[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[Docket Nos. 72-58 and 50-263; NRC-2016-0115]

Xcel Energy, Monticello Nuclear Generating Plant

Independent Spent Fuel Storage Installation

AGENCY: Nuclear Regulatory Commission.

ACTION: Exemption; issuance.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is issuing an exemption in response to a request submitted by Xcel Energy on September 29, 2015, from meeting Technical Specification (TS) 1.2.5 of Attachment A of Certificate of Compliance (CoC) No. 1004, Amendment No. 10, which requires that all dry shielded canister (DSC) closure welds, except those subjected to full volumetric inspection, shall be dye penetrant tested in accordance with the requirements of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel (B&PV) Code Section III, Division 1, Article NB-5000. This exemption applies to one loaded Standardized NUHOMS® 61BTH, DSC 16 (DSC 16), at the Monticello Nuclear Generating Plant (MNGP) Independent Spent Fuel Storage Installation (ISFSI).

ADDRESSES: Please refer to Docket ID **NRC-2016-0115** when contacting the NRC about the availability of information regarding this document. You may obtain publicly-available information related to this document using any of the following methods:

- **Federal Rulemaking Web site:** Go to http://www.regulations.gov and search for Docket ID **NRC-2016-0115**. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: Carol.Gallagher@nrc.gov. For technical questions, contact the individual listed in the FOR FURTHER INFORMATION CONTACT section of this document.

- **NRC's Agencywide Documents Access and Management System (ADAMS):** You may obtain publicly-available documents online in the ADAMS Public Documents collection at http://www.nrc.gov/reading-rm/adams.html. To begin the search, select "ADAMS Public Documents" and then select "Begin Web-based ADAMS Search." For problems with ADAMS, please contact the NRC's Public Document Room (PDR) reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to pdr.resource@nrc.gov. For the convenience of the reader, the ADAMS accession numbers are provided in a table in the "Availability of Documents" section of this document.

- **NRC's PDR:** You may examine and purchase copies of public documents at the NRC's PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

FOR FURTHER INFORMATION CONTACT: Christian Jacobs, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; telephone: 301-415-6825; e-mail: Christian.Jacobs@nrc.gov.

SUPPLEMENTARY INFORMATION:

I. Background

Northern States Power Company-Minnesota, doing business as Xcel Energy (Xcel Energy, or the applicant) is the holder of Facility Operating License No. DPR-22, which authorizes operation of the Monticello Nuclear Generating Plant (MNGP), Unit No. 1, in Wright County, Minnesota, pursuant to part 50 of title 10 of the *Code of Federal Regulations* (10 CFR), "Domestic Licensing of Production and Utilization Facilities." The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the NRC now or hereafter in effect.

Consistent with 10 CFR part 72, subpart K, "General License for Storage of Spent Fuel at Power Reactor Sites," a general license is issued for the storage of spent fuel in an ISFSI at power reactor sites to persons authorized to possess or operate nuclear power reactors under 10 CFR part 50. The applicant is authorized to operate a nuclear power reactor under 10 CFR part 50, and holds a 10 CFR part 72 general license for storage of spent fuel at the Monticello Nuclear Generating Plant ISFSI. Under the terms of the general license, the applicant stores spent fuel at its ISFSI using the Transnuclear, Inc. (TN) Standardized NUHOMS® dry cask storage system Certificate of Compliance (CoC) No. 1004, Amendments No. 9 and No. 10. As part of the dry storage system, the DSC (of which the closure welds are an integral part) ensures that the dry storage system can meet the functions of criticality safety, confinement boundary, shielding, structural support, and heat transfer.

II. Request/Action

The applicant has requested an exemption from the requirements of 10 CFR 72.212(b)(3) and 10 CFR 72.212(b)(11) that require compliance with the terms, conditions, and specifications of CoC No. 1004, Amendment No. 10, for the Standardized NUHOMS® Horizontal Modular Storage System, to the extent necessary for the applicant to transfer DSC 16 into a Horizontal Storage Module (HSM). This would permit the continued storage of that DSC for the service life of the canister. Specifically, the exemption would relieve the applicant from meeting TS 1.2.5 of Attachment A of CoC No. 1004, which requires that all DSC closure welds, except those subjected to full volumetric inspection, shall be dye penetrant tested in accordance with the requirements of the ASME B&PV Code Section III, Division 1, Article NB-5000. Technical

Specification 1.2.5 further requires that the liquid penetrant test acceptance standards shall be those described in Subsection NB-5350 of the ASME BP&V Code.

Xcel Energy loaded spent nuclear fuel into six 61BTH DSCs starting in September 2013. Subsequent to the loading, it was discovered that certain elements of the liquid penetrant test (PT) examinations, which were performed on the DSCs to verify the acceptability of the closure welds, do not comply with the requirements of TS 1.2.5. All six DSCs were affected. Five of the six DSCs (numbers 11-15) had already been loaded in the HSMs when the discrepancies were discovered. The DSC 16 remains on the reactor building refueling floor in a transfer cask (TC). Xcel Energy has performed phased array ultrasonic testing (PAUT) of the closure welds, supported by analysis, as an alternate means for verifying the weld quality. The PAUT nondestructive examination (NDE) consists of testing performed by qualified personnel, using specific procedures and equipment shown by performance demonstration to be sufficient to detect the range of potential weld defects that could be present in the closure welds. The exemption request, if approved, would allow the transfer of DSC 16 into an HSM, and would permit the continued storage of that DSC for the service life of the canister. Xcel Energy plans to request a separate exemption for the remaining DSCs (11-15).

