## FSME Procedure Approval

# *Termination of Uranium Milling Licenses in Agreement States*

# SA-900

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Issue Date:

Review Date:

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***NOTE***
***Any changes to the procedure will be the responsibility of the FSME Procedure Contact. Copies of the FSME procedures will be available through the NRC website.***

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| | **Procedure Title:**<br>***Termination of Uranium Milling Licenses in Agreement States***<br>**Procedure Number: SA-900** | **Page: 1 of 9**<br><br>**Issue Date:** |

## I. INTRODUCTION

This procedure describes the review process for making the determination that all applicable standards and requirements have been met prior to Agreement State uranium milling license termination, as required by 10 CFR 150.15a(a) and Section 274c of the Atomic Energy Act of 1954, as amended (Act).

## II. OBJECTIVES

A. To establish the procedures to be followed by NRC staff for review of uranium milling license termination proposals submitted by Agreement States.

B. To provide guidance for use by Agreement States on preparation and submittal of uranium milling license termination proposals for NRC staff review.

## III. BACKGROUND

A. Section 150.15a(a) of 10 CFR states that the NRC shall have made a determination that all applicable standards and requirements pertaining to material as defined in 10 CFR 150.3(c)(2) have been met prior to termination of any Agreement State license for such material. This provision in NRC's regulations stems from Section 274c.(4) of the Act which reads in part: "[t]he Commission shall also retain authority under any such agreement to make a determination that all applicable standards and requirements have been met prior to termination of a license for byproduct material, as defined in 11e.(2)."

~~B. With the approval of Management Directive 9.15, "Organization and Functions, Office of State Programs" on July 6, 1993, Office of State and Tribal Programs (STP), formerly the Office of State Programs (OSP), was explicitly assigned responsibility for making determinations under §150.15a(a). Management Directive 9.15 provides, in part, that the Office "[m]akes the determination required in Section 274c of the Act of 1954 that all applicable standards and requirements have been met before an Agreement State terminates a license for byproduct material as defined in Section 11e.(2). This determination will be made in consultation with the Office of Nuclear Material Safety and Safeguards."~~

~~C~~B. Two kinds of Agreement State uranium milling licenses are involved: conventional and non-conventional (mainly in-situ ~~leach~~ recovery licenses). A conventional uranium mill (which includes heap leach facilities) is a facility that generates mill tailings which will be transferred to a custodial agency for long term care in accordance with 10 CFR § 40.28 after the entire license is terminated. A non-conventional uranium mill is a facility that generates limited quantities of byproduct materials which are normally transferred to conventional tailings impoundments for disposal and therefore no land transfer is required at license termination.

For both types of licenses, the Agreement State is expected to conduct its review for decommissioning, reclamation and/or groundwater restoration in accordance with license requirements and State standards which are compatible with the requirements of 10 CFR Part 40. Agreement States are responsible for approval of the remediation plans of uranium milling facilities in their States and for site inspections to ensure that the actual remedial actions have been completed pursuant to the approved plans. With NRC's determination that all applicable standards and requirements have been met, the Agreement State terminates the specific licenses for its licensees.

~~D~~C. Historically, the NRC has reviewed non-conventional uranium milling license termination requests from Agreement States on a case-by-case basis without any specific guidance. This procedure describes the specific guidance the NRC staff would use to ensure consistency in the process and information that NRC would need from an Agreement State to make its determination prior to termination of pending and future Agreement State conventional and non-conventional uranium milling licenses. A detailed license termination process for termination of uranium milling licenses in Agreement States is documented in Appendix A.

## IV. ROLES AND RESPONSIBILITIES

A. ~~As stated in the Management Directive 9.15, T~~the Office of Federal and State Materials and Environmental Management Programs (~~STP~~ FSME) Director or designee has overall responsibility for the review and for making the determination required in Section 274c of the Act that all applicable standards and requirements have been met before an Agreement State terminates a license for byproduct material as defined in Section 11e.(2).

B. The Division of Materials Safety and States Agreements (MSSA) Director or designee is responsible for the early interaction activities with the Agreement State~~s~~ involv~~inge~~d the review. The MSSA Director or designee is responsible for assigning a Project Manager (PM) as well as MSSA and Division of Waste Management and Environmental Protection (DWMEP) staff level contacts for the review team. The MSSA Director or designee requests the Office of General Counsel (OGC) to assign staff level contacts to support members of the review team.

C. The review team is responsible for conducting the staff evaluation of Agreement State proposals according to this procedure. A team normally consists of the PM and the assigned staff contacts from MSSA, and DWMEP. OGC will assign a staff member to support the review team.

~~B~~D. The ~~STP~~ MSSA Project Manager ~~(PM)~~ is responsible for completing the NRC's review of uranium milling license termination proposals submitted by Agreement States. The PM is the primary interface between the NRC and the State ~~is the primary NRC contact for the State~~ during the review. T~~Finally, t~~he PM is the

review team leader.

~~C. The review team is responsible for conducting the staff evaluation of Agreement State proposals according to this procedure. A team normally consists of the PM and the assigned staff contacts from the Office of Nuclear Material Safety and Safeguards (NMSS) and the Office of the General Counsel (OGC).~~

## V. GUIDANCE

A. Agreement State's early interaction with NRC

Agreement States are encouraged to seek NRC guidance early-on when a licensing action raises novel or unique issues that are atypical with normal, standard site closure proposals from Agreement State licensees. When a State licensing action is needed in response to such a licensee proposal, an Agreement State should make its own evaluation and determination on whether the licensee's proposal meets the applicable standards and/or requirements. At that time, the Agreement State is encouraged to provide NRC an opportunity to review the basis for its conclusion before the licensing action is taken. NRC will review the State's determination and will provide its views as to whether the basis is sufficient to support the conclusion provided by ~~to~~ the Agreement State ~~for consideration~~. Further interactions between NRC and the Agreement State may be needed to avert difficulties during NRC's review of the license termination if an agreement on the conclusion can not be reached.

In addition, approximately 2 years prior to submitting a draft Completion Review Report (CRR) to NRC, Agreement States should consider whether NRC staff should be invited to visit sites that are in the process of license termination to discuss the histories and conditions of the sites and receive feedback, if any, from NRC staff. Agreement States may contact the ~~STP~~ MSSA Director or designee to discuss any early interaction activities.

B. Each Agreement State license amendment that terminates a portion of the site from a license will be considered as a partial license termination and the NRC will make the Atomic Energy Act, Section 274c.(4) determination for each case.

C. Applicable standards and requirements to be used by NRC to make the determination:

The "applicable standards and requirements" to be used by NRC in making a determination under Section 150.15a(a) are the applicable standards in the Agreement States. Such Agreement State standards were established according to the rules requirements in Section 274o of the Act during the initial establishment or amendment of the State's Agreement, during revision of the regulations to maintain compatibility, or during approval of an alternative

standard.[1] Agreement State standards also include legally binding requirements, orders, or license conditions that implement the requirements of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA).

D. Bases to be used for NRC determination:

The determination that all applicable standards and requirements have been met prior to termination of an Agreement State license has two primary supporting bases:

1. The first basis is a CRR submitted by the Agreement State containing the conclusions from the State's review of a licensee's completed remedial actions. This report should document the State staff's bases in summary form for its conclusion that all applicable standards and requirements have been met.

2. The second basis is NRC reviews of the Agreement State's uranium recovery regulatory program, currently conducted under the Integrated Materials Performance Evaluation Program (IMPEP). The results of the IMPEP reviews provide a basis for confidence on the determinations and conclusions reached by the Agreement State, as set out in the CRR, and also a basis of confidence that the State's reviews, licensing actions, and inspections associated with license termination have been conducted appropriately. The periodic reviews of selected technical areas, conducted under IMPEP, which also include training and qualifications of staff and adherence to necessary program procedures, e.g., license termination process for uranium milling licenses or equivalent procedures, will also serve as a basis that all applicable standards and requirements ~~are~~ have been met.

E. Scope of NRC review of CRR

NRC staff should not duplicate the State's review or conduct an independent detailed technical review of the proposed license termination or of any of the specific documentation submitted by the Agreement State licensee. Rather, NRC staff should examine whether the CRR has documented the State staff's bases in summary form for its conclusion that all applicable standards and requirements have been met. The level of detailed information contained in the CRR should be similar to that contained in the sample CRRs which can be found in Appendices B and C for conventional and non-conventional uranium milling licenses, respectively.

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[1] As stated in the last paragraph of Section 274o of the Act, the Agreement State may adopt alternative standards if, after notice and opportunity for public hearing, the NRC determines that such alternative standards provide an equivalent or greater level of protection for public health, safety, and the environment.

Unless there are obvious flaws identified in the CRR related to the State-approved reclamation, decommissioning and/or groundwater restoration plan, NRC staff will focus its review on whether the State has provided adequate bases in summary form to confirm that closure activities were performed according to the approved plans and specifications. In addition, if any changes or degradation of the design features have occurred since the completion of construction of disposal areas, NRC staff will determine whether the State has evaluated the changes to confirm that the site continues to meet all applicable standards and requirements.

Under unique circumstances NRC staff may require more detailed information than is presented in the CRR if NRC staff determines that the detailed technical information is needed to resolve: (1) issues that may not have been identified under Section V.A.; or (2) issues that were identified under Section V.A. but were not resolved.

F. Two-step CRR review process

A two-step CRR review process would involve an Agreement State formally submitting a draft CRR for NRC review and comment before the Agreement State submits its final CRR.

1. Agreement States should submit draft CRRs to NRC for review and comment. The State staff should alert the PM or the ~~STP~~ MSSA Director or designee at least one month before submitting the draft CRR. The ~~STP~~ MSSA Director or designee should ~~request that NMSS and OGC assign staff level contacts for the~~ assemble a review team.

2. The draft CRR should include the following information depending on whether the license being terminated is a conventional or non-conventional uranium milling license. Sample CRRs for conventional and non-conventional uranium milling licenses can be found in Appendices B and C, respectively.

   a. Conventional Uranium Milling License

      (i) A brief description of licensee's activities associated with decommissioning, tailings remediation, and groundwater cleanup, if necessary.

      (ii) Documentation that the completed surface remedial actions were performed in accordance with applicable standards and requirements.

      (iii) Documentation that the completed site decommissioning actions were performed in accordance with applicable standards and requirements. This documentation should include a discussion of the results of radiation surveys and

soil sample analyses which confirm that the licensed site meets applicable standards and requirements for release.

(iv) Documentation that the completed groundwater corrective actions, if necessary, were performed in accordance with applicable standards and requirements.

(v) Discussion of results of State's site closure inspection(s).

(vi) For partial terminations, documentation that release of a portion of the site will not negatively impact the remainder of the site to be closed at a later date. Such documentation could be a statement from the appropriate State regulatory agency which confirms that the impact of releasing a portion of the site has been evaluated and includes the bases for the State's conclusion.

b. Non-conventional Uranium Milling License (Mainly In-situ Leach License)

(i) A brief description of licensee's activities associated with decommissioning and license termination.

(ii) Groundwater information which demonstrates that the groundwater has been adequately restored to meet applicable standards and requirements.

(iii) Documentation that the production, injection and monitoring wells have been closed and plugged in accordance with applicable standards and requirements. Such documentation could be a copy of correspondence from the State to the licensee which confirms that all wells have been closed and plugged in accordance with the State criteria or a statement from the appropriate State regulatory agency to that effect.

(iv) Decommissioning information which documents that all radiologically contaminated materials have been properly disposed of, transferred to licensee(s) authorized to possess such materials, or meet applicable standards and requirements for release. Such documentation could be a statement from the State which confirms that decommissioning activities have been evaluated and includes the bases for the State's conclusion.

(v) Discussion of the results of radiation surveys and soil sample analyses which confirm that the licensed site meets applicable standards and requirements for release.

(vi) Discussion of results of the State's site closure

inspection(s).

(vii) For partial terminations, documentation that release of a portion of the site will not negatively impact the remainder of the site to be closed at a later date. Such documentation could be a statement from the appropriate State regulatory agency which confirms that the impact of releasing a portion of the site has been evaluated and includes the bases for the State's conclusion.

3. The review team will follow the guidance stated in Section V.E. and review the draft CRR using the acceptance criterion, i.e., whether the draft CRR has documented the State staff's bases in summary form for its conclusion that all applicable standards and requirements have been met.

4. The review team prepares a letter to the State program Director to document the results of its review. The ~~STP~~ FSME Director or designee signs the letter following Office concurrence and no legal objection from ~~NMSS and~~ OGC. The PM may schedule telephone conference calls or meetings with State staff and team members, if needed, to discuss the results of the review.

5. The State should address NRC's comments by making changes to amend the draft CRR as appropriate. The PM may schedule telephone conference calls or meetings with State staff and team members, if requested by the State, to discuss the amended draft CRR. When the State completes the amended draft CRR, the State program Director should submit it as the final CRR to the ~~STP~~ FSME Director or designee.

6. The review team conducts a review of the final CRR to ensure that all the previous comments have been considered and are reflected in the final CRR. The PM may schedule telephone conference calls or meetings with State staff and team members, if the comments are not properly addressed. The State should address those issues by making revisions to the final CRR, if needed.

7. After completing the review, the PM prepares a response letter (samples in Appendix D for conventional licenses and Appendix E for non-conventional licenses) back to the State. The ~~STP~~ FSME Director or designee signs the letter following Office concurrence and no legal objection from ~~NMSS and~~ OGC.

G. Long-Term Surveillance Plan (LTSP)

For a full termination of a conventional uranium milling license, the NRC staff will also review a site LTSP submitted by the custodial agency. Guidance for the NRC review of the LTSP can be found in Appendices D and E of NUREG-1620 entitled "Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act." NRC's review of the LTSP is not included in ~~STP~~ FSME Procedure SA-900. Note that sites that have been partially terminated have involved areas surrounding the actual milling area which were released without the need for an LTSP.

The NRC review and acceptance of the LTSP is conducted in accordance with 10 CFR § 40.28 which is the sole purview of the NRC. Lack of NRC acceptance of a site LTSP can delay termination of the specific license. The NRC staff's acceptance of an LTSP will be documented by written notification to the relevant Agreement State and custodial agency.

H. Process to be followed for NRC determination:

1. A detailed step by step license termination process for conventional and non-conventional uranium milling licenses in Agreement States is documented in Appendix A. An Agreement State licensee's request for amendment to release a portion of site from its license also requires NRC to make a determination based on a site specific CRR for that portion of the site. Similar license termination processes should be followed for both partial and entire license termination cases.

2. Given a determination that all applicable standards and requirements have been met, the NRC should notify the State of its determination by formal correspondence. Upon notification from the NRC, the Agreement State should be prepared to terminate the specific license, if it is a non-conventional uranium milling license, or to amend the license to remove the remediated or unaffected portion from that license, if the license is being partially terminated.

3. For the full termination of a conventional uranium milling license, the Agreement State should be prepared to terminate the specific license after the following occur: (1) notification of the NRC determination that all applicable standards and requirements have been met; (2) notification that the NRC has accepted the LTSP and (3) notification of transfer of the long-term care funds to the appropriate State or the custodial agency.

