~~ENCLOSURE 2 CONTAINS PROPRIETARY INFORMATION – WITHHOLD FROM PUBLIC DISCLOSURE IN ACCORDANCE WITH 10 CFR 2.390~~

Xcel Energy®

Monticello Nuclear Generating Plant
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L-MT-14-016
10 CFR 72.7

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Director, Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety and Safeguards
Washington, DC 20555-0001

Monticello Nuclear Generating Plant
Docket No. 50-263
Renewed Facility Operating License No. DPR-22
Independent Spent Fuel Storage Installation Docket No. 72-58

Exemption Request for Dry Shielded Canisters 11 - 16 Due to Nonconforming Dye Penetrant Examinations

References:

1) TriVis, Inc. letter to NRC Document Control Desk, 12751-NRC-002, Final Report of Potential Substantial Safety Hazard in accordance with Title 10 Code of Federal Regulation, Part 21 Event Number 49628, dated January 29, 2014 (ADAMS Accession No. ML14042A201)
2) NSPM letter to NRC Document Control Desk, L-MT-13-103, Thirty (30) Day Notification Pursuant to 10 CFR 72.212, Conditions of General License Issued under 10 CFR 72.210, for the Storage of Spent Fuel, dated October 7, 2013 (ADAMS Accession No. ML13283A101)
3) NSPM letter to NRC Document Control Desk, L-MT-13-111, Thirty (30) Day Notification for the Fourth and Fifth Dry Shielded Canisters Pursuant to 10 CFR 72.212, Conditions of General License Issued under 10 CFR 72.210, for the Storage of Spent Fuel, dated November 4, 2013 (ADAMS Accession No. ML13310A568)
4) NSPM letter to NRC Document Control Desk, L-MT-13-114, Interim Notification for Dry Shielded Canister MNP-61BTH-1-B-2-016 Pursuant to 10 CFR 72.212, Conditions of General License Issued Under 10 CFR 72.210, for the Storage of Spent Fuel, dated November 15, 2013 (ADAMS Accession No. ML13322A445)

NMSS26

Pursuant to 10 CFR 72.7, "Specific Exemptions", the Northern States Power Company, a Minnesota corporation (NSPM), doing business as Xcel Energy, requests an exemption to the requirements of 10 CFR 72.212(b)(3) and 10 CFR 72.212(b)(11) for six (6) NUHOMS® Dry Shielded Canisters (DSCs) due to nonconforming dye penetrant (PT) examinations performed during the loading campaign started in September 2013. These nonconforming PT examinations were reported in Reference 1 pursuant to 10 CFR 21, "Reporting of Defects and Noncompliance".

Currently, five of the DSCs (numbered 11 – 15) subject to this exemption request are loaded into Horizontal Storage Modules (HSMs), as reported in References 2 and 3. The sixth DSC (numbered 16) subject to this exemption request is loaded and sealed, and located in a Transfer Cask (TC) on the refueling floor of the Reactor Building, as reported in Reference 4. NSPM has determined a reasonable assurance of safety exists for the current condition of all six DSCs with due consideration of the nonconforming PT examinations. Post-loading surveillance parameters have been and continue to be within acceptable limits.

Enclosure 1 provides the Exemption Request including a description of the need and justification for the issuance of an exemption. The exemption request provides the basis and technical justification to permit moving and inserting one DSC (16) into its HSM, and the exemption request would permit a 20-year lifetime for all six DSCs (11 – 16) in their respective HSMs.

Enclosure 2 provides AREVA calculation 11042-0204, Revision 2, "*Structural and Allowable Flaw Size Evaluation of the Spent Fuel Storage Canisters with Nonconforming Closure Welds at Monticello Nuclear Generating Plant.*" This calculation provides a structural analysis of DSCs 11 – 16 assuming reduced Outer Top Cover Plate (OTCP) closure weld size and determines an allowable flaw size that can be tolerated in the Inner Top Cover Plate (ITCP) and OTCP welds for the full circumference of the weld, while still meeting acceptance limits. Enclosure 2 contains proprietary information.

Enclosure 3 provides a non-proprietary version of Enclosure 2. The nonproprietary report is being provided based on the NRC's expectation that the submitter of the proprietary information should provide, if possible, a nonproprietary version of the document with brackets showing where the proprietary information has been deleted.

Enclosure 4 contains an AREVA affidavit executed to support withholding Enclosure 2 from public disclosure. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the NRC and addresses with specificity the considerations listed in 10 CFR 2.390(b)(4). NSPM requests that the proprietary information in Enclosure 2 be withheld from public disclosure in accordance with 10 CFR 2.390(a)4, as authorized by 10 CFR 9.17(a)4. Accordingly, it is respectfully requested that the information which is proprietary to AREVA be withheld from public disclosure in accordance with 10 CFR 2.390.

Correspondence with respect to the copyright or proprietary aspects of AREVA information or the supporting AREVA affidavit in Enclosure 4 should be addressed to Paul Triska, Vice President, AREVA Inc., 7135 Minstrel Way, Suite 300, Columbia, Maryland 21045.

In summary, the Exemption Request has determined that the integrity of the field closure welds for DSCs 11 - 16 can be assured with confidence even though the Technical Specification required PT examinations were non-conforming. The known quality of the welding processes, the use of multi-layer weld technique, the adequate stress margin in the welds to accommodate flaws, plus the visual inspection and helium leak testing demonstrate that the field closure weld integrity of DSCs 11 - 16 is sufficient to ensure that the affected closure welds will continue to perform their design basis functions over the service lifetime of these canisters.

NSPM requests approval of this Exemption Request by November 2014. This approval date would permit transfer of DSC 16 in a better seasonal environment than in the more challenging environments found in Minnesota winter conditions. This date also permits NSPM to begin refueling preparations and receipt of new fuel for the Spring 2015 refueling outage while limiting risks associated with a congested refuel floor and without other restrictions. The exemption request approval is needed by February 2015. This timeframe is necessary as this is the latest date to permit transfer of DSC 16 prior to a planned refueling outage. DSC 16 must be moved off the refueling floor prior to the MNGP refueling outage in the Spring of 2015 in order to perform outage activities. See section 2.0 of Enclosure 1 for further details.

Summary of Commitments

This letter makes no new commitments and no revisions to existing commitments.