In a letter dated September 29, 2015, as supplemented January 29, 2016, and March 29, 2016, the applicant requested an exemption from certain parts of the following requirements to allow storage of the DSC at the MNGP ISFSI:

- 10 CFR 72.212(b)(3), which states that the general licensee must ensure that each cask used by the general licensee conforms to the terms, conditions, and specifications of a CoC or an amended CoC listed in § 72.214.
- 10 CFR 72.212(b)(11), which states, in part, that the licensee shall comply with the terms, conditions, and specifications of the CoC and, for those casks to which the licensee has applied the changes of an amended CoC, the terms, conditions, and

specifications of the amended CoC.

Upon review, in addition to the requirements from which the applicant requested exemption, the NRC staff determined that exemptions from the following requirements are also necessary in order to authorize the applicant's request and added the following requirements to the exemption for the proposed action pursuant to its authority under 10 CFR 72.7, "Specific exemptions":

- 10 CFR 72.212(a)(2), which states that this general license is limited to storage of spent fuel in casks approved under the provisions of this part.
- 10 CFR 72.212(b)(5)(i), which requires that the general licensee perform written evaluations, before use and before applying the changes authorized by an amended CoC to a cask loaded under the initial CoC or an earlier amended CoC, which establish that the cask, once loaded with spent fuel or once the changes authorized by an amended CoC have been applied, will conform to the terms, conditions, and specifications of a CoC or an amended CoC listed in § 72.214.
- 10 CFR 72.214, which lists the approved spent fuel storage casks.

III. Discussion

Pursuant to 10 CFR 72.7, the Commission may, upon application by any interested person or upon its own initiative, grant such exemptions from the requirements of the regulations of 10 CFR part 72 as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest.

Authorized by Law

This exemption would allow the applicant to transfer DSC 16 into an HSM, and would permit the continued storage of that DSC at the MNGP ISFSI for the service life of the canister by relieving the applicant of the requirement to meet the liquid penetrant test requirements of TS 1.2.5 of Attachment A of CoC No. 1004. The provisions in 10 CFR part 72 from which the applicant is requesting exemption, as well as provisions determined to be applicable by the NRC staff, require the licensee to comply with the terms, conditions, and specifications of the CoC for the approved cask model it uses. Section 72.7 allows the NRC to grant exemptions from the requirements of 10 CFR part 72. As explained below, the proposed exemption will not endanger life or property, or the common defense and security, and is otherwise in the public interest. Issuance of this exemption is consistent with the Atomic Energy Act of 1954, as amended, and not otherwise inconsistent with NRC's regulations or other applicable laws. Therefore, the exemption is authorized by law.

Will Not Endanger Life or Property or the Common Defense and Security

This exemption would relieve the applicant from meeting TS 1.2.5 of Attachment A of CoC No. 1004, which requires liquid penetrant test examinations to be performed on the DSCs to verify the acceptability of the closure welds, allowing for transfer of DSC 16 into an HSM, and would permit the continued storage of that DSC at the MNGP ISFSI for the service life of the canister. This exemption only addresses DSC 16, for which the PT test was not performed in accordance with the examination procedures specified in TS 1.2.5. Xcel Energy performed phased array ultrasonic testing to nondestructively examine the welds, and prepared structural analyses based on the actual weld quality to verify that the welds would perform their desired function over the storage term of the DSC. As detailed below, NRC staff reviewed the exemption request to determine whether granting of the exemption would cause potential for danger to life, property, or common defense and security.

Review of the Requested Exemption

The NUHOMS® system provides horizontal dry storage of canisterized spent fuel assemblies in an HSM. The cask storage system components for NUHOMS® consist of a reinforced concrete HSM and a DSC vessel with an internal basket assembly that holds the spent fuel assemblies. The HSM is a low-profile, reinforced concrete structure designed to withstand all normal condition loads, as well as abnormal condition loads created by natural phenomena such as earthquakes and tornadoes. It is also designed to withstand design basis accident conditions. The Standardized NUHOMS® Horizontal Modular Storage System has been approved for storage of spent fuel under the conditions of Certificate of Compliance No. 1004. The DSC under consideration for exemption was loaded under Certificate of Compliance No. 1004, Amendment No. 10.

The NRC has previously approved the Standardized NUHOMS® Horizontal Modular Storage System. The requested exemption does not change the fundamental design, components, contents, or safety features of the storage system. The NRC staff has evaluated the applicable potential safety impacts of granting the exemption to assess the potential for danger to life or property or the common defense and security; the evaluation and resulting conclusions are presented below. The potential impacts identified for this exemption request were in the areas of materials, structural integrity, thermal, shielding, and confinement capability.

Materials Review for the Requested Exemption: The applicant asserted that there is reasonable assurance of safety for the requested exemption for the transfer of DSC 16 to the MNGP ISFSI pad. The applicant's assertion of reasonable assurance of safety for the transfer of DSC 16 is based on the following:

- Repair and verification activities performed on DSC 16;
- PAUT examination and analysis of accessible lid welds on DSC 16;
- Short duration and haul distance of the transfer of DSC 16, and

- The safest location for DSC 16 is in the HSM.

