STAFF TECHNICAL POSITION

ALTERNATE CONCENTRATION LIMITS FOR TITLE II URANIUM MILLS

STANDARD FORMAT AND CONTENT GUIDE, AND STANDARD REVIEW PLAN FOR ALTERNATE CONCENTRATION LIMIT APPLICATIONS

JANUARY 1996

U.S. NUCLEAR REGULATORY COMMISSION

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1. REGULATORY POSITION AND IMPLEMENTATION GUIDELINES

1.1 Introduction

The U.S. Nuclear Regulatory Commission completed its first draft technical position on alternate concentration limits (ACLs) and announced its availability in the Federal Register on June 30, 1988 [53 FR 24820]. Comments on the draft technical position were received from Federal agencies, State governments, Indian Tribes, the American Mining Congress, and private companies from the uranium industry. These comments were reviewed by NRC staff and used in preparing a revised draft entitled "Draft Final Staff Technical Position on Alternate Concentration Limits for Title II Uranium Mills," dated February 1994.

The draft final technical position was announced in the Federal Register [59 FR 13345; March 21, 1994]. The maximum risk permitted in establishing site-specific ACLs was not included in the draft final technical position, and the permitted risk level was reserved pending the then ongoing discussions of the issue between NRC and the U.S. Environmental Protection Agency (EPA). Comments on the draft final technical position were received from the U.S. Department of Energy (DOE), State of Utah, the American Mining Congress, and three NRC licensees or licensee consultants.

The comments on the draft final technical position were reviewed by NRC staff, and the results of the staff review were documented. NRC and EPA have reached an agreement on the maximum permitted risk, and the draft final technical position was used in reviewing two ACL applications. The results of the comments and ACL application reviews and agreement on the permitted risk level with the EPA were used in making yet more revisions on the technical position, and in preparing this final staff technical position (STP) on ACLs.

The guidance in this STP is based on, and is generally consistent with, EPA's ACL guidance entitled, "Alternate Concentration Limit Guidance, Part 1: ACL Policy and Information Requirements," which EPA published in July 1987 for establishing ACLs at hazardous waste management sites under the Resource Conservation and Recovery Act (RCRA).

The definitions in Appendix A ("Introduction") and 40 CFR Part 192 (40 CFR 192.31) apply to the specific terms used in this STP, and should be used in preparing ACL applications and conducting ACL application reviews.

The STP is organized in three sections. Section 1 describes the regulatory position, including the applicable regulations and implementation guidelines for establishing ACLs. Section 2 provides guidance for preparing ACL applications, including a standard ACL application format and content form that the NRC staff finds generally acceptable. This section is intended to provide general guidance, with a view to allow a degree of flexibility in preparing ACL applications; this is because the ACL standards are site-specific by definition, and there will likely be some variability among applications with regard to the types of data needed to make the ACL demonstration at specific sites. Section 3 provides guidance for conducting ACL application reviews. This section is designed to encompass all factors

that might be considered in reviewing ACL applications, and to provide a consistent framework to guide ACL application reviews by the staffs of NRC a Agreement States.

1.2 Purpose and Scope

The purpose of this STP is to provide: (1) guidance on NRC staff's interpretation of the applicable regulations for establishing ACLs at uraniu mills and tailings impoundment sites regulated under Title II of UMTRCA; (2) Standard Format and Content Guide for ACL applications; and (3) standard criteria and procedures for ACL application reviews by NRC and Agreement States.

Specifically, the STP provides guidance on NRC staff's interpretation of the regulatory requirements for establishing ACLs in accordance with the applicable NRC regulations in Appendix A to 10 CFR Part 40 (following section). The STP also provides guidance to existing and prospective NRC licensees applying for site-specific ACLs, and to NRC staff conducting revie of ACL applications. In addition, the STP provides a standard ACL applicati format that licensees can use, for preparing ACL applications, and standard review procedures that NRC and Agreement States can follow, in conducting an documenting application reviews.

This STP is primarily intended for review of ACL applications for uranium mills and tailings impoundment sites regulated under Title II of the Uranium Mill Tailings Radiation Control Act (UMTRCA) of 1978, including existing and new sites and sites with relocated tailings. The STP may not be applied, in its current form, to sites regulated under Title I of UMTRCA, or sites regulated by EPA or States under the RCRA or Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). However, the same technical approach outlined in the STP may possibly be used in reviewing ACL applications for Title I sites, with modifications to reflect the difference between the Title I and Title II programs.

It is expected that the STP will be used by licensees, NRC staff, and possibl Agreement States for assessing and establishing ACLs at Title II uranium mil and tailings sites. The STP can be expected to contribute to improving the completeness, and quality of ACL applications, as well as the uniformity, completeness and efficiency of ACL application reviews and documentation of review findings.

1.3 Applicable Regulations

Pursuant to UMTRCA, EPA promulgated "Environmental Standards for Uranium and Thorium Mill Tailings at Licensed Commercial Processing Sites" (40 CFR Part 192, Subparts D and E, respectively) on October 7, 1983 [48 FR 45946]. The EPA standards included ground-water protection standards that EPA had previously developed under authority of the Solid Waste Disposa Act, which included provisions for establishing ACLs as site-specific ground-water protection standards. The EPA standards have been incorporated into NRC's regulations governing the operation of Title II 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 (Part 40, Appendix A, referred to hereafter as Appendix A) on November 13, 1987 (52 FR 43562).

Both the EPA's ground-water protection standards and NRC regulations include provisions for establishing site-specific ACLs at commercial uranium mill and tailings sites (as designated under Title I of UMTRCA). Provisions for establishing site-specific ACL standards are provided in the EPA standards in 40 CFR Part 192 (40 CFR 192.32(a)(2)(iv)) and the corresponding NRC regulations in Appendix A (Criteria 5B(5) and 5B(6)).

According to the NRC regulations (mainly Criterion 5, Appendix A), ground-water protection programs for Title II uranium mill and tailings sites must include the following four elements: (1) a list of site-specific hazardous constituents; (2) ground-water concentration limits (or standards) for these constituents; (3) a compliance location where the concentration limits must be met; and (4) a time period during which compliance is required.

Criterion 5B(5) of Appendix A requires that the concentration limits for individual constituents must not exceed: (1) the Commission-approved background concentration of constituent in the ground water; (2) the respective value given in Table 5C of Appendix A if the constituent is listed in that table and if the background level of the constituent is below the value listed (which correspond to EPA's maximum concentration limits (MCLs) for drinking water); or (3) an ACL limit established by the Commission.

Criterion 5B(6) of Appendix A states that, conceptually, background concentrations "...pose no incremental hazards..." and the drinking water limits in Criterion 5C "...state acceptable hazards..."; but that these two options may not be practically available at a specific site, and ACLs that present no significant hazard may be proposed by licensees for Commission consideration. In addition, Criterion 5B(6) indicates that the Commission will establish a site-specific ACL for a hazardous constituent if it finds that the constituents will not pose a substantial present nor potential hazard to human health or the environment as long as the ACLs are not exceeded, and that the proposed ACL values are also as low as is reasonably achievable (ALARA), after considering practicable corrective actions. Furthermore, Criterion 5B(6) adds that in making the present and potential hazard finding, the Commission will consider a total of 19 factors that are related to potential adverse effects on water quality in the area of the site, including potential adverse effects on ground-water quality (nine factors) and hydraulically-connected surface water quality (10 factors). These factors, which were adopted from a similar list in EPA regulations in 40 CFR Part 264.94(b) and referenced in 40 CFR Part 192.32(a)(2)(iv), are provided in Table 1, pages 4 and 5.

It is noted that NRC regulations do not preclude coordinating the establishment of ACLs at specific sites with the State or satisfying any applicable State or local government regulations, unless such regulations are in conflict with the applicable NRC regulations (with respect to nonradiological constituents, regulations that are more stringent than those of NRC are not considered in conflict with the applicable NRC regulations).

