should be large enough to keep the injected lixiviant in the wellfield. The LA should demonstrate the validity of the proposed production bleed through either research and development (R&D) or commercial operating experience at the site or appropriate computer flow models.

(c) Proposed plant material balances and flow rates should be supported by models that demonstrate that the public health and safety is not compromised.

(d) Lixiviant makeup should be described so that the staff can evaluate its impact on groundwater quality and the prospects for long-term groundwater restoration. The lixiviant should not incorporate toxic chemicals or organic materials that are known to degrade water quality. Oxidants such as gaseous oxygen and hydrogen peroxide and carbonates such as sodium bicarbonate or carbon dioxide gas have been demonstrated in a number of ISL facilities to be suitable lixiviants.

(e) Recovery efficiency should be demonstrated through documented mass balance calculations.

(f) The description should include an estimate of gaseous, liquid, and solid wastes and effluents that will be generated. Effluent monitoring and control measures are discussed in section 4.0.

(4) Proposed operating plans and schedules include timetables for wellfield operation, surface reclamation, and groundwater restoration. Water balance calculations should be provided that demonstrate that the liquid waste disposal facilities (evaporation ponds, land application, deep well injection) are adequate to handle the proposed production and restoration efforts at any time.

(5) The design, installation, and operation of evaporation and storage ponds at the site equals or exceeds guidance criteria provided in Regulatory Guide 3.11, Design, Construction, and Inspection of Embankment Retention Systems for Uranium Mills (Nuclear Regulatory Commission, 1977). The ponds should have sufficient capacity that the entire contents of one pond can be transferred to the other ponds in the event of a leak.

radiation surveys, monitoring, control of exposures, and respiratory protection in 10 CFR Part 20 will require use of equipment and instrumentation that is part of the facility. This equipment and instrumentation must be described and located (where applicable) on facility drawings. Additional radiation protection equipment that is not part of the facility will be described in Chapters 4.0, Effluent Control Systems and 5.0, Operations.

10 CFR 20.1701 requires that the licensee shall use, to the extent practical, process or other engineering controls (e.g., containment or ventilation) to limit the concentrations of radioactive material in air.

10 CFR 20.1501(b) requires the licensee to ensure that instruments and equipment used for quantitative radiation measurements (e.g., dose rate and effluent monitoring) are calibrated periodically for the radiation measured.

The discussion of instrumentation is acceptable if

(1) Instrumentation has been described for the various components of the processing facility, including wellfields, wellfield houses, trunklines, the production circuit, evaporation ponds, and deep injection disposal wells.

(2) Instrumentation is designed to allow the plant operator to continuously monitor and control a variety of systems and parameters, including total flow into the plant, total waste flow leaving the plant, tank levels, and the yellowcake drier. Instrumentation includes alarms in the event of a failure.

(3) Critical components of the systems are equipped with backup systems that activate in the event of a power failure.

(#) To prevent vertical excursion well field operating pressures should be kept below casing and formation rupture pressures. Well field operating pressures should be routinely monitored either at the well head or on the entire system. It is suggested that they be measured and recorded daily.

3.3.4 Evaluation Findings

The staff should determine, based upon a review of the description of the process instrumentation and control systems, whether the information is sufficient to support the evaluation of the facilities and any conceptual or numerical models used in the LA. The staff should also document any concerns regarding the process instrumentation and control systems. If the staff determines that the description of the process instrumentation and control systems is sufficient to meet the regulatory requirements and acceptance criteria identified in section 3.3.3, then the following finding will be made.

The staff concludes that the description of the process instrumentation and control systems is sufficient to permit evaluation of the operations and processes to assess compliance with the requirements of 10 CFR 20.1002, 20.1501(b), and 20.1701.

3.3.5 References

5.7.8.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

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Prior to mining, well field hydraulic and water chemistry data are collected. The water quality data is used to set the concentration of parameters which will be used to determine if the well field is being operated safely. Water quality data is also used to set the water quality to which the aquifer will be restored after mining. From an environmental standpoint, hydraulic data or information that is used to describe the flow of ground water, is used to evaluate (1) if the well field can be operated safely, (2) to confirm that monitor wells have been located correctly, (3) to design aquifer restoration activities, and (4) to predict post restoration impacts. For approval of a performance-based license, the reviewer should determine that the objectives of the operational monitoring program have been established. To this end, the reviewer will

(1) Verify that procedures for collecting all water quality data result in sets of samples that are adequate to evaluate natural spatial and temporal variations in water quality.

(2) Ensure that excursion indicator upper concentration limits (UCLs) are suitable to detect migration of mining lixiviant away from the ore zone.

(3) Ensure that the applicant uses an appropriate technical basis for determining monitor well spacing.

(4) Evaluate whether wellfield testing is sufficient to establish horizontal connectivity between the ore zone and outer monitor wells, and vertical isolation between the ore zone and vertical excursion monitor wells.

(5) Evaluate whether the excursion monitoring program will result in timely detection and reporting of lixiviant migration from the ore zone.

(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.

(7) Evaluate whether actions to be taken in the event an excursion is detected are consistent with the acceptance criteria.

5.7.8.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR Part 20 provides the regulatory standards for protection against radiation and the requirements of 10 CFR Part 40, appendix A provides criteria for disposition of wastes. Applicants are required to demonstrate not only that exposure to radiation is below allowable dose limits as specified in subpart C of 10 CFR Part 20, but also that radiation exposure during mine operations is ALARA, in accordance with subpart

B of 10 CFR Part 20. An important aspect of complying with these requirements is the establishment of an organizational structure and administrative procedures that facilitate prompt identification and resolution of hazards to workers, the public, and the environment surrounding the facility.

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The groundwater monitoring program should insure that an excursion is detected long before mining solutions could seriously degrade the water quality of ground water outside the well-field-area. Early detection of excursions by a monitor well are influenced by the thickness of the aquifer monitored, the distance that monitor wells are placed from the well field and 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 description of groundwater and surface water monitoring programs is acceptable if ~~The~~ monitoring program is sufficient to ensure that, during day to day operations, groundwater and surface water will be monitored such that early detection and timely restoration of excursions will be achieved. The following criteria must be met by ISL uranium mining operational monitoring programs:

(1) For each new wellfield, the applicant establishes baseline water quality data sufficient to (i) establish the primary restoration goal of returning each wellfield to its premining water quality conditions, and (ii) provide a standard for determining when an excursion has occurred.

Baseline sampling programs should provide enough data to adequately evaluate natural spatial and temporal variations in premining water quality. At least four independent sets of samples should be collected. There should be adequate time between sets to detect premining temporal variations (2 wk recommended; longer if seasonal variations occur). A set of samples is defined to be a group of at least one sample for each of the designated baseline monitor wells within the unit being characterized, taken to represent the water quality conditions of the sampled aquifer at a specific point in time. An acceptable set of samples should include all mining unit perimeter monitor wells, all upper and lower aquifer monitor wells, and at least one production/injection well per acre in each wellfield. For large wellfields, it may not be practical to sample one production/injectionwell per acre; if fewer than one per acre are sampled, enough production/injection wells to provide an adequate statistical population must be sampled. As a general guideline, for normally and log-normally distributed populations, at least six samples are required to achieve ninety percent confidence that any random sample will lie within two standard deviatic ns from the sample mean. In no case should the baseline sampling density for production/injection wells be less than one per four acres.

The applicant should identify the list of constituents to be sampled for baseline concentrations. The list of constituents in table 2.7-1 has generally been accepted by the NRC for ISL uranium mines. Alternatively, applicants may propose a list of constituents that is tailored to a particular location. In such cases, sufficient technical bases must be provided for the selected constituent list. For example, many licensees have decided not to sample for thorium-230; thorium-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 groundwater 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 ISL mines. This example concerning thorium-230 has been found to be an acceptable technical basis for excluding thorium-230 from the list of sampled constituents. For all constituents that are sampled, copies of laboratory reports documenting the measurements should be maintained by the applicant.

Removal of outliers from sample sets should be done using proper statistical methods. An outlier is a single non repeating value that lies far above or below the rest of the sample values for a single well. The outlier may represent a sampling, analytical, or other unknown source of error or 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. It is often necessary to perform log-transformations on data in order to better approximate a normal distribution. When an outlier has been discarded, it may be necessary to take another sample to replace the one discarded. A conservative method for dealing with suspected outliers is to accept any suspicious data that cannot be positively linked to sampling or analytical error. Another acceptable method is to accept any value within three standard deviations of the mean. For a normally distributed set of values, three standard deviations encompass 99.7 percent of variation in the population. The standard deviation should be calculated without using the suspected outliers. Care should be taken not to exclude suspected outliers which ultimately may represnt bimodal distributions. Methods in NUREG/CR-4604 and NUREG-1475 are acceptable methods to the NRC staff for outlier calculation. Other documented and technically justified methods used by applicants will be considered in the evaluation of outliers (U.S. ~~Evironental~~ Environmental Protection Agency, 1989).

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(2) The applicant selects excursion indicator sets and upper control limits. Upper control limits are intended to provide early warning that mining solutions are moving away from the well fields so that groundwater outside the monitor well ring is not significantly threatened. This is accomplished by choosing parameters that are strong indicators of the ISL mining process and that do not greatly attenuate because of geochemical reactions in the aquifers. If possible, the parameters chosen should be easy to analyze, allowing timely data reporting. The concentration of the chosen indicator parameters should be set high enough that false positives (false alarms due to natural fluctuations in water chemistry) are not a frequent problem, but not so high that significant groundwater quality degradation occurs by the time an excursion is identified.

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A minimum of three excursion indicators must be proposed. The choice of excursion indicators must be based on lixiviant content and host rock geochemistry. Staff must ensure that selected excursion indicators are measurable parameters that are found in significantly higher concentrations during solution mining than in the natural waters. At most uranium ISL 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 ISL mining. Conductivity, which is correlated to total dissolved solids (TDS), is also considered to be a good ~~a commonly used~~ excursion indicator (Staub, 1986 and Deutsch, 1985). Total alkalinity (carbonate plus bicarbonate plus hydroxide) is an excellent indicator at

mine units where sodium bicarbonate or carbon dioxide are used in the lixiviant. If conductivity is used to estimate TDS, it must be clearly stated that measurements will be normalized to a reference temperature, usually 25° C., due to the temperature dependence of conductivity.

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Calcium, sodium, and sulfate are projected to be found at significantly higher levels in ISL mining leachate than in natural groundwater concentrations. The use of cations (e.g., Ca^{2+}, Na^{+}) as excursion indicators is generally not appropriate, because they are subject to ion exchange processes in the presence of clay minerals. The use of sulfate may give false alarms because of induced oxidation around a monitor well (Staub, 1986, and Deutsch, 1985). However, this should only be a problem if upper control limit values are set too conservatively. Uranium is not considered a good indicater because while it is mobilized by ISL mining, it may be retarded by reducing conditions in the aquifer. Water level measurements are very useful for any excursion monitoring program, since in artesian aquifers water level changes are quickly transmitted though the aquifer. However, water levels are not considered to be good indicator, because water level data would identify too many false excursions (false positives). The applicant may choose to add a nonreactive, conservative tracer to mining solutions to act as an excursion indicator. The applicant is required to provide the technical bases for the selection of all excursion indicators.

Calcium, sodium, and bicarbonate are also projected to be found at significantly higher levels in ISL mining leachate than in natural groundwater concentrations. The transport of calcium and sodium would be affected by ion exchange reactions between the solution and the sediment (Deutsch 1985). For that reason, bicarbonate is preferable as an excursion indicator. The use of bicarbonate inside the mineralized zone may give false alarms because of induced oxidation around a monitor well (Staub 1986). Also, Deutsch (1985) and Staub (1986) note that there is a similar concern with the use of sulfate as an excursion indicator. However, this should only be a problem if upper control limit values are set too conservatively. Of these two parameters, bicarbonate would be the preferable choice because it is mostly a direct result of the injection of the sodium bicarbonate lixiviant and should reach a high concentration early in the mining of a well field.

UCLs must be calculated such that the presence of two or more excursion indicators in a monitoring well at concentrations greater than the UCL for the respective indicator will be an indication that a lixiviant excursion has occurred. The value of the UCL for each excursion indicator must be less than the lowest concentration at which the indicator could reasonably be expected to occur in the mining lixiviant while the wellfield is in operation. Each UCL must also be greater than the baseline concentration for its respective excursion indicator. Applicant site-specific experience is often valuable in determining appropriate UCLs that provide timely detection and avoid false alarms. One commonly accepted UCL is the baseline mean value plus five standard deviations.

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In choosing the concentration for an upper control limit parameter, NRC staff guidance states that "*in order to account for the spatial and temporal variations in excursion indicator concentrations, upper control limits should be determined on a statistical basis. One such*

statistical technique is the student 'T' distribution" (NRC 1981b). NRC staff guidance also recommends that in some cases a simple percentage increase over baseline values may be used (a 20 percent increase over the established baseline is suggested) (NRC 1981b). NRC staff have decided that it is acceptable to set baseline concentrations based on the mean plus a defined number of standard deviations. In areas of good water quality, NRC has found the mean plus 5 standard deviations to be acceptable. However, in aquifers with good water quality, chloride populations have been found to have such a narrow statistical distribution that the mean plus 5 standard deviations plus a defined concentration has been used (FEIS).