Karen D. Fili
Site Vice-President
Monticello Nuclear Generating Plant
Northern States Power Company-Minnesota

Enclosures (4)

cc: Administrator, Region III, USNRC
Terry Beltz, Project Manager, Monticello Nuclear Generating Plant, USNRC
Pamela Longmire, Project Manager, Spent Fuel Storage and Transportation, USNRC
Resident Inspector, Monticello Nuclear Generating Plant, USNRC

Exemption Request for

Dry Shielded Canisters 11 - 16

Due to Nonconforming Dye Penetrant Examinations

Applicable To:

Northern States Power Minnesota

Monticello Nuclear Generating Plant

Exemption Request for

Dry Shielded Canisters 11 - 16

Due to Nonconforming Dye Penetrant Examinations

Table of Contents | Page

Exemption Request for

Dry Shielded Canisters 11 - 16

Due to Nonconforming Dye Penetrant Examinations

Table of Contents Page

List of Appendices

Exemption Request for

Dry Shielded Canisters 11 - 16

Due to Nonconforming Dye Penetrant Examinations

Table of Contents | Page

List of Tables

List of Figures

Exemption Request for

Dry Shielded Canisters 11 - 16

Due to Nonconforming Dye Penetrant Examinations

Executive Summary

During the 2013 Independent Spent Fuel Storage Installation (ISFSI) cask loading campaign at Northern States Power – Minnesota's (NSPM) Monticello Nuclear Generating Plant (MNGP), six (6) Type 1 NUHOMS®-61BTH Dry Shielded Canisters (DSCs) were loaded under Certificate of Compliance (CoC) 1004, Amendment 10. Condition 1 of the CoC allows use of the Standardized NUHOMS® system subject to the conditions of 10 CFR 72.212 and the CoC 1004 Technical Specifications (TS). TS 1.2.5 of CoC 1004 requires that all DSC closure welds not subjected to full volumetric inspection be dye penetrant tested (PT) in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel (ASME B&PV) Code. The NRC questioned and NSPM subsequently determined that certain elements of the PT examinations performed on these six DSCs do not comply with the examination procedures that support compliance with TS 1.2.5. As a result, NSPM is requesting an exemption from some parts of 10 CFR Part 72 to allow for the transfer of one DSC (DSC 16) into a Horizontal Storage Module (HSM) and the continued storage of the six (6) affected DSCs (DSCs 11 -16) in their HSMs.

This exemption request concludes, based on a preponderance of the evidence, that there is a reasonable assurance of safety for the NRC to approve the requested exemption for the transfer of DSC 16 to the MNGP ISFSI pad. The reasonable assurance of safety for the transfer of DSC 16 is based on the following:

1. Repair and verification activities performed on DSC 16,
2. Short duration of the transfer of DSC 16,
3. Additional controls put in place for the transfer of DSC 16, and
4. The safest location for DSC 16 is in the HSM.

This exemption request further concludes, based on a preponderance of the evidence, that there is a reasonable assurance of safety for the NRC to approve the requested exemption for the 20-year service lifetime of DSCs 11 - 16. The reasonable assurance of safety is based on the following:

1. Integrity of the fuel creates a fission product barrier.
2. The quality of the welding process employed provides indication of development of high quality welds.

3. 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 high quality welds.
4. Visual inspections performed on the welds met quality requirements.
5. The helium leak and DSC backfill testing results verify confinement barrier integrity.
6. The lack of a failure mechanism that adversely affects confinement barrier integrity.
7. *Stress margins are available in the welds when assuming conservatively* large flaws.

1.0 Background

During the 2013 ISFSI cask loading campaign at NSPM's MNGP, six (6) Type 1 NUHOMS®-61BTH DSCs were loaded under CoC 1004, Amendment 10. Condition 1 of the CoC allows use of the Standardized NUHOMS® system subject to the conditions of 10 CFR 72.212 and the CoC 1004 TS. TS 1.2.5 of CoC 1004 requires that all DSC closure welds not subjected to full volumetric inspection be PT tested in accordance with the ASME B&PV Code. The NRC questioned and NSPM subsequently determined that certain elements of the PT examinations performed on these six DSCs do not comply with the examination procedures that support compliance with TS 1.2.5. As a result, NSPM is requesting an exemption from some parts of 10 CFR Part 72 to allow for the transfer of one DSC (DSC 16) into an HSM and the continued storage of the six (6) affected DSCs (DSCs 11 -16) in their HSMs.

The continued storage of DSCs 11 - 16 (after transfer of DSC 16 to the HSM, which are not fully compliant with TS 1.2.5, requires an exemption from parts of 10 CFR Part 72. In the interim, the condition of these DSCs has been evaluated in accordance with the MNGP Corrective Action Program (CAP). In the CAP, assessments conclude that there is reasonable assurance that DSCs 11 - 16 are safe in their current configuration and that they will continue to be safe for a service lifetime of 20-years[1].

1.1 NUHOMS® System Design, Transfer and Storage

The Standardized NUHOMS® System is utilized for the storage of spent fuel at the MNGP ISFSI. As listed in 10 CFR 72.214, the Standardized NUHOMS® System is approved for the storage of spent fuel under the conditions specified in CoC No. 1004, Amendment 10. NSPM uses the Standardized NUHOMS® System at MNGP under the general license provisions of 10 CFR 72.210.

The Standardized NUHOMS® System consists of:

- A DSC that provides criticality safety, confinement boundary, shielding, structural support and heat transfer (removal) for fuel assemblies
- An HSM that provides structural support, heat transfer (heat removal), and shielding during storage on the ISFSI pad
- A Transfer Cask (TC) that provides structural support, heat transfer and shielding during loading and DSC transfer to the HSM.

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[1] The term "service lifetime of 20 years" or "20-year service lifetime" and similar phrases used in this exemption request are meant to convey that the DSCs are meeting the requirements for operation for a 20 year service period from the in-service date of the DSC (per 10 CFR 72.212(a)(3)). CoC 1004, Amendment 10, applicable to the NUHOMS® 61BTH design, expires January 23, 2015. Therefore, these DSCs will continue to be subject to any new or revised NRC requirements applicable to the license renewal of the CoC 1004 and this exemption, if authorized, would still be applicable in that and subsequent license renewal periods (10 CFR 72.240).

The NUHOMS®-61BTH DSC is a redundant weld-sealed containment pressure vessel with no penetrations in the storage configuration. For all practical purposes, helium does not diffuse through stainless steel, so the design keeps leakage rates negligible. The multi-layer closure welds of the DSC effectively eliminate any pinhole leaks which might occur in a single-layer weld as the chance of pinholes being in alignment on successive weld layers is negligibly small.

The primary confinement boundary of the NUHOMS®-61BTH DSC consists of the Shell, Inner Top Cover Plate (ITCP), Inner Bottom Cover Plate, Siphon/Vent Block, Siphon/Vent Port Covers and the associated welds for these components. The redundant confinement boundary of the DSC consists of the outer top cover plate (OTCP) and its associated welds. Refer to Figures 1, 2 and 3 for an illustration of the NUHOMS®-61BTH design.

While the ASME Code is not strictly applicable to the DSC, pursuant to TS 1.1.12.2, the 61BTH DSC is designed, fabricated, inspected and tested to the maximum extent practical to the ASME B&PV Code 1998 Edition through 2000 Addenda, Section III, Subsection NB (the Code). The confinement welds of the DSC are inspected in accordance with the Code, including alternatives to ASME Code documented within TS 1.1.12.4. The assembly consisting of the DSC Shell, Siphon/Vent Block, and Inner Bottom Cover Plate is compliant with the Code (including alternatives) and is welded and tested during DSC fabrication and loading (field welding).

The remainder of the confinement boundary and seal welds[2] are welded after the canister is loaded to comply with the guidance of Interim Staff Guidance 15 (ISG-15) (Reference 6.7), ISG-18 (Reference 6.8), and the ASME Code Alternatives. These are all multi-layer welds that receive root and final weld PT examinations with the exception of the weld for the OTCP, which is to receive root, mid-layer, and final PT examinations. Numerous tests (described in section 3.2.4) are performed during loading operations that directly or indirectly confirm DSC confinement integrity.