VI. APPENDICES

Appendix A - License Termination Process

Appendix B - Sample Completion Review Report for Conventional Uranium Milling License

Appendix C- Sample Completion Review Report for Non-conventional Uranium Milling License

Appendix D - Sample NRC determination letter for Conventional Uranium Milling License

Appendix E - Sample NRC determination letter for Non-conventional Uranium Milling License

## VII REFERENCES

1. Section 274 of the Atomic Energy Act of 1954, as amended

2. 10 CFR Part 150, Exemptions and Continued Regulatory Authority in Agreement States and in Offshore Waters Under Section 274

3. Management Directive 5.6, "Integrated Materials Performance Evaluation Program" (ML041410578)

~~4. Management Directive 9.15, "Organization and Functions, Office of State Programs"~~

~~5~~4. SECY-99-025, "Guidance to Terminate Agreement State Uranium Recovery Licenses under Requirements of 10 CFR 150.15a(a) and Section 274c"

~~6~~5. NUREG-1620 Rev. 1, "Standard Review Plan for the Review of a Reclamation Plan for Mill Tailings Sites Under Title II of the Uranium Mill Tailings Radiation Control Act" (ML032250190)

~~7~~6. Final Report of the Working Group on Uranium Milling License Termination in Agreement States, June 2002

## VIII. ADAMS REFERENCE DOCUMENTS

For knowledge management purposes, all previous revisions of this procedure, as well as associated correspondence with stakeholders that have been entered into NRC's Agencywide Documents Access and Management System (ADAMS) are listed below.

| No. | Date | Document Title/Description | Accession Number |
|---|---|---|---|
| 1 | 9/26/02 | STP-02-069, Notice of Opportunity to Comment on Draft Revision of STP Procedure SA-900: Termination of Uranium Milling Licenses in Agreement States | ML022690215 |

| No. | Date | Document Title/Description | Accession Number |
|---|---|---|---|
| 2 | 12/31/02 | STP Procedure SA-900, Termination of Uranium Milling Licenses in Agreement States. | ML030170416 |
| 3 | 12/31/02 | Analysis of Public Comments on STP Procedure SA-900, Termination of Uranium Milling Licenses in Agreement States. | ML030170435 |

# APPENDIX A - License Termination Process

Termination of uranium milling licenses in Agreement States has been divided into two major parts as follows: (a) termination of conventional uranium milling licenses; and (b) termination of non-conventional uranium milling licenses (mainly in-situ leach licenses).

## (a) Termination of Conventional Uranium Milling Licenses

Steps 1 through 5 and step 7 are applied to entire license termination cases; steps 1 through 6 are applied to partial license termination cases.

**Step 1:** Licensee Documentation of Completed Remedial and Decommissioning Actions

Licensees are required under 10 CFR 40.42(j) or equivalent Agreement State regulations to document the results of site decommissioning by conducting a radiation survey of the premises where the licensed activities were carried out. The results of this survey, the contents of which are specified at the Agreement State regulation equivalent to 10 CFR 40.42(j)(2), are submitted to the State for review, as a final status survey report~~decommissioning report~~.

Criteria 5A-5D, along with Criterion 13, of Appendix A under 10 CFR Part 40 or equivalent Agreement State regulations incorporate the basic groundwater protection standards imposed by U.S. Environmental Protection Agency (EPA) in 40 CFR Part 192, Subparts D and E. These standards apply during operations and prior to the end of closure. In addition, under Criterion 6(7), the licensee should address the non-radiological hazards associated with the wastes in planning and implementing closure. The licensee should ensure that disposal areas are closed in a manner that minimizes the need for further maintenance. Licensees may refer to the introduction section of 10 CFR Part 40, Appendix A, or equivalent Agreement State regulations with respect to the use of alternative standards for groundwater protection.

If the groundwater protection standards are exceeded, the licensee is required to put into operation a groundwater corrective action program (CAP). The objective of the CAP is to return the hazardous constituent concentration levels to the concentration limits set as standards. For licensees with continuing groundwater cleanup, State approval is required for the termination of corrective action. Appropriate groundwater monitoring data and other information that provide reasonable assurance that the groundwater has been cleaned to meet the applicable standards and requirements are submitted to the State for review, as a groundwater completion report.

**Step 2:** Review of Completed Closure Actions by the Agreement State

Upon receipt of the final status survey report ~~decommissioning report~~ and as~~in~~ necessary, the groundwater completion report, the State staff should review the content of the reports for documentation of acceptable completion of the applicable aspect of closure. The State staff should also review the licensee's completed reclamation of the tailings disposal cell which may be documented in a construction completion report or similar report submitted by the licensee. As part of its oversight process during decommissioning, the State staff should conduct site inspections, examining first-hand the closure actions taken. Additionally, the State staff should conduct a final construction-completion inspection, which is expected to consist of a site walk-over.

Typically, there is an observational period following the completion of remedial actions for the State to assess the potential long-term stability of the tailings disposal cell. Licensees should

report significant cell degradation occurring during this period. All identified hazardous constituents for which groundwater compliance sampling is being conducted at a licensed site must be returned to the concentration limits or alternate concentration limits set as standards prior to termination of a specific license. The specific license should not be terminated while an active groundwater CAP is in operation. Passive groundwater CAPs are acceptable for license termination, as long as the CAP achieves the applicable standards and requirements before license termination, and shows that groundwater will remain at or below those standards for the design life of the disposal cell.

**Step 3:** Site Ready for License Termination

When a licensee has completed site reclamation, decommissioning, and/or groundwater corrective actions, and is ready to terminate its specific uranium milling license, the licensee should formally notify the State of its intentions.

**Step 4:** Agreement State Prepares Draft Completion Review Report (CRR) and Submits to NRC

Agreement State staff prepares a draft CRR based on guidance provided in the ~~STP~~ FSME Procedure SA-900 and submits the draft CRR to NRC for review.

**Step 5:** NRC Review of Draft and Final CRRs

Upon receipt of the draft CRR, NRC staff should follow the review process stated in Section V.F. of ~~STP~~ FSME Procedure SA-900 to conduct its review.

**Step 6:** License Amendment for Partial License Termination

Given a determination that all applicable standards and requirements have been met, the NRC would notify the State of its determination by formal correspondence. If it is a partial license termination case for which a Long-Term Surveillance Plan (LTSP) is not required, the Agreement State should be prepared to amend the license to remove the remediated or unaffected portion from it.

**Step 7:** License Termination/Issuance of the General License

In cases involving termination of an entire license, NRC acceptance of the LTSP is required prior to termination of the specific uranium milling license and placement of the site and byproduct material under the general license in 10 CFR 40.28.

The Agreement State should be prepared to terminate the specific license after the following occur: (1) notification of the NRC determination that all applicable standards and requirements have been met; (2) notification that the NRC has accepted the LTSP and (3) notification of transfer of the long-term care funds[2] to the appropriate State or the custodial agency. The long-

[2] Prior to license termination, the Agreement State should establish the final amount of the long-term site surveillance fund to be paid by the licensee in accordance with Criterion 10 of Appendix A under 10 CFR Part 40 or equivalent Agreement State regulations. The Agreement State's process for determining this amount should include consultations with the custodial agency. Payment of this amount to the appropriate State or the custodial

term custodian, for its part, should be prepared to accept title to the land and byproduct material.

**(b) Termination of Non-Conventional Uranium Milling Licenses (Mainly In-Situ Leach Licenses)**

The following steps are applied to both partial and entire license termination cases.

**Step 1:** Licensee Documentation of Completed Decommissioning and/or Groundwater Restoration Actions

When the surface reclamation and/or groundwater restoration is complete, the licensee should submit (1) groundwater information which demonstrates that groundwater has been restored in accordance with the applicable standards and requirements and (2) documentation indicating that the production, injection and monitoring wells have been closed and plugged in accordance with the State criteria, to the State for review, as a groundwater completion report.

Licensees are also required under 10 CFR 40.42(j) or equivalent Agreement State regulations to document the results of site decommissioning, which is accomplished by conducting a radiation survey of the premises where the licensed activities were carried out. The results of this survey, the contents of which are specified at the Agreement State regulation equivalent to 10 CFR 40.42(j)(2), are submitted to the State for review, as a final status survey report~~decommissioning report~~.

**Step 2:** Review of Completed Closure Actions by the Agreement State

Upon receipt of the final status survey report~~decommissioning report~~, and if necessary, the groundwater completion report, the State staff should review the content of the report for documentation of acceptable completion of the applicable aspect of closure. As part of its oversight process during decommissioning, the State staff should conduct site inspections, examining first-hand the closure actions taken. Additionally, the State staff should conduct a final site inspection, which is expected to consist of a site walk-over.

**Step 3:** Site Ready for License Termination

When a licensee has completed site decommissioning, and/or groundwater restoration actions, and is ready to terminate its specific uranium milling license, the licensee should formally notify the State of its intentions.

**Step 4:** Agreement State Prepares Draft CRR and Submits to NRC

Agreement State staff prepares a draft CRR based on guidance provided in the ~~STP~~ FSME Procedure SA-900 and submits the draft CRR to NRC for review.

**Step 5:** NRC Review of Draft and Final CRRs

Upon receipt of the draft CRR, NRC staff should follow the review process stated in Section V.F. of the ~~STP~~ FSME Procedure SA-900 to conduct its review.

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agency is required prior to license termination.

## Appendix A -- License Termination Process

**Step 6:** License Termination/License Amendment for Partial License Termination

Given a determination that all applicable standards and requirements have been met, the NRC should notify the State of its determination by formal correspondence. Upon notification from the NRC, the Agreement State should be prepared to terminate the specific license or amend the license to remove the remediated or unaffected portion from it, if the license is being partially terminated.

## APPENDIX B - Sample Completion Review Report for Conventional Uranium Milling License

## NOTE TO READER

The sample Completion Review Report (CRR) was developed by a Working Group composed of Agreement State and NRC staff. As stated in the ~~STP~~ FSME Procedure SA-900, prior to license termination, Agreement States submit CRRs for NRC review. The CRR should document the State staff's bases in summary form for its conclusion that all applicable standards and requirements have been met.

The purpose of this sample CRR is to generally show the expected level of detailed information in a variety of technical areas which should be provided in the CRR. The Working Group recognized that no single site, or any existing documentation, could serve as a complete template for all aspects of site closure, since each conventional uranium milling site is likely to have its own site-specific conditions. To cover as many aspects of license termination activities as possible, the sample CRR is a composite of examples from a number of existing documents. Stakeholders' comments and input have also been considered and are reflected in the sample CRR.

The reader is advised that the sample CRR provides neither a complete list of all applicable standards and requirements that need to be addressed nor complete boiler-plate language to be used as bases for conclusions. Rather, it provides an example of the level of detailed information that would be expected for inclusion in the CRR.

**Appendix B -- Sample Completion Review Report (Conventional)**

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6. For partial terminations, documentation that release of a portion of the site will not negatively impact the remainder of the site to be closed at a later date.

III. REFERENCES

**Appendix B -- Sample Completion Review Report (Conventional)**

## Agreement State Radiation Control Program

## COMPLETION REVIEW REPORT

Date:
Licensee: XXXXX
License Number: XX-XXXX-X
Facility Name: XXXXX
Location: XXXXX, State
Licensed Area Being Terminated: approximately X,XXX acres
Manager:
Technical Reviewers: [John Smith, M.S.,P.E. (Hydrologic Engineer)]

## I. SUMMARY

The ABC Company's XYZ site is a conventional uranium milling and tailings site which has been decommissioned and reclaimed under XXX State Department of Health (XDOH) Agreement State authority, derived from Title II of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). UMTRCA requires that prior to termination of the license, the U.S. Nuclear Regulatory Commission (NRC) shall make a determination that the licensee has complied with all applicable standards and requirements. Under the Agreement State program, the State of XXX is responsible for approval of the remediation plans for the XYZ site and for site inspections to ensure that the actual remedial actions have been completed pursuant to the approved plans.

This report documents XDOH's basis for its conclusion that decommissioning and reclamation have been acceptably completed at the XYZ site. The NRC ~~STP~~ FSME Procedure SA-900 entitled, "Termination of Uranium Milling Licenses in Agreement States," was used to prepare this report.

The applicable standards for uranium mill reclamation is Chapter XXX-XXX XAC (State Administrative Code), entitled [Radiation Protection-Uranium and/or Thorium Milling]. This State regulation is consistent with and compatible with NRC regulations, as required by the State's Agreement State status with the NRC.

All applicable standards and requirements, with appropriate references to related sections of the CRR, are identified in Table B-1. [Note to Reader: Table B-1 in this sample CRR does not contain a complete list of all applicable standards and requirements.] XDOH has performed a complete review of the XYZ site for compliance with all applicable standards and requirements. As part of that review, XDOH has prepared a Technical Evaluation Report (TER) (reference) or other technical reviews (reference(s)) to document the State's review. The TER or other technical reviews may provide reference to more detailed evaluations by the State and to ABC's documents submitted for State review during the site's reclamation period. XDOH's reviews of licensee submittals were conducted by using guidance document(s) [NRC NUREG-1620 or equivalent, etc.]

Table B-1 Applicable Standards and Requirements* Related to Topics Discussed in the CRR

| Applicable Standards / Requirements | | CRR Sections | TER Sections** |
|---|---|---|---|
| | 1. tailings isolation | Section 2.1 | Section X.XX |

| | | | |
|---|---|---|---|
| 10 CFR Part 40 Appendix A or equivalent State Regulations | 4.<br>(a) erosion potential<br>(b) wind protection<br>(c) flatness of slopes<br>(d) self-sustaining vegetative cover or rock cover<br>(e) seismic design | <br>Section 2.3<br>Section 2.3<br>Section 2.1.1<br>Section 2.3<br>Section 2.1.3 | <br>Section X.XX<br>Section X.XX<br>Section X.XX<br>Section X.XX<br>Section X.XX |
| | 5. groundwater cleanup criteria | Section 4.1 | Section X.XX |
| | 6.<br>(2) radon flux<br>(4) radon measurements and limit<br>(6) radiation cleanup and control<br>(7) closure and post-closure impacts | <br>Sections 2.4-2.5<br>Section 2.4.1<br>Sections 3.1-3.2<br>Sections 4.1-4.3 | <br>Section X.XX<br>Section X.XX<br>Section X.XX<br>Section X.XX |
| | 13. groundwater cleanup criteria | Sections 4.1-4.3 | Section X.XX |
| Other applicable standards and requirements | | | |

*As defined in Section V.C. of the ~~STP~~ FSME Procedure SA-900 issued on [Month Day, Year].
**Sections in TERs or equivalent reference documents.

XDOH concludes that the specific criteria of 10 CFR Part 40 Appendix A (or State equivalent regulations) are met as follows:

Criterion 1. Tailings Isolation

Erosion, disturbance, and dispersion are minimized.

The contaminated tailings will be protected from flooding and erosion by an engineered rock riprap layer. The riprap has been designed in accordance with the applicable guidance (reference). XDOH staff considers that erosion protection that meets that guidance will provide adequate protection against erosion and dispersion by natural forces over the long term. As discussed in the CRR Section XX, adequate protection is provided by (1) selection of proper rainfall and flooding events; (2) selection of appropriate parameters for determining flood discharges; (3) computation of flood discharges using appropriate and/or conservative methods; (4) computation of appropriate flood levels and flood forces associated with the design

discharge; (5) use of appropriate methods for determining erosion protection needed to resist the forces produced by the design discharge; (6) selection of a rock type for the riprap layer that will be durable and capable of providing the necessary erosion protection for a long period of time; and (7) placement of a riprap layer in accordance with accepted engineering practice and in accordance with appropriate testing and quality assurance controls.