Table 1
Factors Considered in Making Present
and Potential Hazard Findings
(10 CFR Part 40, Appendix A, Criterion 5B(6))

A. Potential Adverse Effects on Ground-Water Quality

1. Physical and chemical characteristics of the waste in the licensed site, including its potential for migration.

2. Hydrogeological characteristics of the facility and surrounding land.

3. Quantity of ground water and the direction and rate of ground-water flow.

4. Proximity and withdrawal rates of ground-water users.

5. Current and potential future uses of ground water in the area.

6. Existing quality of ground water, including other sources of contamination and their cumulative impact on ground-water quality.

7. Potential for health risks caused by human exposure to waste constituents.

8. Potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents.

9. Persistence and permanence of potential adverse effects.

B. Potential Adverse Effects on Hydraulically Connected Surface-Water Quality

1. Volume and physical and chemical characteristics of waste in the licensed site.

2. Hydrogeological characteristics of the facility and surrounding land.

3. Quantity and quality of ground water, and the direction and rate of ground-water flow.

4. Patterns of rainfall in the region.

5. Proximity of the licensed site to surface waters.

Table 1
Factors Considered in Making Present
and Potential Hazard Findings
(10 CFR Part 40, Appendix A, Criterion 5B(6))
(continued)

6. Current and future uses of surface waters in the area and any water-quality standards established for those surface waters.

7. Existing quality of surface water, including other sources of contamination and the cumulative impact on surface-water quality.

8. Potential for health risks caused by human exposure to waste constituents.

9. Potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents.

10. Persistence and permanence of potential adverse effects.

1.4 Implementation Guidelines

NRC regulations (Appendix A) include the following requirements for ground-water protection at Title II uranium tailings sites: (1) identifying site-specific hazardous constituents and establishing their concentration limits; (2) defining the point of compliance (POC) where the standards must be met; and, (3) determining a compliance period. The concentration limits are established as background values, MCLs, or ACLs. ACLs may be established on a site-specific basis, provided that it is demonstrated that: (1) the constituents will not pose a substantial present or potential hazard to human health or the environment, as long as the ACLs are not exceeded; and (2) the ACLs are ALARA, considering practicable corrective actions. Licensees are required to implement detection monitoring programs to detect and identify site-specific hazardous constituents, and compliance monitoring programs to verify compliance with the established site-specific standards for individual constituents.

The POC and the point of exposure (POE) are two locations that must be carefully considered in the review of ACL applications. The POC is defined in Appendix A as the site-specific location(s) in the uppermost aquifer where the ground-water protection standard must be met. In practice, the POC will be located within a vertical surface representing the intersection of the down-gradient edge of the reclaimed tailings impoundments with the uppermost aquifer.

It is to be noted that the "uppermost aquifer" is defined in Appendix A as "the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary". Therefore, a proper selection of the POC will include identification of POC locations in the aquifer nearest to the ground surface, as well as other aquifers that are hydraulically interconnected with that aquifer, as warranted by the site-specific conditions. A proper POC selection is particularly important at sites that are located in wellhead protection areas (as defined by the Safe Drinking Water Act).

In contrast, the POE is defined as the location(s) where humans, wildlife, or other environmental species could reasonably be exposed to hazardous constituents from the ground water. For example, the POE may be represented by one or more domestic wells that could be constructed and could result in withdrawal of contaminated ground water, or the locations where aquatic biota may be exposed to hazardous constituents as a result of contaminated ground-water discharge to a river. Thus, ground-water quality at the POE must be maintained at levels that are protective of potential receptors.

The spatial relationship between the POC and POE is critical to the establishment of ACLs. Natural processes such as dilution, dispersion, decay, and sorption may attenuate hazardous constituents between the POC and POE. Thus, ACLs for hazardous constituents established at the POC may be greater than appropriate health and environmental concentration limits for those constituents at the POE, and still be protective of human health and the environment. However, the assumption of a low-concentration projection at the

POE, based on POC monitoring, may not be valid in cases where the contaminant plume for a particular constituent has already passed the POC and can no longer be detected by POC monitoring. The likelihood of this situation developing at a specific site should be evaluated and analyzed by the licensee, and addressed in the ACL application.

The POE, in most situations, will be located at the down-gradient edge of the land that will be transferred to either the Federal government or the State where the site is located for long-term institutional control after the license is terminated. There may be some instances where the property boundary is at a significant distance from the uranium mill and tailings sites. A *distant*[1] POE could be established at a distant property boundary and justified, on the basis that land ownership by the licensee or the long-term care custodian would ensure that no water resource use would exist on the property. It should be noted that in some instances, a distant POE may be established without invoking land ownership or long-term custody; for example, when the possibility of human exposure is effectively impossible because the ground water is either inaccessible or unsuitable for use.

The licensee should carefully evaluate the consequences of the land-transfer provisions of UMTRCA and their effect on the POE location(s) with the appropriate government agency, before proposing an ACL based on a distant POE. Under Title II of UMTRCA, at the time NRC or an Agreement State terminates a license, the title to the land that is used for the disposal of any byproduct materials (tailings), as defined by Section 11.e(2) of the Atomic Energy Act (AEA) of 1954, as amended, shall be transferred to the Federal Government or the State in which such land is located, at the option of such State. In some rare cases, the surface-land-ownership transfer requirements may be waived for Title II disposal sites, such as with deep burial of tailings where ongoing site surveillance would not be required. Section 83.b of the AEA specifically requires that the land used for disposal of any Section 11e.(2) byproduct materials be transferred to the Federal Government or State for long-term institutional control.

When a distant POE is involved, the licensee is required to coordinate and work with NRC to determine whether the State or Federal Government will be the long-term site custodian after the termination of the specific NRC license, and to provide necessary documentation that can be used to secure a commitment from that party to take custody of the site. ACLs may not be established at sites involving a distant POE unless and until the licensee agrees to transfer the title to the land, and the appropriate Federal or State Government commits to take such land, including the land between the POC and POE that is in excess of the land used for disposal of byproduct material. In instances where the licensee chooses to keep the mill property under a specific license and apply for an ACL as part of a compliance monitoring program, the licensee would still be required to coordinate and work with NRC to secure a commitment

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[1] A distant POE refers to any POE that is spatially beyond the area that the appropriate Federal or State agency is required to accept for perpetual care under the land-transfer provisions of UMTRCA.

from the State or Federal Government that will accept the transfer of the specific property after the termination of the specific license, including land in excess of that used for disposal of byproduct material.

In cases where the POE will be located at the edge of the lands that will actually be used for byproduct material disposal as defined in Section 11e.(2) of the AEA -- including those lands necessary to accommodate the design features of the erosion control system and reasonable extensions necessary for perimeter roadways and extreme site terrain features -- State or Federal Government advance commitment and Commission corresponding approval would not be required.

Contaminant attenuation through natural flushing between the POC and the POE can be depended on to reduce constituent concentrations in the ground water to their respective health-based values at the POE. Therefore, the licensee may be able to exercise some control over contaminant attenuation that can be accomplished through natural flushing at a particular site by proper selection of the POE location, as permitted by the site-specific conditions. However, the licensee cannot rely on natural flushing beyond the POE to either attenuate contamination or delay the implementation of corrective action programs. This is because unlike the Title I regulations, reliance on natural flushing to extend the compliance period, to achieve compliance with the established standards, is not permitted under the Title II regulations. However, ACLs may be proposed if new information indicates that previously established site-specific standards can be modified within the applicable provisions in the regulations. In all cases, ACL applications must demonstrate that hazardous constituent concentrations will not pose substantial present or potential hazards to human health or the environment at the POE, and that the ACLs are ALARA considering practicable corrective actions.

ACL applicants must maintain a financial surety, within the specific license, for the restoration of ground water, if required, with the surety scaled to the anticipated cost and timeframe for achieving compliance before the land is transferred to the government for long-term care. The financial surety must be sufficient to cover the cost of corrective action measures that will have to be implemented if required to restore ground-water quality to the established site-specific standards (including an ACL standard) before the site is transferred to the government for long-term custody.