ISG-18 provides guidance for the design and testing of a redundant closure system. The NUHOMS® 61BTH System satisfies ISG-18 via the dual lid design option (refer to Sketch B of ISG-18) where the ITCP weld is a small partial penetration weld subject to PT examination and helium leak testing to the leak tight criteria of ANSI N14.5, and the OTCP weld satisfies the large weld exception criteria for helium leak testing by incorporating a three (3) layer minimum weld requirement where each of the three layers is subject to PT

[2] The confinement boundary and seal welds performed in the field are comprised of the Inner Top Cover Plate (ITCP) weld, the Siphon Port Cover Plate (SPCP) weld, the Vent Port Cover Plate (VPCP) weld, Test Port Plug (TPP) weld and Outer Top Cover Plate (OTCP) weld.

examination, and the layer depth is limited by a flaw evaluation performed in accordance with ISG-15.

After loading the DSC with spent fuel and completion of the welding and welding inspection activities described above, the DSCs are transferred from the refueling floor to the ISFSI and inserted into an HSM. The HSM is the design location for interim storage of a DSC.

Transfer of the DSC is performed by initially lifting the DSC in its TC off the MNGP refueling floor and lowering it to the MNGP reactor building loading bay airlock. In the reactor building loading bay airlock, the DSC/TC is loaded onto a Transfer Trailer (TT). The DSC/TC on the TT is then moved via tugger (prime mover) out of the reactor building bay airlock to the ISFSI pad along an approved heavy haul path.

During the transfer, precautions for weather conditions and temperature conditions are considered to enhance the safety of the transfer of the DSC/TC to the HSM. Transfer of the DSC/TC is not permitted during severe weather, including ice and snow, lightning, tornadoes and high wind conditions. Other precautions such as verifying fire hydrants are operable, not permitting delivery trucks with flammable liquids or gasses to pass the security checkpoint during transfer and insertion operations, and prohibiting the use of vehicles not associated with the transfer operations to be within 12 feet of the DSC/TC during transfer and insertion operations, are taken to enhance the safety of the move.

Each DSC is assigned a designated HSM location to reside. After arriving at the ISFSI, the DSC/TC is moved in front of the designated HSM, the HSM door is removed and the DSC is prepared for transfer into the HSM. The TC is prepared for release of the DSC and the DSC/TC is aligned for insertion of the DSC into the HSM. Once aligned, a hydraulic ram system is used to insert the DSC into the HSM. The DSC slides into the HSM on rails located on the bottom of the HSM. After the HSM is closed, dose rates are verified to be within TS requirements.

1.2 Scope of Welds Included in the Exemption Request

The closure welds for a DSC are all multiple layer welds (also called multi-layer welds). That is, the welds are built up through successive layering of weld material. This technique is used to eliminate the effects of pinhole leaks which might occur on a single layer, taking advantage of the likelihood that pinholes in successive weld layers will not align.

NSPM has determined that 11 weld layers had non-conforming PT examinations completed on each canister. The weld layers affected by the non-conforming PT examinations are:

- Inner Top Cover Plate Weld – two weld layers - root and cover
- Siphon Port Cover Plate Weld – two weld layers – root and cover
- Vent Port Cover Plate Weld – two weld layers – root and cover
- Test Port Plug Weld– two weld layers – root and cover
- Outer Top Cover Plate Weld – three weld layers – root, intermediate and cover

See Figures 1, 2 and 3 for illustrations of the welds.

1.3 Timeline for Nonconforming PT Examinations and Extent of Condition Reviews

In the fall of 2013, NSPM started a dry cask loading campaign at MNGP. By October 17, 2013, six canisters had been loaded in sequence with spent nuclear fuel, and welded closed. Five canisters (designated DSCs 11 - 15) had been placed into service in their respective HSMs. One canister (designated DSC 16) was located on the Reactor Building refueling floor in a TC and had been welded closed prior to transfer to the HSM. The 2013 ISFSI campaign loaded only intact fuel assemblies; the cladding of these assemblies is an additional confinement barrier of radioactive material.

During the loading campaign two sets of videos were made of the loading activities. First, videos were made from cameras located onboard the automated weld machine. This video provides a close-up view of the weld development. The second video is a video of activities performed on the refueling floor during the loading activities. This video shows a wider range of the loading activities and was used to verify the PT/developer dwell times, hold time for certain TS activities and other essential data.

On October 17, 2013 the NRC Senior Resident Inspector at MNGP observed part of the liquid PT examination on the final weld of the OTCP for DSC 16. The inspector questioned if the dwell and development times of the examination were sufficient to meet the requirements of the PT examination procedure. Video recordings of the examination were reviewed by the loading services vendor (TriVis, Inc.), NSPM supervision, and the inspector. Procedural noncompliances were discovered and the loading campaign activities were stopped.

As part of an extent of condition review performed under the Root Cause Evaluation (RCE), video recordings of every PT examination performed during the 2013 campaign were reviewed to determine the extent of the noncompliance. Noncompliance with the PT examination procedure was noted for all of the examinations performed on DSCs 11 -16. TriVis reviewed these noncompliant services pursuant to 10 CFR 21 and issued two reports (References 6.1 and 6.2).

Non-destructive examiner qualifications were reviewed and found to not meet the TriVis written practice and the ASME code. Specifically, the Level III NDE did not complete a certain examination as part of the qualification process. The requirements for the Level II NDE personnel were found satisfactory. The vendor modified their qualification process to comply with the more rigorous requirements for Level III NDE qualification. The review also determined that the NDE personnel did not perform any other welding inspection (VT or PT activities) on MNGP components.

Subsequent to the final 10 CFR 21 report, TriVis issued an assessment of simulated PT conditions (discussed in section 1.3.1), using the actual dwell times and development times determined from video recordings of refuel floor activities, to determine if the PT examinations performed on DSC 11 - 16 field closure welds would have been capable of producing interpretable results for detection of critical weld flaws (Reference 6.5). See section 1.3.1 for further details.

Since the Quality Control (QC) individuals involved in the nonconforming PT examination process also performed the visual examination (VT) inspection for DSCs 11 - 16, and in order to determine extent of condition, NSPM also evaluated the process utilized for the VT inspection to determine if it might also be suspect or in any manner noncompliant. NSPM reviewed remote video recordings of the VT inspections performed on the closure welds and the documentation of the VT examinations for DSCs 11 – 16. The review concluded that there is a reasonable level of confidence that the VT inspections were properly performed. The VT inspection process for these DSCs appeared to be diligent, using flashlights and the proper distance from the weld surface, viewing at the proper angle and weld conditioning can be seen occurring.

Based on the results of the initial extent of condition (review of VT and PT examinations on DSCs 11 -16), NSPM determined that additional reviews were necessary. NSPM used an independent vendor to assess the quality of the welding performed during the performance of field closure welds on DSCs 11 – 16. Section 1.3.2 describes the results of weld head video reviews performed as a review of the quality of the field welding.