The applicant asserts that there is a reasonable assurance of safety for the requested exemption for DSC 16 (CoC No. 1004, Amendment 10) based on the following:

- Integrity of the fuel (cladding) creates a fission product barrier;
- The quality of the welding process employed provides indication of development of quality welds;
- The advantages of the multi-layer weld technique which includes the low probability for flaw propagation, the subsequent covering of weld layer surface flaws and the indication of development of quality welds;
- Visual inspections performed on the welds met quality requirements;
- The DSC backfill and helium leak testing results verify confinement barrier integrity;
- The lack of a failure mechanism that adversely affects confinement barrier integrity; and
- Margin of safety is available in the welds when assuming conservatively large flaws. These margins are demonstrated by two different methods: (1) structural analysis using an analysis-based Stress Allowance Reduction Factor and theoretically-bounding full-circumferential flaws, and (2) a finite element analysis assuming flaw distributions conservatively derived from PAUT examination.

The applicant stated that the PAUT examination and analysis provides an objective review of volumetrically-identified flaw indications in the accessible DSC 16 Inner Top Cover Plate (ITCP) and Outer Top Cover Plate (OTCP) closure welds. The peak strains in the welds remain well below the weld material ductility limit when subjected to the accident pressure and drop loads. The peak strains have a margin of safety of 3.69 and 3.60 for accident pressure and drop loads, respectively. Furthermore, it was shown that the strains in the welds remain stable at 150 percent of the original design loads for the NUHOMS® 61BTH DSC. The applicant's analysis accounted for the identified ITCP and OTCP closure weld flaws and the uncertainties in the PAUT examination. The applicant stated that this approach, which is consistent with the NRC's Spent Fuel Project Office Interim Staff Guidance-15 (ISG-15), conservatively accounts for any additional limitations in the efficacy of the PAUT examinations and also accounts for the inaccessible area around the vent and siphon block as well as the geometric reflectors at the root and near the toe of the closure welds.

The applicant noted that the proposed exemption applies only to DSC 16 and is supported by the following reports:

1. Technical Justification for Phased Array Ultrasonic Examination of Dry Storage Canister Lid Welds Report No. 54-PQ-114-001, January 30, 2015 (AREVA, INC., 2015a).
2. Technical Report of the Demonstration of UT NDE Procedure 54-UT-114-000 Phased Array Ultrasonic Examination of Dry Storage Canister Lid Welds Report No. 51 - 9234641 - 001, January 30, 2015 (AREVA, INC., 2015b).
3. 61BTH ITCP and OTCP Closure Weld Flaw Evaluation, Calculation 11042-0205 Revision 3 (AREVA, INC., 2016).

The NRC staff reviewed Technical Justification for Phased Array Ultrasonic Examination of Dry Storage Canister Lid Welds Report No. 54-PQ-114-001, dated January 30, 2015 (AREVA, INC., 2015a). This report provides the detailed technical justification for the use of the PAUT system to perform the NDE of the OTCP and ITCP closure welds of DSC 16. The NRC staff determined that the technical justification report was adequate to justify the use of PAUT to examine the ITCP and OTCP closure welds because the report included detailed information on the PAUT system design, an assessment of examination sensitivity, flaw detection, flaw sizing, identification and effects of influential parameters, personnel qualification requirements, components to be examined, flaws to be detected, and analysis of flaw detection and flaw sizing data. In addition, the NRC staff determined that the report also described extensive modeling performed to evaluate PAUT array configuration, element arrangements, apertures, frequency, focusing, and beam angles to develop probes for the inspections of the ITCP and OTCP closure welds. The NRC staff also confirmed that the performance of the PAUT system was evaluated using laboratory testing of representative mockup containing 22 typical welding manufacturing flaws that have the potential to exist in field welds. The NRC staff determined that the laboratory testing was adequate to verify the performance of PAUT systems because the non-blind mockup contained representative ITCP and OTCP closure welds with controlled placement of intentional flaws positioned in difficult detection locations such as in the weld root and weld toe regions and were generally small in size.

The NRC staff also reviewed ISG-15, which states that closure lid welds examined by ultrasonic testing (UT) must use UT acceptance criteria of NB-5332 for pre-service examination and be performed in conjunction with the PT of the root and final pass. The ISG-15 also states that if progressive PT examination is used without a volumetric examination, a stress reduction factor of 0.8 is to be imposed on the weld design.

The NRC staff determined that the reduction factor of 0.8 considered by the applicant in their finite element analysis is sufficient to account for weld flaws that potentially were not detected by PAUT, visual inspection and the compliant PT inspection of the OTCP final weld pass. The NRC staff reached this determination based on the demonstrated ability of the PAUT examination to detect weld flaws on both the ITCP and OTCP closure welds including the root pass and the final pass shown in the technical justification of using PAUT to examine the DSC lid closure welds (AREVA, INC., 2015b). The NRC staff noted that the PAUT examination results of the OTCP weld are consistent with the PT examination of the OTCP closure weld final pass after repair and confirmed that no surface breaking flaws are present. Thus, the NRC staff determined that analytical evaluation of the DSC 16 OTCP and ITCP closure welds using the flaw sizing results obtained by the PAUT examination, combined with the discount of the ASME

B&PV Code specified minimum elongations for the weld material, is an appropriate method to determine the acceptability of the DSC inner and outer lid to shell closure welds.