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

(3) The applicant establishes criteria for determining monitor well locations. Ore zone perimeter monitor wells are used to detect horizontal excursions outside the wellfield boundary. They generally surround the entire wellfield and are screened over the entire ore zone hydrogeologic unit. Local groundwater gradients, velocity, and dispersion of the excursion indicators should be considered when choosing the location and spacing for these wells. A horizontal excursion may be more likely to occur down-gradient from the wellfield due to the background gradient of the groundwater. As an excursion migrates away from the wellfield, it will tend to spread laterally due to dispersive processes. Excursions may also occur upgradient or cross-gradient from the natural flow direction if the flow balance between production and injection well is incorrect, or if flow velocities away from the wellfield are low enough that dispersion is the dominant transport process. Perimeter monitor wells should be placed close enough to the wellfield to provide timely detection, yet they should be far enough away from the wellfield to avoid numerous false alarms; they must also be spaced close enough to one another so that, by the time an excursion reaches them, the expected width of the excursion plume is likely to encounter at least one monitor well. In previus reviews the NRC staff has commonly found the location of horizontal monitor wells to be acceptable if the wells were located 140 m (400 ft) from the edge of the production or injection wells and 140 m (400 ft) between each monitor well so that the angle formed by lines drawn from any production well to the two nearest monitor wells would not be greater than 75 degrees. The NRC staff has also approved horizontal monitor well locations based on a modeling demonstration that a theoretical excursion can be controlled at the monitor well locations within 60 days of excursion detection at a monitor well.

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Upper and lower aquifer monitor wells should lie within the wellfield and be completed in the appropriate hydrogeologic unit. Their location within the wellfield should not be arbitrary, and the technical basis for their selection should be discussed in the application. The appropriate number of these monitor wells may vary from site to site. For example, if the site characterization demonstrates that the ore body is underlain by an effectively impermeable layer of significant thickness, It may be appropriate to exclude the requirement to monitor water quality in the underlying aquifer if (1) the underlying aquifer is a poor producer of water, (2) the underlying aquifer is of poor water quality, (3) there is a large aquitard between the mine zone and the underlying aquifer and few boreholes have penetrated the

Insert C page 5-45

aquitard (FEIS), and (4) 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 (1) the aquifers are separated from the production zone by thick aquitards, (2) a high quality mechanical integrity well testing program will be implemented, (3) the aquifers are unsubstantial producers of water or of poor water quality. ~~Generally, an underlying aquitard must be on the order of hundreds of meters thick, of very low conductivity (e.g., less than 10^{-5} m/d), and essentially unfractured for this exclusion to be acceptable.~~ In wellfields where the ore zone confining layers are particularly thin, or of questionable continuity, a greater number of monitor wells is appropriate. In general, when the direction of groundwater flow in an upper or lower aquifer is well known consideration by the applicant should be given to locating these wells on the hydraulically downgradient side of a wellfield, in areas where ore 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).

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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 sneaky above or below the well screens. However, the concentration of indicator parameters might be diluted and therefore may not provide the earliest possible warning that an excursion is occurring. Partially screened monitor wells only sample the zone of mining within an aquifer. These wells might miss some excursions, but would suffer less from dilution effects than fully screened wells. For most situations the NRC staff favors full 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 groundwater 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.

In past the NRC staff has approved a vertical monitor well density 's for the first overlying aquifer of one monitor well per 1.6 ha (4 acres) of the mining unit in the first overlying aquifer, one monitor well per 3.2 ha (8 acres) of mining unit in each higher aquifer, and one monitor well per 1.6 to 3.2 ha (4 to 8 acres) in the underlying aquifer.

(4) The applicant establishes wellfield test procedures. Once a wellfield is installed, it should be tested to establish that the ore zone production and injection wells are hydraulically connected to the perimeter horizontal excursion monitor wells, and hydraulically isolated from the vertical excursion monitor wells. Such testing will serve to confirm the performance of the monitoring system, and verify the validity of the site conceptual model reviewed in section 2. The reviewer should verify that wellfield test procedures have sound technical bases. Test procedures typically consist of a pump test that subjects the wellfield 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 one foot of drawdown in the perimeter monitor wells will verify hydraulic connection, but the amount may vary due to distance from the pumping wells, pumping rates, and hydraulic conductivity.

For the vertical excursion monitor wells, an acceptable criterion for establishing hydraulic isolation is that, during the same wellfield test performed to confirm hydraulic connectivity

6.0 GROUNDWATER QUALITY RESTORATION, SURFACE RECLAMATION, AND PLANT DECOMMISSIONING

6.1 PLANS AND SCHEDULES FOR GROUNDWATER QUALITY RESTORATION

6.1.1 Areas of Review

The staff shall review the following aspects of the groundwater quality restoration program:

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(1) Estimates of the ~~quantities, concentrations~~, and lateral and vertical extent of those chemicals that may persist in ~~leached-out~~ wellfield production zones after termination of *in situ* mining operations and prior to restoration activities must be provided.

(2) Descriptions of proposed methods and techniques to be used to achieve groundwater quality restoration, including identification of *in situ* chemical reactions that may hinder or enhance restoration. The staff should also review descriptions of fluids to be used during restoration and the hydraulic and geochemical properties of the receiving stratum. For commercial-scale operations, the staff should evaluate ~~incorporation~~ of results obtained from research and development operations~~, and~~

(#) a schedule for sequential restoration of mine units should be included.

(3) Descriptions of the expected postreclamation conditions and quality of restored groundwaters, compared with the preoperational land and water quality characteristics if there is prior experience in restoring groundwater at the site.

(4) Assessments of the proposed water quality restoration operations with respect to their adverse effects on groundwaters outside production zones.

(5) Procedures to be used for plugging, sealing, capping, and abandoning wells associated with the ISL operations.

6.1.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

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

(1) Evaluate estimates of postmining contamination 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 the research and development (R&D) site or other site upon which restoration estimates are based.

(2) Compare descriptions of restoration methods to methods that have been used successfully at R&D sites for other ISL mines. Ensure that methods selected are appropriate for the host rock and lixiviant chemistry.

(3) Assess whether the applicant has provided a reasonable standard for the determination of restoration success and a realistic assessment of the expected postreclamation water quality by comparing standards to previous restoration work at the R&D site or other previously restored ISL mines.

(4) Evaluate the ability of the postreclamation stability monitoring program to verify successful restoration.

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(5) Consider whether the proposed restoration program adequately addresses water quality cleanup ~~of contamination~~ due to wellfield flare (undetected spread of contaminants ~~outside~~ between the well field and monitor wells of the production zone), and whether the quantity of water pumped during restoration will adversely affect offsite groundwater uses.

(6) Assess whether plans for plugging and abandoning wells prior to license termination are consistent with generally accepted techniques.

6.1.3 Acceptance Criteria

There are no specific regulatory requirements applicable to groundwater restoration at ISL facilities.

The description of plans and schedules for groundwater quality restoration, surface reclamation, and plant decommissioning is acceptable if

~~(1) The LA clearly demonstrates how the provisions of appendix A to 10 CFR Part 40 have been addressed.~~

~~Criterion 5 of appendix A provides basic groundwater protection standards. Groundwater monitoring to comply with these standards is required by criterion 7. Though the requirements of appendix A are directed toward achieving compliance at uranium mill tailings sites, they also provide a co.. venient framework for achieving compliance with EPA groundwater protection standards at ISL facilities.~~

(2) The LA includes estimates of the extent of ~~chemicals~~ contaminants that might persist after mining.

Generally, these estimates are based on experience in ISL mining or R&D endeavors in similar host rock.

(3) The applicant describes in the LA the method used for estimating wellfield pore volume.

Insert B page 6-2

A pore volume is an indirect measure of the volume of water that must be pumped or processed to restore the groundwater. It represents the water that fills the void space inside a certain

volume of rock or sediment. Restoration costs are closely linked to the amount of water that must be processed to effect restoration. The pore volume parameter is used to represent how many times the contaminated volume of water in the rock must be displaced or processed to restore groundwater quality. It provides a means of comparing the level of effort required to restore groundwater regardless of the scale of the test. In general, the more pore volumes of water it takes to restore groundwater quality, the more money it will cost to achieve restoration. ~~In order to normalize estimates of the extent of contamination so that the concept can be applied to wellfields of different sizes, the extent of contamination is usually expressed as a function of pore volumes of water required to conduct restoration.~~ Estimates of groundwater resotration pore volumes ~~pore volume~~ should take into account the ~~estimated~~ effective porosity of the contaminated region and the lateral and vertical extent of contamination. ~~Realistically, there is no way of knowing the true extent of contamination; however, if the same ISL process is used in all wellfields, and the same assumptions can be made concerning wellfield flare, then the number of pore volumes required to restore the R&D site can be used as a basis for an estimate to be applied to production-scale wellfields. For example, if it takes ten estimated pore volumes to restore an R&D site, then it is reasonable to assume that it will take ten pore volumes to restore a production site so long as the same mining processes and the same method of estimating pore volume are used at both sites.~~

Insert b page 6-2 Continued

(4) The LA includes wellfield restoration plans.

Restoration plans contain descriptions of the process to be used for wellfield restoration. 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. Acceptable restoration plans should use the best available technology. Typically, restoration is divided into distinct phases in which different techniques are employed. Groundwater sweep is used to pump water from the ore zone without reinjecting in order to recall lixiviant from the aquifer and ~~draw in~~ draw in surrounding uncontaminated water. Reverse osmosis/permeate injection circulates water from the wellfield through a reverse osmosis (RO) treatment process and reinjects the permeate into the wellfield, typically at similar rates to those used during production. Groundwater recirculation is used to evenly distribute water throughout the restored wellfield in order to dilute any pockets of remaining contamination. An additional acceptable restoration method is the injection of chemical reductants (usually hydrogen sulfide) into the wellfield. These reductants are used to immobilize metals that may have been dissolved by the oxidizing lixiviant. When chemical reductants are added, the applicant should address any additional treatment necessary to remove the reductant from the aquifer after it has served its intended purpose. Typically, this will require additional RO/permeate injection.

The NRC promotes flexibility and innovation in approaches to restoration. Therefore, applicants should not be limited to one restoration method for all wellfields. Rather, they should describe the phases of restoration that may be used and the most likely restoration scenario, based on R&D results and restoration experience.

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 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 wish to monitor composite samples from the restoration stream. However, prior ~~Prior~~ to determination of restoration success, all wells that were sampled for baseline conditions should be sampled for the full list of monitored constituents.

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 goals of the restoration program and the absence of a significant increasing trend during the stability monitoring period.

For purposes of surety bonding, restoration plans must include estimates of the level of effort, in terms of pore volume displacements, necessary to achieve primary restoration targets ~~at least secondary restoration targets for each wellfield~~. These estimations must be based on historical results obtained from the R&D site or experience in other wellfields having similar hydrologic and geochemical characteristics.

(5) Restoration goals are established in the LA for each of the monitored constituents.

The applicant has the option of determining restoration goals for each constituent on a well-by-well basis, or on a ~~wellfield~~ well-field average basis. Restoration goals should be established for the ore zone and for any overlying or underlying aquifer that remains affected by ISL mining solutions.

Insert A page 6-2

(a) Primary Restoration Standards—The primary goal for a restoration program is to return the water quality of the ore zone and affected aquifers to premining (baseline) water quality or better. It is unlikely that after restoration activities the groundwater quality will be returned to the exact water quality that existed at every location in the aquifer prior to mining. Therefore, it is acceptable to use standard statistical methods to set the primary restoration goal and to determine compliance with it. At many sites average parameters have been used to set primary restoration goals. ~~Because baseline water quality is determined from randomly obtained samples, it is unlikely that this restoration target represents the exact baseline conditions of the aquifer~~. ~~Therefore, it~~ It is also acceptable for the applicant to propose that the baseline conditions for each chemical species be represented by a range of concentrations. For example, a confidence interval of 99 percent has been found acceptable in past licensing actions (i.e., there is only a one percent probability that the true baseline falls outside of the proposed restored water quality range). The reviewer will ensure that statistical methods used to determine such confidence intervals are properly applied. The baseline average plus three standard deviations is another method for establishing primary restoration targets that has been found acceptable by the NRC.

(b) Secondary Restoration Standards—Because the ISL mining process requires changing the chemistry of the ore zone, it is reasonable to expect that ISL mining may cause permanent changes in water quality. For this reason, it is acceptable for the applicant to propose, as a secondary restoration standard, returning the water quality to its pre-mining class of use (e.g., drinking water, livestock, agricultural, or limited use). LAs should state that secondary standards will not be applied so long as restoration continues to result in significant improvement in groundwater quality.