Section 1.3.3 provides a discussion of additional verification activities performed for DSCs 11 - 16. Physical verifications were performed on DSC 16 as this was the only DSC available when the nonconforming PT examinations were discovered. Section 1.3.3 also discusses documentation errors discovered regarding other DSCs.

Finally, section 1.3.4 provides a discussion of a comprehensive extent of condition review of documentation and video regarding DSC loading activities performed by the NSPM Nuclear Oversight (NOS) department. This review utilized industry experts along with NSPM NOS staff to carefully review and document any findings or errors associated with the loading, testing, welding, or other activities associated with DSCs 11 – 16.

Through these additional reviews, NSPM has determined that there are no remaining deficiencies in the welding, TS testing, or examinations associated with the loading activities for DSCs 11 – 16.

1.3.1 Dye Penetrant (PT) Examination

NUREG-1536, Revision 1, Standard Review Plan for Spent Fuel Dry Storage Systems at a General License Facility, Section 10.5.1.3 specifies that use of nondestructive examination (NDE) of weldments, including use of dye penetrant (PT), should be established and documented. A written weld inspection plan prepared in accordance with an approved quality assurance (QA) program that complies with 10 CFR Part 72, Subpart G must include this NDE plan. The inspection plan should identify welds to be examined, the examination sequence, type of examination, and the appropriate acceptance criteria as defined by either the ASME B&PV Code, or an alternative approach proposed and justified by the applicant. NUREG-1536 specifically states that the NRC has accepted multiple surface examinations of welds, combined with helium leak tests for inspecting the final redundant seal welded closures.

In accordance with NUREG-1536, Revision 1, the procedures used for loading of DSCs 11 – 16 contained instructions for performance of PT examinations on every weldment including separate PT examinations for multiple layer welds.

The PT examinations required for the 61BTH DSC are specified in TS 1.2.5. TS 1.2.5 requires that PT examinations be performed in accordance with ASME B&PV code, 1998 Edition through 2000 Addenda, Section III, Division 1, Article NB-5000. The liquid penetrant test acceptance standards are described in Subsection NB-5350 of the Code.

For the field closure welds, the multi-layer weld technique with multi-layer PT examination specified in TS 1.2.5 was developed as an alternative to the ASME Code, Subsection NB requirement for volumetric examination, since a volumetric examination of the DSC field closure welds is not currently practical due to access limitations, weld joint geometry, use of partial penetration groove welds rather than full penetration welds, and other considerations.

In accordance with NB-5350 the PT procedure contains acceptance criteria that establish a minimum dimension of 1/16" for relevancy; specifically, "*only imperfections producing indications with major dimensions greater than 1/16 inch shall be considered relevant imperfections.*" Imperfections producing the following indications are considered unacceptable:

- cracks or linear indications
- rounded indications with dimensions greater than 3/16"
- four or more indications in line separated by 1/16" or less edge-to-edge
- ten or more rounded indications in any 6 square inches of surface

Thus, the PT examinations allow weld acceptance with some degree of imperfection (NB-5350). There is an NRC approved acceptance of any indication up to 1/16". There is specific acceptance for some indications (e.g., rounded indications) that exceed 1/16." This would imply that surface indications may exceed the size of a pinhole (assumed to be smaller than 1/16") and still be considered acceptable.

PT examination performance is described in the ASME code, 1998 Edition through 2000 Addenda, Section V, Article 6. Article 6, Section T-621.1 states that the procedure shall consider at least the following information:

a. The materials, shapes, or sizes to be examined, and the extent of the examination;
b. Type (number or letter designation if available) of each penetrant, penetrant remover, emulsifier, and developer;
c. Processing details for pre-examination cleaning and drying, including the cleaning materials used and minimum time allowed for drying;
d. Processing details for applying the penetrant; the length of time that the penetrant will remain on the surface (dwell time), and the temperature of the surface and penetrant during the examination if outside the range of 50°F to 125°F range;
e. Processing details for removing excess penetrant from the surface, and for drying the surface before applying the developer;
f. Processing details for applying the developer, and length of developing time before interpretation;
g. Processing details for post-examination cleaning.

The PT examination procedure used by TriVis incorporated these parameters. The PT examination materials specified in the procedure were Sherwin Hi-Temp® Penetrant Inspection System.

Appendix A includes Tables A-1 and A-2 which provide the overall weld temperatures, penetrant dwell times, cleaning method, cleaning dry time and developer dwell time for the welds under the scope of this exemption request for each DSC.

Appendix B provides the details of a report prepared by TriVis (Reference 6.5), which details testing performed by TriVis and Sherwin regarding non-compliant PT examinations. The intent of the testing by TriVis and Sherwin was to reproduce the penetrant and developer dwell times to demonstrate that they could have been effective examinations.

Although the TriVis assessment concluded that the majority of PT examinations could have produced interpretable results, NSPM conservatively determined from video records that the examiners did not follow the procedural and ASME code requirements, thus not meeting the TS requirements. Therefore, conservatively, the examiner may not have visually evaluated and documented the examination area with sufficient rigor to ensure that the potentially interpretable results were viewed and resolved appropriately. See Appendix B for details.

1.3.2 <u>Automatic Weld Head Video Review</u>

NSPM contracted the support of an independent vendor to review the weld quality performed on DSCs 11 - 16. This review was provided by Structural Integrity Associates (SIA), who performed a review of weld quality and provided a report of their findings. The results of this report were also reviewed by AREVA (the current license holder for the 61BTH DSC) and the report was reissued with their comments incorporated. (Reference 6.6)

This review determined that the quality of the welding was for the most part satisfactory, but did contain some anomalous practices.

NSPM has concluded that this report provides a sampling of typical welding practices across the industry. Evidence of good weld being applied is ample and dominates the video. But the video also shows infrequent indications of areas where the potential for small weld flaws also exists. See Appendix C for more details on this report.

1.3.3 <u>DSC Verification Activities</u>

NSPM performed a second verification of DSC 16 OTCP outer weld and TPP outer weld to assure proper weld integrity existed.

Additional Relevant Indications

NSPM performed an independent examination of DSC 16 weld condition. NSPM performed this examination after completion of the original TriVis inspections and discovered weld quality issues associated with the outer weld layer of the OTCP of DSC 16. This included relevant indications in a PT examination. The examiner determined that an initially relevant linear 1.6" indication was present in the weld between the weld and the OTCP, with an approximate depth of 0.035" was non-relevant as the indication was due to the weld contour and not a lack of fusion. The complete reexamination of the OTCP outer weld revealed additional indications. All of these indications were determined to be non-relevant. The indications were removed via surface conditioning. The OTCP final weld layer had a VT and PT performed to comply with the requirements of TS 1.2.5 and was found satisfactory.

Inadequate Weld Depth Measurements

After the linear indication described above was discovered, further weld examinations were performed on the OTCP weld for DSC 16. The weld examination found instances of inadequate weld depth measurements in the OTCP weld. The weld depth was originally measured in a hot condition during the placement of the weld in October 2013, with all weld depths verified to be greater than 0.500".