Ultimately, ACLs must be protective of human health and the environment at the POE. The provisions for establishing ACLs in the existing regulations may be difficult to meet and may not even be feasible at specific sites, which may render the ACL standard a non-option at such sites. The ACL framework is not appropriate for cases where the provisions for establishing ACLs that are protective of human health and the environment cannot be satisfied, including instances where there is no appropriate corrective action to restore ground-water quality to the protective limits or standards, or where corrective action is ineffective, prohibitively expensive, or of an indefinite duration. Instances such as these would have to be submitted to the Commission as special cases outside the ACL framework, and will be addressed and decided on by the Commission on a case-by-case basis.

2. APPLICATION CONTENT AND FORMAT

2.1 Application Content

ACL applications should be submitted to the Commission and should primarily provide a list of the site-specific hazardous constituents, including constituents for which site-specific ACL standards are proposed, and the proposed ACL values. Applications must also include a hazard assessment, to demonstrate that the hazardous constituents will not pose a substantial present or potential hazard to human health or the environment as long as the proposed ACLs are not exceeded; and a corrective action assessment, to demonstrate that the proposed ACLs are as low as is reasonably achievable, considering practicable corrective actions.

Hazard assessments should generally evaluate: (1) existing distribution of the hazardous constituents as well as the potential source(s) for future releases of such constituents; (2) direction and rate of transport of hazardous constituents in the ground water and hydraulically connected surface water; and (3) risks associated with exposure of humans and the environment to the hazardous constituents. Corrective action assessments should generally address: (1) practicable corrective actions; (2) technical feasibility of corrective actions; (3) corrective action costs and benefits; and (4) selection of practicable corrective action that would achieve hazardous constituent concentrations that are ALARA.

In conducting the hazard demonstration, applicants must address each of the water-quality factors provided in Table 1, as they apply to site-specific conditions. All the factors may not be applicable at specific sites. If this is the case, the ACL application should provide an explanation of why a particular factor is not considered in the hazard assessment nor addressed in the application. For example, ground-water discharge to surface waters does not commonly occur near mill or tailings sites; therefore, consideration of the factors, in Table 1, that strictly relate to the assessment of present and potential impacts on surface-water quality may not be required at many such sites. However, the burden of proof resides with the applicant to demonstrate that certain factors are not applicable and do not need to be considered in the hazard assessment for particular sites.

In cases where constituent concentration limits that are protective of human health and the environment are not readily available, ACL applications must include human and environmental exposure assessments. Such assessments will evaluate the health and environmental hazards caused by radioactivity and chemical toxicity of constituents, as warranted by the site-specific conditions.

Applications should include sufficient supporting information and be sufficiently detailed to allow the NRC reviewer to independently verify whether the proposed ACLs satisfy the regulations. In general, ACL applications are expected to provide documentation and supporting information about site characteristics, including ground-water sources, direction of ground-water flow, ambient ground-water quality, present and potential water uses and classification, and water resource availability in the general site

area; milling operations, including milling processes and disposal areas and methods; tailings composition, including contaminant source-term characterization and on-property and off-property contamination; existing contamination, including affected water resources and contaminant plume; contaminant transport and attenuation mechanisms and rates between the POC and the POE; and type, status, and effectiveness of remedial action activities.

ACL applications should provide a map showing the tailings disposal area, including the locations of the reclaimed outslopes, POC compliance monitoring wells, POE, contamination plumes, wellhead protection areas, and the boundary of the land to be transferred to the government for long-term custody and control. Data permitting, the spacial distribution of the hazardous constituents in contamination plumes should be delineated and used to determine whether human and environmental populations have been exposed to contamination, and to calibrate transport models where warranted.

Much of the ACL application material may already be available in licensing documents. Commonly, hydrogeologic information is available in license applications, environmental reports, or ground-water monitoring submittals. This information can be readily incorporated into the ACL application, or referenced if it had previously been submitted and is already on file with NRC. The applicant is also free to cite or reference relevant information from other sources, such as those available from the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurement (NCRP) for the effects of radioactivity, and EPA's Integrated Risk Information System (IRIS) for chemical toxicity effects. Additional documentation required subsequent to an ACL application submittal can be submitted as application amendment(s).

2.2 Application Format

Table 2, page 12, provides a generic ACL application outline, which represents a standard format that can be used in preparing ACL applications. This application outline is provided to serve the following purposes: (1) it ensures that the applications include the assessments required by the existing regulations for establishing site-specific ACLs; (2) it helps in ensuring the completeness of information provided in support of the proposed ACLs; (3) it highlights pertinent and critical information; and (4) it provides a uniform application format and thereby contributes to the efficiency of reviewing ACL applications.

Conformance with the standard format is not mandatory. The NRC staff recognizes that the format (and content) of ACL applications for specific sites may vary, because site-specific differences in compliance demonstrations may make stringent observance of the standard format impractical. The NRC staff will accept applications with different formats if the application is complete and provides the information that is necessary to demonstrate compliance with the existing regulations. However, it is expected that some measure of efficiency and completeness may be lost, if the standard format is not followed, and applicants are therefore encouraged to follow the standard format whenever possible.

Applicants are encouraged to use appendices to provide supporting data not specifically included in the main application document. Conventional abbreviations should be used consistently throughout the application. Any abbreviations, symbols, or special terms should be defined where they first appear in the text. Where appropriate, calculated error bands or estimated uncertainties should be included, along with numerical values. Some types of information are better presented by use of maps, graphs, drawings, or tables, in addition to text descriptions. Applicants should ensure that graphical materials are legible and that the physical scales are adequate to clearly show details and notations.

It is suggested and requested that applications be structured to allow ready substitution of pages in response to reviewers' comments and information requests. Pages should be punched for a standard loose-leaf binder. Revisions should be provided on pages that will replace the original pages, with the changes indicated by a "line-change" demarcation. The date and revision number should be indicated in the bottom outside margin of each change page, and each package of revisions submitted should include a listing of all page changes in that submittal.

Table 2
Standard ACL Application Format

EXECUTIVE SUMMARY

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3. REVIEW CRITERIA AND PROCEDURES

3.1 Areas of Review

The NRC staff review will primarily focus on the applicant's hazard and corrective action assessments, and will typically involve a total of eight assessment elements (i.e., three hazard assessment and five corrective-action-assessment elements), as described below.

1. Hazard-Assessment Review

NRC staff hazard-assessment review will involve the following three elements of the hazard assessment provided by the applicant: (1) distribution and extent of hazardous constituents, as well as the potential for future releases of constituents; (2) transport of hazardous constituents in ground water and hydraulically-connected surface water; and (3) risks associated with exposure of humans and the environment to hazardous constituents.

2. Corrective-Action Review

NRC staff corrective-action review will involve the following five elements of the corrective action assessment provided by the applicant: (1) identification of alternatives; (2) technical feasibility; (3) estimated costs; (4) estimated benefits; and (5) selection of practicable corrective actions for controlling, reducing, mitigating, or eliminating ground-water contamination.

3.2 Acceptance and Review Criteria

3.2.1 General Criteria

Consistent with the regulations (Criterion 5B(6), Appendix A), the NRC staff will accept ACL petitions, and the Commission will establish site-specific ACL standards at Title II uranium and mill tailings sites provided that the constituents will not pose a substantial present or potential hazard to human health or the environment as long as the ACLs are not exceeded, and that the proposed ACL values are ALARA, after considering practicable corrective actions.

Therefore, the acceptability of site-specific ACLs proposed by the applicant will depend on the findings of the hazard and corrective-action assessments, including the viability of the methods and reliability of the data used in such assessments. The NRC staff review will verify that the above assessments are completed and properly carried out and documented in the ACL application by the licensee. The staff review will verify the reliability of the methods and the data used by the applicant in the hazard and corrective-action assessments. In some cases, the NRC staff may independently conduct hazard and corrective-action assessments and make present and potential hazard and ALARA determinations to verify the applicant's findings; in this case, the applicant will be required to provide the information and data necessary to complete such assessments.