As discussed in the CRR Sections XX, XDOH staff considers that the riprap layers will not require active maintenance over the 1000-year design life, for the following reasons: (1) the riprap has been designed to protect the tailings from rainfall and flooding events which have very low probabilities of occurrence over a 1000-year period, resulting in no damage to the layers from those rare events; (2) the rock for the riprap layers is designed to be durable and is not expected to deteriorate significantly over the 1000-year design life; and (3) during construction, the rock layers have been placed in accordance with appropriate engineering and testing practices, minimizing the potential for damage, dispersion, and segregation of the rock.

Criterion 4.

(a) erosion potential

The site is located in an area that is flooded by offsite floods from XXXX (area). However, as discussed in the CRR, the site is protected from direct onsite precipitation and flooding by engineered riprap layers for the top and side slopes; the tailings disposal cell will need this protection regardless of where it is located. The riprap for the side slopes and drainage ditches is large enough to resist flooding from the minimal flow velocities of floods occurring from a probable maximum flood (PMF) on the XXXX (area). A large rock apron has been provided to provide protection against the potential migration of the XXXX (area). XDOH therefore concludes that the erosion potential at the site has been acceptably minimized, since any flooding at the site is mitigated by the erosion protection, and the forces associated with offsite floods are minimal.

(b) wind protection

XDOH staff considers that the site is adequately protected from wind erosion by the placement of an engineered riprap layer that protects the tailings from surface water erosion. Studies (reference) have shown that the engineered riprap layer designed to protect against water erosion is capable of providing adequate protection against wind erosion.

(c) flatness of slopes

The relatively flat top and side slopes of the covers is protected from erosion by an engineered riprap layer which has been designed to provide long-term stability (see the CRR Section XX). The erosion potential of the covers is minimized by ~~the~~ designing the rock to be sufficiently large to resist flooding and erosion, based on the slope selected. Thus, XDOH concludes that the slopes, with their corresponding rock designs, are sufficiently flat to meet this criterion.

(d) self-sustaining vegetative cover or rock cover

See discussions under Criterion 1 regarding erosion, disturbance, and dispersion for the type of information which should be included.

Other criteria

## Appendix B -- Sample Completion Review Report (Conventional)

[insert similar summary information for other criteria]

In conclusion, XDOH believes that the ABC's XYZ site has met all applicable standards and requirements. With a determination by NRC, as required by Section 274c.(4) of the Act, that all applicable standards and requirements have been met, the radioactive material license, XX-XXXX-X, may be terminated.

## Appendix B -- Sample Completion Review Report (Conventional)

### II. DOCUMENTATION OF BASES FOR CONCLUSION

Following are XDOH's review results for items specified in the ~~STP~~ FSME Procedure SA-900 "Termination of Uranium Milling Licenses in Agreement States."

1. A brief description of licensee's activities associated with decommissioning, tailings remediation, and groundwater cleanup, if necessary.

ABC completed construction of the mill in [year], and it was operated until [year]. Nominal milling capacity was X,XXX tons of ore per day, with an average design ore grade of 0.XXX percent $U_3O_8$. ABC received ore and processed it from [insert sources of ore or materials for reprocessing]. Approximately XX.X million tons of tailings were placed in the impoundment from milling operations. The estimated radium-226 activity in the impoundment is XXX curies, and Th-230 activity is estimated at XXX curies (reference).

Mill decommissioning activities began in [year] and were completed in [year]. Approximately XXX,XXX cubic yards ($yd^3$) of contaminated mill site soils, building equipment, and debris were excavated from the XYZ processing site and hauled approximately XXX miles for placement in the synthetically lined area of the tailings impoundment (reference). Other materials disposed of in the impoundment include [insert direct disposed materials from off-site sources] with estimated radium-226 activities of XXX curies, total uranium activity of XXX curies, and Th-230 activities of XXX curies.

[Impoundments that exist on-site as opposed to a new cell should describe dewatering and other pre-capping activities.]

The mill site was characterized using a combination of scans for gamma radiation and analyses of surface soils, and borehole logging and soils analyses for subsurface deposits. Areas with contamination found to exceed applicable standards and requirements were excavated. Contaminated materials were disposed in the [lined] tailings impoundment or repositories (reference). The site cleanup was monitored and a Final Status Survey was conducted following guidance in [NUREG 1575 (MARSSIM)].

Once filled, the impoundment was covered with XX.X feet of site borrow soils, and re-vegetated. A diversion channel was constructed around three up-gradient sides of the impoundment. A rock-armored swale outlet for the impoundment cover watershed was installed. All impoundment and margin areas have been covered with either rock armor (riprap) or re-vegetated to provide structural stability (reference).

A Monitoring and Stabilization Plan, in effect during and after reclamation construction in [year], has been evaluating site performance. XDOH staff inspections and reviews of monitoring data and analytical justifications provided by ABC indicate that the site has reached a stable condition.

When all regulatory requirements are completed, the XYZ site will be transferred to XXX (custodial agency) responsibility. The site reclamation fund, held by XXX, will be terminated and the long-term surveillance and control surety fund, held by XDOH, will be transferred to XXX.

2. Documentation that the completed surface remedial actions were performed in accordance with applicable standards and requirements.

Surface remedial actions include the topics of geotechnical stability, and surface water hydrology and erosion protection.

## 2.1 GEOTECHNICAL STABILITY

### 2.1.1 Introduction

This section presents the results of the XDOH's review of the geotechnical engineering aspects of the closure action proposed at ABC's XYZ site. The closure action consists of the consolidation of all contaminated materials from the processing site to the adjacent tailings pile near [City, State]. The final disposal cell ~~I~~is an above-grade stabilized-in-place embankment extending to a maximum height of XXX feet above the prevailing surface grade. Contaminated material and mill debris were added to the disposal cell. The cell was recontoured, and is covered with a X-foot-thick minimum sand cover, plus filter layer and rock armor on the embankment; a XX-inch-thick multiple layer cover plus rock armor over coarse tailings; and a XX-inch-thick multiple layer cover plus rock armor over at least XX feet of regraded coarse tailings over the fine tailings portions of the embankment (reference).

The geotechnical engineering aspects reviewed include: (1) information related to the disposal and borrow sites; (2) materials associated with the closure action, including the foundation and excavation materials, tailings, and other contaminated materials; and (3) design and construction details related to the disposal site, disposal cell, and its cover.

### 2.1.2 Site Description

The XXX-acre impoundment is adjacent to the former XXX mill, about XXX miles northwest of the town of [City, State]. The site is located within the [local area], and is drained by the XXXX River. The uranium mill tailings were placed in a single pile consisting of approximately XXX million tons. The XXX-acre pile forms a deposit with a maximum height of XXX feet. ABC has covered the sides of the pile with an interim soil cover of variable thickness. As the water in the pond atop the tailings has evaporated, additional interim cover has been placed on portions of the top of the pile, working from the edges inward toward the center.

The former mill area is XXX acres in size and contained building foundations and abandoned mill structures which had been partially demolished. Additional contaminated soil lay outside the confines of the tailings pile. The contaminated soil and building rubble generated from the mill demolition were added to the disposal cell.

### 2.1.3 Disposal Cell Area

Several subsurface investigations have been performed at the XYZ site in order to characterize the tailings and contaminated materials for geotechnical engineering and radiological aspects of the closure. Drawings in the [Month Year], XXXX report (reference) illustrate the original test boring and test pit locations. Logs of soil borings and test pits were provided in the ABC's earlier submittals (reference). In [Month] of [Year], additional test pits were excavated within the confines of the mill and the tailings embankment. The [year] test pit logs are reported in Appendix X of the [Month Day, year] submittal (reference).

Exploration to depth within the tailings embankment was not previously performed since the presence of an active evaporation pond impeded drill rig access. To further characterize the tailings, and to evaluate the embankment with respect to stability and potential settlement, ABC has committed to perform piezocone or other in-situ tests after the cover has been placed. The piezocone is an instrument which measures the piezometric pressure at a cone tip as the test device penetrates a material. Cone Penetration Test (CPT) pore pressures, thus measured, reflect both the soil type and the stress history of the material. CPT or equivalent test data have been reviewed along with settlement records to better evaluate the time-rate of tailings consolidation.

2.1.4 Borrow Areas

Radon barrier clay soils from the XXXX area were evaluated by [reference]. The XXXX borrow area is located about XX miles [west] of the tailings pile. In [year], XX exploratory test pits were excavated in the XXXX area Sandy soil for the radon barrier was obtained from material excavated during the reconfiguration of XXXX area (reference). In addition to the sampling associated with the reconfiguration of XXXX area, three additional samples were taken from the borrow area.
~~In [year], XX exploratory test pits were excavated in the XXXX area~~.

~~Finally, in addition to the sampling associated with the reconfiguration of XXXX area, three additional samples were taken from the borrow area.~~

2.1.5 Geotechnical Investigation Conclusions

XDOH staff has reviewed the subsurface exploration discussed above. XDOH concludes that the geotechnical investigations conducted at the processing, disposal, and borrow sites satisfactorily establish the stratigraphy, that the explorations are in general conformance with applicable provisions of Chapter X of the SRP (reference), and that they are adequate to support the assessment of the geotechnical stability of the stabilized tailings and contaminated material in the disposal cell. Additional in-situ testing was performed to confirm the stratification and strength parameters of the tailings and to confirm the settlement analysis.

2.1.6 Testing Program

Geotechnical engineering characteristics and strength parameters for the tailings, contaminated soil, and natural soils have been determined by ABC, through laboratory analysis of samples from the investigations. Early laboratory testing by [reference], and later testing by [reference], included moisture-density (Proctor) determinations, gradation analyses, specific gravity, saturated hydraulic conductivity determinations, Atterberg Limits, capillary moisture, one-dimensional consolidation, static triaxial, and cyclic triaxial compression. XDOH has reviewed the geotechnical engineering testing program for the XYZ site and concludes that the tests identified above were conducted on representative materials.

ABC's laboratory testing of the XXXX (area) borrow material included gradation, Atterberg Limits, moisture-density determination, specific gravity, saturated hydraulic conductivity, capillary moisture relationships, dispersive tendencies, diffusion coefficient, and triaxial shear strength.

Within the XXXX area, one composite sample was made from the "affected" (contaminated) sandy soils. A second sample was made from "clean." The composite samples were then split into three subsamples, and were redivided for geotechnical and radiological sampling.

Laboratory testing by ABC included gradation, Atterberg Limits, moisture-density relationships, specific gravity, diffusion coefficient, and (for the "affected" soils) radium activity and emanation coefficient determination. Three composite samples from [west] of the tailings pile area were tested for gradation, Atterberg Limits, moisture-density relationships, specific gravity, diffusion coefficient, and capillary moisture relationship.

Cover materials were evaluated for durability. Testing included Los Angeles Abrasion, sulfate soundness, absorption, specific gravity, Schmidt Hammer, and Brazilian disk tensile tests. Petrographic analyses were also conducted.

On the basis of the field exploration and laboratory testing programs, ABC concluded that the borrow sites contain suitable quantities of material acceptable for the radon barrier. Testing indicated the soils are non-dispersive.

Based on the review, XDOH staff found that the number and type of tests conducted in the testing program were appropriate for the support of the engineering analyses performed and that the scope of the testing program and the utilization of the test results to define the material properties are in general agreement with the applicable provisions of the guidance document (reference).

2.1.7 Slope Stability

The evaluation of the geotechnical stability of the slopes of the disposal cell containing stabilized tailings and other contaminated materials is presented in this section. XDOH has reviewed the exploration data, test results, slope characteristics, and methods of analyses pertinent to the slope stability aspects of the reclamation plan. The analyzed cross-sections with [10] horizontal to [3] vertical side slopes have been compared with the exploratory records and design details. XDOH found that the characteristics of the slopes have been satisfactorily represented and that the most critical slope sections have been considered for stability analyses.

Soil parameters for the various materials in the disposal cell slope have been adequately established by appropriate testing of representative materials. Soil parameter values have been assigned to other layers (riprap, gravel bedding, bedrock, etc.) by ABC, on the basis of data obtained from geotechnical explorations at the site and data published in the literature. XDOH found that the determinations of these parameters for slope stability evaluation follow conventional geotechnical engineering practice, and are also in compliance with the applicable provisions of the guidance document (reference). XDOH also found that an appropriate method of stability analysis (XXXX method) has been employed by ABC to address the likely extreme adverse conditions to which the slope might be subjected for the static case.

Factors of safety against failure of the slope for static and seismic loading conditions have been determined by ABC for both short-term (end of construction) and long-term states. Factors of safety for the static loading conditions were calculated by ABC to be X.X (short- and long-term) which are in excess of minimum required values of X.X and X.X, respectively.

The seismic stability of the proposed slopes was investigated by ABC using the pseudo-static method of analysis, with horizontal seismic coefficients of X.XXg for both the end-of-construction and the long-term cases. The value of the seismic coefficient was consistent with the design

ground acceleration value used for the nearby XXXX site. In actuality, a horizontal seismic coefficient equal to X.XX times the maximum ground acceleration, or X.XXg, would be used in a long-term pseudo-static evaluation. As a further exercise, ABC arbitrarily increased the horizontal seismic coefficient in order to determine the value which would imply impending failure. The coefficient which resulted in a factor of safety of unity, implying impending failure, was X.XXg.

Subsequently, ABC performed deterministic and probabilistic ground motion evaluations in [Month Year] (reference). XXXX determined that a peak horizontal acceleration of X.XXg, which represents an event with a mean return period of 10,000 years, was an appropriate value for design (see Section XXX). Since ABC's earlier analysis was based on a peak horizontal acceleration in excess of X.XXg, and stable conditions were confirmed, the conservativeness of the seismic design with respect to slope stability was substantiated.

Based on review of these analyses and the results, XDOH concludes that the slopes of the disposal cell are designed to endure the effects of the geologic processes and events, including resistance to earthquake and settlement, to which they may reasonably be subjected during the design life and that the analyses have been made in a manner consistent with the guidance document (reference).

2.1.8 Credible Faults

XDOH evaluated potential earthquake sources (such as capable faults) and earthquake hazards for the site. XDOH's determination that the impoundment has not been placed near a capable fault is based upon review and acceptance of geologic information from literature sources, personal communication with personnel at the State Geological Survey, XDOH review of field mapping of the site by ABC's contractor, XDOH review of subsurface geophysical surveys surrounding the tailings impoundment by ABC's contractor, and XDOH personnel conducting independent field evaluations of the structural geology at the site. Historical seismic activity was also reviewed by XDOH.

XDOH review of regional geologic literature has found no evidence of local faulting in the Pleistocene age glacio-fluvial deposits, or in the Miocene age Basalt Member of the River Basalt Group, at least 14.5 million years before present (reference). The USGS Open-File Report 91-441-0, Known or Suspected Faults with Quaternary Displacement in the Pacific Northwest, was also reviewed (reference). Staff at the State Geological Survey was also consulted for information related to faults in the area during XDOH's assessment of ABC's closure plan. XDOH review of Quaternary faults has concluded that the nearest capable fault is in the XXXX area, approximately XXX miles to the northwest.