The NRC staff determined that the PAUT procedure (AREVA, INC., 2016) was acceptable because the procedure was qualified using a blind performance demonstration in accordance with ASME B&PV Code Section V, Article 14, T-1424(b) Intermediate Rigor (ASME 2004 edition) that qualifies the equipment, procedure, and data analysis personnel for the detection and dimensioning of welding fabrication flaws. The NRC staff determined that PAUT procedures were also acceptable because: (1) personnel conducting the equipment calibration, data acquisition or data analyses must be qualified by the American Society for Nondestructive Testing (ASNT); (2) the examination area includes the accessible area of the ITCP and OTCP closure welds, and (3) specific procedures were developed and demonstrated for both flaw detection and flaw sizing scans. The NRC staff determined that the examinations were appropriate because: (1) they included >99 percent of the OTCP closure weld with the exception of two (2) 0.5-inch long sections that were identified as limited examination areas as a result of the two longitudinal welds in the canister shell; and (2) the entire ITCP closure weld with the exception of the part of the weld located around the siphon and vent port block resulting in >90 percent coverage of the ITCP closure weld (AREVA, INC., 2016). The NRC staff determined that the personnel qualifications for equipment calibration, data acquisition and data analysis are sufficient because: (1) Data Acquisition Operators require direct supervision of American Society for Nondestructive Testing (ASNT) UT Level II or Level III staff; (2) both Calibration Personnel and Data Analysis Personnel were required to be either ASNT UT Level II or Level III certification; and (3) lead personnel responsible for training and review of flaw indications were required to be ASNT UT Level III qualified. The NRC staff determined that the procedures for the flaw detection scans were adequate, because: (1) the procedures used the known geometric features of the DSC to identify the correct position of the transducer for complete coverage of the closure welds to be examined; and (2) the beams are swept through a range of angles at specified increments along the scan line in order to achieve coverage of the examination volume. The NRC staff determined that the flaw sizing scan procedures were adequate because: (1) raster scans were conducted at the higher frequency transducer (increased resolution) with a range of beam angles to achieve maximum insonification of the flaw; (2) focal laws were programmed for a focal depth equal to the reported flaw depth; (3) the acquired data was reviewed to verify that signal saturation had not occurred or whether rescanning of the area was necessary to obtain a response that would allow accurate flaw sizing; and (4) the flaw length and flaw height were determined using prescribed signal thresholds. The NRC staff determined that the PAUT minimum attributes for flaw detection and characterization provided by the applicant were acceptable and are commensurate with NRC confirmatory research findings involving PAUT examinations of welds (A.A. Diaz, S.L. Crawford, A.D. Cinson, and M.T. Anderson, "Technical Letter Report, An Evaluation of Ultrasonic Phased Array Testing for Reactor Piping System Components Containing Dissimilar Metal Welds JCN N6398, Task 2A, PNNL-19018," Richland, WA; Pacific Northwest National Laboratory, November 2009).

The NRC staff determined that PAUT data analysis methods provided by the applicant were adequate because they included specific procedures for flaw detection and flaw sizing necessary to locate and size flaws in the ITCP and OTCP closure welds using PAUT. The NRC staff determined that the applicant demonstrated the accuracy of the PAUT flaw detection and flaw sizing procedures using closure welds mockups with imbedded flaws. The NRC staff determined that PAUT procedure contained sufficient detail to ensure that the examination can be repeated with similar results and provides reasonable assurance that the examination could detect and size flaw indications found within the closure lid weld volumes.

The NRC staff reviewed Technical Report of the Demonstration of UT NDE Procedure 54-UT-114-000 Phased Array Ultrasonic Examination of Dry Storage Canister Lid Welds Technical Report Document 51-9234641-001, dated January 30, 2015 (AREVA, INC., 2015b).

This report summarizes the PAUT performance demonstration on a second ITCP and OTCP weld mockup specimen known as the blind mockup. The report states the overall task objective is to utilize a PAUT technique for detection and characterization of fabrication flaws in the closure lid welds of DSCs. The developed procedure was evaluated through a blind performance demonstration that included the scanning and data analysis of a secured (true-state withheld from examiners) OTCP and ITCP closure weld mockup. The blind mockup contained a number of controlled welding fabrication flaws similar in size and type to the flaws contained in the non-blind mockup, but placed in different locations. The technical report of the demonstration identified a calculated probability of detection (POD) of 97 percent with no missed detections (i.e., none of the known imbedded flaws in the blind mockup were missed in the performance demonstration) and one false call (i.e., one flaw indication reported by an examiner in the blind performance demonstration was incorrect and was not an actual imbedded flaw). As previously stated, the use of PAUT procedure to inspect DSC closure lid welds for this application was developed in accordance with ASME B&PV Code Section V, Article 14, T-1424(b), Intermediate Rigor (ASME 2004 edition). Intermediate rigor requires that a limited performance demonstration be conducted achieving a flaw POD of 80 percent and a false call rate of less than 20 percent. The NRC staff finds the demonstration of PAUT procedure to be acceptable, because the blind performance demonstration results exceed the criteria for acceptable performance listed in ASME B&PV Code Section V, Article 14, T-1471 Intermediate Rigor Detection Test (ASME 2004 edition).