By procedure, weld depth checks are made at four cardinal locations (0^o, 90^o, 180^o and 270^o around the OTCP). The recheck found the 0^o location to be undersized (i.e. less than 0.500"). Based on this finding additional locations around the OTCP weld were reexamined and 13 other locations were identified as being undersized as well.

The weld depth measurement gauge used for the original measurements was recalibrated and was found to be within 0.002" tolerance.

The cause for the inadequate weld depth measurements could not be determined. Causes that could have contributed to the under depth measurements include:

- The measurement is made in a vertical direction of a weld that does vary in the radial direction, as well as in the circumferential direction. It is highly probable that the measurement location is different than the original measurements taken in October 2013.
- Weld distortion can be caused when the weld cools to an ambient temperature; the weld thickness shrinks. Residual stresses can also cause weld distortion.

- The measuring instrument is sitting within 3 heat zones of the weld, thus the instrument is not on a stable base, which can cause a difference in readings as the height of the base changes.
- The gauge was misread by the examiner or attention to detail was lacking.
- The process utilized to measure the depth of the weld layer is reasonably repeatable given the surface conditions. The depth of a given weld layer is measured using a proximity gauge which has its base located on the top face of the OTCP with the measuring point extended down to the face of the weld layer. The weld layers are typically in the as-welded condition where there is variation between weld beads. Likewise, the top face of the OTCP is in the as-rolled condition (face is not machined). Even though the inspector is instructed to locate the minimum thickness of the weld at designated azimuths on the shell perimeter, the surface conditions are such that slight variations in depth measurement are possible.

Therefore, it could not be definitively concluded what caused the undersized welds. However it was determined that the most likely reason for the 0.020" variation in depth measurement is attributed to the surface conditions of the weld layers and top face of the OTCP and the repeatability of these measurements. The inadequate weld depth was repaired by adding additional weld material to approximately 3/4 of the circumference of the OTCP weld. After the repair was completed, satisfactory VT and PT examinations were performed.

From the documented measurements of each DSC, DSC 16 had the lowest weld depth measurements on the OTCP weld. On DSC 16 the largest change in depth for the cardinal point measurements was a decrease of 0.019". The estimated[3] average inadequate weld depth at the 13 undersized locations was 0.021". See Appendix D, Table D-3 for weld depth measurements for DSCs 11 – 16.

Based on this discovery in DSC 16, the presence of undersized welds is a potential occurrence in other DSCs. Therefore, this potential condition is considered in the structural analysis described in section 3.2.5.1. The structural analysis has determined that inadequate weld depth in the OTCP of this size and scope can still achieve satisfactory stress results. See section 3.2.5.1 for details.

Documentation Errors

A documentation error related to TS 1.2.2 compliance was identified through the corrective action program. While reviewing DSC loading documentation, the vacuum drying test hold time requirement (specified in TS 1.2.2) was not

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[3] Estimated, because original depth measurements were not taken at any other locations except the cardinal locations and assumptions had to be made regarding the original depths for the 13 undersized locations.

met for DSCs 12 and 13. TS 1.2.2 specifies a hold time of at least 30 minutes for the vacuum test. The documentation indicated for DSCs 12 and 13 that less than 30 minutes had elapsed during the performance of TS 1.2.2. NSPM performed a review of the video recordings and determined that the documentation was incorrect and indeed the TS vacuum drying test hold times had been met. Therefore, additional repair or testing of the affected DSCs is not necessary as this is a documentation issue.

Another corrective action document called into question the extent of condition review performed during the RCE. The RCE extent of condition focused only on the PT examinations of other DSCs and should have looked more broadly at other TS and design requirement compliance during the DSC loading. Based on these findings a more broad-based extent of condition review was performed for weld information and overall DSC condition for DSCs 11 – 15, and the inaccessible welds for DSC 16. This broader based look was performed by the Nuclear Oversight (NOS) department and is documented in section 1.3.4 and Appendix E of this enclosure.

1.3.4 Nuclear Oversight Review of DSC 11 – 16 Activities

NSPM directed the NOS department (augmented by technical experts in DSC loading activities and weld performance and inspection) to perform an independent extent of condition review (assessment) of the DSC loading activities associated with DSCs 11 -16. NOS reviewed video and documentation from the loading activities and provided a report of their results. Thus, record reviews and video reviews (same video as described in section 1.3.1) were performed to ascertain the as-left weld conditions, TS compliance, and compliance with design requirements. Appendix D provides the results of the extent of condition review for DSCs. Appendix E provides a listing of issues discovered during the NOS assessment.

NOS performed the following scope of work:

- Verify the RCE adequately identifies and corrects all deficiencies associated with the Monticello spent fuel loading campaign to ensure that the same or a similar condition does not exist today and that the same or a similar condition will not occur in the future.
- Verify the documentation created during the 2013/14 Monticello Spent Fuel Loading campaign is complete and in compliance with license requirements.
- Verify that the remote monitoring video of the activities (other than welding and liquid penetrant examinations) demonstrate that documentation accurately reflects the activities and results.
- Verify DSCs 11 through 16 were loaded with the correct fuel.

- Verify reviews performed of welding and liquid penetrant examination ensure completeness of the documentation.
- Verify all identified deficiencies documented in the corrective action program have been evaluated, and dispositioned.
- Verify all workers (other than welders and liquid penetrant examiners) who were responsible for activities within the work documents are qualified.
- Verify Measurement and Test Equipment utilized for spent fuel loading was calibrated at the time of use to maintain accuracy within necessary limits.
- Review the results of this assessment and determine if there are any Nuclear Safety Culture issues.

To accomplish this scope of work, documentation for the following activities was reviewed:

- Transfer Trailer Pre-Operational Testing
- Transfer Cask Inspection
- Pre-Operational Testing
- Transfer Cask Yoke Inspection
- Fuel Spacer insertion
- Hold Down Ring insertion
- Plug insertion
- Transfer to Horizontal Storage Module

NOS also reviewed remote monitoring video (as described in section 1.3.1) of DSC loading/transfer activities to ensure the documentation accurately reflects the activities and results. Remote monitoring video was reviewed for the following activities:

- Fuel verification
- DSC Blowdown
- Initial DSC Vacuum Drying
- Initial Helium Backfill
- Final Vacuum Drying
- Final Helium Backfill
- Siphon and Vent port cover install
- Helium test of Siphon and Vent port covers
- Final Helium Leak Test

The NOS assessment concluded that the RCE for the non-conforming PT examinations was too narrowly focused and did not fully evaluate the extent of condition, extent of cause and underlying causal factors. Reevaluation of the RCE has not been completed at this time.

NOS further concluded that correct fuel assemblies were loaded into DSCs 11 – 16 and that fuel was loaded into the correct locations.

NOS discovered additional documentation and procedural compliance issues associated with the performance of DSC loading and transfer operations. However, the assessment did not identify any new issues that impact the ability of DSCs 11 – 16 to perform their design functions or meet TS requirements. See Appendix E for details of the findings identified.

Finally, NOS concluded that, except for the identified discrepancies (i.e., those previously reported and those discovered during the NOS assessment – see Appendix E), the spent fuel loading of DSCs 11 -16 was completed in accordance with procedural requirements.