Detailed geologic mapping at the ABC's XYZ site performed by XXXX. found no evidence of faulting in the Pleistocene glacio-fluvial deposits or Miocene age River basalts, XX.X million years before present (reference). Geologic field evaluations at the ABC site by XDOH staff also found no evidence of faults in the glacio-fluvial deposits, XXX River basalts, or Tertiary aged clays found near the tailings impoundment. The layers in the unconsolidated sediments may generally be described as flat lying over structures that have been observed in the older granitic rocks of Cretaceous age. Therefore, the literature review and field mapping indicate that the fracturing and faulting in the Cretaceous rocks are a result of pre-Miocene deformation occurring at least XX.X million years before present.

Two geophysical seismic surveys were conducted for the subsurface around the tailings impoundment by a ABC contractor (reference). XDOH staff independently reviewed the information provided in the XXXX reports and determined that there is no evidence presented in these reports of a capable fault at depth.

Historic seismic data have been reviewed by XDOH and State's Dam safety program. Some of the historic seismic data reviewed are presented in reports prepared for ABC (reference), the XXXX Final Environmental Impact Statement for the ABC site (reference), and the initial engineering report (reference). There are no historic seismic data that suggest large-magnitude earthquakes near the ABC site. Recent earthquake analyses performed by XXXXX have indicated that there have been five low-magnitude events within XX km of the ABC site. However, XXXX's probabilistic seismic assessment analysis has determined that these low-magnitude seismic events are not significant with respect to stability of the site (reference).

In summary: (1) faults that have been identified and mapped in and near the site to a distance of 100 miles have not moved once in the last 35,000 years, or twice or more in the last 500,000 years, do not have macro seismicity associated with them, nor are they associated with capable faults such as the XXXX fault; and (2) no historic earthquakes have originated near the site that by magnitude, alignment, or magnitude-distance relationship to the site indicate a buried capable fault source, or any other earthquake source, that should be considered explicitly in the seismic design basis assessment for the site. XDOH evaluated low- magnitude seismic events that appear approximately XX-XX km northeast of the site by reviewing geologic maps for the area and personal communication with XXXX State's seismic experts at the State Geological Survey. Based upon XDOH review conducted in the fall of XXXX, XDOH concludes that these low-magnitude seismic events are not associated with earthquakes along the trace of a capable fault, and the data indicate that these events appear to be the result of mine blasts.

2.1.9 Seismic Evaluation

According to 10 CFR 40, Appendix A (or equivalent State regulations), the impoundment may not be located near a capable fault that could cause a maximum credible earthquake larger than that which the impoundment could reasonably be expected to withstand. As used in this criterion, the term "capable fault" has the same meaning as defined in Section III (g) of Appendix A of 10 CFR Part 100. The term "maximum credible earthquake" means that earthquake which would cause the maximum vibratory ground motion based upon an evaluation of earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material. The guidance document (reference) describes the methodologies that may be used to conduct this evaluation. Details of the review for XYZ site were presented in the TER (reference).

A review was conducted of all recorded earthquakes in [name the tectonic province in which the site is located] and in other tectonic provinces within XXX miles of the site. The review contained the date of occurrence of the earthquake, its magnitude, and the location of the epicenter.

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Data were obtained by [e.g., standard photo geologic analysis] and field reconnaissance of the study area and from review of the pertinent literature (references). Information in the form of maps, papers, or other, specific to the area or region, generated by State and Federal agencies or published in the literature were reviewed (references). [Insert conclusions]

Where possible, an association of epicenters or locations of highest intensity of historic earthquakes with tectonic structures was conducted. Epicenters or locations of highest intensity that were not reasonably identified with tectonic structures were identified with tectonic provinces. Maps on which the locations of epicenters of historic earthquakes associated tectonic structures, and tectonic provinces were produced and presented in the TER (references). [Insert conclusions].

In addition to the historical review, the proposed maximum earthquakes associated with [each tectonic province or capable fault or structure] were determined and deterministic and/or probabilistic seismic hazard analyses were conducted.

Seismic design ground motion (PHA)

Capability was determined by [suitable methods, such as those outlined by (reference). For each maximum magnitude earthquake, the PHA at the site was determined using [an accepted attenuation relationship between earthquake magnitude and distance] (reference). The PHA value adopted for each capable fault or tectonic source was no less than the median value provided by the attenuation relationship. Possible soil amplification effects were considered (reference).

To assess potential ground motion at the site from earthquakes not associated with known tectonic structures (i.e., random or floating earthquakes), the largest floating earthquake reasonably expected within [the tectonic province] was identified. [insert site-specific results]. In addition, the largest floating earthquakes characteristic of [any adjacent tectonic provinces] was also identified, since such earthquakes may cause appreciable ground motion at the site [insert site specific results]. ~~The~~ XX miles was used as the site-to-source distance for floating earthquakes within [the host tectonic province]. (For floating earthquakes in other tectonic provinces, the distance between the site and the closest approach of the province boundary was used as the site-to-source distance). The PHA for the site was therefore the maximum value of the PHAs determined for earthquakes from all capable faults, tectonic sources, and tectonic provinces. In summary, ABC has presented information and used acceptable methods of investigations that support its conclusions about the seismic characterization of the site and the seismic design value. Information presented includes descriptions of historical earthquakes, locations of their epicenters, an analysis of the seismic hazard at the site, and the design considered a deterministic and/or a probabilistic PHA [PSHA]. The information presented is sufficient to support an analysis of the geotechnical stability.

2.1.10 Settlement and Cover Cracking

Long-term settlement of materials in the disposal cell, which could result in either local depressions or cracks on top of the cover, was addressed by ABC in XXXX's report of [Month Day, Year]. A proposed settlement monitoring program was provided. Settlement monuments have been installed directly on the tailings prior to the initiation of regrading activities. Construction equipment is required to maintain a minimum distance of XXXX feet from all monuments.

The monuments were surveyed for vertical displacement on a daily basis for the first XXX weeks of initial fill placement, weekly for the following XXX months, and then monthly for the final two months. After ABC had concluded that XX percent of the consolidation settlement was complete, and with XDOH's concurrence, final soil cover placement operations began.

Settlement monuments were located in areas where consolidation is expected to be the greatest, including areas believed to have maximum thicknesses of fine tailings. Such an arrangement assures that differential settlement would not adversely affect the integrity of the cover. Additionally, the final soil cover was spread and compacted in a uniform manner to minimize the effects of settlement due to the weight of the final soil cover materials. ABC concluded that XX percent of the primary consolidation should take XX years, based on the fact that there has been no disposal of tailings since XXXX and that the pumping program conducted at the site has accelerated the dewatering process.

In addition, ABC conducted an exploration program within the embankment using XXXX methods. The in-situ data were evaluated along with settlement records to confirm the conclusion that XX percent of the expected settlement has occurred. The in-situ test results were also used to assess the potential for cover cracking. XDOH found that the settlement monitoring program is sufficient to satisfy applicable portions of Criteria 1, 6, and 12, of 10 CFR Part 40, Appendix A, regarding reclamation design to control radiological hazards for the design life without active maintenance after reclamation is complete.

2.1.11 Liquefaction Potential

The liquefaction potential for the XYZ site was initially evaluated for ABC by [reference]. XXXX evaluated the liquefaction potential based on empirical techniques and on the basis of a laboratory evaluation. Minimum factors of safety of X.XX (empirical) and X.XX (laboratory) were derived in the [reference] study. Based on the similarity in results, and considering minimum acceptable safety factors of X.X, XXXX concluded that no major problem related to liquefaction would occur during the postulated seismic event, which they considered to be a Magnitude X event with a hypocentral distance of approximately XX km and a maximum ground acceleration of X.XXg.

An understanding of seismic hazards and the liquefaction process has improved since [year]. Based on more recent interpretations of potential seismic events, and in accordance with a [Month Day, Year] request from the XDOH, ABC re-evaluated the liquefaction potential for the site [reference]. Liquefaction potential was re-evaluated using standard penetration test values, soil gradation, and sample descriptions from previous analyses with updated empirical relationships. The potential induced stresses were estimated from simplified procedures using field-based methods.

Liquefaction susceptibility can be estimated by either of two approaches. The first method correlates resistance with Standard Penetration Test (SPT) blowcounts, measured in-situ. The second method relies on laboratory measurements of dynamic tests that strain soil samples in repeated cycles of motion until liquefaction is induced. [Reference] stated that the field-based method is the preferred analytical procedure.

By using methods detailed in [reference], the in-situ liquefaction resistance was computed. In the [reference] analysis, corrected SPT values are normalized and correlated with the cyclic stress ratio required to trigger liquefaction, in observational data. The field cyclic stress ratio is thus obtained from curves dependent on the normalized blowcounts and soil fines content. For a calculated factor of safety less than X.X, failure is assumed to occur. For a factor of safety between X.X and X.X, liquefaction is not assumed to occur, but the soils may suffer some strength loss.

[Reference] showed that very few sample points indicate susceptibility to liquefaction, and that isolated incidences of liquefaction, if it were to occur, would be deep within the embankment. ABC determined that liquefaction of the tailings and underlying soils is unlikely to occur, and that there is no threat to the stability of the embankment.

Based on a review of the analysis presented by ABC [reference], XDOH concludes that there is adequate assurance of safety with respect to liquefaction damage.

2.1.12 Cover Design

ABC has used three different embankment cover sections, depending on location:

(1) The final cover profile for the embankment consists of X feet (minimum) of sandy soil above the regraded coarse tailings. The sandy soil is capped by a filter layer and rock armor of variable thickness.

(2) The cover profile over coarse tailings consists of:

X inches (minimum) of low-grade ore from the mill area;
XX inches (minimum) of affected soil;
X inches (minimum) of compacted clay; and
X inches of sandy soil.

The coarse tailings areas are covered with rock armor of variable thickness.

(3) The cover profile over fine tailings includes:

X feet (minimum) of regraded coarse tailings;
XX inches (minimum) of affected soil;
XX inches (minimum) of compacted clay; and
X inches (minimum) of sandy soil.
The sandy soil is covered with rock armor of variable thickness.

The cover system described above provides a minimum of XX inches of cover above tailings on

the top and sides of the cell. The system has been designed to limit the infiltration of precipitation, protect the pile from erosion, and to control the release of radon from the tailings below.

Tests on the compacted clay from XXXX indicate that hydraulic conductivities are near XX-XX cm/sec at placement conditions. In addition, the physical shape and surface grading of the reclaimed tailings embankment effectively remove surface water resulting from precipitation which falls on the area. The relatively low permeability of the cover materials and the low annual rainfall with high evaporation rate prevent significant tailings recharge.

ABC has evaluated the potential for frost penetration using the [BERGGREN.BAS] computer code developed at the [U.S. Army Corps of Engineers (reference)]. The code has been used on several other uranium mill tailings remediation projects. In order to evaluate the potential for frost penetration, temperature data including the freezing index, mean annual air temperature, length of freezing season, and geotechnical parameters are considered. The model calculates the heat capacity, thermal conductivity, and latent heat of fusion for the soil layers unless these data are entered manually.

Values used in the computer analysis included the mean and worst-case situations based on the available XX years of weather records. In the worst-case scenario, ABC determined that the depth of frost penetration would be XX.X inches. By thickening the sand layer to X inches, and in conjunction with the exterior rock armor, the potential for frost penetration into the clay layer is eliminated, and the cover integrity should not be significantly affected.

XDOH has reviewed the input data used in determining the total frost penetration depth and concludes that these values are a reasonable representation of the extreme site conditions to be expected. Therefore, ABC's evaluation of the frost penetration depth is acceptable to XDOH.

XDOH has evaluated the cover design for geotechnical long-term stability and concludes that the design is acceptable.

2.1.13 Subsidence

ABC presented an analysis [reference] to show that a worst-case scenario of subsidence would not adversely affect the stabilized tailings. The (reference) approach was based on a simplified procedure by [reference], and considered instantaneous subsidence of XX meter(s) and, for added conservatism, of XX meter(s).

The modified XXXX procedure was developed from finite element analyses and physical models for propagation of earthquake fault ruptures in the bedrock beneath cohesive soil deposits. The analytical and physical model results were also compared with case histories of earthquake fault rupture propagation through soil, such as those described by [reference]. XDOH considers ABC's approach to be conservative for evaluating the surface deformation associated with vertical subsidence caused by salt dissolution because it assumes the deformation to be instantaneous and concentrated within a single narrow zone rather than being incremental and more distributed, as would be expected for salt dissolution subsidence.

ABC's analysis [reference], using the simplified fault rupture propagation model of [reference], indicates that the thickness of alluvium and tailings is greater than the distance of propagation

for XX and XX meter bedrock offsets. Thus, differential displacements of bedrock, resulting from salt dissolution subsidence under the tailings pile, would not be expected to propagate to the surface and impair the function of the clay cap and radon barrier. XDOH concludes that the analysis was conservative for the reasons discussed above. XDOH therefore concludes that the licensee provided adequate assurance that the potential for differential offsets reaching the surface of the pile as a result of salt dissolution over the next 1000 years is negligible.

2.1.14 Construction Methods and Features

XDOH has reviewed design text, tables, and drawings in the technical specifications submitted by ABC (reference). The text discusses the investigations and testing which formed the basis of the design and specifications. Additionally, the text discusses the design concept in detail. The text is supported by tables which summarize design parameters and figures which clearly show plans, profiles, and details of the proposed remedial action.

In summary, the side slopes were re-contoured to a [10]H to [3]V proportion. Mill debris has been buried systematically at the toe of the slope. A permanent layered cover provides protection from excessive radon emanation, and permits rainfall to drain away satisfactorily.

XDOH has reviewed and evaluated the geotechnical construction criteria provided in the Reclamation Plan. Based on this review, XDOH concludes that the plans and drawings clearly convey the proposed closure action design features. In addition, the excavation and placement methods and specifications are consistent with accepted standard practice and the guidance document (reference).

2.1.15 Testing and Inspection

XDOH has reviewed drawings and technical specifications submitted by ABC (reference). The technical specifications discuss testing methods and quality control procedures applicable to the remedial work. Appropriate reference is made to [ASTM] methods which will govern the placement and testing of soil and rock materials.

Based on XDOH's review, the plan is found to provide a program for testing and inspection that is generally consistent with the XXXX guidance document (reference).

2.1.16 Conclusion

Based on the review of the geotechnical engineering aspects of the design of the ABC closure action as presented in the Reclamation Plan, XDOH concludes that the embankment and proposed borrow soils have been adequately characterized. Furthermore, the cover system appears to be adequately designed to resist the effects of freezing conditions which can reasonably be expected. XDOH concludes that the slopes of the disposal cell are designed to endure the effects of the geologic processes and events, including resistance to earthquake and settlement, to which they may reasonably be subjected during the design life and that the analyses have been made in a manner consistent with the guidance document (reference). XDOH concludes that there is adequate assurance of safety with respect to liquefaction potential. In conclusion, the XDOH's review of geotechnical stability has found the XYZ site to be in conformance with regulatory requirements of criteria X, X, X, X, and X in 10 CFR Part 40 Appendix A (or equivalent State regulations).