The hazard assessment review will verify that the applicant has considered al of the hazard-assessment factors listed in Table 1, pages 4 and 5, as they apply to the site conditions, to define and evaluate the adverse effects of the hazardous constituents on ground-water and surface-water quality. The review will address the present and potential health and environmental hazards, including the cancer risk caused by human exposure to radioactive constituents, and other health hazards that may be caused by the chemical toxicity of constituents, and make a determination as to the acceptability of the proposed ACL values, based on health effects. The use of previously established and documented health-based constituent concentration limits in the hazard assessment would be acceptable as a basis for establishing ACL values at specific sites, but such values may have to be determined for constituents for which health-based concentration limits have not been established.

The corrective-action review will verify that the licensee has taken into consideration all practicable corrective actions that can be implemented to restore ground-water quality at the site, that valid criteria and reliable data were used to evaluate such corrective actions and to select an appropriate corrective action by the licensee, and that the proposed ACL values meet the ALARA requirement in consideration of the corrective action s identified.

The hazard and corrective-action assessments can use data obtained from on-site observation and monitoring, including data on site characterization and performance monitoring, to demonstrate compliance with the regulatory requirements. The use of properly developed and calibrated models to make projections about the site performance would also be acceptable.

Information and data used in the hazard and corrective action assessments in support of the proposed ACLs may be provided in the ACL application or referenced.

3.2.2 Acceptance Criteria

Before conducting a detailed review, the NRC staff will initially conduct an acceptance review, to determine whether an ACL application is justified by th site-specific conditions, and provides the minimum documentation and information needed for a detailed staff review.

An ACL application will be accepted and scheduled for a detailed staff review if: (1) the application is justified in consideration of site-specific conditions and corrective actions undertaken to meet the otherwise applicable standards; and (2) the application provides site-specific hazard and corrective-action assessments, as required by the regulations, including supporting documentation and data.

An ACL application will be rejected if: (1) the application is made for the purpose of delaying corrective action when a significant human-health or environmental hazard exists; or (2) if the application lacks sufficient analyses, documentation, or data to permit a detailed review and evaluation o the proposed ACL values.

3.2.3 Specific Review Criteria

3.2.3.1 Review Element 1: Hazard Assessment

The hazard assessments will be reviewed to ascertain that the following assessments and evaluations have been carried out by the licensee and satisfactorily documented in the ACL application: (1) characterization of the hazardous-constituent source term and the extent of ground-water contamination; (2) assessment of hazardous-constituent transport in the ground water and hydraulically-connected surface waters, and their adverse effects on water quality, including their present and potential health and environmental hazards; and (3) assessment of human and environmental exposure to hazardous constituents, including the cancer risk and other health and environmental hazards.

3.2.3.1.1 Source-Term and Contaminant Characterization

Characterization of the contaminant source(s) and their extent provides the source term for contaminant transport assessments. The source characterization should provide reliable estimates of the release rates of hazardous constituents as well as constituent distributions.

In addition, the source-term characterization should provide relevant information about the facility, including: (1) the uranium recovery process(es) used; (2) types and quantities of the reagents used in milling; (3) milled-ore compositions; and (4) historical and current waste management practices. This information should be considered in conjunction with the physical and chemical composition of the waste and the type and distribution of existing contaminants, to characterize the source term and evaluate future hazardous-constituent release into the ground water (e.g., location of waste discharges, retaining structures for wastes, and waste constituents).

Depending on the hazardous constituents present, additional information on the hazardous constituents and their properties may also be required, including: (1) density, solubility, valence state, vapor pressure, viscosity, and octanol-water partitioning coefficient; (2) presence and effect of complexing ligands and chelating agents, to the extent that constituent mobility may be enhanced; (3) potential for constituents to degrade because of biological, chemical, and physical processes; and (4) constituent-attenuation properties, considering such processes as ion exchange, adsorption, absorption, precipitation, dissolution, and ultrafiltration.

At sites with well-defined contaminant plumes, the spatial distribution of the various hazardous constituents must be defined. This information is needed to calibrate contaminant transport models and to evaluate whether humans and environmental populations are currently being exposed to elevated concentrations of hazardous constituents. Characterization of the contamination extent should include: (1) the type and distribution of hazardous constituents in the ground-water and contamination sources; (2) the monitoring program used to delineate and characterize hazardous-constituent distribution; and (3) documentation of the sampling, analysis, and quality-control/quality-assurance programs followed in the implementation of

the site-monitoring programs. Such information would be needed to assess present human and environmental population exposure to elevated concentrations of hazardous constituents, calibrate contaminant transport models, and evaluate projected future exposures.

3.2.3.1.2 Hydrogeologic and Contaminant Transport Assessment

The hydrogeologic and contaminant transport assessment should provide and document estimates of projected contaminant distribution, including contaminant transport and degradation and attenuation mechanisms between the POC and the POE. The assessment should generally characterize and provide information on: (1) site hydrogeologic characteristics, including ground-water flow direction and rates; (2) background water quality; and (3) estimated transport rates, geochemical attenuation, and concentrations of hazardous constituents in the ground water and hydraulically-connected surface water.

The hydrogeologic characterization must describe the ground-water regime in sufficient detail to define the hazardous-constituent transport mechanisms. The scope of the hydrogeologic characterization at specific sites should take into consideration the potential hazards associated with ground-water contamination, and potentially affected human and environmental populations. ACL applicants may develop estimates that conservatively bound the anticipated magnitude of hazardous-constituent transport, distribution, and impacts.

Characterizations of site hydrogeology should generally include: (1) a characterization of the hydrogeologic units (including aquifers and aquitards) that have been or may be impacted by transport of hazardous constituents from the site, and their characteristics (such as geometry, stratigraphy, structural inconsistencies, lithology/mineralogy, hydraulic conductivity, effective porosity, potentiometric data, recharge/discharge locations and rates, and dispersivity); (2) representative conceptual models of the ground-water flow regime, and information on the lateral and vertical ground-water flow rates and directions; (3) surface waters that are hydraulically-connected to ground water; (4) climatic characteristics such as local precipitation and evapotranspiration rates; infiltration and recharge rates; temporal variations in water levels and their effects on ground-water recharge, flow rates, and ground-water, surface-water flow interactions; and (5) a documentation of the data base used to characterize the site hydrogeology, including monitoring practices, procedures, and quality-assurance and data-validation programs.

Background water quality characterization should accurately depict the ground-water quality that existed at the site before facility operation, or the water quality that would be expected in the absence of contamination from the facility, based on reliable water-quality data that do not reflect contamination because of facility operation. Background water quality characterization should include: (1) a map showing the locations of background monitoring sites; (2) a description of the monitoring wells, springs, surface-water samplers, suction lysimeters, and other devices; (3) descriptions of the distribution of wastes at the site; (4) information on historical changes in hydraulic heads, flow directions, flow rates, and ground-water quality; (5) analytical background water quality data;

(6) descriptions and analysis of potential sources of off site contamination; and (7) descriptions of the sampling, analysis, preservation, and quality assurance protocols.

Contaminant transport estimates should be based on the site hydrogeologic characteristics, transport rates, attenuation factors, background water quality, extent of contamination, and sources of contamination. The objective of the hazardous-constituent-transport assessment is to develop reasonably conservative projections of contaminant concentrations in ground water and surface water, which can subsequently be used to make defensible exposure estimates (in the exposure assessment). The contaminant-transport assessment should consider anticipated future events that may alter exposure and transport rates and pathways as well as the transfer of hazardous constituents from aqueous media to other environmental media, as warranted by the site-specific condition. Transport assessments should include: (1) reasonably conservative estimates of the hazardous constituent transport rate in the ground-water and hydraulically connected surface water; (2) estimates of the duration of constituent migration; (3) projected temporal and variability distribution of hazardous constituents; (4) waste-composition and water-quality-monitoring data used to validate projections of constituent transport; (5) assessments of the long-term potential for desorption and remobilization of contaminants into ground water or hydraulically connected surface water; (6) characterization of the source term for hazardous constituents for ground-water and surface-water transport; and (7) assessment of uncertainties associated with the projected concentrations and distributions of hazardous constituents and the site hydrogeologic conditions.