~~Secondary goals~~ It is acceptible to the NRC staff if ~~if have historically been determined~~ on a constituent-by-constituent basis Secondary Goals are determined by applying the lower of the state or U.S. EPA secondary and primary drinking water regulations ~~maximum concentration limits (MCLs) for drinking water~~. For example, if premining water quality is not suitable for drinking water only because of high radium concentrations, then postmining restoration must return all constituents except for radium to drinking water standards. Some uranium ISL mine operators have asserted that if pre-mining use is not suitable for drinking water because of one or more constituents, then it is not reasonable to require restoration to drinking water standards for all other constituents. However, NRC has maintained that if only a few constituents are above drinking water standards, then the water could reasonably be treated for use as drinking water. Thus, class of use should be considered on a constituent by constituent basis. For radionuclides without drinking water standards, it is acceptable to the NRC staff on a constituent by constituent basis to determine Secondary Standards from the concentrations for unrestricted release to the public in water, from Table 2, of 10 CFR Part 20 Appendix B.

Insert B page 6-4

(c) ~~Tertiary Restoration Standards—ISL mine operators may propose a tertiary cleanup standard for constituents based on ALARA principles. NRC will consider granting ALARA exemptions if it can be shown that (1) a reasonable effort has been made to restore to premining use using best available technology; (2) benefits to be gained by additional restoration do not justify the expense; (3) the level of cleanup proposed is protective of human health and the environment; and (4) the proposed level of cleanup has been approved by the appropriate state agency. Such exemptions would normally require a separate application for an amendment to an existing license, once the applicant has attempted restoration to secondary standards. Such an amendment request would be similar in nature to the process used by UMTRCA mill tailings sites to apply for alternate concentration limits (ACLs).~~ (note to CNWRA: the discussion of ALARA above is incorrectly applied. First the goal is achieved and then ALARA is applied).

Insert A page 6-5

(#) If a groundwater parameter could not be restored to its secondary goal, an applicant would have to make a demonstration to NRC that leaving the parameter at the higher concentration would not be a threat to public health and safety and that, on a parameter by parameter basis, water use would not be significantly degraded. This situation might possibly arise with respect to the total dissolved solids parameter. Total dissolved solids is a measure of the total sum of all dissolved constituents,

but it is most affected by the major constituents (sulfate, chloride, calcium, bicarbonate, carbonate, fluoride, sodium, and potassium). However, not all the major constituents have a secondary or primary drinking water standard (for example bicarbonate, carbonate, calcium, magnesium, potassium). Consequently, it is possible that after groundwater restoration, the total dissolved solids secondary goal might be achieved, but the secondary goal for individual major ions that contribute to total dissolved solids might not be achieved. If such a situation occurred, the applicant would have to make a demonstration to NRC that leaving a parameter at higher than secondary goal concentrations would not be a threat to public health and safety and that water use would not be significantly degraded.

Insert A page 6-5 continued

(6) The postrestoration stability monitoring program is described in the LA.

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. NRC has previously approved stability monitoring periods as short as nine months with samples taken from designated monitor wells every three months. These requirements will vary based on site-specific post-mining water quality ~~contamination~~ and geohydrologic and geochemical characteristics. Prior to final wellfield decommissioning, all designated monitor wells must be sampled for all monitored constituents. Wellfields may be decommissioned when all constituent concentrations meet approved standards and show no strong trends in ground water quality deterioation as a result of solution mining activities.

(7) The LA includes discussion of the potential external effects of groundwater restoration.

Groundwater restoration operations, and the expected postreclamation groundwater quality, must not adversely affect groundwater use outside the mining zones. Water users from nearby municipal or domestic wells that were in use prior to mining operations should be provided reasonable assurance that their water quality will not be degraded by mining operations. Degraded water quality includes changes in color, odor, and taste of water, in addition to changes in concentrations of chemical constituents. In cases where such threats exist, the use of secondary restoration targets may not be appropriate. In one such case the NRC has found it acceptable to allow the ISL operator to move municipal wells used by a nearby town to a location that would eliminate potential for degraded water quality due to ISL operations (Nuclear Regulatory Commission, 1997). In this situation, it was decided that the water quality of the town well could be degraded as long as the water quality at each individual well head would not exceed EPA primary and secondary drinking water standards and a concentration of 0.44 mg/L uranium as a result of future ISL mining activities.

(8) Methods for abandoning wells are included in the LA.

The basic purpose for sealing abandoned wells and bore holes is to restore the wellfield to premining 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. ISL mine operators usually rely on a drilling contractor to perform well abandonment. The LA 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 conform to ASTM Standard D 5299 (American Society for Testing and Materials, 1992) are considered acceptable by the NRC. 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 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 mining, water quality impacts usually are more of a concern than water consumption impacts. This is because water consumption during mining is relatively small. However, when restoration activities begin, water consumption will dramatically 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 couldbe available to downgradient groundwater and surface water users.

Insert A page 6-6

6.1.4 Evaluation Findings

Should find that water quality and water quantity impacts are documented.

The staff should determine, based upon a review of the proposed plans and schedules for groundwater quality restoration, whether the information is sufficient to support the evaluation of the facilities. The staff should also document any concerns regarding the proposed plans and schedules for groundwater quality restoration. If the staff determines that the proposed plans and schedules for groundwater quality restoration are sufficient to meet the regulatory requirements and acceptance criteria identified in section 6.1.3, then the following finding will be made.

The staff concludes that the proposed plans and schedules for groundwater quality restoration are sufficient to restore groundwater to premining conditions or to other approved restoration targets specified by license condition in accordance with requirements equivalent to those in 10 CFR Part 40, appendix A, criteria 5 and 7.

6.1.5 References

American Society for Testing and Materials. 1992. *Standard Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, and Other Devices for Environmental Activities, Designation: D 5299.* Philadelphia, PA: American Society for Testing and Materials.

7.6.3 Resources Committed

(Note to CNWRA: Impacts on water levels and water consumption not discussed. Allowable impacts on town water supply not discussed. See redlined test below)

Post-groundwater restoration impacts at public water supply wells are judged to be acceptable if the water quality at town wells does not exceed EPA's primary and secondary drinking water standards and the NRC standard of 0.44 mg/L for uranium.

7.6.3.1 Areas of Review

The staff should review irreversible and irretrievable commitments of resources due to the construction, operation, restoration, reclamation, and decommissioning of the proposed facility. This review should include both relative impacts and long-term net effects. Such resources should include permanent land withdrawal, irreversible or irretrievable commitments of mineral resources, water resource needs, permanent vegetation and wildlife losses (e.g., unique habitat, species), and consumption of material resources such as processing chemicals and power or energy needs. The staff should review information presented concerning the percentage terms in which the expected resource loss is related to the total resource in the immediate region and in which the immediate region is related to the surrounding regions in terms of affected areas and distances from the site.

7.6.3.2 Review Procedures

Selection and emphasis of various aspects of the areas covered by this SRP section will be made by the reviewer. The judgment on the areas to be given attention during the review is to be based on an inspection of the material presented; prior knowledge of the site and its operating history; whether the LA is an application, a renewal, or an amendment; and whether items of special safety significance are involved.

The staff should determine whether sufficient detail is presented to evaluate irreversible and irretrievable commitments of resources due to the construction, operation, restoration, reclamation, and decommissioning of the proposed facility. The description of these commitments should be reviewed considering the facility description and operations discussed in earlier chapters to ensure consistency and completeness. Resource needs previously identified in existing environmental reports for similar facilities that are currently operating can be used in the staff's review for comparison.

7.6.3.3 Acceptance Criteria

Acceptance criteria for this SRP section are based on meeting the following regulatory requirements.

10 CFR 51.45(b)(5) requires the environmental report to include a discussion of any irreversible or irretrievable commitments of resources that would be involved in the proposed action if implemented.

The description of resources committed is acceptable if

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IN-SITU SRP

The SRP needs to reflect staff guidance on protecting evaporation ponds from the effects of flooding. Current guidance includes RG 3.11 and WM-8201.

In general, the ponds must be designed to safely store a 6-hour PMP - guidance may be found in WM-8201. Also, any diversion channels around the ponds should be designed such that an occurrence of the PMF will not result in release of contaminated material. This means that the channel could be designed for a 25-year flood, as long as the PMF dosn't cause enough erosion to erode the embankment and release contaminated material, even though the damage could be extreme to the embankment.

The SRP could be similar to the Title I or Title II SRP, subject to tailoring it to the specific review of flooding of evaporation ponds. I suggest that the Center use this marked-up version of the Title I SRP as a rough guide to accomplish the design (and review) objectives stated above. Center should take care to assure that formats, numbering, etc are similar.

Center needs to add some more discussion on how we'll review those cases where the channel is underdesigned and will be damaged by a PMF, without releasing contamination. Several places need additional verbage to handle this case. We need to discuss things like: (1) how the maximum erosion will be determined; (2) what models will be used to determine is erosion will occur; and (3) what assumptions need to made in these cases.

2.X ~~3.0~~ SURFACE WATER HYDROLOGY AND EROSION PROTECTION

2.X.1 ~~3.1~~ Areas of Review

The NRC staff will review hydrologic information, analyses, and design details ~~presented in the RAP and/or its supporting documents~~ to assure the plan provides ~~long-term~~ erosion protection, ~~in accordance with the EPA standards for stability (40 CFR, Part 192, Subpart A)~~. The major areas of review in the ~~long-term~~ erosion protection aspects of the design are briefly described in the following sections.

2.X-1.1 ~~3.1.1~~ Hydrologic Description of Site

The staff will review the following hydrologic site characterization information:

(1) identification of the relationships of the site to surface water features in the site area, and

(2) identification of flooding mechanisms, ~~such as flood and dam failures,~~ that may require special design features to be implemented.

This review requires identification of the hydrologic characteristics of streams, lakes (e.g., location, size, shape, drainage area, etc.), and existing or proposed water control structures that may adversely affect the long-term stability of the site design.

~~3.1.2~~ Flooding Determinations

The staff will review the assessment of the flooding potential, ~~for each site,~~ including a determination of the precipitation potential, the precipitation losses, the runoff response characteristics of the watershed, the accumulation of flood runoff through river channels and reservoirs, the magnitude of the probable maximum flood (PMF) or project design flood (if a flood less than the PMF is used) at the site, and the critical water levels, shear stresses, and velocity conditions at the site. The staff also will review: (1) the analyses ~~and justification for the use of~~ a flood less than the PMF, (2) the probable maximum precipitation (PMP) potential, and resulting runoff, for site drainage and for drainage areas adjacent to the site, and (3) the modeling of physical rainfall and runoff processes to estimate possible flood conditions at the site.

The assessment of flooding also will include a review of possible geomorphic changes that could affect the potential for flooding and erosion at the site. ~~As applicable, the staff will review the following:~~

(1) identification of types of geomorphic instability; (2) changes to, and impacts associated with, flooding and flood velocities due to geomorphic changes; and (3) mitigative procedures to reduce or control geomorphic instability.

The assessment of flooding also ~~will~~ may include a review of potential dam failures, if upstream reservoirs exist. Peak water levels, flood routing procedures, and velocities will be reviewed in the determination of potential hazards due to failure of upstream water control structures from either seismic or hydrologic causes. ~~If an existing analysis concludes that seismic or hydrologic events will not cause failures of upstream dams and produce the governing flood at the site, the analysis will be reviewed to assure that information which supports such a conclusion (e.g., record of contact with dam designers) is included. If an analysis is provided that concludes that a dam failure flood due to a PMF or a seismically-induced flood is the design basis flood, the computations will be reviewed to assure that appropriate and/or conservative model input parameters have been used.~~

3.1.3 Water Surface Profiles, Channel Velocities, and Shear Stresses

Depending on the type of computational models used, the staff will review the model, including the determination of flooding depths, channel velocities, and/or shear stresses used to determine ~~riprap sizes needed for~~ erosion protection. The staff will review the various detailed computations for each model and will review the acceptability of the input parameters to the model.

3.1.4 Erosion Protection Design

Design details and analyses pertinent to the following aspects of erosion protection will be reviewed, as applicable:

(1) Erosion protection against the effects of flooding from nearby ~~large~~ streams.

(2) Erosion protection for drainage and diversion channels.

~~(3) Erosion protection for the top and side slopes of the pile.~~

~~(4) Erosion protection for the apron/toe area of the side slope.~~

~~(5) Durability of the erosion protection.~~

(6) Construction considerations, including specifications, quality assurance programs, quality control programs, and inspection programs.

3.1.5 Design of Unprotected Soil Covers and Vegetated Soil Covers

If an unprotected soil cover or a vegetated soil cover is proposed, the following design details, calculations, and analyses will be reviewed:

(1) Determination of allowable shear stresses and permissible velocities for the cover.

(2) Determination of allowable shear stresses and permissible velocities for the cover in a degraded state, including the effects of fires, droughts, vegetation succession, and other impacts to the ability of the cover to function without maintenance.

(3) Information on types of vegetation proposed and its ability to survive natural phenomena.

(4) Information, analyses, and calculations of all input parameters to models used.

