SAFETY EVALUATION REPORT

INDEPENDENT SPENT FUEL STORAGE INSTALLATION
MATERIALS LICENSE NO. SNM-2506
AMENDMENT NO. 9

1.0 SUMMARY

This safety evaluation report (SER) documents the review and evaluation of a license amendment request (L-PI-14-031) (Agency Document Access Management System (ADAMS) Accession No. ML14143A202) to Special Nuclear Material (SNM) License No. 2506 for the Prairie Island (PI) Independent Spent Fuel Storage Installation (ISFSI), which is currently in timely renewal pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) section 72.42(c). By letter dated May 23, 2014, as supplemented November 19, 2014, Northern States Power Company – Minnesota (the licensee) submitted license amendment request L-PI-14-031 to the NRC in accordance with 10 CFR 72.56, to amend the Technical Specifications (TS) of SNM License No. SNM-2506, to revise the cask cavity pressurization TS for the spent fuel storage casks, as outlined below:

1. Add a TS requiring cask cavity pressure verification prior to backfilling with helium as part of a loading process to ensure oxidizing gases are limited to 0.25% by volume,

2. Re-number the existing Surveillance Requirement (SR) 3.1.2.2 as SR 3.1.2.3, and

3. Revise TS Bases for helium backfill pressure requirements from “preventing air in leakage” to “ensuring oxidizing gases are limited to 0.25% by volume”.

NRC staff (staff) has reviewed the license amendment request including the justifications for the requested changes. As discussed in further detail below, based on the statements and representations in the application, as supplemented, staff finds that the requested amendment to Materials License No. SNM-2506 for the PI ISFSI meets the regulatory requirements of 10 CFR Part 72.

2.0 REVIEW CRITERIA

Staff's evaluation of the requested changes is based on ensuring the PI ISFSI continues to meet the applicable requirements of 10 CFR Part 72 for independent storage of spent fuel and of 10 CFR Part 20 for radiation protection. Staff followed the guidelines provided in NUREG-1567 “Standard Review Plan for Spent Fuel Dry Storage Facilities” in conducting the evaluation. Staff’s evaluation focused only on changes to SNM-2506 requested in the licensee’s amendment request and did not reassess previously approved portions of the license, TS, the Final Safety Analysis Report (FSAR) or those areas of the FSAR modified by the licensee as allowed by 10 CFR 72.48 which are not associated with this amendment request. The

objectives for the following review disciplines are as described below for the requested change.

3.0 CONFINEMENT EVALUATION

3.1 Confinement Integrity

Spent fuel at the PI ISFSI is stored within a robust sealed confinement vessel; i.e., a cask. The cask confinement of the spent fuel, as described by the licensee, occurs using a 1.5 inch thick steel cylindrical shell with an integrally-welded bottom closure and a bolted lid closure system. There are two aspects of the bolted lid closure system which ensure that the cask does not leak: (1) double O-ring seals and (2) a monitored and pressurized interspace between the seals. After loading the cask, the space between the double O-rings is filled with helium and initially pressurized to a pressure which is higher than both the cask cavity pressure and the external ambient pressure. In the case of an inner seal leak, the helium in the seal interspace would flow from the overpressure system into the cask cavity. In the case of an outer seal leak, helium would leak from the overpressure system to the exterior. In both instances, radioactive material would not be released to the environment, air would not be introduced into the cask cavity, and the overpressure system would alert personnel to a potential leak from the space between the O-rings by utilizing a low pressure alarm. Defense in depth against both air in leakage and helium escape by permeation, as well as subsequent release of radioactive material, through the steel containment vessel walls or welds is achieved by a close fitting outer steel shield shell which is seal welded at the top of the cask.

The cask cavity is filled with helium gas. This establishes an inert, non-reactive environment which protects the spent fuel cladding from degrading as a result of it interacting with oxidizing gases in the air. Currently, the licensee fills the cask cavity with enough helium to maintain a cask cavity pressure of at least one atmosphere above the ambient external pressure when the ambient external temperature at the end of the initial storage period is -40°F. The FSAR identifies this positive helium pressure as a barrier which prevents air from entering the cask cavity. Over time, spent fuel gradually cools causing the cavity pressure to decrease. Beyond the initial storage period, the spent fuel will cool sufficiently to cause the cavity pressures to decrease below the ambient external pressure.