When possible, the hydrogeologic characterization should be based on actual measurements and monitoring records. The POC and POE locations should be considered as critical monitoring points in characterizing the site hydrogeology and contaminant transport and attenuation rates, and POE monitoring prior to establishing ACLs may be considered in instances where there is an uncertainty about the basis used in evaluating the site-specific attenuation rates between the POC and the POE. Contaminant transport and attenuation estimates can be based on data obtained from on site measurements and monitoring records, analytical and numerical models, and available and documented information about hazardous-constituent attenuation properties. In some cases, licensees' estimates that conservatively bound the magnitude of the processes affecting hazardous constituent transport and attenuation would be acceptable.

3.2.3.1.3 Exposure Assessment

The exposure assessment should identify the maximum permissible levels that are protective of human health and the environment, evaluate human and environmental exposure to hazardous constituents, and demonstrate that the proposed ACLs do not pose substantial present or potential hazards to human health or the environment.

The exposure assessment at specific sites should evaluate health and environmental hazards using water-classification and water-use standards, and existing and anticipated water uses. Agricultural, industrial, domestic,

municipal, environmental, and recreational water uses, as they pertain to the site, should be considered. The assessment should identify and evaluate hazardous-constituent exposure pathways and make projections on human and environmental population response, based on the projected constituent concentrations, dose levels, and available information on the radiological and chemical toxicity effects of hazardous constituents. The assessment should also address the underlying assumptions and variability of the projected health and environmental effects.

The human-exposure assessment will be evaluated primarily on the basis of the extent to which people are using, and likely to use, contaminated water from the site. Site-specific water uses should be determined on the basis of the following considerations: (1) ground-water quality in the site area and present water uses; (2) statutory or legal constraints and institutional controls on water use in the site area; (3) Federal, State, or other ground-water classification criteria and guidelines; (4) applicable water-use criteria, standards, and guidelines; and (5) availability and characteristics of alternative water supplies.

The human-exposure assessment commonly considers two potential exposure pathways: (1) ingestion of contaminated water, and (2) ingestion of contaminated foods. The assessments distinguish between health impacts associated with threshold and non-threshold constituents. Mutagenic, teratogenic, and synergistic effects are considered in the analysis, if applicable, based on toxicological testing, structure-activity relationships, or epidemiological studies. Other pathways that may impact human health include dermal contact and inhalation, which should also be considered, but need not always be assessed, unless it is determined that these exposures could result in significant hazards to human health or the environment.

Potential responses of environmental or non-human populations to the various hazardous constituents will be assessed if such populations can realistically be exposed to contaminated ground water or hydraulically connected surface water. Terrestrial and aquatic wildlife, plants, livestock, and crops are included in the assessment. In the absence of available information that readily may be used to demonstrate that there will be no substantial environmental impacts caused by ground-water contamination from the site, the exposure assessment should provide: (1) inventories of potentially-exposed environmental populations; (2) recommended tolerance or exposure limits; (3) contaminant interactions and their cumulative effects on exposed populations; (4) projected responses, of environmental populations, that result from exposure to hazardous constituents; and (5) anticipated changes in populations, independent of the hazardous-constituents exposure. Alternatively, an applicant may demonstrate that environmental hazards are not anticipated, because exposure will not occur.

The hazard assessment also evaluates potential damage to physical structures (such as corrosivity), that may result from exposure to the hazardous constituents in ground water and hydraulically connected surface water (if and where applicable). Alternatively, an applicant may demonstrate that damage to physical structures is not anticipated, because the exposure will not occur.

3.2.3.2 Review Element 2: Corrective-Action Assessment

Ground-water corrective-action assessments should typically: (1) identify target concentration levels that are at or below the MCL determined by the hazard assessment; (2) identify practicable corrective-action alternatives, and assess their technical feasibility, costs, and benefits; (3) select appropriate corrective action; and (4) demonstrate that the proposed concentration limits are ALARA, considering the practicable corrective-actions considered.

Ground-water corrective action assessments will be approved and ACLs will be established at specific sites if it can be demonstrated that the proposed ACLs are no higher than the allowable MCLs determined by the hazard assessment, and that they also represent the lowest practicably achievable concentration levels, considering practicable corrective-action alternatives. Therefore, corrective-action assessments should be performed on concentration levels that are at or below the concentration limit that the hazard assessment determines to be protective of human health and the environment. At least three different target concentration levels that are at or below the level identified in the hazard assessment and that can reasonably be attained by practicable corrective action should generally be proposed and evaluated by the licensee.

To select a corrective-action alternative and a target concentration level that meet the ALARA provision, the corrective-action assessment should provide information on the costs and benefits of each of the corrective-action alternatives considered by the licensee, and supporting documentation, including calculations and assumptions. It may not be necessary in some cases to select and adopt the most stringent alternative if it can be demonstrated that the cost of implementing such an alternative is too high, compared to the expected benefits.

3.3 Review Procedures

3.3.1 General

A systematic and consistent approach will be followed by NRC staff in all ACL application reviews, and all reviews will be conducted to confirm that the proposed ACLs are in compliance with the regulatory requirements in Criterion 5B(6) of Appendix A. Staff reviews will be guided by the review areas in Section 3.1 and the review criteria in Section 3.2 of this STP.

In general, the NRC reviewers will ascertain that the regulatory requirements have been satisfactorily met before site-specific ACLs are established. Typically, this would include a determination that hazard and corrective-action assessments have been satisfactorily completed and documented in the ACL application, with the result that the proposed ACLs do not pose substantial present or potential hazard to human health or the environment and that they are also ALARA, considering practicable corrective actions.

An NRC reviewer determination that the regulations have been satisfied may be

based on reviewing and accepting the applicant's findings, or on an independent staff analysis and a determination that the proposed ACLs meet the regulatory requirements. The staff may independently conduct literature surveys and perform its own evaluations and assessments, as needed, to satisfy itself as to the applicant's findings or to determine that the proposed ACLs are in compliance with the regulations.

Open issues or requests for additional information resulting from the staff review will be transmitted to the ACL applicant in the form of written comments. The comments would document the issues identified in the staff review. When possible and appropriate, the staff will offer suggestions concerning a technical approach that may be followed by the applicant to resolve issues.

ACL application reviews will be conducted in two stages. The first stage will involve an "acceptance review," which will be conducted to ascertain that the applicant has conducted and fully documented the required hazard and corrective-action assessments, and has provided sufficient documentation and data to conduct a detailed review and verification of the applicant's findings. The second stage will involve a "detailed review" to substantiate and accept the applicant's findings, or to independently make present and potential hazard and ALARA determinations and decide on the acceptability of the proposed ACLs accordingly.

Application acceptance and detailed review procedures are discussed next in Sections 3.3.2 and 3.3.3, respectively.

3.3.2 Acceptance Review Procedures

ACL applications will be initially reviewed and evaluated to determine whether applying for ACLs is justified and if the application provides the minimum information and documentation required for a detailed staff review. Applications will be accepted or rejected based on the application acceptance criteria provided in Section 3.2.2 of this STP.

If the application is accepted, a tentative detailed review schedule will be established, and the applicant will be notified in writing. The schedule will not be binding nor mandatory, but will represent the best estimate of the anticipated timeframe for completing the detailed review. It is expected that the tentative review schedules will be unique to individual applications, and will largely depend on the relevancy, quality, and reliability of information submitted or pending in support of the ACL application, outstanding site-specific issues, and the regulatory workload.

If the application is rejected, or if it is decided that the application does not provide sufficient documentation or supporting information to warrant a detailed review, the applicant will be notified accordingly, and deficiencies in the application will be communicated to the licensee in writing.