3.2 Acceptance Criteria

3.2.1 Regulatory Requirements

The basic acceptance criteria pertinent to the erosion protection aspects of these reviews is provided in ~~EPA's 40 CFR Part 192, Subpart A. 40 CFR 192.02 states that:~~ 40CFR40

"~~Control of residual radioactive materials and their listed constituents~~ shall be designed to:

(a) ~~be effective for~~ up to one thousand years, to the extent reasonably achievable, and in any case, for at least 200 years and

(b) provide reasonable assurance that releases of radon-222 from residual radioactive material to the atmosphere will not:

(1) ~~exceed an average release rate of 20 picocuries per square meter per second~~, or

(2) ~~increase the annual average concentration of radon-222 in air at or above any location outside the disposal site by more than one-half picocurie per liter.~~"

~~Control is defined in the regulation as "any remedial action intended to stabilize, inhibit future misuse of, or reduce emissions or effluents from residual radioactive materials."~~

3.2.2 Regulatory Guidance

~~NRC regulatory guides have not~~ been developed which ~~are~~ directly applicable to the surface water hydrology aspects of the ~~UMTRA program.~~ ~~However,~~ there ~~are~~ staff technical positions that ~~may~~ provide ~~generic~~ guidance in this area. These reports are:

(a) Final Staff Technical Position (FSTP) (NRC, 1990) - "Design of Erosion Protection Covers for Stabilization of Uranium Mill Tailings Sites."

(b) Staff Technical Position (NRC, 1989b) - "Standard Format and Content for Documentation of Remedial Action Selection at Title I Uranium Mill Tailings Sites."

The Final Staff Technical Position, in particular, discusses acceptable methods for designing erosion protection ~~to provide reasonable assurance of effective long-term control and thus meet the EPA standard~~. The FSTP also provides discussions and technical bases for use of specific criteria to meet ~~the 1000-year longevity requirement, without the use of active maintenance.~~

3.3 Review Procedures

3.3.1 Hydrologic Description of Site

The information normally presented is not amenable to independent verification, except through cross-checks with available publications related to hydrologic characteristics of the site region and through observation during site visits. The review procedure consists of evaluating the completeness of the information and data, by sequential comparison with information available from references. Based on the description of the hydrosphere (e.g., geographic location and regional hydrologic features), potential site flood mechanisms are identified.

The staff also will analyze geomorphic considerations, as described in SRP Section 1. Based on these analyses, the staff will estimate the potential for geomorphic changes to occur and to have a significant effect on the ability of the site and its protective features to prevent flood intrusion and erosion of the tailings ~~over a long period of time~~. If geomorphic problems are identified, the staff will give particular attention to several areas of the design, depending on site conditions and potential for geomorphic changes to occur. These areas include: (1) the apron and toe of the disposal cell; (2) intersection of natural gullies with erosion protection features, such as a diversion channel, and (3) diversion channel outlets. A detailed discussion of the erosion protection design for these and other features is given in SRP Section 3.3.4, below.

Acceptance of the information presented is based on a qualitative evaluation of the completeness and quality of information, data, and maps. The description of structures, facilities, and erosion protection designs should be sufficiently complete to allow independent evaluation of the impact of flooding and intense rainfall. Site topographic maps should be of good quality and of sufficient scale to allow independent analysis of pre- and post-construction drainage patterns.

3.3.2 Flooding Determinations

The staff will estimate the flood levels, velocities, shear stresses, and magnitudes, as described below. Staff estimates may be made independently from basic data, by detailed review and checking of the RAP analyses, or by comparison with estimates made by others that have been reviewed in detail. The evaluation of the adequacy of the estimates is a matter of engineering judgment, and is based on the confidence in the estimate, the degree of conservatism in each parameter used in the estimate, and the relative sensitivity of each parameter as it affects the flood level or flood velocity.

The evaluation of flooding is, for review purposes, separated into two parts: (1) flooding on large adjacent streams, as applicable, and (2) flooding on local drainage channels and protective features. The acceptability of using the PMF as the design flood event is presented in the FSTP. The review procedure for evaluating a PMP/PMF event is outlined in the FSTP. For large drainage areas, PMF estimates approved by the Chief of Engineers, Corps of Engineers, and contained in published or unpublished reports of that agency, or generalized estimates may be used instead of independent staff-developed estimates. The staff will utilize flood estimates developed by Crippen and Bue (1977) and by the U. S. Bureau of Reclamation (1986) to determine historic regional floods. If the historic maximum floods exceed the proposed PMF estimates, the staff will perform a detailed evaluation to determine the reasons for the discrepancies; the staff will compare basin lag times, rainfall distributions, soil types, and infiltration loss rates to determine if there is a logical basis for the PMF values being less than historic floods. Without such estimates, the staff will generally use Corps of Engineers' runoff, impoundment, and river routing models to independently estimate PMF discharge and water levels at the site. If a computer model such as HEC-1 is used, the staff will review the adequacy of the various input parameters to the model, including but not limited to the following: drainage area, lag times and times of concentration, design rainfall, incremental rainfall amounts, temporal distribution of incremental rainfall, and runoff/infiltration relationships. When detailed independent estimates are necessary, the applicant will be requested to provide all necessary basic data not already included in the supporting documents.

Information pertinent to computation of the design flood should be

submitted in sufficient detail to enable the staff to perform an independent flood estimate. Acceptance of the analysis is based on: acceptability of model input parameters; general agreement of the staff's and the RAP estimates of flood levels and peak discharges; and the adequacy of the computational methods used for such estimates.

For dam failures, the staff will review the analyses provided in the RAP or will independently estimate the peak flows at the site. The acceptable "worst conditions" that should be postulated in the analysis of upstream dam failures are: (1) an approximate 25-year flood on a normal operating reservoir pool level coincident with the dam-site equivalent of the earthquake for which the remedial action project is designed; (2) a flood of about one-half the severity of a PMF on a normal reservoir pool level coincident with the dam-site equivalent of one-half of the earthquake for which the remedial action project is designed; and (3) a PMF (or design flood) on a normal reservoir pool. Conditions (1) and (2) are applied when the dam is not designed with adequate seismic resistance; condition (3) is applied when the dam is not designed to safely store or pass the design flood. Often, it may be much easier to perform simplified flood analyses assuming a dam failure, rather than detailed analyses of the seismic resistance of a dam. In such cases, the staff will review those simplified flood analyses by the procedures outlined in Section 3.3.4, below.

In those cases where it is documented that ~~it is clearly impractical to design erosion protection features for an occurrence of the PMF~~, the staff will evaluate the information provided in the RAP ~~as follows~~:

(1) The staff will review several proposed designs (of varying slopes, configurations, alignments, drainage areas, etc.) to (a) determine the difficulties in providing a reasonable design at a given site, (b) determine that reasonable designs have been identified, and (c) determine that the designs are impractical.

(2) The staff will review erosion protection requirements associated with each of the above designs.

(3) The staff will review the costs (including transportation) associated with each design.

(4) The staff will review the analyses and logic that justify the reduction in flood criteria.

(5) The staff will review the flood design bases and design of protective features with respect to the ability of the design to satisfy the EPA minimum stability requirement of 200 years.

(6) The staff will review the ability of readily-available erosion protection materials to satisfy design requirements.

Additional information regarding justification of a stability period of less than 1000 years can be found in the FSTP. In general, a proposed design based on less than a PMF event must provide reasonable assurance of meeting the EPA stability requirement of 200 years. The ability of the design to resist such flood events is independently checked and evaluated by the staff to assure that minimum EPA standards are met.

In the detailed review of flooding, the staff will carefully consider several factors that are important in determining a local PMP/PMF event. These factors include:

(1) Determination of Design Rainfall Event. The staff will consult appropriate Hydrometeorological Reports and determine that correct values of the one-hour and six-hour PMP events, as applicable, have been determined.

(2) Infiltration Losses. The staff will check calculations to verify that conservative values of infiltration have been selected.

(3) Times of Concentration. The staff will verify that appropriate methods (depending on the slope, configuration, etc.) have been selected. The staff will independently verify that the methods selected compare reasonably well with various velocity-based methods of design.

(4) Rainfall Distributions. The staff will verify that the rainfall distributions (particularly the 2½-minute, 5-minute, and 15-minute distributions) compare well with the distributions suggested in the FSTP.

For dam failures, the acceptability and conservatism of the RAP estimate of flood potential and water levels are reviewed. In general, depending on the potential for flooding, the staff will verify that the RAP dam failure analyses are either realistic or conservative by determining locations and sizes of upstream dams assuming an instantaneous failure (complete removal) of the dam embankment and computing the peak outflow rate.

If this simplified analysis indicates a potential flooding problem, the analysis may be repeated using more refined techniques, and additional information and data may be requested. Detailed failure models, such as those of the Corps of Engineers and National Weather Service are utilized to identify the outflows, failure modes, and resultant water levels at the site.

If a flood less than a PMF can cause dam failure and is proposed as the design basis flood, the review procedures outlined above are employed to determine the impracticality of designing for a PMF and to determine the acceptability of the flood used.

3.3.3 Water Surface Profiles, Channel Velocities, and Shear Stresses

Using the guidance presented in the FSTP, the staff will verify that localized flood depths, velocities, and shear stresses used in models for rock size determination (such as the Safety Factors Method or the Stephenson Method) are acceptable. For offsite flooding effects, the staff will verify that computational models (such as HEC-2) have been correctly and appropriately used and that the output from the model has been correctly interpreted. The staff will verify that acceptable models and input parameters have been used in all of the various portions of the flood analyses and that the resulting flood forces have been acceptably accommodated. Information regarding acceptable models may be found in the FSTP.

3.3.4 Erosion Protection Design

The staff will check the ~~RAP~~ analyses or perform independent review analyses of floods, flood velocities, ~~and rock durability according~~ to the guidelines provided in the FSTP. If the design assumptions and calculations are reasonable, accurate, and/or compare favorably with independent staff estimates, the designs are found acceptable.

Depending on the designs proposed, the staff will review erosion protection designs for the following areas: (1) top slope; (2) side slope; (3) apron/toe; (4) diversion channel; and (5) diversion channel outlet. Specific review procedures and acceptance criteria for each of these areas are discussed below, including areas of particular concern and importance.

3.3.4.1 Top Slope

Because the use of the Safety Factors Method (Simons and Senturk, 1977) provides an acceptable computation method for design of erosion on relatively flat slopes, the staff will review input parameters to the model according to the recommendations given in the FSTP and referenced technical procedures. The staff will assess the design flow rate, the depth of flow, angle of repose, specific gravity, and other parameters.

3.3.4.2 Side Slope

The staff will review parameters to acceptable models, such as the Stephenson Method (Stephenson, 1979), similar to those listed in Section 3.3.4.1, above.

3.3.4.3 Apron/Toe

The review of the design of the apron and toe is accomplished by verifying that several design features in this area have been

properly designed.

For the lower end of the side slope where it meets the toe, the staff will verify that proper consideration has been given to the potential occurrence of increased shear forces resulting from turbulence and energy dissipation produced by hydraulic jumps when the flow transitions from supercritical to subcritical. The staff will verify that appropriate design criteria (such as that used by the Corps of Engineers in their Hydraulic Design Criteria manual) have been used to increase the rock size to account for the increased velocities or shear forces.

For the main area of the toe, the staff will assure that appropriate methods have been used to design the riprap, depending on the magnitude of the slope of the toe.

For the downstream end of the toe, the staff will verify that acceptable assumptions have been made regarding the assumed collapse of the rock into scoured areas to prevent gully intrusion into the pile. Flow concentrations, collapsed slopes, and computational models used by the applicant will be evaluated.

For the natural ground area at the downstream end of the toe, the staff will verify that appropriate methods have been used to compute scour depths and that natural erosion will not adversely affect long-term stability.

~~3.3.4.4~~ Diversion Channels

Using the criteria and guidance presented in the FSTP, the staff will evaluate the design of diversion channels in several critical areas.

For the main channel area, the staff will verify that appropriate models and input parameters have been used to design the erosion protection. The staff will assure that flow rates, flow depths, and shear stresses have been correctly computed.

For the channel side slopes, the staff will verify that the side slopes are capable of resisting flow velocities and shear stresses from flows that occur directly down the side slope. This occurs often when diversion channels are constructed perpendicular to natural gullies (which discharge into the diversion channel). The shear forces in these locations often greatly exceed the forces produced by flows along the channel, particularly when the natural ground slopes in the area are greater than the slope of the diversion channel.

For the outlet of the diversion channel, the staff will evaluate the

design of erosion protection to assure that erosion in the discharge area (normally a natural gully, swale, or channel) has been adequately addressed. Designs similar to apron/toe designs will be evaluated to determine their resistance to erosion.

For the entire length of the diversion channel, the staff will evaluate the effects of sediment accumulations on flow velocities, ditch capacity, and need for increased rock size or capacity.

3.3.4.5 Rock Durability

The staff will review the results of durability testing of proposed rock sources to assure that durable rock will be provided. The FSTP provides a detailed method for evaluating rock quality.

3.3.4.6 Construction Considerations

The staff will review the plans, specifications, inspection programs, and QA/QC programs to assure that adequate measures are being taken to construct the design features according to accepted engineering practices. The staff will compare the information provided with typical programs used in the construction industry.

3.3.5 Design of Unprotected Soil Covers and Vegetated Soil Covers

If a soil cover is proposed, the staff will evaluate the design using the general criteria outlined in the FSTP. Particular attention will be given to the input parameters to various models.