The NOS review provided a comprehensive evaluation of the activities associated with DSC on-site loading activities. This thorough evaluation provides reasonable assurance that no other deficiencies exist regarding DSC compliance with TS and design considerations.

1.4 Regulatory Criteria

10 CFR 72 contains design criteria that are applicable to spent fuel handling, packaging, transfer, and storage systems. Specifically, 10 CFR 72.124 provides requirements for nuclear criticality safety of spent fuel handling, packaging, transfer, and storage systems. This regulation specifies that: *"When practicable, the design of an ISFSI ...must be based on favorable geometry, permanently fixed neutron absorbing materials (poisons), or both. Where solid neutron absorbing materials are used, the design must provide for positive means of verifying their continued efficacy. For dry spent fuel storage systems, the continued efficacy may be confirmed by a demonstration or analysis before use, showing that significant degradation of the neutron absorbing materials cannot occur over the life of the facility."*

10 CFR 72.104, Criteria for radioactive materials in effluents and direct radiation from an ISFSI, specifies radiological protection requirements for ISFSIs. Specifically, 10 CFR 72.104(b) states:

"(b) Operational restrictions must be established to meet as low as is reasonably achievable objectives for radioactive materials in effluents and direct radiation levels associated with ISFSI ... operations."

10 CFR 72.236(f) requires the cask design to have adequate heat removal capacity without active cooling systems. 10 CFR 72.122(h) provides that the fuel cladding should be protected against degradation and gross rupture. 10

CFR 72.126(a) provides that radioactive waste storage and handling systems should be designed and tested to control external and internal radiation exposures and reliably minimize radiation exposure to personnel.

10 CFR 72.236(e) requires that the cask must be designed to provide redundant sealing of confinement systems. 10 CFR 72.236(j) requires that the cask must be inspected to ascertain that there are no cracks, pinholes, uncontrolled voids, or other defects that could significantly reduce its confinement effectiveness. .

10 CFR 72.236(l) requires that the spent fuel storage cask and its systems important to safety must be evaluated, by appropriate tests or by other means acceptable to the NRC, to demonstrate that they will reasonably maintain confinement of radioactive material under normal, off-normal, and credible accident conditions. This would require the structural fidelity of the DSC to be maintained during cask load drops, seismic and thermal events.

From these regulatory criteria, five (5) design functions are derived for the DSCs:

- Criticality Safety
- Shielding (Radiological Safety)
- Heat Removal
- Confinement
- Structural Support

Each of the five design functions are assessed in this exemption request to demonstrate that they are not affected by the requested exemption and that the integrity of the field closure welds for DSCs 11 - 16 can be assured notwithstanding the nonconforming TS required PT examinations. The known quality of the welding processes, the use of multi-layer weld technique, plus the VT inspection, pressure and vacuum drop testing, and helium leak testing demonstrate that the field closure weld integrity of DSCs 11 - 16 is sufficient to ensure that the affected closure welds will continue to perform their design basis functions over the 20-year service life of these canisters.

Table 1.4-1 compares the welds covered in the exemption request to the design function that they are credited with performing.

Table 1.4-1 – Weld Design Functions

Weld	Weld Effect on DSC Design Functions				
	Criticality Safety	**Shielding**	**Heat Removal^**	**Confinement**	**Structural Support**
Inner Top Cover Plate	NA	NA	NA	X	X
Siphon Port Cover Plate	NA	NA	NA	X	NA
Vent Port Cover Plate	NA	NA	NA	X	NA
Outer Top Cover Plate	NA	NA	NA	NA*	X
Test Port Plug	NA	NA	NA	NA*	NA

^ Direct effects only
* Redundant barrier function for Confinement Design Function if the Inner Top Cover Plate weld leaks.

1.5 <u>Ongoing Monitoring of DSC 16</u>

As mentioned previously, DSC 16 remains in a TC located on the MNGP reactor building refuel floor. As this is not the designed storage location for a DSC, extra monitoring of this DSC is occurring.

Operations personnel perform rounds twice per day to inspect DSC 16 to check for any abnormal conditions. Specifically, these inspections are looking for DSC - TC damage, water leakage, and location of the Reactor Building crane in relation to DSC 16. In addition, periodic temperature checks are performed with contact pyrometer readings on the OTCP of DSC 16. DSC 16 is in thermal equilibrium. Typical temperature readings taken at several locations around the circumference of DSC are within a band of 150°F – 160°F. Finally, the DSC - TC annulus water level is verified periodically as well. Water is added to the annulus periodically (historically, no greater than once per month) due to evaporation. The TC neutron shield expansion tank water level is also verified periodically; however, this water level has not changed since the DSC - TC is in thermal equilibrium.

1.6 Application of Alternative NDE Techniques

NSPM has considered alternative NDE techniques to interrogate the welds that are the subject of this exemption request. NSPM teamed with AREVA (the current license holder for the 61BTH design) and requested they investigate the feasibility of performing alternative NDE techniques.

AREVA determined that there are two possibilities for performing ultrasonic testing (UT) examination of the partial penetration welds on the OTCP and ITCP, examination from the top surface, or examination from the DSC shell outside diameter (OD). Examination from the top surface can be performed both in the radial and tangential directions to interrogate the welds; however, there are coverage limitations for both welds. Both scans are complicated by the geometry of the joint and would require UT examination via automated phased array technique to have any chance of success.

For the ITCP, the shell inner diameter (ID) causes an interference with the transducer where the outermost 0.25" of the weld has no coverage in the radial direction, and where 0.15" of the weld has no coverage in the tangential direction. This is a significant volume of the ITCP weld that cannot be examined due to the proximity of the transducer to the shell ID. So, this approach would not be considered feasible.

For the OTCP, the UT technique is complicated by the partial fill of the weld preparation depth, any remnant of the shell OD that may project above the weld surface, and the as-welded surface. Any remnant of the shell ID projecting above the weld surface, would cause an interference with the transducer where the outermost 0.25" of the weld would have no coverage in both the radial and tangential scan directions. Furthermore, the transducers can only accommodate up to 1/16" "liftoff" from the top surface of the OTCP to the weld surface. For these reasons, UT is not considered feasible for the OTCP weld.

Another approach considered was to perform a phased array UT inspection from the DSC OD using both straight and angled beam transducers. Special transducers would need to be designed, manufactured and tested to fit within the annular space between the TC ID and the shell OD. The OTCP and ITCP welds are contained within the top 4" of the transfer cask cavity where the annular region is larger to accommodate the inflatable seal. In this region of the transfer cask, the annular space (i.e., radial gap) is a minimum of 1/2" with an average of about 7/8" which is large enough to accommodate a custom UT transducer. If scanning were possible from the canister OD from four orthogonal directions, complete coverage could be achieved without the need to perform UT from the top surface. Performing a UT from the surface on the canister OD would eliminate the concerns for weld surface conditions and partially filled weld preparation on the OTCP weld. This option could achieve

100% coverage with better results, while eliminating the need to remove the OTCP to access the ITCP weld.

