

May 19, 2000

Mr. John L. Erickson, Director  
Division of Radiation Protection  
Washington Department of Health  
7171 Cleanwater Lane, Bldg. 5  
P.O. Box 47827  
Olympia, Washington 98504-7827

Dear Mr. Erickson:

I am responding to your February 29, 2000 letter regarding the Washington State Department of Health's (WDOH's) proposal to terminate Western Nuclear, Inc.'s (WNI) Sherwood Uranium Mill License. In that letter, you request an Nuclear Regulatory Commission (NRC) determination that all applicable standards and requirements pertaining to WNI's uranium mill closure project have been met.

We have reviewed your submittals based on the Office of State and Tribal Programs (STP) Procedure SA-900, "Termination of Uranium Mill Licenses in Agreement States." The submittals included several documents but in particular the Completion Review Report (CRR) dated February 2000. The CRR presented the State's basis for its determination that the licensee's closure action has met all license requirements and State regulations. We appreciate WDOH's effort in closely following the SA-900 Procedure in preparing the CRR.

Enclosed is a list of additional information that we need to assist in completing our review of your request. We understand that some of the additional information mentioned in the enclosure may not be specifically listed in the STP Procedure SA-900 but is important to assist us in making our concurrence determination. We would appreciate receiving your response by June 16, 2000. If you need additional time, please let us know. We are also available to meet to discuss our review and the enclosed information requests if you believe such a meeting would be of assistance.

Finally, the Sherwood proposal is the first full license termination package that we have received from an Agreement State for a conventional uranium mill since the STP Procedure SA-900 was issued in April, 1999. During the review of your submittals, we recognized that in some areas the guidance in the procedure may need to be expanded to better characterize the level of detail in information which should be considered by an Agreement State in preparing the CRR. We plan to examine the need to revise the procedure based on review of the Sherwood proposal. At that time, we would also appreciate your views on any areas for improvement or revision to the procedure.

If you have any questions, please contact me or Kevin Hsueh at (301) 415-2598.

Sincerely,

*/RA/*

Paul H. Lohaus, Director  
Office of State and Tribal Programs

Enclosure:  
As stated

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**NRC Staff Comments on the  
Termination Finding of the Western Nuclear, Inc.'s Sherwood Uranium Mill License  
Submitted by the Washington State Department of Health**

Licensee: Western Nuclear, Inc. (WNI) Licensee No.: WN-I0133-1 Location: Wellpinit, Washington Area: approximately 383 acres Type of License: Conventional Uranium Mill License Full / Partial License Termination: Full License Termination
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The following items were reviewed based on the Office of State and Tribal Programs (STP) Procedure SA-900, "Termination of Uranium Mill Licenses in Agreement States."

**1. A brief description of licensee's activities associated with decommissioning, tailings remediation and/or groundwater cleanup.**

This information is provided in section 1 of the Completion Review Report (CRR) submitted by the Washington State Department of Health (WDOH), dated February 2000. The submitted information was found to be complete.

**2. Documentation that the completed surface remedial actions were performed in accordance with license requirements and regulations.**

GEOTECHNICAL STABILITY

A review of the CRR and Technical Evaluation Report (TER) with respect to geotechnical stability indicates that additional information is needed to confirm the long-term stability of the tailings embankment.

**ISSUE 1:** As long as the hypalon liner remains intact and/or the tailings remain saturated, there is a potential for liquefaction of the tailings during a significant seismic event. Such liquefaction could result in the formation of sand (tailings) boils on the cover. Sand (tailings) boils would compromise the cover and could be difficult to mitigate.

**Q1:** *Please provide further information and justification to confirm that the formation of sand boils was considered, and that resulting damage could be accommodated by the design.*

**ISSUE 2:** If the hypalon liner were to fail, the dam embankment, or portions of the embankment, could become saturated. The horizontal hydraulic conductivity of the tailings is such that lateral flow could occur in the absence of an effective liner. A saturated dam face would be subject to liquefaction and or slumping failure.

**Q2: *Please provide additional information and documentation to confirm that the embankment stability under saturated conditions was considered.***

**ISSUE 3:** The Peak Ground Acceleration (PGA) used in the pseudo-static and, presumably, liquefaction analyses was not stated in the TER. It is likely that a PGA of 0.14g or greater would apply (for a foundation on soft or firm rock). The 200 feet or more of unconsolidated sand below the embankment may result in amplification of the PGA.

**Q3: *Please provide additional information and documentation to confirm that an appropriate PGA, including amplification, if necessary, was considered in the stability and liquefaction analyses.***

**ISSUE 4:** The document concludes that it is unlikely that the recharge of the tailings would occur from ponding. There are probably a few months of the year when infiltration from ponding could occur. Such infiltration could saturate portions of the cover, and continue to keep the tailings saturated.