(a) The staff will verify that the design flow rate includes an appropriate flow concentration factor that reflects consideration of settlement, soil removal by sheet flow and wind, degradation of the vegetation cover, intrusion of trees, blockage of flows by fallen trees, etc.

(b) The staff will assure that estimates of Manning's "n" value correspond to the vegetation cover proposed and do not underestimate or overestimate the value to determine allowable shear stresses and permissible velocities, respectively.

(c) The staff will verify that appropriate values of allowable shear stresses and permissible velocities have been used and conservatively reflect potential changes that could occur to the cover over a long period of time as a result of fires, droughts, diseases, vegetation succession, or general cover degradation.

(d) The staff will check analyses and/or independently calculate allowable slopes using several different methods and ranges of input parameters. Using a range of flow concentration factors, shear

stresses, permissible velocities, "n" values, and models, the staff will check the sensitivity of the analyses and will verify that reasonable and appropriate values of input parameters have been selected.

If a sacrificial soil cover is proposed for use for the minimum 200-year period, the staff will check the calculations and justification for reduction of the stability period using procedures given in the FSTP.

3.4 Evaluation Findings

If the evaluation by the staff, based upon complete review of hydraulic engineering aspects of the remedial action plan, confirms that the EPA standards and regulatory guidelines have been met, documentation of the review will state that:

(1) the flood analyses and investigations adequately characterize the flood potential at the site,

(2) the analyses of hydraulic designs are appropriately documented and employ an acceptable level of conservatism, and

(3) the general remedial action plan with respect to surface water hydrology and erosion considerations represents a feasible plan for assuring the long-term stability provisions of the EPA standards established by 40 CFR 192, Subpart A.

Staff reservations and unresolved technical issues, based on the review of the surface water hydrology and erosion protection aspects of the proposed remedial action, will be stated in sufficient detail to clearly define the nature of the concerns.

3.5 References

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Chow, V. T., Open Channel Hydraulics, McGraw-Hill Book Co., New York, 1959.

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Stephenson, D., Rockfill Hydraulic Engineering Developments in Geotechnical Engineering No. 27, Elsevier Scientific Publishing Company, 1979.

Temple, D.M., et al., "Stability Design of Grass-Lined Open Channels," U.S. Department of Agriculture, Agricultural Handbook Number 667, 1987.

U. S. Army Corp of Engineers, "Flood Hydrograph Package," HEC-1, Hydrologic Engineering Center, continuously updated.

---"Water Surface Profiles," HEC-2, Hydrologic Engineering Center, Davis, California, continuously updated.

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---"Stone Protection," CE 1308, January 1948.

---"Standard Project Flood Determinations", EM 1110-2-1411, 26 March 1952 (rev. March 1965).

---"Flood Hydrograph Analysis and Computations," EM 1110-2-1405, 31 August 1959.

---"Backwater Curves in River Channels," EM 1110-2-1409, 7 December 1959.

---"Routing of Floods through River Channels," EM 1110-2-1408, 1 March 1960.

---"Hydraulic Design Criteria," continuously updated and revised.

---"Hydraulic Design of Spillways," EM 1110-2-1603, 31 March 1965.

INSERT 1, page xx, General Procedure (Note citations in **[BOLD]** are for use in referencing the regulations in this or other sections, if needed)

The general licensing process is outlined in the flow diagram provided in figure 1. An ISL source and byproduct material LA may be denied or rejected under specific instances during the review process. Beginning construction of process facilities, wellfields or other substantial actions that would adversely affect the environment of the site, before the staff has concluded that the appropriate action is to issue the proposed license, is grounds for denial of the application **[40.32(e)]**. The applicant's failure to demonstrate compliance with requirements **[40.31(h)]**, or refusal or failure to supply information requested by staff to complete the review **[2.108]** are also grounds for denial of the application. The steps of the LA review are described in the following paragraphs.

INSERT 2, page 4-6

(4) Plans and procedures for addressing contingencies for all reasonably expected system failures should include:

- A listing of potential failures in process or wellfield equipment that could result in a release of material.
- Identification of appropriate plant and corporate personnel who must be notified in the event of specific types of failures.
- Measures for quickly containing and mitigating the impacts of released materials.
- Provisions for issuing radiation work permits for workers to mitigate impacts.
- Specific procedures for complying with notification requirements in the regulations, license, and other permits, as appropriate.

Processing plants should have sump capacity sufficient .....

INSERT 3, Page 5-48

.....ensure that adequate funds are available to cleanup the groundwater 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 UCLs, or no more than one excursion indicator exceeds its respective UCL 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.

INSERT 4, Page 6-5
delete (c) and insert following for last paragraph of (b)

ISL licensees may propose an alternative to specific portions of the primary or secondary restoration standards on a parameter-by-parameter basis. the licensee must show that the alternative is protective of human health and the environment and is consistent with the established groundwater protection policy of the affected state. Such proposed alternatives must be evaluated as a license amendment request, only after restoration to the primary or secondary are shown to be not practicable.

From: Michael Layton
To: SWRI.CNWRA-OS2.PMACKIN, RHT
Date: 7/2/97 10:33am
Subject: Financial Assurance Appendix

Pat,

Attached is the stream-lined financial assurance guidance for ISLs we talked about for inclusion in the ISL SRP as an appendix. I tried to excise references to Criterion 10 and long-term care provisions and make this document exclusively for ISL facilities. The file is in WordPerfect 5.1 format. **Please make a careful edit of the file to be sure I haven't missed any reference to long-term care or tailings pile reclamation.** There is one more surety-type document (estimating worksheet) that should be included in the SRP. I'll get an electronic copy and send it to you directly.

Rich,

Please give this appendix a quick read and let me know if you feel it is still consistent with Staff Technical Position, which is still the governing document for financial assurances.

Many Thanks,

Mike

CC: JJH1

APPENDIX A

FINANCIAL ASSURANCES FOR RECLAMATION, AND DECOMMISSIONING OF IN SITU LEACH URANIUM RECOVERY FACILITIES

TABLE OF CONTENTS Page

1.0 INTRODUCTION

1.1 Organization of This Document

The guidance outlined in this appendix is entirely based on the staff Technical Position for "Financial Assurances for Reclamation, Decommissioning and Long-Term Surveillance and Control of Uranium Recovery Facilities," dated October, 1988 (LLWM 88-04). Minor modifications of the Technical Position were made in this appendix to remove portions applicable to conventional mills which do not apply to in situ leach (ISL) facilities. In particular, the long-term surveillance funding requirements in 10 CFR 40, Appendix A, Criterion 10 do not generally apply to ISL facilities. The references to and the recommended wording for various types of financial assurance instruments, included as appendices in the Technical Position, are not in this appendix. The applicant or licensee should refer to the Technical Position for specific wording of the appropriate surety instrument.

As with the Technical Position, this appendix is organized to allow applicants/licenseeseasy access to their respective information needs, depending on the type of financial assurance to be used. Chapter 1.0 is an introduction defining the purpose and regulatory basis.

Chapter 2.0 provides generic financial assurance guidelines applicable to any financial mechanism being proposed. Items discussed include timing of submissions/format, legal/signature authority, amount of coverage, maintenance of costs, cancellation, and termination.

Chapter 3.0 presents various financial assurance mechanisms which the U.S. Nuclear Regulatory Commission (NRC) views as acceptable. Each mechanism is presented as a section delineating terms, conditions, or guidance which are instrument-specific. Each section contains a definition, identifies roles of parties, and establishes specific guidelines for each instrument.

Chapter 4.0 recommends methods for cost estimating with regard to reclamation and decommissioning.

Even though this document provides general guidance, it does not lessen the responsibility of the applicant/licensee to ensure that the terms and conditions of the financial instrument are clearly stated and support the regulatory requirements of 10 CFR Part 40, Appendix A.

1.2 Purpose

This document provides guidance, to ISL facility licensees and license applicants, for establishing and maintaining financial assurance for the decommissioning, and reclamation of such sites. NRC views this document as a regulatory tool, for applicants, licensees, and NRC staff, for implementing 10 CFR Part 40, Criterion 9 of Appendix A, entitled "Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content."

This appendix has the following primary purposes:

- identifying suggested financial assurance methods and instruments (as discussed in

Criterion 9) for the: decommissioning of the mill and site; disposal of any byproduct material; and

- establishing a uniform method of determining cost estimates for decommissioning and reclamation to serve as the basis for obtaining financial assurance, so that licensees if are unable to pay, or default, sufficient funds will be available to complete site reclamation.

This document will help licensees understand and fulfill the financial assurance and other regulatory requirements applicable to their operation. This guidance will also benefit licensees by enabling them to provide more detail, to the financial community, on various acceptable NRC financial instruments.

Acceptable methods for demonstrating compliance with the regulations are included in this appendix. Other methods, solutions, and financial assurances may be proposed and submitted to NRC.

This document closely follows the intent and scope of the U.S. Environmental Protection Agency's (EPA's) document entitled, "Financial Assurance for Closure and Post-Closure Care: Requirements for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities. A Guidance Manual" (May 1982, PB82-237595). Additionally, portions of the NRC Technical Position entitled "Funding Arrangements for Closure, Postclosure, and Long-Term Care of a Low-level Waste Disposal Facility," were also used (June 1982).

1.3 Regulatory Basis

Criterion 9 of Appendix A of 10 CFR Part 40 contains financial requirements for uranium mill operators (this includes in situ operations). It states that each mill operator must establish financial surety arrangements before beginning operations, to assure that sufficient funds will be available to carry out decommissioning of the ISL facility and site.

The amount of funds to be assured by such arrangements are to be based on Commission-approved cost estimates in a Commission-approved plan for: (1) decommissioning of the mill buildings, the milling site, and wellfields to levels which allow unrestricted use of these areas upon decommissioning; and (2) the disposal of byproduct material in accordance with Criterion 2 of 10 CFR Part 40, Appendix A. The licensee shall submit this plan in conjunction with an environmental report that addresses the expected environmental impacts of the ISL operation, decommissioning, byproduct material disposal, and evaluates alternatives for mitigating these impacts.

In establishing specific financial arrangements, the licensee's cost estimates shall take into account total costs that would be incurred if an independent contractor were hired to perform the decommissioning and reclamation work. To avoid unnecessary duplication and expense, the Commission may accept financial sureties that have been consolidated with financial or surety arrangements established to meet requirements of other Federal or State agencies and/or local governing bodies for such decommissioning, and reclamation. However, such arrangements should be considered adequate to satisfy these requirements; and the portion of the surety which covers the decommissioning and reclamation of the process facilities, wellfields and associated

areas.

The regulations further specify that the Commission will review the licensee's surety mechanism annually to assure that sufficient funds are available for completion of the reclamation plan. The amount of financial responsibility should be adjusted to recognize any increases or decreases resulting from inflation, changes in engineering plans, activities performed, and any other conditions affecting costs. Regardless of whether reclamation is phased through the life of the operation or takes place at the end of operations, an appropriate portion of surety liability shall be retained until final compliance with the reclamation plan is determined. This will yield a surety that is sufficient at all times to cover all the costs of decommissioning and reclamation of the areas that are expected to be disturbed before the next license renewal.

The term of the financial assurance should be open-ended, unless it can be demonstrated that another arrangement would provide an equivalent level of assurance. This assurance could be provided with a financial instrument which is written for a specified period of time (e.g., 5 years), yet which must be automatically renewed unless the financial assurance provider notifies the beneficiary (the Commission or State regulatory agency) and the principal (the licensee) of its intention not to renew, some reasonable time (90 days before the renewal date.) In such a situation, the financial assurance mechanism would remain in effect until the licensee obtained an acceptable replacement surety, this must be accomplished within 30 days after notification of pending termination. If the licensee were unable to obtain a new mechanism, the regulatory agency would have 60 days to collect under the existing mechanism.

Proof of forfeiture must not be necessary, to collect the surety, so that if the licensee can not provide an acceptable replacement surety within the required time, the surety shall be automatically collected before its expiration. The conditions described above shall be clearly stated on any financial assurance instrument which is not open-ended, and should be agreed to by all parties.

Uranium mill financial-responsibilityarrangements, that are generally acceptable to the Commission staff as specified in Criterion 9 include: (a) Surety bonds; (b) cash deposits; (c) certificates of deposit; (d) deposits of government securities; (e) irrevocable letters or lines of credit; and (f) combinations of the above, or such other types of arrangements as the Commission may approve.

Self-insurance or any arrangement which essentially constitutes self-insurance will not satisfy the financial assurance requirements, since this provides no additional protection other than that which already exists through license requirements.

2.0 GENERIC FINANCIAL RESPONSIBILITY GUIDELINES

This chapter provides generic applicable to all financial assurance instruments being propose uranium recovery facility licensees and license applicants. The guidance in this chapter is not meant to be exhaustive; however, the NRC finds these conditions acceptable for a financial instrument and anticipates that they would be used to evaluate financial assurances applicants/licensees propose. Meeting these generic guidelines should facilitate the review of applicants'/licensees' submissions under 10 CFR Part 40 Appendix A, Criterion 9.

If an applicant/licensee proposes alternate financial assurance mechanisms other than that

recommended in this document, the applicant/licensee should allow for additional time required for the NRC review.