In general, the detailed review will not proceed until the applicant rectifies the deficiencies in the ACL application, and provides the required information and data. In some cases where the deficiencies are few and not critical to

the review, the detailed review can proceed even though some information may still be pending. Likewise, the acceptance of an application does not preclude later requests for additional information in the course of the detailed review by the NRC staff.

3.3.3 Detailed Review Procedures

3.3.3.1 Review Element 1: Hazard-Assessment Review

In general, the NRC reviewers will ascertain that the hazard assessment was duly completed and documented in the ACL application, and that the proposed ACLs are consistent with, and supported by, the hazard assessment finding. Specifically, the reviewers must ascertain that the hazard assessment was carried out in conformance to the regulatory provisions, that the applicant followed valid and acceptable analysis methods and procedures, and that sufficient supporting data and information were provided or referenced in the ACL application for the staff to verify the applicant's findings. The reviewer typically verifies that the applicant has demonstrated that the proposed ACLs will attenuate sufficiently from the proposed ACL levels at the POC, to their protective health-based values at the POE (i.e., concentrations that are protective of human health and the environment), and that there will be no adverse effects, on the ground-water or surface-water quality, that would cause substantial health or environmental hazards at the POE location(s). The reviewer also verifies that the applicant has considered the water-quality factors provided in Table 1, pages 4 and 5, as they apply to site conditions, in making these determinations.

The hazard-assessment review will typically involve reviewing the following assessments provided by the applicant to demonstrate compliance with the regulations, or that the proposed concentration limits do not cause substantial present or potential hazards to humans and the environment:

1. The hazardous-constituent source term must be characterized and extent of ground-water contamination at the site must be defined.

2. The rates and directions of hazardous-constituent migration and transport in the ground water and hydraulically-connected surface waters must be evaluated.

3. The pathways of human and environmental exposure to hazardous constituents must be identified, and exposure magnitudes and effects, including the cancer risk, must be evaluated.

Specific procedures that will be followed in reviewing each of these assessments are discussed in the following paragraphs.

3.3.3.1.1 Source-Term Characterization Review

The reviewer evaluates the characterization of the hazardous-constituents source term, considering the transport assessment. Generally, the source term will include the tailings, contaminated ground water, contaminated soils, and other wastes that may cause future releases of hazardous constituents and

should be considered as contributing to the source term. The reviewer determines whether the characterization is sufficient to provide a defensible estimate of the types, characteristics, and release rates of hazardous constituents that have been or are anticipated to be released from the source term.

The reviewer will ensure that the demonstration: (1) identifies appropriate hazardous constituents in the waste or leachate derived from the waste; (2) identifies the extent and characteristics of contaminated ground water and soils; (3) characterizes the properties of the hazardous constituents that affect their transport; and (4) estimates release rates of hazardous constituents as a function of time and space.

The reviewer generally assesses information on the uranium recovery process, the amounts and types of reagents that were used, and the composition of ore as well as transport characteristics and leachability of the hazardous constituents. These factors are combined with the current distribution of contaminated ground water to evaluate potential transport of hazardous constituents. Other relevant information may include the volume of waste, as well as its volatility, octanol-water partitioning coefficient, viscosity, degradation-rate constants, and density, if it is determined that these properties can significantly affect transport or toxicity of hazardous constituents at the site.

3.3.3.1.2 Site Hydrogeology and Contaminant Transport Review

The NRC staff review of the site hydrogeology and contaminant transport assessment will verify that the proposed ACLs will not result in excessive constituent concentrations that would cause substantial health or environmental impacts at the POE location(s). The review will verify that: (1) the hazardous constituents will attenuate sufficiently from the proposed ACL levels at the POC to their protective health-based values at the POE (i.e., concentrations that are protective of human health and the environment); (2) there would be no adverse effects on the ground-water or surface-water quality that would cause health or environmental hazards beyond the POE location(s); and (3) the water-quality factors provided in Table 1, as they apply to site-specific conditions, are considered in making the above determinations.

The reviewer will examine the hydrogeologic characterization of the site by the applicant to determine if it is adequate to support the projected extent and distribution of hazardous constituents. The reviewer considers site-specific and regional information on the physical and hydrogeologic characteristics of ground-water and surface water systems, including: (1) hydrogeologic characterization and hydraulic coefficients of formations and background water quality; (2) potentiometric head distribution and flow directions and rates; and (3) ground-water and surface-water flow regimes, including ground-water recharge and discharge locations and rates. The reviewer may also consider other site-specific factors that may be affecting ground-water and surface-water flow and contaminant release, such as mine dewatering and site construction practices.

Contaminant transport and attenuation reviews will address: (1) extent and distribution of existing ground-water contamination, and estimated projections of future contamination; (2) geochemical characteristics affecting attenuation properties in the soil and geologic formations; (3) degradation and attenuation properties of constituents, including their distribution coefficients; (4) duration of contaminant release, transport, and attenuation; and (5) uncertainties associated with the attenuation mechanisms, geochemical characteristics of soils and geologic formations, attenuation properties of constituents, and possibly other site-specific factors.

The review of hazardous-constituent transport will include an evaluation of constituent mobility in ground water and contaminant transport from ground water to surface water, if the ground-water discharges to surface water. The reviewer determines whether estimated hazardous constituent concentrations and projected distribution are either best estimates or reasonably conservative representations of the rate, extent, and direction of constituent transport. This determination is made considering the existing distribution of hazardous constituents in ground water and their characteristics, as well as the effects of such factors as chelation, degradation, and attenuation mechanisms. The reviewer confirms that all likely and significant pathways of hazardous transport in ground water and surface water have been identified and assessed, considering conservative effects on humans and the environment, and that the assessments used to estimate constituent transport are appropriate to support regulatory decisions. Additionally, the reviewer confirms that the projections have been sufficiently validated and calibrated based on site-specific information. In instances where there is a great uncertainty in the attenuation-rate estimate, the reviewer may request the applicant to rely on measurements of constituent concentrations at the POC and the POE over a sufficient time period, before ACLs are established, to verify the projected attenuation rate.

The reviewer also evaluates the adequacy of the existing detection-monitoring program, water-quality data, modeling approach and results, facility characteristics, and the procedures used to measure the background concentrations. The reviewer determines whether the transport assessment reasonably characterizes facility impacts on the quality of ground water and surface water. Background concentrations may be complicated in areas where there are several affected aquifers, or where existing contamination from activities unrelated to uranium milling has altered ambient water quality. The reviewer should verify that appropriate characterizations of background water quality are established for each affected aquifer and for hydraulically connected surface-water bodies that are down-gradient from the facility.

At sites where entire aquifers are contaminated by seepage, the reviewer evaluates the applicant's justification for not characterizing background water quality and the applicant's estimate of the unaffected water quality. The reviewer evaluates site and facility information and either confirms the determination of background water quality or determines that the estimates are not reasonably conservative. Facility information is reviewed to ensure that estimates of background water quality are sufficient to support analyses of potential use and effects associated with human and environmental exposure to hazardous constituents.

3.3.3.1.3 Exposure-Assessment Review

The reviewer verifies that the proposed POE location(s) are consistent with the POE definition presented in Section 1.4 ("Implementation Guidelines"). In most cases, the POE for pathways assumes well-water use will be proposed at the down-gradient boundary of the specific property that will be transferred to the government for long-term custody. The reviewer must verify that a written assurance has been secured, either by the licensee or NRC, that the appropriate Federal or State agency will accept the transfer of the specific property, including land in excess of that needed for tailings disposal. The reviewer also evaluates the assessment of the risks associated with human and environmental exposure to hazardous constituents, considering the source term, rates, and directions of constituent transport, and the POE location(s). The risk-assessment review should take into consideration existing and potential uses of water resources that may be affected by the facility, human and environmental exposure to hazardous constituents, and permanence and persistence of any adverse effects associated with exposure.