The confinement function of the cask is what provides reasonable assurance that public health and safety is protected. The licensing basis for the confinement function of the cask, is that permeation of gases through the cask body walls and welds is negligible. Therefore, the bolted cask lid closure system is the only area where credible leakage could occur, and the cask body walls, welds, and cask lid closure system provide the design licensing basis for preventing air in leakage. Previous safety evaluations, as well as the original FSAR, stated that internal cask pressurization contributed to preventing air in leakage. The licensee's application stated that, because the confinement function is fully maintained by the cask body walls, welds, and cask lid closure system, internal cask pressurization is not necessary to prevent air in leakage. Staff requested additional information on this topic (ML14304A528), and the licensee provided a response (ML14325A583).

Based on the staff's review of the application, staff concludes that the confinement boundary, as identified above, is sufficient to prevent both radioactive release and air in leakage and maintain the confinement function of the cask. Therefore, it is not necessary to maintain internal cask pressure at above the outside ambient pressure to prevent air in leakage.

3.2 Oxidizing Gases

Pacific Northwest National Lab report PNL-6365, "Evaluation of Cover Gas Impurities and Their Effects on Dry Storage of LWR Spent Fuel," presented information on the effects of air on fuel and cladding materials. The report also identified a limiting concentration of 0.25% by volume of oxidizing gases below which no cladding degradation is expected. This limit is accepted by and incorporated into NUREG-1536. Therefore, staff finds the use of this concentration by the licensee acceptable to determine the necessary threshold to prevent oxidation of spent fuel cladding contained within the casks.

FSAR Figure 5.1-1, Sequence of Operations, identifies the cask loading operations. The cask loading operations which ensure that oxidizing gases are reduced to less than 0.25% by volume include the following steps:

- After the cask is loaded with spent fuel, the lid is installed, and the internal cavity is drained through the drain port. During the draining process, air is backfilled into the cask.

- Air and residual water are then removed by vacuum drying. A Vacuum Drying System applies a vacuum at the vent port, vaporizing any liquid water present and sweeping the water vapor out of the cask. Vacuum drying is performed in accordance with TS [Limiting Condition of Operation (LCO)] 3.1.1, Cask Cavity Vacuum Drying.

- The Vacuum Drying System is then disconnected and the Vacuum Backfill System is connected. During this process the cask vacuum is broken and the cask cavity is exposed to air.

- The Vacuum Backfill System then evacuates the cavity to remove oxidizing gases. The system applies vacuum at the vent port and evacuates the cask cavity to at least 14 mbar absolute.

- After oxidizing gases have been evacuated, the cask cavity is backfilled with dry helium gas. The backfill pressure is established between 1345 and 1445 mbar absolute, in accordance with TS LCO 3.1.2, Cask Helium Backfill Pressure. This is verified in accordance with current TS SR 3.1.2.2.

Staff determined that the proposed TS changes would not alter the physical work performed by the above steps. Rather, they affect the information recorded during performance of these steps. Since the proposed new TS cannot be retroactively applied to the previously loaded casks, to demonstrate that the physical conditions inside each of the previously loaded casks will conform to the proposed TS changes in the amendment request, the licensee reviewed work order records for each previously loaded cask and confirmed the following:

- A cask cavity pressure of at least 14 mbar absolute was achieved prior to helium backfill, and

- A cask cavity pressure of at least 1320 mbar absolute was achieved during the helium backfill process.

The licensee also submitted calculations which show that an oxidizing gas concentration of less than 0.25% is obtained when the pressures identified in the historical records are achieved

during performance of the operational steps outlined above.

Staff reviewed the operations sequence identified in the FSAR, the licensee's statements about previously loaded casks and the calculations provided by the licensee. Staff determined that the operations sequence described in the FSAR ensures the amount of oxidizing gases remaining in the cask after vacuum drying and helium backfill operations is below 0.25% by volume, and that this amount of oxidizing gases will not negatively impact fuel cladding performance. Staff also determined that the licensee used bounding values to generate the results from their calculations, and therefore their calculations are conservative. In addition, staff determined that, because the licensee's proposed TS changes will not alter the operations sequence, the amount of oxidizing gases within the cask cavity for future cask loadings will be below 0.25%. Finally, based upon the licensee's review of historical records, staff determined that, because operations performed on previously loaded casks ensure that the amount of oxidizing gases within the cask cavity are less than 0.25% by volume, re-pressurization of previously loaded casks is not required.