The NRC staff reviewed Monticello DSC 16 phased array UT examination results that were used as an input to the 61BTH ITCP and OTCP Closure Weld Flaw Evaluation CALCULATION 11042-0205, Revision 3 (AREVA, INC., 2016). The NRC staff determined that the examination results were acceptable because:

1. The examination was conducted in accordance with the PAUT examination procedure developed in accordance with ASME B&PV Code Section V, Article 14, T-1424(b), Intermediate Rigor (ASME 2004 edition).
2. Flaws identified were appropriately characterized in terms of flaw length and flaw height. The PAUT examination identified the location of the flaws with respect to the geometric features of the DSC shell, the ITCP and the OTCP, and closure lid welds.
3. The largest flaw in the OTCP closure weld was characterized as having a height of 0.14 inches which is not greater than the thickness of one weld bead and less than the OTCP closure weld critical flaw size of 0.29 inches.
4. The largest flaw in the ITCP closure weld was characterized as having a height of 0.11 inches which is not greater than the thickness of one weld bead and less than the ITCP closure weld critical flaw size of 0.15 inches.

The NRC staff reviewed the preservice examination requirements of ASME B&PV Code Section III NB-5280 (ASME 1998 edition with 2000 addenda). The NRC staff determined that the PAUT examination results identified and sized flaws that exceed the acceptance criteria of NB-5332 (ASME 1998 edition with 2000 addenda), and NB-5332 is an acceptable approach under ISG-15. The applicant stated that the flaws identified by the PAUT examination were explicitly included in the finite element models as design features. Further, all indications found through the PAUT exam were, according to the applicant, conservatively characterized as planar and evaluated as such. The NRC staff determined that the approach taken by the applicant is acceptable, because: (1) the PAUT system was capable of identifying and sizing the flaws in the ITCP and OTCP welds with the exception of small sections of the OTCP closure weld as a result of longitudinal welds in the canister shell and the portion of the ITCP closure weld around the siphon and vent block; (2) the size of the flaws used in the analysis conservatively bounds the size and distributions of flaws identified by PAUT; and (3) the applicant applied a reduction factor of 0.8 on the ASME B&PV Code specified minimum elongations to the weld material to account for flaws that may not have been detected by the PAUT examination.

As a result of the conclusions discussed above, the NRC staff finds that there is adequate material performance of the components important to safety for DSC 16, loaded under CoC No. 1004, Amendment No. 10, and that DSC 16, as addressed in the exemption request, remains in compliance with 10 CFR part 72.

Structural Review for the Requested Exemption: The partial-penetration welds of the canister OTCP and the ITCP of the Type 1 NUHOMS® 61 BTH DSCs were originally evaluated in accordance with the ASME B&PV Code Section III, Subsection NB code limits. After the weld repair and verification activities on DSC 16, the applicant performed a PAUT examination and documented volumetrically-identified flaw indications in the welds. In the *Materials Review for the Requested Exemption*, the staff determined that the PAUT examination results were appropriate for analytical modeling. The results provided a basis for the applicant to model weld flaw size and distribution in performing structural evaluation by analysis. The evaluations and resulting conclusions to demonstrate the welds structural performance is presented below.

AREVA Calculation No. 11042-0204, Revision 3, “Allowable Flaw Size Evaluation in the Inner Top Cover Weld for DSC # 16,” used the ASME B&PV Code, Section XI, Appendix C flaw evaluation methodology to compute the allowable flaw size for governing Load Case TR-9 of an internal pressure of 20 psi plus a 25-g inertia loading associated with the DSC corner drop. A theoretical subsurface crack or an equivalent surface crack residing in the full circumference around the 0.25-inch deep ITCP weld in DSC 16 was assumed to be subject to the radial tensile membrane force on the weld. For the membrane stress of 17.08 ksi resulting from multiplying the calculated stress of 13.14 ksi with a service factor, SF_m, of 1.3 for Service Level D, the applicant determined a 0.15-inch wide allowable flaw size. The staff reviewed the analysis assumptions and concludes that the flaw size and distribution are conservatively modeled in accordance with the ASME B&PV Code Section XI flaw evaluation methodology to demonstrate sufficient structural performance margins in the welds.

In Structural Integrity Associates (SIA) Calculation Package No. 1301415.301, Revision 0, “Development of an Analysis Based Stress Allowable Reduction Factor (SARF), Dry Shielded Canister (DSC) Top Closure Weldments,” the applicant used a finite element analysis (FEA) approach to perform generic evaluation of flaw effects on the weld stress performance. Three types of flaw geometry, radial, circumferential, and laminar flaws for a range of distribution of flaw length, depth, and spacing in the DSC ITCP and OTCP were analyzed. Following a commonly acceptable FEA practice to simulate flaws with the elements of near zero stiffness, the applicant computed the membrane and membrane-plus-bending stress intensities in the welds. By comparing the results from the FEA models, with and without flaws, for the pressure and side drop load cases, a ratio, or SARF, was determined for each critical weld section cut of interest. For the OTCP, the applicant computed SARFs for 7 flaw configurations each for the individual pressure and side drop loading cases. This established a minimum SARF of greater than 0.7 for the through-wall circumferential flaws assumed to span an arc length of 2.016 inches with a common arc spacing of 5.184 inches. From the weld quality review documented in the SIA report, No. 1301415.405, “Expectations for Field Closure Welds on the AREVA-TN NUHOMS® 61BTH Type 1 & 2 Transportable Canister for BWR Dry Fuel Storage,” the applicant determined that only the circumferential flaws are potentially representative of the weld condition of the ITCP. This provided the basis for postulating a 360 degree, 50 percent intermittently embedded, through-wall circumferential flaw with a 0.006 in^2 cross section area for the FEA. This resulted in the calculated SARFs of 0.945 and 0.931 for the pressure and side drop cases, respectively. The staff reviewed the modeling assumptions and FEA results and concludes that the FEA method is suitable for analyzing the stress performance of the weld as a continuum with multiple embedded flaws.