When an applicant/licensee submits a new financial assurance instrument or a revision including the annual update to the NRC, such submissions will be deemed to constitute a request for license amendment and should thus be accompanied by the appropriate NRC amendment fee.

2.1 Submission and Form Guidelines

An applicant should submit the financial instrument to the State or the NRC before beginning operations at the uranium recovery facility(ies). The NRC staff recommends that the financial instrument be submitted 120 days prior to planned start of processing.

The financial instrument should be submitted directly to the U.S. Nuclear Regulatory Commission, Chief, Uranium Recovery Branch, Mail Stop T-7-J 9, 11545 Rockville Pike, Rockville, Maryland 20852.

The financial instruments should clearly state the regulatory authority for their establishment. Each instrument should contain a statement as follows:

- This financial instrument is being established to carry out the surety requirements of Title 10, Chapter I of the Code of Federal Regulations (10 CFR) Part 40, Appendix A. These regulations were established to implement applicable provisions of the Atomic Energy Act of 1954, as amended, Title II of the Energy Reorganization Act of 1974, and Title II of the Uranium Mill Tailings Radiation Control Act of 1978.

The financial instrument should clearly state that it is issued pursuant to the obligations of the Commission-approved plan for the decommissioning of the mill, mill site, and wellfields (hereafter referred to as the "Reclamation and Decommissioning Plan").

The financial instrument and cost estimate detail should be organized to allow the NRC to review the adequacy of the coverage at least annually accounting for variations in the approved reclamation and decommissioning plans, in inflation, and in the operations of the facility(ies).

The financial instrument's form should allow the NRC licensing staff to determine that it is properly signed and notarized, that it covers estimated costs for the facility (ies), and is effective for the proper period.

Each instrument should clearly identify the NRC license number, the type of instrument being used, the amount covered by each instrument, the effective date of each instrument, and the period of coverage.

All financial instruments, the original and any additions or replacements, should describe and pertain to the licensed facility(ies) covered under the existing license.

2.2 Legal, Beneficiary and Signature Guidelines

Qualifications and authority of the issuer to issue and execute the financial instrument should appear in the instrument. Certification of legal authority should be provided to NRC. For sureties, the issuer should certify listing in Circular 570 of the U.S. Department of Treasury, and that the surety is licensed in the State where the instrument is issued. For letters of credit, the bank providing the letter of credit should certify that it is regulated and examined in the State where the facility is located.

- The instrument should specify that the financial issuer's liability is joint and several.

- The firm name and legal status (i.e., corporation, partnership, or sole proprietorship) of the principal licensee (and of the parent, in the case of a parent guarantee) should appear on the financial instrument.

- The instrument's named beneficiary should specify the NRC or other governmental agency acceptable to the NRC, such as a State regulatory agency.

- If the instrument's beneficiary is a State regulatory agency, the licensee should submit to the NRC written verification of the State's agreement to use assured funds to carry out the activities required by the NRC-approved Reclamation and Decommissioning Plan for the facility covered by the instrument.

- All signatories should be legally bound by the instrument. The applicant/licensee should ensure that parties signing the various documents are legally authorized to act as representatives for the firm in these transactions.

  - Corporations -- Two corporate officers, preferably the president and vice president, should sign the instrument and should indicate the legal capacity.

    The legal authority of the corporate signatories should be described and substantiated by an attached copy of a resolution of the shareholders or board of directors or other certified evidence.

    The corporate seal must be affixed.

  - Partnership -- At least one partner should sign the financial instrument.

  - Limited Partnership -- The general partner or a party authorized to sign or the general partner must sign. (The limited partners are prohibited from participating in the management and control of the partnership by the Uniform Limited Partnership Act, Revised 303 (1976), which has been adopted by most states.)

  - Jointly Owned -- (not a partnership) All owners should sign the financial instrument.

  - Power of Attorney -- If applicable, the attorney-in-fact acting on behalf of the issuer should sign the financial instrument.

    If an attorney-in-fact signs the financial instrument, a copy of a properly executed

power of attorney in favor of the attorney-in-fact should be attached.

- Resident Agent -If applicable, the instrument should include the signature of the qualified resident agent of the financial organization issuing the instrument, who should be certified to do business in the State where the facility(ies) is located. Certification should be documented and provided to NRC.

- Each party should sign his or her own name.

2.3 Cost and Coverage Guidelines

The financial instrument should be adjustable so that the covered amount is sufficient at all times to cover any cost changes due to inflation or modifications in the work plans for the decommissioning, and reclamation of the uranium recovery facility(ies).

The amount of the financial instrument, whether provided by a single instrument or a combination of instruments, should be equal to or be greater than the current cost estimates found in the currently approved Reclamation and Decommissioning Plan (including decommissioning, and ground-water restoration). Additionally, the amount of the financial instrument should reflect total costs incurred if an independent contractor were hired to perform the required activities.

The amount of coverage may be larger than the actual cost estimate because of projected inflation costs.

The financial instrument should provide coverage throughout the term of the license.

Multiple financial instruments are acceptable, with the exception of parent company guarantees, which should not be used in combination with other financial methods. If multiple financial instruments are used for a single facility, the combined coverage should be equal to or greater than the cost estimates for the facility identified in the current version of the NRC-approved Reclamation and Decommissioning Plan.

A single financial instrument may be used by a principal (licensee) for multiple licensed facilities. In addition to other stated guidance, this single instrument should identify, for each facility, the amount of coverage, the type of facility, the NRC license number, an location of the activities.

2.4 Terms, Cancellation, and Collection Guidelines

The instrument should state the terms and conditions under which the licensee may cancel the instrument and should require that the licensee notify the NRC, the appropriate State or Federal agency and receive approval before cancellation.

The term of the financial instrument should be open-ended or, if written for a specified term, the instrument should provide that it be renewed automatically unless, 90 days or more days before the renewal or expiration date, the issuer notifies the Commission, the beneficiary, and the licensee of its intention not to renew.

An issuer of a financial instrument should notify the licensee and the NRC (also the State, if applicable), by certified mail of its intent to cancel the financial instrument. Notification to all parties at least 90 days before intended termination must be received by all parties.

The financial instrument cannot be cancelled during the 90-day notification period. The 90-day notification period begins with the receipt date of the notice by the licensee and the NRC (and the State, if applicable), as evidenced by the return receipts.

The licensee is responsible for obtaining another financial instrument within 30 days of receipt of intent to cancel, If the financial institution or corporate guarantor gives notice that it intends to cancel.

The instrument should provide that the beneficiary may unilaterally collect the assured amount before the date of expiration, without proof of default or forfeiture, so that if the licensee fails to provide an alternative surety acceptable to the NRC within 30 days of receipt of the notification of cancellation, the funds are automatically collected before expiration.

If the owner or operating entity for an uranium recovery facility(ies) is transferred, the NRC will not allow the existing financial instrument to be terminated until the new licensee has obtained an instrument acceptable to NRC for the licensed uranium recovery facility(ies).

A licensee should immediately obtain replacement financial assurance coverage in the event of bankruptcy of the organization acting as trustee, or the issuer of the financial instrument.

- Each licensee should comply with the terms and conditions of 10 CFR Part 40, 40.41 Paragraph (f) which became effective February 8, 1987 (52 Federal Register dated January 12, 1987) regarding bankruptcy notification. 40.41(f) states that each licensee shall notify the appropriate NRC Regional Administrator, in writing, immediately following the filing of a voluntary or involuntary petition for bankruptcy.

If the financial instrument is a letter of credit or bond, it should be accompanied by a standby trust to automatically receive assets in the event of licensee bankruptcy or default.

2.5 Adjustments, Changes, and Release Guidelines

Annual updates of cost estimates and coverage of financial instruments are necessary even if cost estimates are sufficient to cover another year's inflation and no other changes have taken place.

Financial instruments should be adjusted for inflation either by recalculating the cost estimate in current dollars or by using the inflation factor derived from the Consumer Price Index published by the U.S. Department of Labor, Bureau of Labor Statistics. The adjustment should be made 90 days prior to the anniversary of the effective date of the surety instrument or as specified in the license.

If the current cost estimates exceed the coverage of the existing financial assurance mechanisms, additional coverage should be obtained and evidence of it submitted to NRC within 60 days after the cost estimate increase.

If, during the operating life of the uranium recovery facility, the cost estimate for decommissioning and reclamation decreases due to a change in operating plans or other factors, the licensee may apply to NRC for approval of the decreased coverage.

Licensees may change the type of financial instrument in use with prior written approval from NRC. To obtain approval, the new assurance should comply with NRC's regulations for eligibility found in 10 CFR Part 40, Appendix A, Criterion 9. The new assurance, if approved, should become effective before or at the time the existing assurance expires. If a letter of credit or a surety bond will be the mechanism used, the licensee should also establish a standby trust fund.

The instrument should be established so that the uranium recovery licensee will have its financial assurance released by the NRC after the NRC has concurred that decommissioning and reclamation of the uranium recovery facility(ies) have been accomplished in compliance with the current approved Reclamation and Decommissioning Plan and the license has been terminated.

3.0 FINANCIAL ASSURANCE OPTIONS

This chapter provides specific guidance to licensees on the types of financial assurances that the NRC has found to be acceptable. The discussion contained here differs from Chapter 2.0 in that it more explicitly defines the requirements and terms of each individual mechanism.

3.1 Surety Bonds

A surety bond is a contract that a licensee (sometimes called the PRINCIPAL can enter into with a qualified surety company (sometimes called the SURETY which guarantees that responsibilities spelled out in the bond will be undertaken. Two standard types of surety instruments are allowed, financial guarantee bonds and performance bonds. It is recommended that both instruments submitted to the NRC be accompanied by a standby trust fund. Standby trust funds are discussed in more detail in Section 3.6.

Both types of sureties are intended to ensure that adequate funds will be made available by the surety, if the licensee fails to perform activities specified in its NRC-approved Reclamation and Decommissioning Plan.

The performance bond provides assurance that if the licensee fails to perform its activities, as is required in the Reclamation and Decommissioning Plan, then the surety company will either pay the amount covered by the bond into a standby trust, or perform the responsibilities. The financial guarantee bond stipulates that the surety will fund the standby trust fund in the amount guaranteed by the bond, if the licensee fails to perform the activities specified in its NRC-approved Reclamation and Decommissioning Plan.

An acceptable bond for the purposes of this document should meet the following considerations, In addition to the general guidelines stated in Chapter 2.0.

- It is recommended that licensees wishing to use a surety bond should also establish a standby trust fund at the same time. Both the bond and standby trust agreement should

be submitted as evidence of financial assurance.

- The surety bond should contain terms so that any funds drawn under this instrument should be placed directly into the standby trust fund by the institution making the payment. (In this regard, the Commission is following the approach of EPA, who imposed this requirement after it found that without such a mechanism, any funds drawn under a surety bond which would be payable to the EPA would have to be paid into the U.S. Treasury and could not be used specifically to pay for closure and postclosure care of a hazardous waste facility(ies) (31 U.S.C. 3302(b).))

- Licensees wishing to use a surety bond should first enter into a contract with a qualified surety. The NRC staff considers qualified sureties to be those listed in the most currently issued-version of the U.S. Department of Treasury's Circular 570, which is "Surety Companies Acceptable on Federal Bonds." Circular 570 is published approximately July 1 of each year, with periodic updates appearing in the Federal Register. Circular 570 specifies the amount of liability the surety can maintain at any point in time without reinsurance. Also, Circular 570 lists those States in bond. A surety bond used to meet the NRC financial assurance requirements should be signed in one of those States. The surety bond should certify that the surety company is listed in Circular 570 and has not exceeded its specified level of liability exposure.

- The penal sum of a surety bond must be in an amount equal to or greater than the cost estimates in the current Reclamation and Decommissioning Plan, which should be adjusted to current dollars. The licensee wishing to use this instrument should verify that the amount and the terms and conditions are satisfactory to the NRC during the licensing review.

3.2 Irrevocable Standby Letters of Credit

A letter of credit is another financial assurance mechanism satisfactory to the NRC. This type of letter of credit enables the NRC to provide written documentation to the issuing institution stipulating the deposit of funds in a standby trust, when the licensee fails to perform reclamation and stabilization activities.

A letter of credit is a binding arrangement by which the credit of one party, the ISSUER, such as a bank, is extended on behalf of a second party, called the ACCOUNT PARTY, to a third party the BENEFICIARY. The licensee would be the ACCOUNT PARTY, and the NRC (or suitable State agency) would be the BENEFICIARY. The terms for letters of credits evolved from the Uniform Commercial Code and the Uniform Customs and Practice of Documentary Credits, published by the International Chamber of Commerce. The first party, the ISSUER, allows the BENEFICIARY to draw funds upon the presentation of documents in accordance with the terms of the letter of credit.

The letter of credit mechanism allowed for NRC licensees for financial assurance is different in major ways from standard commercial versions:

- The NRC version can only be cancelled with 90 days advance notice by certified mail to all parties before the current expiration date, and

- If the licensee cannot provide an alternative financial assurance mechanism within 30 days of notification of cancellation, the NRC will cause the letter of credit to be drawn upon for the necessary amount of reclamation, decommissioning, and any long-term surveillance cost, and

- The NRC version should be extended automatically for at least one year if it is not cancelled.