However, the phased array UT technique has not been developed or tested previously. Therefore, the technique would need to be developed and qualified on a mockup containing known fabrication flaws. Since the OTCP and ITCP welds are partial penetration welds and normally subject to only surface examination, the rigor of the qualification process is undefined (ref. ASME V, Article 14). In order to provide meaningful results and support the exemption request a fully qualified approach would need to be developed. NSPM considers this approach to be a high risk proposition (no guarantee of success) with a long lead time (currently estimated at 4 – 6 months) to develop and qualify the process first to our satisfaction, then to the industry and finally to the NRC. Therefore, this approach does not seem readily achievable and has been determined to not be timely and too high a risk for this specific application.

Figure 1

Typical Cross-Section View of DSC to Illustrate Confinement Boundaries

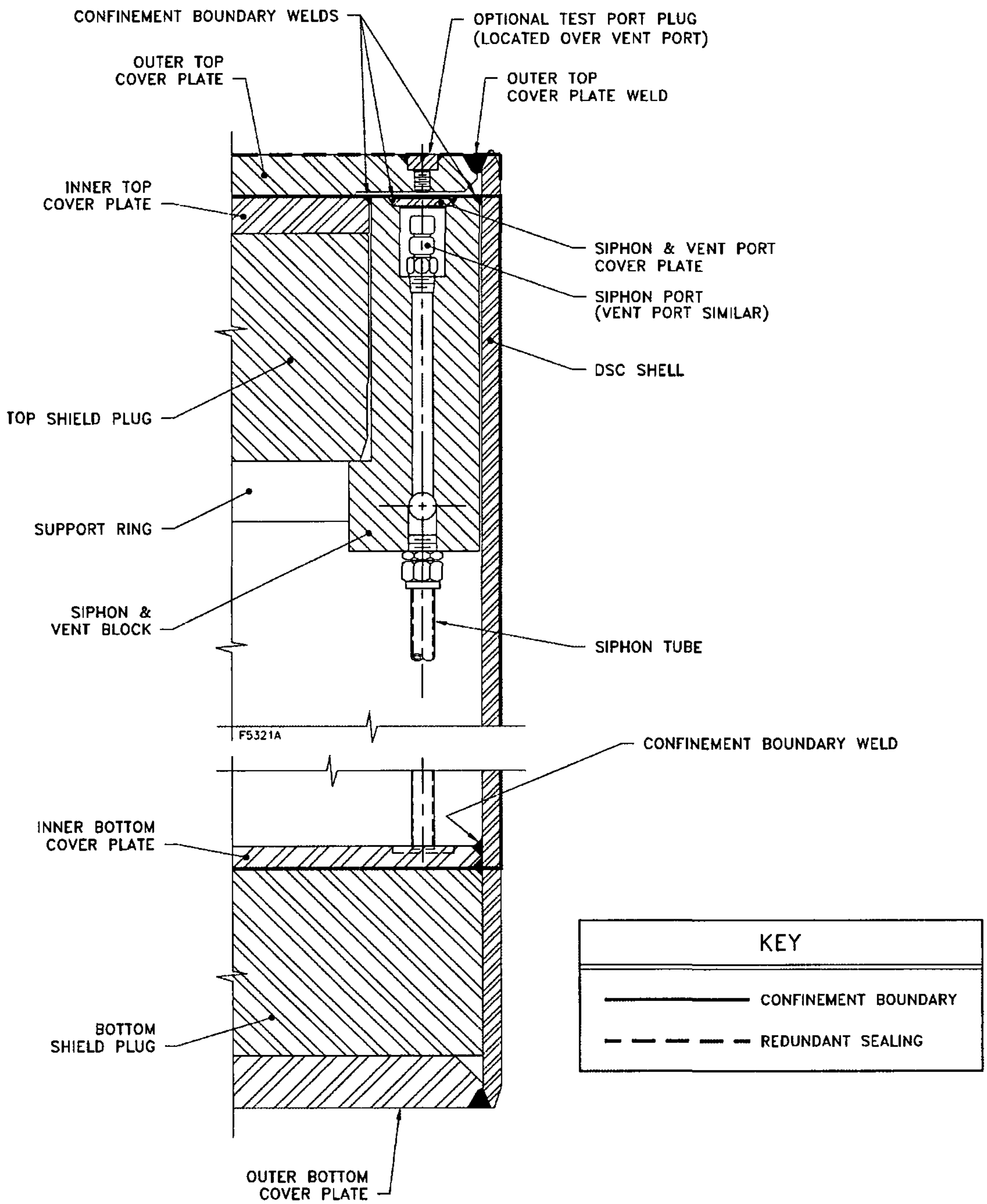


Figure 2

Inner Top Cover Plate and Siphon & Vent Port Cover Plate Field Closure Welds

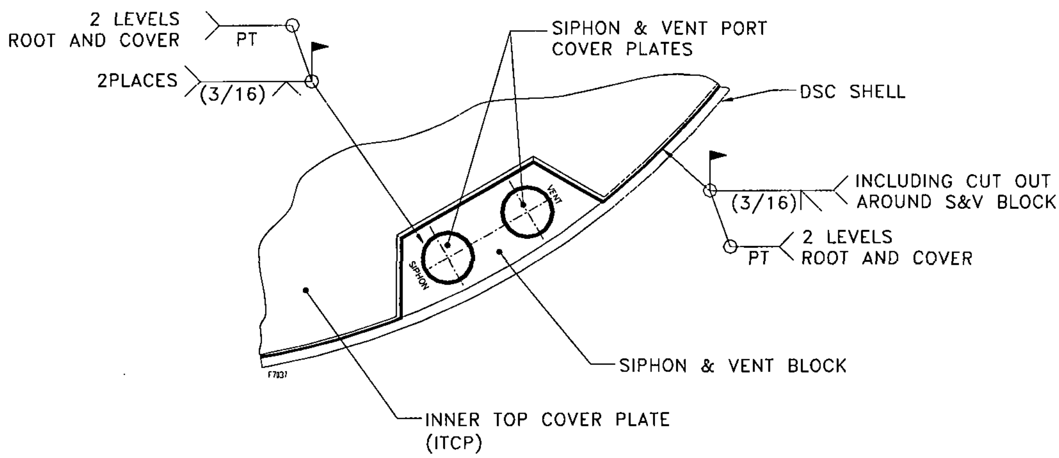
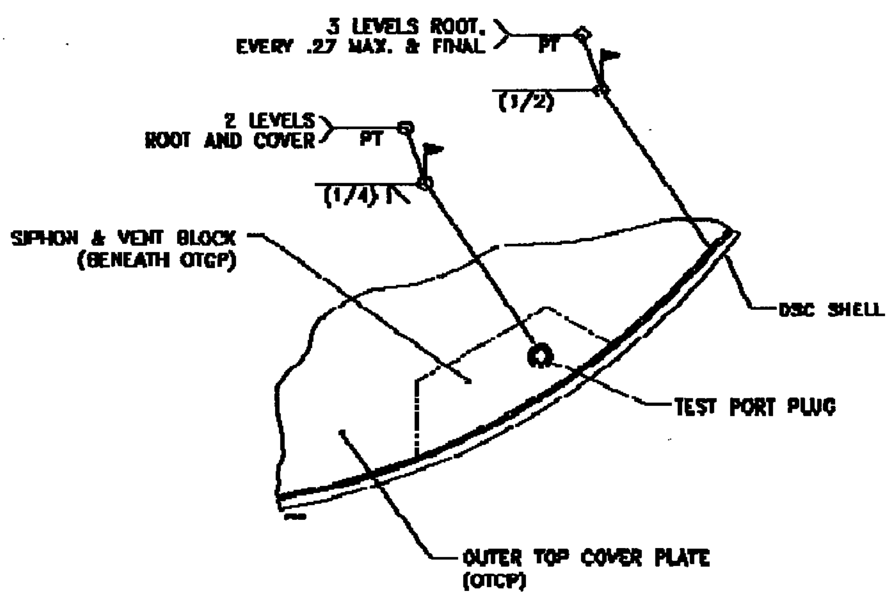