Using the PAUT flaw indication examination results, the applicant performed an FEA to determine the weld structural performance margins, in accordance with the ASME Section III code limits, for the ITCP and OTCP of DSC 16. As noted in AREVA Calculation No. 11042-0205, Revision 3, “61BHT ITCP and OTCP Closure Weld Evaluation,” two full-circumferential, bounding flaw sets for the OTCP and one for the ITCP were used in the simulation of the flaw indications in the FEA models. The first set of the two bounding flaws in the OTCP are 0.14 inches and 0.195 inches each in height while the second set of the three flaws range in height from 0.07 inches to 0.16 inches. The single flaw set for the ITCP consists of two bounding flaws, a 0.09-inch high flaw between the weld metal and the DSC shell and another 0.11-inch high inside the ITCP, but at close proximity to the weld metal.

Using an elastic-perfectly plastic material property model, the applicant evaluated the top cover plates-to-shell welds for three governing load cases: (1) internal pressure loading of 32 psi for Service Levels A/B; (2) internal pressure loading of 65 psi for Service Level D; and (3) side drop loading of 75 g for Service Level D. Given that the potential exists for the weld to undergo material yielding, the applicant performed a limit analysis, per the ASME B&PV Code, Section III, Paragraph NB-3228.1, “Limit Analysis,” provisions, for the Service Level A/B, normal and off-normal condition load cases. Correspondingly, the rules of ASME B&PV Code Section III, Appendix F, Paragraph F-1341.3, “Collapse Load,” were used for the Service Level D, accident condition load cases. The limit analysis, with elastic-perfectly plastic material model, revealed that the weld would undergo unbounded deformation after the material yielding strength is exceeded.

To address the potential material rupture associated with large weld deformation and, hence, high plastic strain concentrations, the applicant performed an elastic-plastic analysis to supplement the determination of the weld performance margins for DSC 16. This was accomplished by considering a Ramberg-Osgood idealization of the stress-strain curve for SA-240 Type 301 stainless steel, which recognizes strain hardening effects for the large-deformation FEA models with embedded flaws in the welds. The elastic-plastic analyses resulted in the maximum equivalent plastic strains of 5.97 percent and 6.09 percent for the Service Level D design pressure of 65 psi and side drop of 75 g, respectively. The calculated strains are much smaller than the ASME B&PV Code specified minimum elongations of SA-240 Type 304 stainless steel at 40 percent and E308-XX electrode at 35 percent.

Additionally, for a conservative determination of margins of safety, the applicant considered a load factor of 1.5 to evaluate the welds subject to a DSC internal pressure of 100 psi (65 x 1.5 = 97.5 < 100 psi) and a side drop of 122.5 g (75 x 1.5 = 122.5 g). The elastic-plastic analyses, per the ASME B&PV Code, Section III, Paragraph NB-3228.3 Plastic Analysis provisions, resulted in a peak equivalent plastic strain of 12.6 percent for both loading cases. On the basis of the weld material elongation limit of 28 percent, a reduction of the ASME B&PV Code specified weld elongation limit of 35 percent by a factor 0.8 (0.35 x 0.8 = 0.28), to account for flaws that may not have been detected by the PAUT examination, the applicant calculated the margins of safety of 3.69 and 3.60 for the internal pressure and side drop loading cases, respectively.

The NRC staff reviewed the FEA modeling assumptions and concludes that the elastic-plastic analysis was implemented with appropriate loading conditions and materials properties, as described above. The analysis results show that the welds would undergo plastic deformation for the Service Level D loading associated with canister internal pressure and side drop accident conditions. However, no material rupture or breach of DSC confinement boundary at the welds is expected because of the large margins of safety against the ASME B&PV Code specified elongation limits. For this reason, the staff has reasonable assurance to conclude that the ITCP and OTCP welds of DSC 16 have adequate structural integrity for the normal, off-normal, and accident and natural phenomenon conditions. The NRC staff also finds that the retrievability of DSC 16 is ensured based on the demonstration of adequate structural integrity discussed above.

The NRC staff finds that the structural function of DSC 16, loaded under CoC No. 1004, Amendment No. 10, addressed in the exemption request remains in compliance with 10 CFR part 72.

Thermal Review for the Requested Exemption: The applicant stated that even though nonconforming examinations exist, satisfactory completion of the required helium leak test conducted on DSC 16 has specifically demonstrated the integrity of the primary confinement boundary (ITCP and siphon/vent cover plate) welds. These tests (conducted per TS 1.2.4a) specifically demonstrate that the primary confinement barrier field welds are "leak tight" as defined in American National Standards Institute (ANSI) N14.5-1997. The licensee stated that, in this respect, the helium leak test demonstrates the basic integrity of the confinement barrier and the lack of a through-weld flaw in the field closure welds that would lead to a loss of cavity helium in DSC 16. The licensee stated that the field closure welds indirectly support the thermal design function by virtue of their confinement function (as demonstrated by the helium leak test conducted on DSC 16) which assures the helium atmosphere in the DSC 16 cavity is maintained in order to support heat transfer.