## 2.2 SURFACE WATER HYDROLOGY AND EROSION PROTECTION

The constructed reclamation site is robust by design, and includes a thick, vegetated cover design of site soils surrounded by a large surface water diversion channel over X,XXX feet long. The tailings impoundment is situated in a relatively small watershed area (about XXX acres), which limits surface water flow potential. The small catchment area inside the diversion channel is less than XXX acres. The reclamation site is expected to return to a wildlife and forestry land use, similar to the surrounding area, which shows few erosional impacts.

Embankment dam (XX%), margins (XX to XX%), cover (X.XX%), and diversion channel (X.XX to X.XX%) slopes are relatively flat. Erosion protection studies have been performed on these topographic features. Some areas required stabilization by rock (riprap), some by vegetation, and some are naturally stable.

### 2.2.1 Flood Flow

The primary criteria used to evaluate erosion protection are a determination of long-term erosional stability using Criteron 6 (reference), which requires site stability for 1,000 years. [NRC guidance] was used to develop a conservative design basis. A probable maximum precipitation (PMP) event was selected and found to be a X-hour storm of XX.X inches, peaking at mid-storm at XX inches per hour (reference). Probable Maximum Flood (PMF) surface water flow rates were determined, based on the worst-case precipitation event, surface flow characteristics (elevations and contours, surface roughness and vegetation) at the site, and antecedent soil moisture (near-saturated or frozen ground), using the [XXX computer program]. The XXXX method was used to verify surface water flow rates on the cover.

XDOH reviewed and independently verified ABC's flood flow estimates. The [reference] method was used to determine that vegetation is not necessary for erosion protection (reference). The margin areas were found to require XX% vegetal coverage for long-term erosional stability, based on a PMF event. Short-term erosion protection requirements were also determined and require XX% vegetal cover, based on a 10,000-year storm (reference). The Monitoring and Stabilization Plan (MSP) was used to verify vegetation productivity performance after reclamation construction was completed. The XX% short-term requirement was met in [year], and the trend line for performance since reclamation construction in [year] predicts performance in the XX% range by the [summer] of [year] (reference).

PMF flow rates were determined for the diversion channel to be XXXX cfs (cubic feet per second), and for the swale outlet from the impoundment surface area to be XXX cfs. These worst-case flood flow rates were used to determine channel cross-sections and to size the riprap (reference). Diversion channel cross-sections were designed for both the minimum flow resistance, large velocity case, and for the high resistance, low velocity case. Rock protection is required for the first case with a smaller channel cross-section. Long-term performance requires limited rock protection but a larger cross-section channel.

Using these two cases, the diversion channel was designed for a large cross-section, but with rock placed only in the lower portion consistent with the smaller cross-section (reference). Rock and filter sizing was performed using the XXXX method, as recommended by [NRC guidance]. XDOH reviewed and independently verified ABC's analyses (reference). Rock sizes that were

placed met, and generally exceeded the minimum rock sizing required by the analysis-based design. ABC chose to oversize the rock to limit the number of rock sizes produced and placed (reference).

2.2.2 Rock Durability and Gradation

Rock durability and gradation were evaluated during construction to meet approved construction design plans and specifications. An initial petrographic examination per [reference] was made to qualify the rock source. XDOH reviewed the report of the independent evaluation and accepted the rock source (reference). Rock samples were then tested every XX,XXX cubic yards of production for Bulk Specific Gravity and Absorption per [reference], Sodium Sulfate Soundness per [reference], Los Angeles Abrasion per [reference], and Schmidt Hammer Rebound per [reference].

Two different rock sources were used, including a local basalt borrow area and a quartz monzonite area that required blasting.

Rock durability scores, using the XXXX scoring method, averaged XX.X, with the lowest at XX and the highest at XX. XDOH reviewed rock durability test results from the independent laboratory. Rock source gradation was periodically sampled and evaluated by an independent contractor during construction. XDOH inspectors reviewed inspection records during construction and found the evaluations, methods, and records to be adequate. ABC performed a quality assurance construction performance audit program of ABC operations, contractor construction activities, and independent contractor inspections. The ABC auditor reported to corporate management and exercised independent authority, as observed by XDOH inspectors (reference).

XDOH reviewed the data from ABC's construction completion report (reference). The basalt rock source qualified and produced a small fraction of the produced rock (about X,XXX cubic yards). Rock durability test results for basalt scored XX on two tests. The quartz monzonite source qualified and produced most of the rock used during construction (about XX,XXX cubic yards). Rock durability test scores for the quartz monzonite averaged XX.X, with a standard deviation of X.X. XDOH believes that the quartz monzonite source produced uniform rock durability, based on department inspection, the consistency of the rock durability scores, and the small statistical standard deviation for the data.

[NRC guidance] provides a minimum rock durability score of XX, without oversizing. ABC oversized the rock placed by a considerable amount, on average. Oversizing of rock was by design. Rock production used a small number of screens. ABC used only X", X" and XX" $D_{50}$ (median stone diameter) rock sizes. Placement sizes were greater, compared with design rock sizes developed to meet erosion protection criteria. The erosion protection criteria were also determined based on conservative criteria.

In addition to conservative methods for rock sizing and durability, the structural integrity of the site is not dependent only on rock for erosion protection. The XYZ millsite has site-specific attributes (soil, bedrock, weather, etc.) that suggest a durable long-term forest and wildlife environment. Therefore, the rock protection placed during construction becomes less important for structural stability (erosion protection) as vegetation becomes established. The rock performance timeframe is about a thousand years (based on XXXX guidance and methods), while the forest succession timeframe is about a hundred years. This is a convenient overlap of performance features.

During reclamation plan development, ABC evaluated erosion protection requirements for the diversion channel for both the vegetated and non-vegetated conditions. For that area, rock was required in the lower section of the channel (for the non-vegetated condition), and not in the upper section of the channel (for the vegetated condition). The difference between conditions is a factor of three in velocity reduction and in channel cross-section increase, once vegetation establishes. The long-term performance expectation is for a similar velocity reduction in all areas of the site after vegetation succession occurs.

2.2.3 Vegetation Cover

For the design of the top slope, ABC addressed the stability of the slope under three conditions: (1) bare soil with no vegetation; (2) normal, fair vegetation cover; and (3) poor vegetation cover. The stability of these three cover conditions was evaluated using the allowable shear stress method (reference) and the maximum allowable velocity (reference), with corrections for depth (referene). Additionally, XDOH staff independently evaluated the stability of the top slope, using very conservative assumptions. It was assumed that the vegetation was burned, deteriorated, and/or damaged to the extent that approximately XX% of its shear resistance capability had been removed (reduced from X.X pounds per square foot to X.X pounds per square foot), coincident with the occurrence of the design PMF discharge of X.X cfs. Further, an evaluation was conducted assuming a XX% reduction in shear resistance (X.X pounds per square foot), coincident with a discharge of X.X cfs (PMF with no flow concentration, or FCF = 1). Under both conditions, the proposed slope of X.XX was found to be stable. Following is a summary of calculations performed by ABC and XDOH regarding the stable slope design.

Table B-2 Summary of Calculations on Vegetation Cover Performed by ABC and XDOH

| Design Method | Cover Condition | Allowable Stress ($lb/ft^2$) | Actual Stress ($lb/ft^2$) | Allowable Velocity (ft/sec) | Actual Velocity (ft/sec) | Stable Slope (ft/ft) |
|---|---|---|---|---|---|---|
| Allowable Shear Stress | Bare | [0.08] | [0.44] | NA | | [0.0013] |
| | Poor | [3.0] | [0.5] | | | [0.012] |
| | Normal | [4.2] | [0.6] | | | [0.030] |
| Allowable Velocity | Bare | NA | | [2.9] | [2.9] | [0.003] |
| | Poor | | | [3.8] | [3.8] | [0.01] |
| | Normal | | | [3.9] | [3.8] | [0.015] |
| XDOH Independent Estimate | | | | | | |
| (FCF=3) | [90%] Lost | [0.4] | [0.4] | NA | | [0.01] |
| (FCF=1) | [95%] Lost | [0.2] | [0.2] | | | [0.01] |

Additionally, ABC provided further information and justification regarding the design of the vegetation cover in a report (reference) which addresses the concerns raised in XXXX (Reference). These concerns included a conclusion in the [reference] report which indicated that typical soil loss rates in this portion of the United States were so excessive that a soil cover could not be provided for a 1000-year period, based on results of the Universal Soil Loss Equation. ABC performed detailed calculations of the soil loss rates for the specific design and location chosen; these calculations indicated that the design would provide acceptable protection against sheet erosion.

2.2.4 Sedimentation

Sedimentation in the diversion channel was evaluated using the XXXX and XXXX computer programs. The analyses were performed on the PMF case, as well as several lesser flood flow cases, to determine if sedimentation would accumulate in the diversion channel over time and reduce diversion channel flow capacity. It was determined that, except for the first few years after construction, there is no likely flood flow in the channel for flood recurrence intervals less than XXX years, due to expected infiltration. For larger, low-probability flood events, sediment would likely flush out with the expected flood flow. Even without flushing, sediment accumulation predicted by the analysis was approximately X.X feet at the bottom of the diversion channel. The channel was designed so that a minimum of X foot of freeboard would be present, and included a very conservative design PMF basis, sedimentation in the channel, and re-vegetation of the channel (reference). In addition, the channel was constructed somewhat

oversized to meet the design cross-section minimum requirements, and therefore has a capacity excess from the design minimum required.

The impoundment swale outfall requires rock (riprap) erosion protection, since it is designed to convey concentrated flood flow from the impoundment surface and to discharge it away from the reclamation site. This area was evaluated with the same analytical tools as the diversion channel, and found to be adequate. The design was prepared by ABC, and evaluated and approved by XDOH. Worst-case assumptions were used to evaluate the design, based on [NRC guidance]. Vegetation productivity on the impoundment cover has reached a self-sustaining performance level and will continue to improve over time, limiting the probability of occurrence of maximum flood flow (reference). The swale outfall is located over a large area of competent quartz monzonite of sufficient structural capacity, extent, and elevation, that limits potential erosion of cover soils from the impoundment. The swale outfall therefore protects the cover from erosion and promotes sedimentation on the shallow-sloping impoundment surface (reference).

2.2.5 Conclusion

In conclusion, XDOH's review of surface water hydrology and erosion protection has found the XYZ site to be in conformance with regulatory requirements of criteria X, X, X, X, and X in 10 CFR Part 40 Appendix A (or equivalent State regulations).

3. Documentation that the completed site decommissioning actions were performed in accordance with applicable standards and requirements.

3.1 RADIATION CLEANUP AND CONTROL

3.1.1 Introduction

Cleanup of the site was based on the approved decommissioning plan (reference) ([include license conditions or tie downs)]. The decommissioning plan was reviewed by XDOH using guidance document(s)[NRC NUREG 1620 or equivalent, etc.] The operating history of the facility was reviewed in order to ensue that all potential sources of contamination were identified. Applicable standards and requirements were identified during the development of the decommissioning plan and are outlined in Table B-1. Cleanup parameters and guidelines were appropriate and designed to demonstrate compliance. Disequilibrium (Th-230, Ra-226, U-tot) was evaluated, and cleanup criteria were established in accordance with XXX (equivalent Criteria 6(6) rule). [MARSSIM methodologies (NUREG 1575)] were applied ([or an alternate approved method)] for demonstrating cleanup. The MARSSIM process utilized the Data Quality Objectives (DQO) process such that stakeholder data requirements were identified and applied (references). Characterization of the site was performed to identify impacted areas outside the impoundment (e.g., mill buildings, haul roads, bone yards). Background was appropriately determined using reference areas representing the various media [include results]. Areas were then classified properly according to contamination potential.

3.1.2 Millsite Decommissioning

Remediation activities at the site commenced in [year] and ended in [year]. Remediation (demolition/excavation) technologies (or alternate methods) were evaluated and found to be

effective. Effluent controls were in effect for air, water, and soil. Environmental monitoring was in place for all affected media. Changes from the decommissioning plan were explained and justified (reference). A total of XX structures were remediated, and approximately XXXX cubic yards of material were placed in the impoundment, including building rubble, soils, and other permitted materials. Buildings were remediated by XX process. XX acres of the site were remediated to meet the 10 CFR Part 40 Appendix A Criteria 6(6) requirements (or equivalent State requirements). XDOH has reviewed the information as presented in the Mill Decommissioning Completion Report (reference) and the report was found acceptable.

3.1.3 Final Status Surveys

Concurrent with remediation activities, Final Status Surveys (FSS) were conducted to demonstrate cleanup to the stated goals. The FSS designs were reviewed and approved by XDOH (reference). Appropriate instrumentation was chosen for the contaminants of interest and properly calibrated. Th-230 was evaluated by correlation to Ra-226 where feasible, and through soil analysis where a correlation could not be demonstrated. Minimum detectable concentrations of survey instrumentation and other DQOs were compared to plans. The surveys consisted of a combination of gamma scans and soil samples. Borehole surveys for subsurface verification were also made. A summary of survey units, scan and sample results is presented below in Tables B-3-1 to B-3-3.

Table B-3-1 Survey unit summary

| Survey Unit Classification | Number of Survey Units | Samples per Survey Unit | Area of Survey Unit, $m^2$ |
|---|---|---|---|
| I | 75 | 18 | 100 |
| II | 26 | 10 | 100 |
| III | 33 | varies | varies |

Table B-3-2 Summary of gamma exposure rate ranges

| Analytical categories | Gamma exposure rates (mR/h) |
|---|---|
| Number of surveys | [674] |
| Minimum | [9] |
| Maximum | [1,355] |
| Mean | [16] |

[Note: The limit for gamma exposure rate is xxx mR/h]

Table B-3-3 Summary of soil sample analyses

| Analytical categories | Concentration (pCi/g) | | |
|---|---|---|---|
| | Ra-226 | Th-230 | U(total) |

| | | | |
|---|---|---|---|
| Number of soil samples | [354] | [271] | [251] |
| Minimum | [0.5] | [0.0] | [0.2] |
| Maximum | [34.3] | [35.1] | [82.4] |
| Mean | [2.2] | [1.7] | [7.6] |

[Notes:
1. Results include background.
2. The limit for Ra-226 in value can range from XXX to XXX pCi/g.
3. The limit for Th-230 in value can range from XXX to XXX pCi/g.
4. The limit for U(total) in value can range from XXX to XXX pCi/g.]

Verification and validation of the survey results combined with an assessment of the quantity and quality of the data were conducted. The data were validated to ensure that the results supported the objectives of the survey. The Final Status Survey was found acceptable.

3.1.4 Independent Verification

An independent verification survey was conducted by XXXX. Approximately XX% of the survey units were surveyed by the independent verification contractor. Results from the independent verification surveys were compared to the results of the site contractor. The results were in relative agreement, indicating that the FSS report is representative of site conditions.

3.1.5 State Oversight [insert narrative]

In addition to the independent verification, XDOH conducted XX site visits, XX inspections, collected XX samples, and conducted XX gamma surveys on XX survey units. Results of the XDOH's surveys were compared to ABC's results and are in good agreement. (references). [Insert table with results of State analyses].