**Q4: *Please provide additional information and documentation to support your conclusion regarding the potential for recharge of the tailings. If there is potential for ponding water to infiltrate and recharge the tailings, please provide additional information and documentation to confirm that an increased likelihood of liquefaction of a wet embankment was considered.***

**ISSUE 5:** The document concludes that the tailings are expected to remain saturated over a long period of time and that there is a seasonal pond on the surface of the impoundment. Given the impoundment of these two volumes of water, it is not clear whether the tailings impoundment system, as reclaimed, will be classified as a dam. If so, active maintenance is required under the Federal Guidelines for Dam Safety, issued June 25, 1979, and the National Dam Safety Program Act, passed as Section 215 of the Water Resources Development Act of 1996 (Public Law 104-303).

**Q5: *Please provide additional information and documentation to confirm whether this dam will be classified as a dam under the Federal Guidelines for Dam Safety and the National Dam Safety Program Act.***

#### ROCK DURABILITY

The Information is provided in the CRR and the TER submitted by the WDOH. Our review of these submittals indicates that additional information and documentation is needed to confirm the conclusions of the durability of the rock riprap (regarding the regulatory requirement in the State's equivalent of 10 CFR Part 40, Appendix A, Criterion 4(d)). Further, several areas in the reports need to be clarified.

**ISSUE 6:** In a WDOH memorandum (Ref. 1) regarding WNI petrographic analyses review, it is stated that additional rock durability test data have not been reviewed and it was recommended that the final determination of the suitability of the quarry not be made until all of the rock durability test results have been submitted and evaluated.

**Q6: *Please provide additional information and discussion of rock durability test results that supports WDOH's final approval of the quarry for riprap source.***

**ISSUE 7:** A number of observations by NRC reviewers related to rock durability issues are discussed below:

- (1) WDOH staff reviewed a report (Ref. 2) and photomicrograph of 3 rock samples, noted the absence of smectite or expanding lattice clay minerals in those samples and concluded that the samples scored at least "fair" according to guidelines in NUREG-4620 (Ref. 1).
- (2) WDOH staff examined rock outcrops of the quartz monzonite at the proposed rock quarry (Ref. 1). It is unclear where these observations were made with regard to the 3 rock samples that formed the basis for the rock durability decision.
- (3) Contractor to Western Nuclear, Inc, Shepherd Miller, Inc (SMI) proposed that the quartz monzonite rock is acceptable as riprap because it passed NUREG-4620 guidelines (no significant weathering, no smectites or expanding lattice clays, little clay). SMI relied on a consultant's examination of three samples of unweathered quartz monzonite (the consultant did not collect them, but claimed they were representative of degree of weathering and alteration of the rock to be used as riprap (Ref. 2)). Notably, the samples did not show any fractures to the eye, but further examination showed them to have fractures spaced 2.5 to 6.0 inches. These incipient joints were unweathered.
- (4) WDOH staff observed the riprap in place (Ref. 3) and enhanced the descriptions of the rocks. It is unclear from the riprap descriptions if the three samples from the quarry continue to represent the bulk of the riprap quarried and emplaced.

Relevant field observations by WDOH staff include:

- (a) very minor fraction of the quartz monzonite containing a higher fraction of biotite and white mica deteriorated by crumbling or fracturing (this suggests that the samples may not be representative),
- (b) a minor fraction of the quartz monzonite had a greenish alteration product on outer surfaces or fracture surfaces, probably resulting from weathering (this component was not sampled and identified),
- (c) southwest portion of the cover outlet swale showed an increased percentage of quartz monzonite that had deteriorated,
- (d) up to 10% of the total placed rock is basalt and other volcanic rocks such as andesite and dacite. The volcanic rocks, except some basalt, has largely crumbled.

- (5) NRC reviewer observations of color photos of various riprapped portions of the reclaimed tailings that are relevant to a determination of acceptability of the quartz monzonite for use as riprap include:
- (a) a majority of the quarried cobbles and boulders in one area are rounded, are stained by yellow-brown limonite, and are covered with patches of white material suggestive of comminuted feldspar or clay. The rusty staining indicates a higher degree of weathering than reported earlier,
  - (b) about 10% of the cobbles and boulders in one area show spalls and through-going fractures that occurred in place,
  - (c) about 20% of the cobbles and boulders in another area showed incipient joints.

These observations do not support the descriptions of weathering competency and fracturing in earlier reports (Refs. 1 and 2).

- (6) The reports provided indicate that overall rock quality is good but that some of the total rock volume may not meet durability requirements. However, it is not clear if large segments or patches of non-quartz monzonite rock or poor-quality quartz monzonite rock could be present in the placed rock materials, which may result in some areas having percentages of poor-quality rock in excess of 10%.