The NRC staff reviewed the licensee's exemption request and also evaluated its effect on the DSC 16 thermal performance. The NRC staff concludes that the cask thermal performance is not affected by the exemption request because the applicant has shown that a satisfactory helium leak test was conducted on DSC 16, which assures integrity of the primary confinement boundary. Integrity of the primary confinement boundary assures the spent fuel is stored in a safe inert environment with unaffected heat transfer characteristics that assure peak cladding temperatures remain below allowable limits. Therefore, based on the NRC staff's review of the licensee's evaluation and technical justification, the NRC staff finds the exemption request acceptable by virtue of the demonstrable structural integrity of the ITCP and OTCP.

The NRC staff finds that the thermal function of DSC 16, loaded under CoC No. 1004, Amendment No. 10, addressed in the exemption request remains in compliance with 10 CFR part 72.

Shielding and Criticality Safety Review for the Requested Exemption: The NRC staff reviewed the criticality safety and radiation protection effectiveness of DSC 16 presented in the Monticello exemption request. The NRC staff finds that DSC 16 is not affected by the nonconforming PT examinations because storage of DSC 16 on the MNGP ISFSI will not significantly alter the assumptions of the criticality safety and radiation protection analysis of the 61BTH DSC. The interior of DSC 16 will continue to prevent water in-leakage, which means that the system will remain subcritical under all conditions. The nonconforming PT examinations do not affect the radiation source term of the spent fuel contents, or the configuration of the shielding components of the Standardized NUHOMS® system containing the 61BTH DSC, meaning that the radiation protection performance of the system is not altered.

The NRC staff finds that the criticality safety and shielding function of DSC 16, loaded under CoC No. 1004, Amendment No. 10, addressed in the exemption request remains in compliance with 10 CFR part 72.

Confinement Review for the Requested Exemption: The objective of the confinement evaluation was to confirm that DSC 16 loaded at the MNGP met the confinement-related requirements described in 10 CFR part 72.

As described in the licensee’s “Exemption Request for Nonconforming Dry Shielded Canister Dye Penetrant Examinations” (Enclosure 1 of the September 29, 2015, submittal), certain elements of the DSC 16 closure weld PT examinations did not comply with examination procedures. To support the exemption request, the licensee noted that a helium leakage rate test of the closure’s confinement boundary, including ITCP weld, siphon cover plate weld, and vent port cover plate weld, were conducted per TS 1.2.4a and demonstrated that the primary confinement barrier field welds met the TS acceptance criterion of 1E-7 cc/sec (i.e., “leaktight” as defined by ANSI N14.5). The applicant noted that failure to comply with the PT examination procedures would not change the general integrity of these DSC closure welds. NRC staff concludes that not performing the PT examination procedures relevant to this exemption request would not change the results of the helium leakage test and, therefore, the demonstration of the closure confinement integrity, as defined by the licensing basis, is unaffected. In addition, in the *Structural Review for the Requested Exemption* and *Materials Review for the Requested Exemption* evaluations described previously, staff evaluated the applicant's repair and verification activities and the PAUT examinations and analyses associated with DSC 16 and concluded DSC 16 meets the requirements of 10 CFR part 72.

As discussed above, because the PT examinations did not affect DSC 16's helium leak test results, the NRC staff finds that the confinement function of DSC 16, loaded under CoC No. 1004, Amendment No. 10, remains in compliance with 10 CFR part 72.

Review of Common Defense and Security: The NRC staff considered the potential impacts of granting the exemption on the common defense and security. The requested exemption is not related to any security or common defense aspect of the MNGP ISFSI, therefore granting the exemption would not result in any potential impacts to common defense and security.

Based on its review, the NRC staff has reasonable assurance that the storage system will continue meet the thermal, structural, criticality, retrievability and radiation protection requirements of 10 CFR part 72 and, therefore, will not endanger life or property. The NRC staff also finds that there is no threat to the common defense and security.

Therefore, the NRC staff concludes that the exemption to relieve the applicant from meeting TS 1.2.5 of Attachment A of CoC No. 1004, Amendment No. 10, which requires that liquid penetrant test examinations be performed on DSCs to verify the acceptability of the closure welds, allowing for transfer DSC 16 into an HSM, and would permit the continued storage of that DSC for the service life of the canister at the MNGP ISFSI will not endanger life or property or the common defense and security.

Otherwise in the Public Interest

In considering whether granting the exemption is in the public interest, the NRC staff considered the alternative of not granting the exemption. If the exemption were not granted, in order to comply with the CoC, either (1) DSC 16 would have to be opened and unloaded, and the contents loaded in a new DSC, and that DSC welded and tested, or (2) the OTCP would need to be machined off, and the ITCP weld machined down to the root weld; and the DSC, ITCP and OTCP inspected to determine if there was any damage as a result of the machining (which would then necessitate the actions detailed in option 1). If there were no such damage, the DSC would need to be re-welded and inspected. Both options would entail a higher risk of a cask handling accidents, additional personnel exposure, and greater cost to the applicant. Both options would also generate additional radioactive contaminated material (including the unloaded DSC for option 1) and waste from operations, because the lid would have to be removed in either case, which would generate cuttings from removing the weld material that could require disposal as contaminated material.

The proposed exemption to allow transfer of DSC 16 into an HSM, and permit the continued storage of that DSC for the service life of the canister at the MNGP ISFSI, is consistent with NRC's mission to protect public health and safety. Approving the requested exemption produces less of an opportunity for a release of radioactive material than the alternatives to the proposed action because there will be no operations involving opening the DSCs which confine the spent nuclear fuel. Therefore, the exemption is in the public interest.