3.1.6 Conclusion

XDOH's review of radiation cleanup and control has found the XYZ site to be in conformance with regulatory requirements of criteria X, X and X in 10 CFR Part 40 Appendix A (or equivalent State regulations).

3.2 RADON EMANATION

ABC designed the impoundment cover from site soils and determined that an average cover design thickness of XX.X feet was required in order to meet the regulatory limit of 20 pCi/$m^2$s found in Criterion 6 (reference). ABC used the XXXX computer code to perform this analysis. The analysis is based on the concentration of radium 226 in the tailings, and on the site specific soil parameter values applicable to tailings impoundment cover design for radon emanation control. XDOH reviewed ABC's design and analysis reports using guidance document(s) [NRC NUREG 1620 or equivalent, etc.], verified their results, and approved the design plans and specifications. A sensitivity analysis was performed, using realistic, expected long-term soil parameters, and found that a radon 222 flux of only X.XX pCi/$m^2$s would be expected during the

summer and fall when the cover soils are not expected to be saturated (reference).

A thick soil cover of at least XX.X feet thick was placed over the impounded tailings at the XYZ site. The total volume of soil moved during construction to place the cover is in excess of X million cubic yards ($yd^3$). The vegetated cover was designed to have long-term performance. Natural materials (vegetation, soils, and rock) have been used to prepare and construct the cover design. Actual materials used in construction had a greater proportion of fine material than required by the construction design plans and specifications. The actual thickness of the constructed cover averaged over XX.X feet from the sloped sub-grade. The sub-grade, although made up of radium 226-contaminated material, was produced by re-grading the tailings to the required contour and adding additional soil from the contaminated soils cleaned up in the mill area, with clean fill to meet grade requirements. Therefore, the upper portion of the tailings had less radium 226 concentration than was used in the analysis for determining cover thickness. All together, the design is quite conservative and the actual construction met the requirements of the approved design plans and specifications.

3.2.1 Radon 222 Measurements

ABC submitted a reclamation plan which provided the design of a cover system which would reduce the radon 222 flux to XX $pCi/m^2/s$ or less. Use of a published radon flux model (reference) with the design information provided by the licensee confirmed the radon flux reduction provided by the cover system. ABC also demonstrated that the cover system would continue to reduce radon flux for 1000 years or at least 200 years by using an environment dose assessment model (reference) to confirm that the cover system would perform adequately. After completion of the cover system, ABC made radon flux measurements using the radon flux measurement methodology in [Appendix B, Method 115, 40 CFR Part 61]. A mean radon 222 flux rate of X.XX +/- X.XX $pCi/m^2s$ was measured. This measurement is well below the regulatory standard from state regulation XDC-XXX-XXX, Criterion 6 (b), and consistent with the design based on analytical evaluations.

3.2.2 Conclusion

In conclusion, the XDOH's review of radon emanation has found the XYZ site to be in conformance with regulatory requirements of criteria X, X and X in 10 CFR Part 40 Appendix A (or equivalent State regulations).

4. Documentation that the completed groundwater corrective actions, if necessary, were performed in accordance with applicable standards and requirements.

4.1 GROUNDWATER REMEDIATION (EXAMPLE 1: No Action Scenario)

There is no evidence of impact to groundwater at ABC's tailings facility. From the beginning of ABC's operations, tailings were neutralized prior to discharge to the lined impoundment, significantly reducing the risk for groundwater contamination (reference).

The hydrogeology of the site was evaluated prior to construction of the tailings impoundment in [year] and again as part of the design phase of the reclamation cover. The basin hydrologic evaluation was performed by ABC to characterize physical parameters, which control groundwater occurrence, flow, and potential transport of contaminants. Results of this

evaluation and the tailings impoundment investigation were reviewed by XDOH (reference). XDOH supplemented review of ABC's hydrogeologic evaluation with geologic and hydrogeologic field evaluations by XDOH staff. XDOH staff also independently reviewed published geologic and hydrogeologic literature for the area of ABC's facility. XDOH staff reviews have confirmed the findings reported by ABC (reference).

4.1.1 Monitoring Wells

Monitoring wells have been in place surrounding the tailings impoundment since before operations began through the Monitoring and Stabilization phase of the project. Groundwater data have been evaluated by XDOH since [year] for possible leakage from the impoundment (reference). ABC sampled tailings pore fluid for all hazardous constituents defined by State regulations (reference) and found that the hazardous constituents which could be of concern for groundwater are uranium, radium 226, radium 228, thorium 230, arsenic, nickel, and thallium (reference). Therefore, groundwater samples were analyzed for these constituents along with other indicator parameters such as TDS, pH, temperature, sulfate, chloride, and other metals. Samples have been obtained quarterly by ABC since before operations began.

4.1.2 State's Split Sampling

XDOH has split groundwater samples from all of the monitoring wells with ABC and had the samples analyzed at the XDOH's independent laboratory. Samples have been obtained from monitoring wells by XDOH semi-annually since operations began in [year], through [year]. Groundwater samples are collected by XDOH when static water levels of the aquifer are at the seasonally high and low periods of the year. Review of the analytical results from XDOH's laboratory shows the same water quality trends compared to the analytical results from ABC's laboratory.

The Monitoring and Stabilization Plan included three levels of monitoring for frequency and constituent evaluation depending upon conservative trigger exceedances. Although conservative trigger levels have resulted in increased monitoring surveillance, no federal or state regulatory standards have been exceeded (reference). XDOH's review of all groundwater quality data has determined that the hazardous constituents in the tailings impoundment (uranium, radium 226, radium 228, thorium 230, arsenic, nickel, and thallium) are stable in groundwater within the range of natural variability and remain below regulatory levels. Fluctuations in static water levels and indicator parameter values (e.g., sulfate and chloride), observed during post-reclamation construction compliance monitoring, are consistent with anticipated trends and values (reference).

4.1.3 Geo-Chemistry

An extensive independent geochemical review of the tailings impoundment and chemistry of the groundwater was conducted by a XDOH Geochemist. The purpose of the review was to evaluate long-term water quality of the site. The conclusions of this review are that the tailings should remain saturated (not dewatered), and groundwater quality should remain good (reference). Dewatering of tailings was considered, but XDOH determined that for long-term groundwater protection, dewatering of tailings was not desirable or required (reference).

4.1.4 Conclusion

XDOH has made a determination that the closure of ABC's facility is in compliance with State groundwater regulations associated with uranium mill closure. The closure is specifically in compliance with the following groundwater criteria delineated in Chapter XXX-XXXX [State regulations], Criterion 5 and Criterion 13, which incorporate the basic groundwater protection standards imposed by EPA in 40 CFR Part 192, Subparts D and E; and imposed by NRC in 10 CFR Part 40, Appendix A which specifies groundwater monitoring requirements.

4.2 GROUNDWATER REMEDIATION (EXAMPLE 2: Remediation Scenario)

Analytical results of groundwater samples collected from monitoring wells at ABC's facility indicate that the shallow aquifer has been contaminated by the tailings impoundment at concentrations in excess of applicable standards (reference). Using these validated groundwater data, the extent of contamination was delineated by constructing isoconcentration plume maps for ammonia, chloride, molybdenum, nitrate, selenium, sulfate, and uranium (reference). These data indicate that degradation of groundwater quality has occurred as a result of ABC's milling operations which warranted groundwater restoration actions. Subsequent to dewatering, removal, and transfer of the tailings to another licensed site, XDOH worked with ABC to remediate groundwater contamination (reference).

4.2.1 Remedial Selection

The following groundwater remedial alternatives were reviewed by XDOH (reference):

1) natural flushing,
2) hydraulic gradient control via infiltration galleries,
3) slurry wall, groundwater pumping wells, and evaporation pond disposal,
4) groundwater pumping wells, wastewater treatment, and discharge to the [XXXX area], and
5) permeable reactive barriers.

Results of the review indicated that Option 5, permeable reactive barriers, was the most technologically efficient and cost effective remedy based on site-specific characteristics and the nature and extent of groundwater contamination at ABC's facility (reference). Permeable reactive barriers avoid the technological limitations and budgetary constraints associated with traditional approaches such as pump and treat technology (reference). Another significant advantage of permeable reactive barriers is the greatly reduced operation and maintenance costs which are limited to simple groundwater head and water quality monitoring (reference). Permeable reactive barriers are placed in the path of a migrating plume of contaminated groundwater and reactive media within the barrier promote geochemical reactions that result in the destruction, immobilization, and/or stabilization of groundwater contaminants.

4.2.2 Alternate Concentration Limits (optional)

Additional assessment studies of tailings contaminant fate, aquatic toxicology, and environmental risk were conducted to develop alternate concentration limits (ACLs) for the contaminants of concern at ABC's facility including ammonia, chloride, molybdenum, nitrate, selenium, sulfate, and uranium (Reference). The establishment of ACLs was dependent on the approval by XXXX and the exclusion of current and future water rights for local groundwater and surface water by XXXX (reference).

4.2.3 Remedial Implementation

After delineating the areal extent of groundwater contamination and characterizing the horizontal and vertical hydraulic gradients of the aquifer, two separate permeable reactive barriers were installed at ABC's facility including: 1) a zero-valent iron reactive wall was installed across the tailings area and the former mill site location to remediate uranium and heavy metals, and 2) a shorter zeolite reactive wall was installed in a second trench located behind the zero-valent iron reactive wall to remediate ammonia (reference). Both permeable reactive barriers were installed as simple reactive walls because site characteristics prevented the construction of low-permeability funnel walls on the sides of the reactive walls (reference). The design and installation of the permeable reactive barriers included groundwater flow modeling and engineering analysis for optimal reactive wall design and to properly position the reactive walls in the local groundwater flow system (reference).

The design analyses for the permeable reactive barrier included evaluations of the barrier's life-cycle; considering the amount of reactive mass necessary to assure that groundwater concentrations would remain within compliance limits for the closure design life, and whether the barrier permeability would not be adversely impacted by the precipitation of minerals or microbial growth (reference). Post-closure monitoring of the permeable reactive barrier was performed for a period of XX years before the license termination request was submitted to demonstrate the barrier was performing as designed (reference).
[Scenario for post-license termination monitoring of reactive barrier if warranted at a specific site]

Even though post-closure monitoring has confirmed that the reactive barrier is performing as designed, monitoring is recommended beyond license termination in order to evaluate long-term groundwater and reactive barrier chemistry. The costs associated with long-term groundwater monitoring and potential reactive barrier replacement have been calculated and included in the Perpetual Care and Maintenance Fund.

4.2.4 Remedial Monitoring

Monitoring wells and piezometers were completed in the contaminated and uncontaminated portions of the aquifer and in the permeable reactive barriers to monitor groundwater head and water quality during remediation (reference). Piezometers were installed in the zero-valent iron and zeolite reactive walls to monitor reactive wall performance including changes in internal groundwater head, flux, and water chemistry (reference). Bimonthly monitoring was conducted by ABC during the first two years of operation followed by semi-annual monitoring in years three to five, then annually thereafter (reference).

Split groundwater samples were analyzed by XXXX on a semi-annual basis for the first five years of remediation and annually thereafter. Groundwater samples were collected by the State when static water levels of the aquifer were at seasonally high and low periods of the year. Analytical results of split samples from the State Laboratory are in agreement with ABC's laboratory analytical results and indicate that all contaminants of concern have been reduced to concentrations below applicable standards (references).

4.2.5 Permeable Reactive Barrier Closure

In-place closure of the permeable reactive barriers was achieved by grouting the reactive walls in order to hydraulically and chemically isolate the zero-valent iron and zeolite reactive media.

4.2.6 Post-closure Monitoring

Post-closure groundwater monitoring of point-of-compliance (POC) wells will be conducted as part of the long-term surveillance plan (LTSP) to ensure that the closed reactive walls remain hydraulically and chemically isolated. Groundwater samples from POC wells will be analyzed for ammonia, chloride, molybdenum, nitrate, selenium, sulfate, and uranium.

4.2.7 Conclusion

XDOH has determined that groundwater contamination at ABC's facility has been remediated to concentrations below applicable standards [or ACLs] and license requirements for the contaminants of concern which include ammonia, chloride, molybdenum, nitrate, selenium, sulfate, and uranium. As a result of these successful groundwater restoration actions, XDOH has determined that closure of ABC's facility is in compliance with State groundwater regulations (reference) associated with uranium mill closure. The closure is specifically in compliance with the following groundwater criteria delineated in Chapter XXX-XXX-XXX State regulations, Criteria 5, 6(g), and 13, which incorporate the basic groundwater protection standards imposed by EPA in 40 CFR Part 192, Subparts D and E; and imposed by NRC in 10 CFR Part 40, Appendix A, Criteria, 5, 6(7), and 13, which specify groundwater monitoring requirements.

5. Discussion of results of State's site closure inspection(s).

XDOH has performed site closure inspections over the years as the site remediation moved from one phase to the next. XDOH has employed inspection staff or provided specialized consultants to review and verify virtually every aspect of site closure.

XDOH's site inspections were conducted to ensure that the site reclamation activities were

performed as required by regulations and license conditions. For significant aspects of reclamation, ABC submitted detailed plans and specifications for the work. These plans were reviewed and approved by XDOH. In these cases, XDOH inspectors have performed many field inspections to verify conformance of site activities to approved plans. This is particularly the case for reclamation construction of the diversion channel and thick, vegetated cover. Of particular emphasis was inspection of soil, rock, vegetation, and groundwater.

Monitoring during site closure has continued to evaluate environmental media and site performance. Periodic inspection and monitoring activities have been performed to determine radionuclide concentrations in soil, air, and groundwater. ABC has been required to perform this monitoring and to report results annually. XDOH has performed split sampling and has evaluated monitoring results in the State's independent laboratory to provide verification of ABC's results.

6. For partial terminations, documentation that release of a portion of the site will not negatively impact the remainder of the site to be closed at a later date.

XDOH has determined that the release for unrestricted use and removal of the subject site will not negatively impact the remainder of the sites associated with the license, which will be released for unrestricted use and removed from the license at a later date, based on the following:

The site being removed from the license is not contiguous with any other site associated with licensed activities; and removal of the site from its associated license will not in any way prevent or hinder the licensee's ability to complete decommissioning of the remainder of the licensed areas.

## III. REFERENCES

# APPENDIX C - Sample Completion Review Report for Non-conventional Uranium Milling License

## NOTE TO READER

The sample Completion Review Report (CRR) was developed by a Working Group composed of Agreement State and NRC staff. As stated in the ~~STP~~ FSME Procedure SA-900, prior to license termination, Agreement States submit CRRs for NRC review. The CRR should document the State staff's bases in summary form for its conclusion that all applicable standards and requirements have been met.

The purpose of this sample CRR is to generally show the expected level of detailed information in a variety of technical areas which should be provided in the CRR. The Working Group recognized that no single site, or any existing documentation, could serve as a complete template for all aspects of site closure, since each non-conventional uranium milling site is likely to have its own site-specific conditions. To cover as many aspects of license termination activities as possible, the sample CRR is a composite of examples from a number of existing documents. Stakeholders' comments and input have also been considered and are reflected in the sample CRR.

The reader is advised that the sample CRR provides neither a complete list of all applicable standards and requirements that need to be addressed nor complete boiler-plate language to be used as bases for conclusions. Rather, it provides an example of the level of detailed information that would be expected for inclusion in the CRR.