Based on the above observations, following are specific areas where additional information is needed:

- Q7: Please provide additional information and justification of the representativeness of the 3 samples on which durability estimates were based. Based on field photos, the samples tested do not appear to be representative of the rocks used and could have led to underestimation of rock durability.**
- Q8: Please provide additional information and justification of the acceptability of the rock that has already been placed to function for the performance period of 1000 years and at least 200 years, given that some areas have degraded. The objective is to get a more realistic basis for projected performance of the rocks than can be gotten from more pristine samples from quarry walls.**
- Q9: Please provide further information and analyses that demonstrate that large areas of non-quartz monzonite rock or poor-quality quartz monzonite rock have not been placed in the rock cover, particularly in the diversion channel.**

#### GEOLOGY AND SEISMOLOGY

Our review of the CRR and the TER indicates that additional information and documentation is needed to confirm conclusions reached by WDOH in the areas of geology and seismology. WDOH indicates that the guidelines of the Standard Review Plan (SRP) for Title 1 sites were used as the basis for the evaluation of the site, but in the subjects of geology and seismology, more information and documentation is needed. There are geological studies cited in the TER that may contain such information; however, it appears that this information was not explained in detail and/or was not incorporated into the TER.

Following are specific areas where additional information is needed:

- (1) Geologic and Seismologic Characterization

**Q10: Please provide additional information on this subject sufficient to understand the subsequent brief discussion of site stability.**

- (2) Geologic Stability

The purpose of this section is to provide information on the stability of the unconsolidated sediments and other strata beneath the site sufficient to support analysis of future site stability. No technical discussion or summary of this material is provided in the TER.

**Q11: Please provide additional information and discussion of WDOH's findings on its review of the key reference materials relevant to site stability analysis.**

- (3) Bedrock Stability

The purpose of this section is to provide information on the faults, fractures and other geologic structures in and around the site sufficient to support analysis of future site stability.

**Q12: Please provide additional information and discussion related to specific local bedrock features, especially discontinuities such as faults and fractures, for consideration in seismotectonic hazard analyses.**

**Q13: Please provide additional information and discussion of WDOH's findings related to its review of key references and the geologic map of Coulee Dam Vicinity (Waggoner report, 1990, Ref. 4). The TER points out a large discordance in the structural trends at the site. Waggoner indicates north-south; Shepherd Miller, Inc (Reclamation Plan, 1994, Ref. 5), indicates east-west. Please provide further discussion and clarification of the significance of this discordance in WDOH's determination that all applicable standards and regulations have been met.**

- (4) Geomorphic Stability

The purpose of this section is to provide information on evaluations of potential destructive geomorphic processes such as mass movements (e.g., landslide or debris flow potential), excessive erosion and stream encroachment onto the diversion channel and the tailings disposal area. The CRR does not address whether a review or acceptance of licensee-submitted material was conducted regarding regulatory requirement in the State's equivalent of 10 CFR Part 40, Appendix A, Criterion 4(d) concerning evaluations of the surrounding geomorphology to assure that there are not ongoing or potential processes, such as gully erosion, which would lead to impoundment instability.

**Q14: *Please provide additional information, technical discussion and/or summaries of operative surface processes, including but not limited to mass movements, stream erosion/deposition potential at the site that supports a finding that there are not potential processes which would lead to impoundment instability.***

(5) Seismotectonic Stability

**ISSUE 8:** The seismology portion of the TER mentions only seismic exploration surveys, but nothing on earthquake hazard. The State's regulations require that a determination be made of the maximum credible earthquake as the seismic design basis. There was no justification in the CRR for the finding that the faults mapped near the site are not capable faults, such a finding is a requirement of the State's equivalent of 10 CFR 40, Appendix A, Criterion 4(e). The seismic survey results that were used in delineating the bedrock surface beneath the tailings should be explained and amplified. There is a deep channel in bedrock beneath the site that contains sediments of various types. It is not clear whether this channel reflects a potentially-active tectonic feature or an erosional-depositional (e.g., glacial) feature. Characterization of the subsurface geology and local seismicity is needed for consideration of the causes of and responses to earthquakes that might affect slope stability, cracking of cover or liquefaction potential.

**Q15: *Please provide additional information and discussion of WDOH's evaluation of earthquake sources (such as capable faults) and earthquake hazards for the site. The information should include discussion of seismic design basis ( maximum credible earthquake or reasonable alternative basis) for the engineering structures and WDOH's evaluation of liquefaction potential.***

## GROUNDWATER

**ISSUE 9:** The CRR does not address whether a review or acceptance of licensee submitted material was performed against the regulatory requirement in the State's equivalent of 10 CFR Part 40 Appendix A, Criterion 6 (7) related to the impacts to groundwater caused by potential release of liquids from the disposal cell.