Environmental Consideration

The NRC staff also considered in the review of this exemption request whether there would be any significant environmental impacts associated with the exemption. The NRC staff determined that this proposed action fits a category of actions that do not require an environmental assessment or environmental impact statement. Specifically, the exemption meets the categorical exclusion in 10 CFR 51.22(c)(25).

Granting this exemption from 10 CFR 72.212(a)(2), 72.212(b)(3), 72.212(b)(5)(i), 72.214, and 72.212(b)(11) only relieves the applicant from the inspection or surveillance requirements associated with performing PT examinations with regard to meeting Technical Specification (TS) 1.2.5 of Attachment A of CoC No. 1004. A categorical exclusion for inspection or surveillance requirements is provided under 10 CFR 51.22(c)(25)(vi)(C) if the criteria in 10 CFR 51.22(c)(25)(i)-(v) are also satisfied. In its review of the exemption request, the NRC staff determined, as discussed above, that, under 10 CFR 51.22(c)(25): (i) granting the exemption does not involve a significant hazards considerations because granting the exemption neither reduces a margin of safety, creates a new or different kind of accident from any accident previously evaluated, nor significantly increases either the probability or consequences of an accident previously evaluated; (ii) granting the exemption would not produce a significant change in either the types or amounts of any effluents that may be released offsite because the requested exemption neither changes the effluents nor produces additional avenues of effluent release; (iii) granting the exemption would not result in a significant increase in either occupational radiation exposure or public radiation exposure, because the requested exemption neither introduces new radiological hazards nor increases existing radiological hazards; (iv) granting the exemption would not result in a significant construction impact, because there are no construction activities associated with the requested exemption; and; (v) granting the exemption would not increase either the potential or consequences from radiological accidents such as a gross leak from the closure welds, because the exemption neither reduces the ability of the closure welds to confine radioactive material nor creates new accident precursors at the MNGP ISFSI. Accordingly, this exemption meets the criteria for a categorical exclusion in 10 CFR 51.22(c)(25)(vi)(C).

IV. Availability of Documents

The documents identified in the following table are available to interested persons through one or more of the following methods, as indicated.

DOCUMENT	ADAMS ACCESSION NO.
Monticello Nuclear Generating Plant Exemption Request for Nonconforming Dry Shielded Canister Dye Penetrant Examinations, September 29, 2015	ML15275A023 ML15275A024 ML15275A025
Monticello Nuclear Generating Plant Exemption Request for Nonconforming Dry Shielded Canister Dye Penetrant Examinations, Supplemental Information, January 29, 2016	ML16035A214 ML16049A081 ML16049A094
Monticello Nuclear Generating Plant Exemption Request for Nonconforming Dry Shielded Canister Dye Penetrant Examinations, Supplemental Information to Respond to the Second Request for Additional Information, March 29, 2016	ML16091A228 ML16097A460
Interim Staff Guidance No. 15, Rev. 0, Materials Evaluation, January 10, 2001	ML010100170
Technical Justification for Phased Array Ultrasonic Examination of Dry Storage Canister Lid Welds Report No. 54-PQ-114-001, January 30, 2015	ML16035A185 ML16035A186 ML16049A094
Technical Report of the Demonstration of UT NDE Procedure 54-UT-114-000 Phased Array Ultrasonic Examination of Dry Storage Canister Lid Welds Report No. 51 - 9234641 - 001, January 30, 2015	ML16035A184
61BTH ITCP and OTCP closure Weld Flaw Evaluation, Calculation 11042-0205, Revision 3, March 21, 2016	ML16097A460
Technical Letter Report, An Evaluation of Ultrasonic Phased Array Testing for Reactor Piping System Components Containing Dissimilar Metal Welds JCN N6398, Task 2A, PNNL-19018," Richland, WA; Pacific Northwest National Laboratory, November 2009	ML093570315
AREVA Calculation No. 11042-0204, Revision 3, Allowable Flaw Size Evaluation in the Inner Top Cover Weld for DSC # 16, September 29, 2015	ML15275A024
Structural Integrity Associates Calculation Package No. 1301415.301, Revision 0, Development of an Analysis Based Stress Allowable Reduction Factor (SARF), Dry Shielded Canister (DSC) Top Closure Weldments, October 2014	ML15275A025

Structural Integrity Associates report, No. 1301415.405, Expectations for Field Closure Welds on the AREVA-TN NUHOMS® 61BTH Type 1 & 2 Transportable Canister for BWR Dry Fuel Storage, November 3, 2014	ML14309A194

IV. Conclusion

Based on the foregoing considerations, the NRC staff has determined that, pursuant to 10 CFR 72.7, the exemption is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest. Therefore, the NRC grants the applicant an exemption from the requirements of 10 CFR 72.212(a)(2), 72.212(b)(3), 72.212(b)(5)(i), 72.214, and 72.212(b)(11), only with regard to meeting Technical Specification (TS) 1.2.5 of Attachment A of CoC No. 1004 for DSC 16.

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 8th day June, 2016.

For the Nuclear Regulatory Commission.

Bernie White, Acting Branch Chief
Spent Fuel Licensing Branch
Division of Spent Fuel Management
Office of Nuclear Material Safety
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