**APPENDIX C - Sample Completion Review Report for Non-conventional Uranium Milling License**

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I. SUMMARY

II. DOCUMENTATION OF BASES FOR CONCLUSION

1. A brief description of licensee's activities associated with decommissioning and license termination.

2. Groundwater information which demonstrates that the groundwater has been adequately restored to meet applicable standards and requirements.

3. Documentation that the production, injection and monitoring wells have been closed and plugged in accordance with applicable standards and requirements.

4. Decommissioning information which documents that all radiologically contaminated materials have been properly disposed of, transferred to licensee(s) authorized to possess such materials, or meet applicable standards and requirements for release.

5. Discussion of the results of radiation surveys and soil sample analyses which confirm that the licensed site meets applicable standards and requirements for release.

6. Discussion of results of the State's site closure inspection(s).

7. For partial terminations, documentation that release of a portion of the site will not negatively impact the remainder of the site to be closed at a later date.

III. REFERENCES

**APPENDIX C - Sample Completion Review Report for Non-conventional Uranium Milling License**

## Agreement State Radiation Control Program

## COMPLETION REVIEW REPORT

Date:
Licensee: XXXXX
License Number: XX-XXXX-X
Facility Name: XXXXX
Location: XXXXX, State
Licensed Area Being Terminated: approximately X,XXX acres
Manager:
Technical Reviewers: [John Smith, M.S.,P.E. (Hydrologic Engineer)]

## I. SUMMARY

The ABC Company's XYZ site is an in-situ leach mining and processing site which has been decommissioned and reclaimed under XXX State Department of Health (XDOH) Agreement State authority, derived from Title II of the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA). UMTRCA requires that prior to termination of the license, the U.S. Nuclear Regulatory Commission (NRC) shall make a determination that the licensee has complied with all applicable standards and requirements. Under the Agreement State program, the State of XXX is responsible for approval of the remediation plans for ABC and for site inspections to ensure that the actual remedial actions have been completed pursuant to the approved plans.

This report documents XDOH's basis for its conclusion that decommissioning and reclamation have been acceptably completed at the XYZ site. The NRC ~~STP~~ FSME Procedure SA-900 entitled, "Termination of Uranium Milling Licenses in Agreement States," was used to prepare this report.
The primary applicable standards for uranium mill reclamation is Chapter XXX-XXX XAC (State Administrative Code), entitled [Radiation Protection-Uranium and/or Thorium Milling]. This State regulation is consistent with and compatible with NRC regulations, as required by the State's Agreement State status with the NRC.

All applicable standards and requirements, with appropriate references to related sections of the CRR, are identified in Table C-1 [Note to Reader: Table C-1 in this sample CRR does not contain a complete list of all applicable standards and requirements.] XDOH has performed a complete review of the XYZ site for compliance with all applicable standards and requirements. As part of that review, XDOH has prepared a Technical Evaluation Report (TER) (reference) or other technical reviews (reference(s)) to document the State's review. The TER or other technical reviews may provide reference to more detailed evaluations by the State and to ABC's documents submitted for State review during the site's reclamation period. XDOH's reviews of licensee submittals were conducted by using guidance document(s) [NRC NUREG-1569 or equivalent, etc.]

Table C-1 Applicable Standards and Requirements* Related to Topics Discussed in the CRR

| Applicable Standards / Requirements | CRR Sections | TER Sections** |
|---|---|---|

**APPENDIX C - Sample Completion Review Report for Non-conventional Uranium Milling License**

| | | |
|---|---|---|
| State regulation XX.XXXX<br><br>Restoration of groundwater with all wells plugged and capped.<br><br>Criteria for groundwater restoration | Sections 2 and 3 | Section X.XX |
| State regulation XX.XXXX<br><br>Surface decontamination to a level sufficient for unrestricted use.<br><br>Criteria for release for unrestricted use | Section 4 | Section X.XX |
| State regulation XX.XXXX<br><br>Release of equipment and materials.<br><br>Criteria for release of equipment and materials for unrestricted use | Section 4 | Section X.XX |
| Other applicable standards and requirements | | |

*As defined in section V.C. of the ~~STP~~ FSME Procedure SA-900 issued on [Month Day, Year].
**Sections in TERs or equivalent reference documents.

In conclusion, XDOH believes that the ABC's XYZ site has met all applicable standards and requirements. With a determination by NRC, as required by Section 274c.(4) of the Act, that all applicable standards and requirements have been met, the radioactive material license, XX-XXXX-X, may be terminated.

## APPENDIX C - Sample Completion Review Report for Non-conventional Uranium Milling License

### II. DOCUMENTATION OF BASES FOR CONCLUSION

Following are XDOH's review results for items specified in the ~~STP~~ FSME Procedure SA-900 "Termination of Uranium Milling Licenses in Agreement States."

1. A brief description of licensee's activities associated with decommissioning and license termination.

The XYZ project is an in-situ leach uranium mine located near XXX, State. XYZ's uranium leases cover approximately X,XXX contiguous acres of land. The site facility included a main building (housing offices, a warehouse, a lab, and maintenance facilities), a processing plant, [four PVC lined] water storage ponds, a production well-field, an irrigation area, and a deep disposal well. The site was operated from [year] to [year] when production operations were ceased.

From [year] until [year] [active/passive] groundwater restoration was performed along with limited surface reclamation. The State Water Commission authorized ceasing groundwater restoration and final plugging of all wells [in the Fall of year]. Following plugging of all wells, full-scale surface reclamation and decommissioning began. Any material and/or equipment which was contaminated was disposed of by 1) transfer to another licensed mine site; 2) decontamination and release for unrestricted use; or 3) disposal at [a licensed byproduct disposal facility]. XDOH has determined that proper release for disposal, recycle or reuse, of all material and/or equipment was adequately documented by ABC.

ABC performed surveys to confirm the effectiveness of reclamation and decommissioning activities. The surveys consisted of scans, direct and/or swipe surveys of all affected areas. [Direct survey of land was conducted by taking readings at 10 meter intervals across the wellfield pattern. Soil samples were taken from four 10 meter by 10 meter areas per acre, or insert applicable survey protocol (e.g., MARSSIM), DCGLs, etc.] Reclamation and decommissioning activities were completed in [year].

In [year], XDOH performed confirmatory surveys of the facility. [Two times background was used as an allowable limit (reference). The survey was performed by walking 10 meters apart moving across the wellfield pattern. Soil samples were taken from a 100 square meter area around areas that exceeded two times background, or insert applicable survey protocol (e.g., MARSSIM), DCGLs, etc.] Post-cleanup surveys conducted by XDOH staff indicate that the site has been decontaminated to a radiation level that meets the State release criteria (reference). Analysis of all soil samples indicates that average radium-226 and uranium concentrations were below release criteria of [5 pCi/g and 30 pCi/g, respectively].

On site disposal of radioactive materials was not authorized at this facility, thus there is no land to be transferred to the State or the Federal Government.

2. Groundwater information which demonstrates that the groundwater has been adequately restored to meet applicable standards and requirements.

A letter/letters (attached) dated [Month Day, Year] from XDOH to the ABC provides the following information: XDOH has reviewed the groundwater restoration data for Productions Area XX of the XYZ mine submitted by ABC. XDOH determined that the groundwater has been restored in accordance with the specifications contained in permit XX-XXXX and as required by State

regulations XX-XXX-XXXX. ABC has been authorized to cease any restoration activities, including monitoring, at the production area.

3. Documentation that the production, injection and monitoring wells have been closed and plugged in accordance with applicable standards and requirements.

A letter/letters (attached) dated [Month Day, Year] from XDOH to the ABC provides the following information: In accordance with State regulations XX-XXXX-XX, XDOH revokes permit XXXX. All of the Class III wells were plugged as of [Month Year], and certifications have been received from the mine operator and from an independent registered processional engineer that plugging was accomplished in accordance with the plugging and abandonment plan in the permit.

4. Decommissioning information which documents that all radiologically contaminated materials have been properly disposed of, transferred to licensee(s) authorized to possess such materials, or meet applicable standards and requirements for release.

During surface reclamation and decommissioning all material and equipment was surveyed for radioactive contamination. Any material and/or equipment which was contaminated was released by utilizing one of the following methods: 1) transfer to licensee(s) authorized to possess such materials; 2) decontamination and released for unrestricted reuse or recycling; 3) or disposal at a licensed byproduct disposal facility.

All material and equipment to be released for unrestricted use (e.g., reuse, recycle, or disposal) have been surveyed by ABC to demonstrate compliance with [State regulations for control of radiation XX.XXX]. The surveys consisted of scans, direct measurements and swipes for determination of removable activity. These surveys have been taken and documented by ABC to meet these criteria as summarized below:

## APPENDIX C - Sample Completion Review Report for Non-conventional Uranium Milling License

[(1) Removable surface contamination: 1000 dpm alpha per 100 $cm^2$
(2) Total surface contamination (average over 1 $m^2$): 5000 dpm alpha/beta per 100 $cm^2$
(3) Maximum fixed contamination: 15,000 dpm alpha/beta per 100 $cm^2$]

All soils have been surveyed to demonstrate compliance with the requirements of State regulation XX.XXX. These surveys have been completed and documented to meet these criteria:

[(1) 5 pCi/gm of Ra-226 averaged over any 100 $m^2$ area and averaged over the first 15 cm depth of soil; (2) 15 pCi/gm of Ra-226 averaged over any 100 $m^2$ area and averaged over any subsequent 15 cm depth of soil; and (3) 30 pCi/gm of U-nat.]

5. Discussion of the results of radiation surveys and soil sample analyses which confirm that the licensed site meets applicable standards and requirements for release.

Surveys, conducted by ABC, to confirm the effectiveness of reclamation and decommissioning activities were performed by scans, direct and/or swipe surveys of equipment and structures to be turned over to the landowner. [Direct survey of land was conducted by taking readings at 10 meter intervals across the wellfield pattern. Soil samples were taken using applicable survey protocol (e.g., MARSSIM), DCGLs, etc.] ABC subsequently requested termination of its license.

In [Month Year], XDOH staff performed confirmatory surveys of the wellfield. The surveys were performed using [one-by-one sodium iodide probes and XXXX survey meters]. The survey was performed by [walking X meters apart moving across the well field pattern (reference), or insert applicable survey protocol (e.g., MARSSIM), DCGLs, etc.].

Background gamma count rate readings were approximately [X.XXX cpm or mR/hr] on all meters. As a result of the surveys, [twenty-nine] areas were identified as having readings greater than the action level. These areas were cleaned up by ABC and resurveyed by XDOH staff. All areas resurveyed had readings which were less than action level.

Concurrently XDOH staff collected soil samples from XX areas. Soil sample results were within the regulatory limits for radium-226 and natural uranium soil concentrations of [5 pCi/gm and 30 pCi/gm, respectively], except for [two] soil samples which exceeded these limits.

In [Month Year], XDOH staff returned to the production area to resurvey and take soil samples after the licensee had cleaned the two areas that had exceeded release limits. Soil sample results

were within the regulatory limits for radium-226 and natural uranium soil concentrations of [5 pCi/gm and 30 pCi/gm, respectively].

6. Discussion of results of the State's site closure inspection(s).

In [Month Year], XDOH staff performed a survey of ABC's XYZ site. The surveys were performed using [one-by-one sodium iodide probes and XXXX instruments]. The purpose of the survey was to allow ABC to release the X.X acres for unrestricted use. [Two times background was used as an allowable limit (reference). The survey was performed by walking 10 meters apart moving across the wellfield pattern.] Background readings ranged from XXXX -XXXX cpm.

[One area was identified which exceeded two times background. A visible pile of pipescale on the surface was the cause for the elevated reading. This area was cleaned up by ABC and a post-cleanup survey indicated no readings above background.]

Since no elevated readings were found in the production [except for the pile of visible pipescale], soil samples were not collected.

On-site disposal of solid radioactive material or byproduct material was not authorized at the XYZ site, thus there is no land to be transferred to the State or the Federal Government. As a result of these findings, XDOH is proposing to remove the XYZ site from the license.

7. For partial terminations, documentation that release of a portion of the site will not negatively impact the remainder of the site to be closed at a later date.

XDOH has determined that the release for unrestricted use and removal of [the subject site] will not negatively impact the remainder of the sites associated with the license, which will be released for unrestricted use and removed from the license at a later date. XDOH based its decision on the following: The site(s) being removed from the license [is/are] not contiguous with any other site associated with licensed activities that may lead to recontamination of the release site(s); and removal of the sites from their associated license will not in any way prevent or hinder the licensee's ability to complete decommissioning of the remainder of the licensed areas.

## III. REFERENCES

**APPENDIX D - Sample NRC Determination Letter for Conventional Uranium Milling License**

Month Day, Year
, Director
State Agency Address

Dear XXXX

We have completed review of your [Month Day, Year] submittal regarding the proposed termination of Radioactive Material License, XX-XXXX-X, issued to ABC. The license covered the ABC's XYZ Site, a conventional uranium mill facility located near XXX, State. You requested in your submittal that the U.S. Nuclear Regulatory Commission (NRC) make a determination that all applicable standards and requirements have been met for termination of the XYZ site license.

The process that we used to make the determination is set out in the Office of ~~State and Tribal~~Federal and State Materials and Environmental Management Programs ~~STP~~ FSME Procedure SA-900. Our determination is based on two supporting bases: review of a Completion Review Report (CRR) documenting the State Department of Health (XDOH) staff's bases for its conclusion that all requirements have been met; and review of State Agreement State uranium recovery program, conducted under the Integrated Materials Performance Evaluation Program (IMPEP).

First, the information you have submitted in the CRR, dated [Month Day, Year], documents that the XDOH has performed a complete review of the XYZ Site for compliance with regulatory and license requirements. XDOH's review covered all necessary technical areas and regulatory requirements relating to reclamation of the XYZ Site including geotechnical engineering, surface water hydrology and erosion protection, radiation cleanup and control, and groundwater protection. XDOH also conducted appropriate inspections of site reclamation activities at the XYZ Site. Based on the review findings documented in the CRR, XDOH concluded that the XYZ Site has met all regulatory and license requirements.

Second, the most recent IMPEP review of the State Agreement State Program, conducted in [Month Year], concluded that the State program is adequate to protect public health and safety, and compatible with NRC's regulatory program. This finding is consistent with previous State program evaluation findings.

Based on our review of the above information and in accordance with the provisions at 10 CFR 150.15a(a) and Section 274c of the Atomic Energy Act of 1954, as amended, we determine that all applicable standards and requirements for the protection of the public health, safety and the

environment have been met for the termination of the Radioactive Material License, XX-XXXX-X.

A copy of our evaluation report, entitled "Documentation of NRC Review on the Termination Findings of the ABC's Uranium Milling License Submitted by the State Department of Health," without associated attachments is enclosed.

If you have any questions, or we can be of further assistance, please contact me or ~~STP~~ MSSA Staff Name at (301) 415-XXXX.