The reviewer determines whether the characterization of exposure pathways is adequate, considering human and environmental exposure to hazardous constituents. Physical and biological pathways of constituent transport by ground water and surface water are primary considerations. The reviewer confirms the licensee's identification and characterization of human and sensitive environmental populations, and that the sensitive populations have been adequately considered in the exposure assessment. The assessment must consider human exposure caused by ingestion of drinking water and contaminated food products. If other exposure pathways are likely, these should also be identified and considered.

The applicant's assessment of adverse effects associated with present and potential human exposure to hazardous constituents should be confirmed, based on the exposure pathways characterization. The human exposure assessment includes: (1) classification of affected water resources; (2) assessment of existing and potential water uses; (3) evaluation of the likelihood that people will be exposed to hazardous constituents; and (4) evaluation of adverse effects associated with exposure to hazardous constituents, including assessment of the permanence and persistence of adverse effects.

When ground-water flow contributes to surface water, the recipient surface water will be considered as a POE location, and the reviewer ensures that the proposed ACLs will not result in: (1) hazardous constituent concentrations in the surface water that are in excess of the protective health or environmental limits; and (2) exposure of human and environmental receptors to contaminated ground water will not occur between the POC and the location where the ground water discharges to the surface water.

Both radiological and some chemical constituents may have important health and environmental effects, and both types of information are usually required in support of ACL applications. The applicant is free to provide information in support of the exposure assessment directly in the ACL application, or cite and reference relevant information and studies such as those available from ICRP and NCRP for the effects of radioactivity, and IRIS for chemical-toxicity

effects. The applicant can also use or reference site-specific information provided in previous reports such as the license application or the environmental report. Although some data may be difficult to provide for certain constituents, a technical basis would still be needed to provide a reasonable assurance that the proposed ACLs do not pose a health hazard to human health nor the environment.

Exposure assessment at specific sites will be based on water resource classification and use, evaluation of health hazards, and evaluation of environmental hazards, as described in the following paragraphs.

Evaluation of Water-Resource Classification and Use

A review of water resource classification and existing and potential water uses confirms that the applicant has considered all commonly known water uses, including domestic and municipal drinking-water use; fish and wildlife propagation, including special ecological communities; and industrial, agricultural, and recreational water uses. The applicant's assessment of existing and potential uses of water at the facility should be consistent with Federal, State, and local water-use inventories, thereby providing an adequate basis on which to assess existing and potential human and environmental exposure to hazardous constituents. Additionally, the applicant's assessment of water yields; costs for development of alternate water supply sources; and legal, statutory, or other administrative constraints on the use and development of the water resources should be verified.

The reviewer ensures that the assessment conservatively estimates the probability of human exposure to contaminated water. Such estimates are often difficult to establish quantitatively. Consequently, defensible qualitative estimates are often necessary, and can be characterized as:

1. Reasonably likely - when exposure has or could have occurred in the past, or available information indicates that exposure to contamination may reasonably occur during the contamination period; or,

2. Reasonably unlikely - when exposure could have occurred in the past, but will probably not occur in the future, either because initial incentives for water use have been removed, or because available information indicates that no incentives for water use are currently identifiable, based on foreseeable technological developments.

Qualitative exposure determinations consider existing and potential water uses on the basis of background water quality. In general, the reviewer considers existing and potential uses of water that may be affected by the facility. Past uses may be included as existing or potential uses. Potential uses include those uses that are reasonably sure to occur (i.e., anticipated use), and uses that are compatible with the untreated background water quality (i.e., possible use).

The review of long-term water use considers the ground-water classification in EPA's "Groundwater Protection Strategy" (i.e., Class I, where the ground water

represents an irreplaceable drinking water source or provides the base-flow for a particularly sensitive ecological system; Class II, where the ground water is currently used or potentially available for drinking or other beneficial uses; and Class III, where the ground water is heavily saline with a total dissolved solids content of more than 10,000 parts per million (ppm), or otherwise contaminated beyond levels that allow cleanup, using methods that are reasonably employed in public water system treatment, and which do not migrate into Class I or Class II ground waters or discharge and degrade surface waters). For Class I and Class II ground water, the reviewer assumes that exposure is likely to occur unless the applicant demonstrates that exposure of humans and unique habitats to contamination is effectively impossible throughout the period of the contamination. For Class III ground water, exposure is not generally evaluated unless the water is currently used or a future beneficial use is anticipated.

The reviewer confirms the assessment of existing and anticipated uses of water by comparing background water quality with Federal, State, and local water-quality standards. When water-use standards are inconsistent among several intended water uses, the more stringent criteria will be applied, unless the applicant demonstrates to NRC staff satisfaction that lesser standards apply, based on site-specific considerations. Additionally, the reviewer considers any applicable legal constraints and institutional control on current or future water use; wellhead protection areas; and water use estimates based on demographic projections, zoning patterns, and projected population growth estimates.

The reviewer may use information on water use from local organizations, water supply companies, and State and Federal agencies.

Evaluation of Health Hazards

The applicant's assessment is reviewed to determine if it provides reasonably conservative or best estimates of potential health effects caused by human exposure to hazardous constituents. This determination involves assessing potential health hazards for each constituent for which an ACL is proposed, based on comparisons of existing and projected constituent concentrations with appropriate exposure limits and dose-response relationships from available literature, including the MCLs, reference doses (RfDs), or risk-specific doses (RSDs). MCLs represent the EPA standards for drinking water. RfDs are the amounts of toxic constituents to which humans can be daily exposed without suffering any adverse effect. RSDs are the amounts of proven or suspected carcinogenic constituents to which humans can be daily exposed, without increasing their risk of contracting cancer, above a specified risk level.

MCLs, RfDs, and RSDs for most hazardous constituents in uranium mill tailings can be obtained from EPA. The RfD and RSD assessment assume a human mass of 70 kg and consumption of 2 liters of water per day. More stringent criteria may apply if sensitive populations are exposed to hazardous constituents. In most cases, constituents will have MCLs, RfDs, and/or RSDs, and the applicant should in this case use this information to show compliance with the risk level and Hazard Indices. The reviewer confirms that the applicant considers MCLs, RfDs, or RSDs in assessing potential health hazards. In the absence of

applicable MCLs, RfDs, or RSDs, the reviewer confirms that the applicant has provided a technical basis for the risk assessment provided in the ACL application, by analyzing the dose-response relationships based on literature searches or toxicological research. The reviewer verifies that the exposure analysis distinguishes between threshold (toxic) and non-threshold (carcinogenic) effects associated with human exposure, as well as teratogenic, fetotoxic, mutagenic, and synergistic effects.

As a requirement, finding that a proposed ACL does not represent a substantial present or future hazard to human health, when use of ground water for drinking purposes must be considered, or an ALARA determination, on a case-by-case basis, because of the absence of limits in the regulations. Applications for ACLs must demonstrate that the proposed limits are ALARA, considering practicable corrective actions, as required in Criterion 5B(6) of Appendix A. When considering the potential for health risks from human exposure to known or suspected carcinogens in the use of ground water for drinking purposes, an ACL would be acceptable if it does not pose an excess lifetime risk of fatal cancers to an average exposed individual at the POE on the order of 10^{-4} or more from individual constituents.

The cancer risk should be evaluated for individual constituents, including radioactive and carcinogenic chemicals, and compared with the maximum permitted risk level. The health effects of non-radioactive and non-carcinogenic constituents that are chemically toxic will be evaluated considering their RSD levels, and for some chemicals that have threshold effects, it will be necessary to calculate a Hazard Index using the RfDs (the Hazard Index is the ratio of calculated intake to the RfD, and an acceptable Hazard Index must be less than unity).

The applicant should also show that the cumulative effects of human exposure to hazardous constituents for which ACLs are proposed and other constituents present in contaminated groundwater will be maintained at a level adequate to protect public health. For the purposes of the ACL guidance, it should be understood that combined effects from both radiological and non-radiological constituents should be considered.

The reviewer also verifies that the applicant has identified the range of variability in estimating the risk, and the persistence and permanence of adverse effects. The reviewer determines whether the proposed human exposure levels are reasonably conservative, defensible, and sufficiently protective of human health to avoid a substantial present or potential hazard to people for the estimated duration of the contamination.