3.3 Evaluation Findings

F3.1 Based on staff's review of the documents provided by the licensee, including licensing bases and calculations, as well as staff guidance and applicable regulations, staff finds the confinement integrity ensured by the bolted lid closure system is acceptable and sufficient to preclude air in leakage.

F3.2 Staff also finds that maintaining cask internal pressure at or above ambient is not necessary to preclude air in leakage, as this function is performed by the physical barriers of the cask design as well as the interspace seal pressurization system.

F3.3 Staff also finds that the loading operations performed on previously loaded casks sufficiently limit the amount of oxidizing gases within the cask cavity below levels which will adversely impact the fuel cladding.

F3.4 Staff finds reasonable assurance that the confinement requirements of 10 CFR Part 72 and 10 CFR Part 20 are satisfied.

4.0 TECHNICAL SPECIFICATIONS

4.1 Review of Requested Change

The licensee proposed adding a TS and an associated Surveillance Requirement which verifies the cask is evacuated to at least 14 mbar absolute during cask loading operations prior to backfilling the cask with helium. Although this operational step has always been performed, the licensee sought to make it a formal requirement by incorporating it into the TS. The addition of the associated Surveillance Requirement necessitated the licensee re-numbering the existing Surveillance Requirements.

The proposed TS changes were reviewed by staff to ensure that they will not adversely impact the ability of the storage casks to safely store irradiated fuel while in use at the PI ISFSI. The technical and safety aspects of these changes were evaluated by staff. As documented in Section 3 above, staff concluded that the changes were acceptable.

4.2 Evaluation Findings

F4.1 Staff finds that the conditions for use remain in compliance with 10 CFR 72.44(c), and that the applicable design and acceptance criteria have been satisfied. The revised TS provide reasonable assurance that the PI ISFSI will continue to allow safe storage of spent fuel.

5.0 REQUIREMENTS FOR NOTICING PROPOSED ACTION

In accordance with 10 CFR 72.16, a Notice of Proposed Action and a Notice of Opportunity for Hearing was published in the *Federal Register* on September 3, 2014 (79 FR 52375). No requests for a hearing or leave to intervene were submitted. Accordingly, pursuant to 10 CFR 72.46(d), action can be taken on this license amendment request.

6.0 ENVIRONMENTAL REVIEW

The licensee stated that the amendment request met the categorical exclusion criteria in 10 CFR 51.22(c)(11). Per 10 CFR 51.22(c)(11), a categorical exclusion for an amendment which is administrative, organizational, or procedural in nature - or which results in a change in process operations or equipment - is allowed provided the amendment: (i) would not produce a significant change in either the type or amount of effluents released to the environment, (ii) would not produce a significant increase in occupational radiation exposure, (iii) would not have significant construction impacts, and (iv) would not produce a significant increase in the potential for or consequences from radiological accidents.

After evaluating the amendment request, staff made the following determinations: (i) the amendment would not produce a significant change in either the type or amount of effluents released to the environment because the amendment did not alter the confinement boundary components as documented in Section 4, (ii) the amendment would not produce a significant increase in occupational radiation exposure because, as shown in Section 4, the likelihood of fuel cladding failure would not be increased by the requested changes, (iii) the amendment would not have significant construction impacts because the amendment only changed information recorded during cask closure operations, and (iv) the amendment would not produce a significant increase in the potential for or consequences from radiological accidents because the change did not alter confinement boundary components as documented in Section 3. Consequently, staff finds the amendment request meets the categorical exclusion criteria in 10 CFR 51.22(c)(11).

7.0 CONCLUSION

Based on its review of license amendment request L-PI-14-031, as revised and supplemented, staff determined there is reasonable assurance that: (i) the activities authorized by the amended license will be conducted without endangering the health and safety of the public, and (ii) these activities will be conducted in compliance with the applicable regulations. Staff further determined that the issuance of the amendment will not be inimical to the common defense and security. Therefore, the amendment should be approved.

Issued with Materials License No. SNM-2506.

Dated: April 10, 2015