The issuer offers this assurance in exchange for a fee paid by the licensee. The licensee also agrees to repay, with interest, any funds drawn through the letter of credit. The terms of the credit arrangement between the licensee and the issuer may depend on individual circumstances and negotiations.

Licensees should also establish a standby trust fund at the same time, if they wish to use a letter of credit, and if they do not wish to have the State as the named beneficiary. Under the terms of the letter of credit, any funds drawn under this instrument are to be placed-directly into the standby trust fund by the institution making the payment. In this regard, the Commission is following the lead of EPA, who imposed this requirement after it found that without such a mechanism, any funds drawn under a surety bond which would be payable to the EPA would have to be paid into the U.S. Treasury and could not be used specifically to pay for closure and post-closure care of a hazardous waste facility(ies) (31 U.S.C. 3302(b)).

In addition to the criteria specified in Chapter 2.0, the following terms and conditions should be met by a licensee wishing to use a letter of credit.

- The issuing institution for the letter of credit should be an entity that has the authority to issue a letter of credit, and whose letter of credit operations are regulated and examined by a Federal or State agency. (All domestic commercial banks and some mutual savings banks, domestic branches of foreign banks, credit unions, and savings and loan associations satisfy this requirement and should so certify.)

- Letters of credit should conspicuously state that they are irrevocable letters of credit and that the bank's undertaking should be limited to the amount of the instrument.

- The bank's obligation to pay should arise only upon the presentation of a draft or other document(s as specified in the letter of credit, and the bank should not be called upon to determine questions of fact or law at issue between the account party and the beneficiary.

- Letters of credit should be effective and irrevocable the entire time they are in effect, during the coverage period specified in the license. If the letter of credit ends after a one-year period, it should be automatically renewed, unless the issuer notifies the NRC and the account party that it is cancelling 90 days before cancellation.

- The letter of credit should contain a definite time period over which it is effective.
- The letter of credit should include the letter of credit number, name of the insurer, date, license number, name and address of mill, and the amount of funds assured for decommissioning, and reclamation of the site.

- The NRC or the State is the only party authorized to draw upon the letter of credit. If the licensee fulfills its obligations, the NRC will not draw upon the letter of credit.

- The letter of credit can be terminated by the licensee when: (1) alternate financial assurance has been established by the licensee and approved by the NRC; or (2) when the license has been terminated by the NRC. The only permissible evidence of termination of the license is a written termination notice by the NRC.

3.3 Parent Company Guarantees

The NRC financial assurance requirements for uranium recovery facilities may be satisfied by the use of a parent company guarantee: here, the licensee's parent company passes one of the two specified financial tests and agrees to guarantee the performance of or payment for decommissioning, reclamation, and long-term surveillance and control of the uranium recovery facility(ies).

A parent company guarantee acceptable to NRC should state that the parent company has adequate resources to cover the cost of decommissioning and reclamation of the uranium recovery facility(ies). The tests used to determine that adequate resources are available are patterned after those developed by the EPA for sites
permitted under the Resource Conservation and Recovery Act (RCRA).

However, because the domestic uranium industry currently is not economically viable, because the risk of default consequently is higher, and because of added requirements for ground-water remediation, the NRC is reevaluating the continued use of parent company guarantees as an allowable financial assurance mechanism by Part 40 licensees. Until such time as the NRC completes its reevaluation, it has enhanced the assurance provided by the parent company guarantee in two ways. First, all licensee subsidiaries whose performance/costs are being guaranteed by parent companies should show a positive tangible net worth. Second, the parent company providing the guarantee should show a tangible net worth of at least $20 million, rather than the $10 million previously required. The parent company, tangible net worth should be independent of the assets and liabilities of the subsidiary for which the guarantee is being issued.

Use of this instrument requires the NRC to completely re-evaluate every parent company at least annually, even if there has been no change in decommissioning, reclamation, and long-term surveillance and control cost estimates for the uranium recovery facility(ies).

An acceptable parent company guarantee for the purposes of this document should have the following characteristics:

- The authorization and capacity of the parent company to enter into the guarantee should be certified and documentation included in the submission.

- The parent company guarantee should be signed by the authorized representative of the parent firm's Board of Directors and by the firm's legal counsel, shall certify that the firm can legally engage in the guarantee.

- If the guarantor is a corporation, the authorizing documentation should include a Board of Directors' resolution or shareholders' vote or similar verification and proof that the corporation can validly execute a guarantee under the laws of the State of its incorporation and its bylaws articles of incorporation.

- If the guarantor is a partnership, joint venture, syndicate, or other business entity, each party or an authorized representative for the parties with a beneficial interest, direct or indirect, should sign the agreement.

- The parent company guarantee should specify that all bound parties shall jointly and severally liable for all litigation costs incurred by the beneficiary in any successful effort to enforce the agreement against the guarantor.

- If a registered agent for service of process is used, its name, address, and telephone number should be listed in the parent company guarantee.
- To qualify for a parent company guarantee, the parent company should hold at least 51 percent of the voting stock of the licensee's firm.

- The parent company's financial statements should be audited by an independent certified public accountant and the accountant's certification provided to NRC. If the accountant gives an adverse opinion or a disclaimer of opinion of the financial statements, the parent company can not qualify for the financial test. Furthermore, if the accountant gives a qualified opinion of the financial statements, the NRC may disallow the use of the financial test.

- The parent company guarantee's financial test requirements may be satisfied by meeting one of the two alternative sets of test criteria. The tests have a number of points in common, but there are two important differences.

  First, Alternative I requires the parent company guarantor to demonstrate financial soundness by passing at least two of three financial ratios, while Alternative II requires the parent company guarantor to demonstrate financial soundness with an investment grade bond rating. Second, Alternative I requires the parent company guarantor to have a large amount of working capital relative to reclamation and decommissioning cost estimates, while Alternative II has no such requirement. Both tests require the parent company to have a large amount of tangible net worth and U.S. assets relative to reclamation and closure estimates, and a minimum absolute level of tangible net worth ($20 million). Also, the licensed subsidiary whose performance/cost is being guaranteed should show a positive tangible net worth.

- To use the parent company guarantee as a means of satisfying a licensee's financial requirements for reclamation, decommissioning and long-term surveillance and control, the licensee should submit the following documents on an annual basis to the NRC.

  (a) <u>Chief Financial Officer's Letter Including Cost Estimates and Data from Audited Financial Statements</u>

The parent company should provide the NRC with a letter signed by its chief financial officer.

The chief financial officer of the parent company should certify in the letter that the parent company meets the criteria of the financial test. The letter should also:

- specify the facilities to be covered by the test, including NRC license number, name, address, and current decommissioning and reclamation cost estimates to be covered by the test;
- indicate the date on which the required documents will, if currently unavailable, be submitted (at the latest, within 90 days of the end of the fiscal year);
- certify that the year-end financial statements of the firm will be audited by an independent certified public accountant.
- attest that the licensee(s) for which the guarantee is being made has a positive tangible net worth.

(b) Accountant's Opinion

The licensee should submit to the NRC a copy of the independent certified public accountant's opinion of the parent company's year-end financial statements-and footnotes for the latest complete fiscal year. A SEC 10Q form is acceptable. Additionally, the following SEC reports should be submitted, if applicable: SEC Forms 8-K and 13D. There is no NRC suggested form or wording for this accountant's opinion.

(c) Auditor's Special Report

The parent company should submit a special report from an independent certified public accountant to the NRC that contains the accountant's confirmation that the financial data contained in the letter from the chief financial officer can be derived from the independently audited year-end financial statements and footnotes for the latest complete fiscal year. The auditor's special report should also state that no matters came to the attention of the independent certified public accountant which caused him to believe that the information in the chief financial officer's letter should be adjusted.

(d) Parent Company Guarantee Document

A licensee wishing to use the parent company guarantee should also submit a written guarantee agreement to the NRC completed by the parent company. The written guarantee states that the guarantor meets or exceeds all the requirements of the financial test criteria, including the submittal of the accountant's opinion, the special report, and the letter from the chief financial officer. The written guarantee specifies that if the licensee fails to perform the required decommissioning and reclamation activities at the uranium recovery facility(ies), then the parent company guarantor must do so, or set up a standby trust fund for the amount of the cost estimates for these activities.

- The licensee should submit revised information annually within 90 days of the close of the parent company's fiscal year. As with the initial submittal, the revised information should consist of a letter from the chief financial officer, the accountant's opinion, and the auditor's special report from an independent certified public accountant.

- NRC staff may determine that a report of financial conditions, in addition to the required annual reports, is necessary.

- The NRC, based on the parent company's financial reports or any other materials, may, at any time, determine that the parent company no longer meets the financial test criteria. If so, the licensee should provide alternate financial assurance within 30 days after receiving notification of this determination. The existing mechanism should not be terminated until the alternate mechanism is effective.

- The parent company, in conjunction with the licensee, should comply with 10 CFR Part 40, 40.41, Paragraph (f) regarding bankruptcy notification. Also, if either the company holding the uranium recovery facility license or the parent company is sold or merged, the new parent company should meet all the criteria for the financial test or the licensee should provide an alternate financial assurance.

- A parent company wishing to cancel its guarantee of financial assurance should notify the NRC and the licensee by certified mail of its intent to cancel. Actual cancellation is not allowed for 90 days from the receipt date of the notice of cancellation by both the licensee and the NRC, as evidenced by the return receipts. If the licensee fails to provide an alternate financial mechanism within 30 days of the above notification, the NRC may collect the guaranteed monies.

- The parent guarantor may request NRC approval to terminate the parent company guarantee in two situations: (i) when alternate financial assurance has been substituted and approved by the NRC; or, (2) when the license has been terminated by the NRC.

- Licensees should ensure that the financial test criteria are still satisfied if cost estimates increase or decrease.

- Two officers of uranium recovery facility(ies) and two officers of the parent guarantor who are authorized to bind the respective organizations should sign the agreements. A copy of such authorization for each person signing should be attached to the parent company guarantee. The corporate seal should be affixed.

- The parent company guarantor should certify and demonstrate that it has full authority under the laws of the State of its incorporation, its articles of incorporation and bylaws to enter into this guarantee; and, that the guarantor has full approval from its Board of Directors to enter into this guarantee.

3.4 Assets Held by a Third Party, Such as a State Fund

Licensees may demonstrate financial assurance by depositing assets such as cash, certificates of deposits, or deposits of government securities with a third party, such as a trust fund, or the State Fund, where the uranium recovery facility(ies) is located. If a licensee purchases several $100,000 certificates of deposits from the same institution, it should be structured so that each is eligible for Federal Deposit Insurance Corporation's (FDIC) insurance.

It is beyond the scope of this document to attempt to address the variety of possible contractual mechanisms that a State could set up. However, if a licensee proposes to have a State hold its assets, the NRC would evaluate each on a case-by-case basis. Additionally, if such a State-administered trust fund had a combined feature, then the NRC will need to carefully evaluate it to ascertain that the trust has funds clearly dedicated to meet the license's requirements for funding of decommissioning and reclamation of the uranium recovery facility(ies).

3.5 Trusts

A trust is a three-party agreement whereby one party, called the GRANTOR (also called the truster) transfers some assets to a second party called the TRUSTEE, to hold on behalf of a third party, called the BENEFICIARY. The entire arrangement is governed by a trust agreement that sets out the responsibilities and rights of each party. For a uranium recovery facility licensee, the licensee is the GRANTOR, a bank or other entity would be the TRUSTEE, and the NRC (or the State where the uranium recovery facility(ies) is located) would be the BENEFICIARY. The licensee, as grantor, deposits assets into the trust fund which is held in trust by the trustee. The funds are then available if necessary to pay for decommissioning, reclamation, and long-term surveillance and control of the uranium recovery facility(ies).

The trustee is empowered to invest the funds during the existence of the trust. Trustee investments may be limited by State law. Any investment income accrues to the trust, and reduces the amount the licensee must put into it. The licensee usually pays a fee for the trust services provided.

An acceptable trust for the purposes of this document should comply with the following criteria.

- A trustee should be an entity that has the legal authority to act as trustee and whose trust operations are regulated and examined by a Federal or State agency. The trustee should certify that it has this legal authority.

- The wording of the trust language should be irrevocable; that is, it cannot be changed or terminated by the licensee, except with the written agreement of both the trustee and the beneficiary.

- The trust should contain at all times sufficient assets to accomplish decommissioning, reclamation, and long-term surveillance and control of the site. The licensee remains responsible at all times for the full amount of decommissioning, reclamation, and any long-term surveillance and control of the uranium recovery facility(ies).

- The trust agreement should be signed by both the licensee and the trustee. It should also identify the uranium recovery facility and the cost estimates, as well as identifying the liquid

assets used to establish the trust fund.