Evaluation of Environmental Hazards

Similar to the review of human health effects, the reviewer verifies the assessment of risks of environmental populations' exposure to hazardous constituents. The review includes consideration of adverse effects on aquati and terrestrial wildlife, plants, agricultural crops, animals, and physical structures. The reviewer confirms that the assessment adequately identifies and evaluates adverse effects such as: (1) contamination-induced biotic

changes, (2) loss or reduction of unique or critical habitats, and (3) jeopardizing endangered species. If adverse effects on endangered species and critical habitats are predicted, they are included in the assessment. Consultation with the U.S. Fish and Wildlife Service is required under the Endangered Species Act, if an endangered or threatened species is found on the site, or thought to inhabit the site.

For each potential exposure pathway, the reviewer compares existing and predicted constituent concentrations with chronic toxicity levels for plants and animals. Acute and sub-chronic effects may be considered based on estimated constituent concentrations and limits for acute and sub-chronic environmental exposure. For physical structures, such as foundations, underground pipes, and roads, the reviewer ensures that estimated constituent concentrations will not result in any significant degradation or loss of function as a result of contamination exposure. The reviewer verifies that the applicant's assessment adequately evaluates the potential adverse effect to environmental species and physical structures that may be exposed to contaminated ground water and hydraulically-connected surface water.

Bioaccumulation and food web interactions are also considered in reviewing adverse effects. Aquatic wildlife effects are evaluated by comparing estimated constituent concentrations with Federal and State water-quality criteria. The reviewer ensures that the applicant considers terrestrial wildlife exposure to constituents through direct exposure and food-web interactions. The assessment should identify and assess terrestrial habitats at sites where terrestrial wildlife may potentially be exposed to hazardous constituents.

Agricultural effects consider both direct and indirect exposure pathways, crop impacts, reduced productivity, and bioaccumulation of constituents. Reasonably conservative estimates of constituent concentrations are compared with Federal and State water quality criteria to estimate agricultural effects associated with constituent exposure. Additionally, crop exposures through contaminated soil, shallow ground-water uptake, and irrigation, along with livestock exposure through direct ingestion of contaminated water and indirect exposure through grazing, should be assessed. The reviewer ensures that the agricultural assessment is consistent with any assessment of human exposure to hazardous constituents through ingestion of contaminated food products.

3.3.3.2 Review Element 2: Corrective-Action Review

The applicant's assessment of ground-water corrective-action alternatives is reviewed in conjunction with the hazard assessment. Previous, current, and proposed practicable corrective actions are reviewed to determine if the applicant has demonstrated that the proposed ACLs are ALARA. The demonstration includes identification of alternative corrective actions; assessment of their technical feasibility, implementation, costs, and benefits; and selection of practicable corrective actions.

The ground-water corrective-action assessment should ensure that the following are satisfied:

1. A complete range of reasonable alternative corrective actions has been identified.

2. The identified corrective actions are feasible and appropriate to reduce constituent concentrations at the site.

3. The corrective actions have been designed to optimize their effectiveness.

4. An objective comparison of the costs and benefits associated with the corrective actions is complete.

5. The proposed ACLs are ALARA.

The reviewer verifies that the applicant's assessment identifies and evaluates an adequate range of reasonable corrective-action measures. The assessment should provide sufficient descriptive detail for each of the identified measures, so that the reviewer can independently verify reasonableness of the corrective action. Different corrective actions are currently in operation at Title II uranium mill sites. These corrective actions, their results, and their application at other sites can serve as the basis for an applicant's selection of a corrective-action program. Projections of hazardous-constituent concentrations at specific corrective-action measures could be based on previous experience and data obtained from the implementation of such measures at other sites.

Following the review of the identified corrective actions, the reviewer verifies the applicant's assessment of the technical feasibility for each of the identified actions. The technical feasibility review considers site-specific hydrogeologic characteristics that may affect the performance of the corrective measure. In addition, the contamination extent and the potential for human and environmental exposure are also considered. The applicant's feasibility assessment, based on proven applications of corrective-action techniques at other contaminated sites, will be approved. New and promising corrective action techniques that are proposed by the applicant will also be approved if the applicant can demonstrate, to NRC staff satisfaction, that the proposed techniques have a high likelihood of success. Additionally, the reviewer confirms that the identified corrective action is followed by a suitable monitoring period, to verify that the remediated water quality is stable.

The reviewer should then determine whether the corrective actions included in the feasibility assessment have been so selected and designed to optimize the effectiveness in reducing hazardous-constituent concentrations. This may be demonstrated with backup calculations that provide approximations of the effects of the proposed actions on the ground-water quality under the site-specific hydrogeologic conditions. The reviewer may also require that site-specific tests be conducted before a best alternative is selected or approved by NRC. Ideally, the licensee will not be expected to consider or implement other alternative corrective actions in the event that an NRC-approved corrective action proves to be ineffective. However, NRC must reserve the right to require a licensee to identify and implement an

alternative corrective action if circumstances warrant, at specific sites, based on new information.

The direct and indirect benefits of implementing each of the identified corrective actions should be compared with the costs of performing (or not performing) such measures. The cost estimates include consideration of capital costs for design, implementation, and decommissioning, along with operation and maintenance costs. The reviewer verifies estimates of the current and projected value of pre-contaminated water resources, based on water rights, availability of alternative water supplies, and projected water-use demands. The reviewer generally considers the value of potentially contaminated water resources as equal to either the cost of domestic or municipal drinking-water supplies, or the cost of supplied water to replace the contaminated resources. The absence of alternative water supplies increases the relative value of potentially contaminated water resources. Th adequacy of the benefits assessment is similarly evaluated, considering the avoidance of adverse health effects, value of pre-contaminated ground-water resources, prevention of land-value depreciation, and benefits accrued from performing the corrective action.

Ultimately, the adequacy of the applicant's consideration of practicable corrective actions will be evaluated and used to determine whether the proposed corrective-action measures satisfy the ALARA requirement. In making this determination, the reviewer should consider relevant guidance concerning the ALARA determination, including relevant guidance in Appendix I to 10 CFR Part 50, Report Number 39, and ICRP's Publication 22. The reviewer verifies that the applicant's assessment has demonstrated that the proposed ACLs are ALARA, considering practicable corrective action.

3.4 Documentation of Review Findings

The findings from the detailed application review will likely support one of the following recommendations: (1) approval of the entire application proposal, (2) approval of selected ACLs, or (3) non-approval of the application in its entirety. The reviewer develops a separate written report that fully documents the recommendations, including a detailed description of the technical basis that supports each recommendation. The report should address the general and specific criteria presented in Sections 3.3.2 and 3.3.3, along with any other criteria that may be relevant, because of site-specific conditions presented in the application. The documentation report must be prepared before formal approval of the proposed ACLs, so that it can be used for reference in the licensing action.

If the applicant's ACL submittal satisfies the acceptance review criteria and the detailed review confirms the basis for the proposed ACLs, then it can be concluded that regulatory compliance has been achieved. The reviewer may the recommend approval of the site-specific ACLs for the constituents requested b the applicant and provide the documentation to support the approval.

The reviewer may also recommend establishing ACLs for only those constituents for which the applicant's demonstration is sufficient to satisfy regulatory requirements. In this case, the reviewer would document and describe which

ACLs proposed by the applicant were not recommended for implementation, along with those approved. These descriptions should cite specific inadequacies that caused the demonstration to fail for the selected constituents, describe the technical basis for the review conclusions, and identify an alternative technical approach that might resolve the inadequacies. The reviewer will also develop documentation for the approved ACLs.

If the applicant's ACL submittal fails to demonstrate compliance with Criterion 5B(6) of Appendix A, then the reviewer documents the basis for the failure, cites specific inadequacies, and describes the technical basis for the review conclusions. These review findings are then transmitted to the applicant for resolution.