**Q16:** *Please provide documentation demonstrating that the review and acceptance, if appropriate, of licensee submitted information pertaining to the impacts to groundwater caused by potential releases of liquids from the disposal cell, given credible failure scenarios of the engineering design components of the disposal cell. This information should not be limited to synthetic liner failure and over-topping from water buildup, but include any other credible scenario that could cause release of liquids.*

3. **Documentation that the completed site decommissioning actions were performed in accordance with license requirements and regulations. This documentation should include a discussion of results of radiation surveys and confirmatory soil samples which indicates that the subject site meets unrestricted release requirements.**

A review of the CRR and TER with respect to results of radiation surveys and confirmatory soil samples indicates that additional information is needed to confirm that completed site decommissioning actions were performed in accordance with license requirements and regulations.

**ISSUE 10:** In section 3 of the CRR, WDOH determined that residual radioactive material in all the areas potentially impacted by the mill operation was cleaned up to the State standards. The basis for the conclusion is based on the following information:

- (1) WDOH conducted several inspections to ensure compliance with conditions of the licensee's Radiological Verification Program(RVP).
- (2) WDOH staff collected or split 100 samples with WNI and sent them to the State laboratory for independent analysis and performed approximately 140 gamma grid confirmation surveys in the same areas as WNI.

**Q17:** *Please provide discussion of results of confirmatory soil samples and radiation surveys (including highest, lowest and average values, and data comparisons between WNI and WDOH's results) that indicates that the subject site has been cleaned up to the State standards (including uranium and thorium limits) for both surface and subsurface soil.*

**Q18:** *Please provide information on the cleanup criteria used for remaining structures, if any, to demonstrate compliance with the State's equivalent of 10 CFR 40.42(k)(2).*

**Q19: Please provide information and discussion of the evaluation of the sites compliance with the State's equivalent of 10 CFR 40, Appendix A, Criteria 6 (2) and (5), concerning the overall gamma radiation level and radioactivity content of the cover material.**

**4. Documentation that the completed groundwater corrective actions, if necessary, were performed in accordance with license requirements and regulations.**

This information is provided in section 4 of the CRR and in two memoranda (Refs. 6 and 7) from a WDOH hydrogeologist. WDOH'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 thalium) are stable in groundwater within the range of natural variability and remain below regulatory levels. The submitted information was found to be acceptable.

**5. Discussion of results of State's site closure inspection.**

A number of the State's site closure inspection reports have been reviewed. Following is a specific issue where additional information is needed.

**ISSUE 11:** In a September 21, 1999 letter (Ref. 8) from WDOH to WNI, it lists a total of 12 issues and corresponding review result of each issue by WDOH. For issues 9, 10 and 11, the WDOH's review states that WDOH concurs with WNI's approach to add appropriately sized rock to areas previously identified as not having the required amount or thickness according to the approved plans and specifications. An inspection report in a memorandum (Ref. 9) dated October 27, 1999, addressed these issues and reached a conclusion that the WNI's remedial work satisfies WDOH's concerns as stated in Issues 9, 10, 11 and 12 in the September 21, 1999 letter.

It was noted that during WNI's remedial work, existing stockpile rock ( $d_{50} = 3$  inch) was used in several places that large ( $d_{50} = 10-15$  inch) rock was supposed to be placed.

**Q20: Please provide additional information to support your basis that WNI's remedial work was performed according to the approved plans and specifications.**

**6. Documentation that release of this portion of the site will not negatively impact the remainder of the site to be closed at a later date, if it is a partial license termination case. Such documentation could be a statement from the appropriate State regulatory agency which confirms that the impact has been evaluated and includes the bases for the State's conclusion.**

Not applicable. This is a full license termination.

**7. Integrated Materials Performance Evaluation Program (IMPEP) review of the WDOH uranium recovery regulatory program.**

Based on the 1999 IMPEP review, the WDOH 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 Washington 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.

## List of References

- (1) Memorandum from D.B. Stoffel to J. Blacklaw and E. Fordham "Completion of WNI Petrographic Analyses Review," April 12, 1996.
- (2) Letter from T.P. Paster to L.E. Fiske dated January 11, 1996.
- (3) Memorandum from D.B. Stoffel to G. Robertson, J. Blacklaw and E. Fordham dated August 9, 1999.
- (4) Waggoner, Stephanie, 1990. Geologic Map of the Coulee Dam 1:100,000 Quadrangle, Washington, Open File Report 90-15. Washington Division of Geology and Earth Resources.
- (5) SMI. 1994. Sherwood Project, Tailings Reclamation Plan.
- (6) Memorandum from D.B. Stoffel to G. Robertson and J. Blacklaw dated December 2, 1999.
- (7) Memorandum from D.B. Stoffel to G. Robertson and J. Blacklaw dated January 24, 2000.
- (8) Letter from WDOH to B. DeWaard dated September 21, 1999.
- (9) Memorandum from E. Fordham to G. Robertson dated October 27, 1999.