- A trust fund can contain more than interest-bearing cash deposits. Liquid assets such as government securities or notes can be placed in trusts. However, if a non-cash item such as trust receipts are placed in it, then special consideration should be given to ensure proper asset evaluation. (A trust receipt is an instrument acknowledging that the licensee holds items of inventory for sale in trust for the trustee.) If other types of assets were allowed, the trustees should agree to pay the governmental authority a stipulated cash amount. NRC will refuse to allow assets of a speculative nature or of uncertain value to be placed in trust. NRC may require a licensee submitting non-cash assets to pay for an independent appraiser to periodically evaluate the value of such assets. If assets other than cash are deposited into the trust fund, it may be necessary for the trustee to buy and sell securities with the approval of government staff, or to take other steps to manage the assets in order to maximize their value. However, unless specified under the terms of the trust, a trustee should invest under a "reasonably prudent" investor standard as defined by statute or case of the jurisdiction where the trust is located.

- The NRC-staff would consider any individual or organization for the position of trustee in addition to financial institutions, who can succeed in obtaining insurance for the position. (This type of insurance is currently available and is commonly obtained by banks and by other financial institutions.)

- The terms of the trust should define the investment responsibilities of the trustee.

- The trustee should have possession of the assets or funds placed in trust by the party who created the trust. The trustee should have the legal interest in the funds, since he has control over it, can sue to protect it, and is responsible for its preservation.

- The trustee should be under a fiduciary duty to comply with the terms of the trust, and, unless the trust provides otherwise, should be liable for breaches of this duty.

- The trustee is allowed to invest in time or demand deposits of the trustee institution, up to the amount insured by law. The trustee is permitted to put trust fund assets into any appropriate, common, commingled, or collective trust fund created by the Trustee," in other words, a common trust.

- Once the trust fund is established, the licensee should make additional necessary payments into the trust fund so that sufficient funds are available to reflect any changes in the cost estimates for site decommissioning, reclamation, and long-term surveillance and control.

- The trust agreement should contain language requiring the trustee to submit annually to the licensee and NRC a statement of the valuation of the assets in the trust funds, detailing the results of investment activity and the expenses levied against the fund. Securities in the trust fund should be valued at their market value no more than 60 days before the anniversary date of the fund. The licensee may object, in writing, to the trustee's investment activities or to expenses levied against the trust fund within 90 days of receiving

the valuation statement. However, if objections do exist, the licensee is still obligated to deposit the necessary funds into the trust to ensure that the amount available is equal to the cost estimates in the approved Plan.

- If the licensee sells or transfers operating responsibility for the facility(ies) for which the trust fund provides financial assurance, the trust fund will not automatically transfer to the next owner. The NRC would have to approve a new financial assurance through the license condition for the facility(ies). The new licensee could enter into an agreement with the old licensee, by which the trust fund is transferred to the new owner. This, however, would require amendments to the trust agreement that should be approved by the trustee and the NRC.

- The licensee should alert the trustee that it is responsible for annual valuations of the trust; for notifying the NRC if the licensee fails to make payment when directed to do so by the Commission; and for making payments out of the trust fund at the direction of the NRC.

- A change in trustee will not affect the existence of the trust itself. The trustee may be changed if the licensee is dissatisfied with the performance of the trustee or if the trustee resigns; the trustee should be changed if the trustee institution enters bankruptcy or ceases to meet the trustee qualifications For either case, the trustee can be changed only upon agreement by the licensee, the new trustee, and the NRC. The trust agreement should be signed by the licensee and the trustee and be properly notarized.

- The amount of coverage should reflect NRC-approved cost estimates for reclamation and decommissioning for the uranium recovery facility(ies).

- The licensee, its successors or the trustee has the responsibility for completing reclamation and decommissioning. The trust agreement should state that disbursements by the trustee for reclamation, decommissioning, and long-term surveillance and control expenses shall be approved by the NRC (or other Beneficiary) before release.

3.6 Other Considerations Such as Standby Trusts

It is recommended that a licensee include a standby trust fund when submitting a letter of credit or surety bond (performance or financial guarantee) to comply with the financial assurance requirements of 10 CFR Part 40, Appendix A. In the event of a licensee failure to reclaim the licensed site in accordance with its approved reclamation and decommissioning plan, monies from surety bonds and letters of credit should be paid to a standby trust. Parent company guarantors also have the option of submitting (and funding) a standby trust fund, instead of actually performing such activities.

The purpose of the standby trust is to receive any funds that may eventually be paid by the surety company, financial institution issuing the letter of credit, or parent company. NRC recommends the use of standby trusts because without such an instrument, 31 U.S.C. 3302(b) requires NRC to deposit any assets received from the surety bond or letter of credit (or, if applicable, the parent company guarantee) directly into the U.S. Treasury.

Standby trust funds are similar to trust funds as described in Section 3.5, except that the following activities are not required with the standby trust:

- regular payments into the standby trust; (It is only funded If the surety bond, parent company guarantee, or letter of credit is collected);
- updating the trust agreement to show current cost estimates and annual valuations; and,
- notices of nonpayment to the NRC.

3.7 Other Financial Assurances

NRC considers the previously described financial assurances to be common, standardized financial mechanisms that would adequately provide financial security for the purposes of this document. Additionally, the staff will consider other financial assurances on a case-by-case basis, provided the licensee can demonstrate that the method provides an adequate degree of security, and also meets the generic guidelines mentioned in Chapter 2.0. Licensees may propose a combination of the financial assurances discussed above, with the exception of parent company guarantees, which may not be used in combination with other financial mechanisms. However, NRC would have to approve such combinations.

4.0 DETERMINING SITE-SPECIFIC RECLAMATION AND DECOMMISSIONING COST ESTIMATES

As required under Criterion 9 of 10 CFR Part 40, Appendix A, the licensee shall supply sufficient information for NRC to verify that the amount of coverage provided by the financial assurance accounts for all necessary activities required under the license to allow the license to be terminated. Cost estimates for the following activities (where applicable) should be submitted to NRC with the initial license application or reclamation plan and updated annually, as specified in the license and as provided in the technical criteria of Appendix A of 10 CFR Part 40. Cost estimates should be calculated on the basis of completion of all activities by a third party. Unit costs, calculations, references, assumptions on equipment and operator efficiencies, etc., should be provided.

4.1 Detailed Cost Information Breakdown for In-Situ Facilities

The detailed cost information necessary to verify the cost estimates for the above categories of closure work is described in the following outline.

4.1.1 Facility Decommissioning

In Situ Facility Decommissioning - This includes dismantling, decontamination and disposal of all structures and equipment. This may be accomplished in two phases. In the first phase, only the equipment not used for ground-water restoration is removed. The remaining equipment would be removed in a second phase, when ground-water restoration and well plugging are complete. The buildings used for the in-situ operations may be decontaminated and released for unrestricted use.

A. Salvageable building and equipment decontamination (list). For each building or pieces of equipment listed, the following data should be provided.

1. Labor for dismantling and decontamination
   a. Person-hours and categories of labor
   b. Average hourly wage for each category
   c. Total labor cost (benefits, insurance, etc., and all labor overhead should be included here or calculated on the basis of total project labor)

2. Equipment and material for dismantling and decontamination
   a. Itemization of equipment and material to be used for decontamination
   b. Itemized cost for material and equipment cost per hour listed in (a) above (equipment costs should include hourly operating, ownership and overhead expenses)
   c. Operating hours for each piece of equipment
   d. Total equipment and material, cost

B. Non-salvageable building and equipment disposal
   1. List of major categories of building and equipment to be disposed of and their corresponding quantities
      a. Structures (list each major) (tons of material and building volume in cubic feet)
      b. Foundation concrete (cubic yards)
      c. Process equipment (tons)
      d. Piping & insulation (lump sum)
      e. Electrical & Instrumentation (lump sum)

   2. Unit cost of disposal for each item above (Include equipment, labor, material, transportation, and disposal costs)

   3. List and state how each chemical solution within the mill area will be disposed, along with the associated cost of disposal

   4. Total cost

C. Restoration of contaminated areas (ore storage pad, access roads, process area, evaporation pond residues, etc.)

Removal and Disposal of Evaporation Pond and Residues - These materials should be transported to a licensed tailings area or licensed disposal site in accordance with 10 CFR 40, Appendix A, Criterion 2. The quantity of material to be removed, the distance to the disposal site, and the fees charged by the receiving facility are important considerations in determining the costs of disposal.

Reclamation - This entails recontouring the well fields and evaporation ponds and placing top soil

or other materials acceptable to NRC. This may also include revegetation.

1. Removal
   a. Area, depth and quantity of material to be removed (cubic yards, or size of liner if appropriate)
   b. Unit cost (include excavation, loading, transportation and deposition)
   c. Total cost (equipment and labor)

2. Revegetation
   a. Area to be revegetated (acre)
   b. Unit cost (include fill material, replacing topsoil, and revegetation cost)
   c. Total cost (equipment, labor and materials)

4.1.2 Ground-Water Restoration and Well Plugging

In Situ Site Ground-Water Restoration - In most cases, ground-water restoration consists of ground water sweeping and water treatment with partial reinjection. The water treatment equipment used during the uranium recovery phase of the operation is generally suitable for the restoration phase. The capital cost of this equipment is usually absorbed during the initial stages of the operation, leaving only the costs of operation, maintenance and replacement filters for the restoration phase. However, if additional or replacement equipment will be required for restoration, associated costs should be detailed here.

A. Method of restoration

   1. projected length of time required to complete restoration

B. Volume of aquifer required to be restored

   1. area and thickness of aquifer

   2. number of required pumping cycles (pore volumes)

   3. cycling time

C. Labor and equipment cost estimates associated with aquifer restoration (e.g., reverse osmosis unit)

D. Verification sample analysis

   1. number of samples

   2. unit cost for sample collection and analysis (per sample)

   3. total cost for verification sample analysis

E. Well plugging

1. number of drill holes to be plugged

2. depth and size of each drill hole

3. material to be used for plugging--include acquisition, transportation, and plugging

4. total cost for well plugging

F. Total cost for ground-water restoration

4.1.3 Radiological Survey and Environmental Monitoring

Radiological Survey - Gamma surveys and soil samples for radium in areas to be released for unrestricted use. Soils around the mill building, well field, evaporation ponds and process buildings should be analyzed for radium content. A gamma survey of all areas should be made before release for unrestricted use. All equipment released for unrestricted use should be surveyed and records maintained.

A. Soil samples for radium-226

B. Decommissioning equipment and building smear samples

C. Gamma survey

D. Environmental monitoring

Costs of labor, materials and analysis for continuation of environmental monitoring and inspection program throughout reclamation

E. Total cost

1. Number of each kind of sample listed above

2. Unit cost for sample and analysis (price per sample)

3. Total cost for radiological survey

4.1.4 Project Management and Miscellaneous Costs

Itemize estimated costs associated with project management, engineering changes, mobilization costs, legal expenses, power costs during reclamation, quality control radiological safety costs, etc.

4.1.5 Labor and Equipment Overhead, Contractor Profit

Overhead costs for labor and equipment and contractor profit may be calculated as separate items or loaded into hourly rates. If included in hourly rates, the unit costs should identify the percentages applied for each area.

4.1.6 Contingency

The licensee should include a contingency amount to the total cost estimate for the final site closure. The staff currently considers a 15 percent engineering contingency to be an acceptable minimum amount. Additionally, the licensee should include a 10 percent minimum contingency for contract administration, in the event the licensee defaults, and the State or Federal Government is required to administer a contract to carry out the licensee's reclamation and decommissioning responsibility.

4.1.7 Adjustments to Surety Amounts

The licensee is required by 10 CFR 40, Appendix A, Criterion 9 to adjust its cost estimates annually to account for inflation and changes in reclamation plans. The submission should be in the form of a request for amendment to the license.

A. Adjustments for Inflation

The licensee should submit a revised surety incorporating adjustments to the cost estimates for inflation ninety (90) days before each anniversary of the effective date of the surety instrument or as specified in the license. The adjustment should be made using the inflation rate indicated by the change in the Consumer Price Index published by the U.S. Department of Labor, Bureau of Labor Statistics.

B. Changes in Plans

- Changes in the process such as size or method of operation.
- Licensee-initiated changes in reclamation plans or reclamation/decommissioning activities performed.
- Adjustments to reclamation plans required by the NRC.
- Proposed revisions to reclamation plans should be thoroughly documented and cost estimates and the basis for cost estimated detailed for NRC review and approval. Where a licensee is authorized by the NRC to secure a surety arrangement with the State, no reduction to the surety amount shall be initiated without prior NRC approval. Copies of all correspondence relating to the surety between the licensee and the State shall be provided to the NRC. If authorized by the NRC to maintain a surety with the State as the beneficiary, it is the responsibility of the licensee to provide the NRC with verification of same, ensure that the agreement with the State specifically identifies the financial surety's application to the entire facility.

All costs (unit and total) are to be estimated on the basis of independent contractor costs (include overhead and profit in unit costs or as a percentage of total). Equipment owned by the licensee and the availability of licensee staff should not be considered in the estimate, to reduce cost calculations. All costs should be based on current year dollars. Credit for salvage value is generally not acceptable on the estimated costs.

The NRC staff review may include a comparison of unit cost estimates with standard construction cost guides (e.g., Dodge Guide, Data Quest) and discussions with appropriate State or local authorities (highway cost construction). The licensee should provide supporting information or the basis for its selection of the unit cost figures used in its estimates.