Sincerely,

~~STP~~ FSME Director
Office of Federal and State Materials and Environmental Management~~State and Tribal~~ Programs

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Enclosure:
As stated

## Appendix D -- NRC Determination Letter (Conventional)

**Documentation of NRC Review on the Termination Findings of the ABC's XYZ Uranium Milling License Submitted by the XXXX State Department of Health**

Licensee: A... B... C... (ABC)
Licensee No.: XX-XXXX-X
Location:
Area: approximately XXX acres
Type of License: Conventional Uranium Milling License
Full / Partial License Termination: Full License Termination

H. Documentation of major events/activities related to the review of the Completion Review Report (CRR) for the XYZ site

1. On [Month Day, Year], NRC staff received a letter from the U.S. Department of Energy (DOE) regarding the Long-Term Surveillance Plan (LTSP) for the ABC's XYZ site. The DOE letter can be found in Attachment X.

2. On [Month Day, Year], NRC staff received the ABC's XYZ draft CRR from XDOH. A letter dated [Month Day, Year] with a copy of the XDOH's draft CRR can be found in Attachment X.

3. The review of the draft CRR was conducted by an NRC staff team. A list of NRC staff technical reviewers can be found in Attachment X.

4. On [Month Day, Year], NRC staff discussed the review process and status of NRC's review of the draft CRR at a meeting with DOE, XDOH and ABC representatives.

5. On [Month Day, Year], after completing review of the draft CRR, NRC staff provided comments to XDOH. The cover letter and attached comments can be found in Attachment X.

6. On [Month Day, Year], NRC staff met at the ABC's XYZ site with DOE, XDOH and ABC representatives to observe site conditions and to discuss LTSP issues. NRC's comments (see Attachment X) on XDOH's draft CRR were also discussed.

7. On [Month Day, Year], NRC staff received XDOH's response to the [Month Day, Year] letter. The letter, dated [Month Day, Year] and its attachment, ABC's response letter to NRC's comments, can be found in Attachment X.

8. On [Month Day, Year], NRC and XDOH staffs met to discuss the status of NRC's review, areas needing further information or clarification (see Table below), XDOH feedback and comments on the review process, future actions, and a proposed schedule for completion of the review.

## Appendix D -- NRC Determination Letter (Conventional)

Sample Table

| No. | REVIEW AREA | POTENTIAL SIGNIFICANCE |
|---|---|---|
| 1. | Radiation Cleanup and Control<br>Appendix A to 10 CFR Part 40, Criterion 6(1)(ii), (5) and (6),<br>Radiation Surveys and Soil Sample Analyses | Staff needs further supporting information to complete our review of XDOH's basis for its conclusion that the subject site has been cleaned up to the standards. |
| 2. | Identify applicable standards / requirements | Provide brief description of further supporting information needed to complete NRC's review of XDOH's basis for its conclusion. |

9. On [Month Day, Year], NRC staff met with DOE, XDOH and ABC representatives to discuss the status of NRC's review, areas where further information or clarification were needed, and the schedule for completion of the review.

10. On [Month Day, Year], NRC staff received Revision #1 to the draft CRR from XDOH. XDOH indicated Revision #1 to the draft CRR provided responses to NRC's comments as documented in Attachment X. The [Month Day, Year] letter and its attachment can be found in Attachment X.

11. On [Month Day, Year], after completing review of Revision #1 to the draft CRR, NRC staff communicated with XDOH staff through e-mail on areas where further information or clarification was needed. On [Month Day, Year], XDOH staff provided responses to NRC's comments through e-mail. These e-mails can be found in Attachment X.

12. On [Month Day, Year], NRC staff provided comments to DOE on a draft LTSP. The comments reflect consideration of information contained in the draft CRR and resulting from NRC staff review of the draft CRR. The letter notes that because the mill tailings will be saturated for an indefinite period of time, and a large amount of water is impounded behind the dam, the tailings impoundment system is formally classified as a dam. To meet Federal obligations under the requirements of the National Dam Safety Program Act, the dam must be inspected at regular intervals. The letter concludes that additional inspection items must be included in the LTSP to meet applicable requirements. The comment letter and its attachment can be found in Attachment X.

13. On [Month Day, Year] , NRC staff received the final CRR from XDOH. Following review, NRC staff concluded that the final CRR addressed all NRC's comments and provided XDOH staff's bases for its conclusion that the ABC's XYZ Site has met all regulatory and license requirements. The letter and its attachment can be found in Attachment X.

14. The five issues identified during the [Month Day, Year] meeting were closed based on additional information documented in the final CRR (Items X-X) or based on information provided in the [Month Day, Year] letter from NRC to DOE (Item X). This is summarized in the Table below.

Sample Table

| No. | REVIEW AREA | COMMENTS |
|---|---|---|
| | Radiation Cleanup and Control | Additional information is documented in |

## Appendix D -- NRC Determination Letter (Conventional)

| No. | REVIEW AREA | COMMENTS |
|---|---|---|
| 1. | Appendix A to 10 CFR Part 40, Criterion 6(1)(ii), (5) and (6), Radiation Surveys and Soil Sample Analyses | the Radiation Cleanup and Control portion of the final CRR. |
| 2. | Identify applicable standards / requirements | Additional information is documented in the XXXX portion of the final CRR. |

**B. Documentation of review comments on items specified in the ~~STP~~ FSME Procedure SA-900 "Termination of Uranium Milling Licenses in Agreement States."**

1. A brief description of licensee's activities associated with decommissioning, tailings remediation and groundwater cleanup, if necessary.

   Comment: This information is provided in section X of the final CRR. The submitted information was found to be complete.

2. Documentation that the completed surface remedial actions were performed in accordance with applicable standards and requirements.

   Comment: This information is provided in section X of the final CRR. XDOH staff reviewed geotechnical stability, surface water hydrology and erosion protection, and radon emanation aspects of the reclamation of ABC's XYZ site. Based on its evaluation, XDOH concluded that reclamation of the site has met all applicable standards and conformed with design specifications. The submitted information was found to be acceptable.

3. Documentation that the completed site decommissioning actions were performed in accordance with applicable standards and requirements.

   Comment: This information is provided in section X of the final CRR. ABC's initial measurement indicated that XX% of all gamma and soil sample grids were below the radium regulatory limit. Following the initial surveys, all gamma grids and soil grids that were in excess of limits were excavated until results indicated concentrations below the applicable limit. XDOH data confirm that ABC's sampling process was valid. XDOH concluded that residual radioactive material in all the areas potentially impacted by the mill operation was cleaned up to the State standards. The submitted information was found to be acceptable.

4. Documentation that the completed groundwater corrective actions, if necessary, were performed in accordance with applicable standards and requirements.

   Comment: This information is provided in section X of the final CRR. XDOH's review of all groundwater quality data has determined that the hazardous constituents in the tailings impoundment (uranium, Ra-226, Ra-228, Th-230, arsenic, nickel, and thallium) are stable in groundwater within the range of natural variability and remain below regulatory limits. XDOH concluded that the closure of ABC's XYZ site is in compliance with XXXX State groundwater regulations associated with uranium mill closure. The submitted information was found to be acceptable.

5. Discussion of results of State's site closure inspection(s).

   Comment: This information is provided in section X of the final CRR. XDOH staff performed appropriate site reclamation inspections over the years as site remediation moved from one phase to the next. XDOH employed inspection staff or provided specialized consultants to review and verify all important aspects of site closure. XDOH staff site inspections have provided a presence to ensure that site reclamation activities were performed as required by regulations and license conditions. The submitted information was found to be acceptable.

6. For partial terminations, documentation that release of a portion of the site will not negatively impact the remainder of the site to be closed at a later date.

   Comment: Not applicable. This is a full license termination.

7. IMPEP review of the XDOH uranium recovery regulatory program

   Comment: Based on [year] IMPEP review, the XDOH uranium recovery program was found to be satisfactory based on the IMPEP evaluation criteria. (A satisfactory rating is the highest rating possible for each IMPEP common and non-common performance indicator.) The overall XXXX (State name) Agreement State program was found to be adequate to protect public health and safety and compatible with NRC's program. The IMPEP team had one recommendation in the Uranium Recovery area that the State develop additional specialized inspection procedures.

## Appendix D -- NRC Determination Letter (Conventional)

Based on review of the above information, as specified in the ~~STP~~ FSME Procedure SA-900, and in accordance with the provisions at 10 CFR 150.15a(a) and Section 274c of the Atomic Energy Act of 1954, as amended, staff determines that all applicable standards and requirements have been met for the termination of the Radioactive Material License, XX-XXXXX-X.

Project Manager: _____ Date: _____
Full Name, Title
Office of Federal and State Materials and Environmental Management Programs, Division of Materials Safety and State Agreements~~State and Tribal Programs~~

Office Director: _____ Date: _____
Full Name, Director
Office of Federal and State Materials and Environmental Management~~State and Tribal~~ Programs

**APPENDIX E -- Sample NRC determination letter for Non-conventional Uranium Milling License**

Month Day, Year

, Director
State Agency Address

Dear XXXX

We have completed our review of your [Month Day, Year] and [Month Day, Year] submittals regarding the proposed termination of the Radioactive Material License, XX-XXXX-X, issued to ABC's XYZ Site, an in-situ leach uranium milling facility located near XXX, State. You requested in your [Month Day, Year] submittal that the U.S. Nuclear Regulatory Commission (NRC) make a determination that all applicable standards and requirements have been met for the termination of the XYZ site license.

The process that we used to make the determination is set out in the Office of Federal and State Materials and Environmental Management ~~State and Tribal~~ Programs (~~STP~~FSME) Procedure SA-900. Our determination is based on two supporting bases: review of a Completion Review Report (CRR) documenting the State Department of Health (XDOH) staff's bases for its conclusion that all applicable standards and requirements have been met; and review of State's Agreement State uranium recovery program, conducted under the Integrated Materials Performance Evaluation Program (IMPEP).

As indicated in ~~STP~~ FSME Procedure SA-900, closure of an in-situ leach uranium milling site requires a demonstration that the groundwater has been adequately restored, all the wells have been closed and plugged according to the appropriate State statute, disposal or transfer of radioactive material is documented, and radiation surveys and confirmatory soil samples indicate that the site meets applicable standards and requirements for release.

First, the information you have submitted indicates that the groundwater has been restored by the licensee to the satisfaction of XDOH. All the wells have been plugged and abandoned by the licensee as authorized by XDOH. Based on XDOH's review of the license termination, you reported that proper disposition of radioactive materials took place at the site and there has been no on-site disposal of radioactive materials; therefore, there is no need to transfer ownership of land to the State or the Federal Government.

XDOH has reviewed the results of radiation surveys submitted by the licensee and performed confirmatory surveys for the subject site. Post-cleanup surveys conducted by XDOH indicate that the site has been decontaminated to a radiation level that meets the State criteria. According to the XDOH report, the analysis of soil samples indicates the radium-226 and t~~T~~horium-230, and uranium concentrations were below the release criteria of [insert derived criterion 6(6) values]. The statements made in the submittals indicate that the XDOH has adequately determined that all applicable standards and requirements have been met by the licensee.

Second, the most recent IMPEP review of the State Agreement State Program, conducted in [Month Year], concluded that the [State] program is adequate to protect public health and safety, and compatible with NRC's regulatory program. This finding is consistent with the previous State program evaluations.

Based on our review of the above information and in accordance with 10 CFR 150.15a(a) and Section 274c of the Atomic Energy Act of 1954, as amended, we determine that all applicable standards and requirements for the protection of the public health, safety and the environment have been met for the termination of the Radioactive Material License, XX-XXXX-X.

A copy of our evaluation report, entitled "Documentation of NRC Review of the Termination Findings of the ABC's Uranium Mill License Submitted by the State Department of Health," without associated attachments is enclosed.

If we can be of further assistance in this regard, please contact me at (301) 415-3340 or ~~STP~~ MSSA Staff Name at (301) 415-XXXX.

Sincerely,

~~STP~~ FSME Director
Office of Federal and State Materials and Environmental Management ~~State and Tribal~~ Programs

Enclosure:
As stated

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**Documentation of NRC Review on the Termination Findings of the ABC's XYZ Uranium Milling License Submitted by the State Department of Health**

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|---|
| Licensee: A...B...C... (ABC)<br>License No.: XX-XXXX-X<br>Location:<br>Area: approximately XXX acres<br>Type of License: Non-conventional (in-situ leach) Uranium Milling License<br>Full / Partial License Termination: Full License Termination |

The following items were reviewed based on the Office of Federal and State Materials and Environmental Management ~~State and Tribal~~ Programs (~~STP~~FSME) Procedure SA-900 "Termination of Uranium Mill Licenses in Agreement States."

1. A brief description of licensee's activities associated with decommissioning and license termination.

   Comment: This information is provided in a State Department of Health (XDOH) letter dated [Month Day, Year] (Attachment 1). Acreage information for the mine site is provided in a XDOH letter dated [Month Day, Year] (Attachment 2).

2. Groundwater information which demonstrates that the groundwater has been adequately restored to meet applicable standards and requirements.

   Comment: This information is provided in Enclosure X of the XDOH letter dated [Month Day, Year].

3. Documentation that the production, injection and monitoring wells have been closed and plugged in accordance with applicable standards and requirements.

   Comment: This information is provided in Enclosure X of the XDOH letter dated [Month Day, Year].

4. Decommissioning information which documents that all radiologically contaminated materials have been properly disposed of, transferred to licensee(s) authorized to possess such materials, or meet applicable standards and requirements for release.

   Comment: This information is provided in the XDOH letter dated [Month Day, Year]. XDOH indicated that any material and/or equipment which was contaminated was transferred to another licensed mine site, decontaminated and released for unrestricted use, or disposed of at a licensed byproduct disposal facility.

5. Discussion of the results of radiation surveys and soil sample analyses which confirm that the licensed site meets applicable standards and requirements for release.

   Comment: This information is provided in the XDOH letter dated [Month Day, Year]. Results of radiation surveys and confirmatory soil samples can be found in Enclosure X of the letter. Additional information related to the results of two confirmatory soil samples is provided in the [Month Day, Year] letter.

6. Discussion of results of the State's site closure inspection(s).

   Comment: This information is provided in the Enclosure X of the XDOH letter dated [Month Day, Year]. As stated above, additional information can also be found in the [Month Day, Year] letter.

7. For partial terminations, documentation that release of a portion of the site will not negatively impact the remainder of the site to be closed at a later date.

   Comment: Not applicable. This is a full license termination.

8. IMPEP review of the [State] uranium recovery regulatory program

   Comment: According to the results of the [Year] IMPEP review, the State uranium recovery regulatory program was found to be satisfactory based on the IMPEP evaluation criteria. (A satisfactory rating is the highest rating possible for each IMPEP common and non-common performance indicator.) The overall State Agreement State program was found to be adequate to protect public health and safety, and compatible with NRC's program.

Based on review of the above information, as specified in ~~STP~~ FSME Procedure SA-900, and in accordance with the provisions at 10 CFR 150.15a(a) and Section 274c of the Atomic Energy Act of 1954, as amended, staff determines that all applicable standards and requirements have been met for the termination of the Radioactive Material License, XX-XXXX-X.

Project Manager: _____Date:_____
Full Name, Title
Office of Federal and State Materials and Environmental Management ~~State and Tribal~~ Programs, Division of Materials Safety and State Agreements

Office Director: _____ Date: _____
Full Name, Director
Office of Federal and State Materials and Environmental Management ~~State and Tribal~~ Programs