Figure 3

Outer Top Cover Plate and Test Port Plug Field Closure Welds



2.0 Requested Exemption

In accordance with 10 CFR 72.7, “Specific Exemptions”, NSPM requests NRC approval of an exemption for the MNGP ISFSI from the following requirements of 10 CFR 72.212, due to non-compliance with Technical Specification 1.2.5 of Certificate of Compliance (CoC) No. 1004, Amendment 10:

- 10 CFR 72.212(b)(3), which states the general licensee must *"[e]nsure 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"*
- The portion of 10 CFR 72.212(b)(11) which states that *"[t]he licensee shall comply with the terms, conditions, and specifications of the CoC . . ."*.

Specifically, the PT examinations of the six (6) dry shielded canisters listed below in Table 2.0-1 were not performed in accordance with approved procedures such that compliance with the TS 1.2.5 requirements cannot be ensured.

Table 2.0-1 – DSCs Affected by Nonconforming PT Examinations

DSC Information		HSM Information		
Serial Number	**Model**	**Serial No.**	**Model**	**Placed into Service**
MNP-61BTH-1-B-2-011	61BTH	HSM-6A	HSM-H	9/9/2013
MNP-61BTH-1-B-2-012	61BTH	HSM-6B	HSM-H	9/17/2013
MNP-61BTH-1-B-2-013	61BTH	HSM-7A	HSM-H	9/26/2013
MNP-61BTH-1-B-2-014	61BTH	HSM-8A	HSM-H	10/7/2013
MNP-61BTH-1-B-2-015	61BTH	HSM-9A	HSM-H	10/14/2013
MNP-61BTH-1-B-2-016	61BTH	In TC	HSM-H	In TC

Each of these DSCs was loaded with spent fuel and all required welding was completed. DSCs designated 11 - 15 were placed into service (in their respective HSMs) in the fall of 2013. DSC 16 has not yet been placed into service. It is presently located in the TC in the MNGP Reactor Building.

For each DSC, PT Examinations are required for each weld layer listed below. Therefore, each of the following weld layers is applicable to this exemption request for each DSC referenced in Table 2.0-1. The weld layers affected by the nonconforming PT examinations are:

- Inner Top Cover Plate (ITCP) Weld – two weld layers - root and cover

- Siphon Port Cover Plate (SPCP) Weld – two weld layers – root and cover
- Vent Port Cover Plate (VPCP) Weld – two weld layers – root and cover
- Test Port Plug (TPP) Weld – two weld layers – root and cover
- Outer Top Cover Plate (OTCP) Weld – multiple weld layers – typically this would include the root, intermediate and cover welds. NOTE: For DSC 16 the final weld layer of the OTCP had a PT examination performed that met the requirements of TS 1.2.5.

The requested exemption would permit a complete transfer and insertion of DSC 16 into an HSM on the MNGP ISFSI pad, and the exemption would permit a 20-year service lifetime for DSCs 11 – 16, including retrievability, such that they would be available for movement to a permanent repository or other approved condition as determined by the 10 CFR 72 general license for the ISFSI at MNGP. In other words, upon approval of the requested exemption DSCs 11 -16 would be treated as fully operable DSCs in every respect. This exemption request does not apply to 10 CFR 71 transport designs, and transport applications.

NSPM is requesting approval of this exemption request by November 2014. Approval of the exemption request in this time frame would permit transfer of DSC 16 in a better seasonal environment than in the more challenging environments found in Minnesota winter conditions. The November 2014 date also permits NSPM to begin refueling preparations and perform receipt of new fuel for the Spring 2015 refueling outage without the interference and potential bump hazard caused by DSC 16 occupying a portion of the MNGP refueling floor next to the equipment hatch. The equipment hatch is the pathway for bringing new fuel and other outage materials form the reactor building first floor up to the refuel floor. This pathway is located immediately adjacent to where DSC 16 resides.

The exemption request approval is needed prior to the MNGP refueling outage in the Spring of 2015. The refueling floor loading analysis indicates that the floor loading cannot accommodate both the refueling laydown loads and DSC 16. Specifically six cavity shield blocks are required to be removed for refueling activities, these blocks are quite large and weigh between 70 to 83 tons each. The refueling laydown analysis locates three of the cavity shield blocks within inches of where DSC 16 - TC (approximately 102.5 tons) is located (increasing the risk of an accidental bumping of DSC 16 by movement of the shield blocks). Reanalysis and likely modification of the refueling floor would be required to support the weight of both a fully loaded DSC with TC and the three cavity shield blocks in the same area. Other areas of the refuel floor are not designed to hold the cavity shield blocks. Therefore, NSPM has concluded that refueling operations cannot commence with DSC 16 located on the refueling floor.

Movement of these 3 cavity shield blocks permits access to the reactor from the refuel floor. Movement of these blocks occurs early in the outage. To permit time to transfer DSC 16 off the refuel floor prior to the refueling outage, NSPM estimates at least 6 weeks are necessary to accomplish this transfer as resources would have to be remobilized to support the transfer. Therefore, NSPM would need the exemption approved by February 2015.

This exemption request concludes that transfer and insertion of DSC 16 into the HSM is considered safe, that storage of DSC 16 is safer in the HSM rather than on the MNGP refuel floor and therefore, the best storage location (design location) for DSC 16 is in the HSM. Since DSC 16 was not in HSM storage at the time of discovery, repairs and TS 1.2.5 compliant PT examinations have been completed on the final two layers of the OTCP weld (i.e., the weld layer as left in October 2013 and the final weld layer added to remediate the inadequate weld depth concerns). Note, the final weld layer on DSC 16 covered approximately 3/4 of the circumference of the OTCP due to weld depth concerns.

Finally, the exemption request demonstrates that DSCs 11 – 16 are safe to store for the duration of the license period and should be exempt from meeting the requirements of TS 1.2.5 for the subject welds. Therefore, upon approval of the requested exemption DSCs 11 -16 would be treated as fully operable DSCs in every respect. This exemption request does not apply to 10 CFR 71 transport designs, and transport applications.

3.0 Technical Assessment

The proposed exemption is limited in scope in that it only relates to compliance with the PT examination of certain field weld layers as described above. The proposed exemption is technical in nature, but it involves no physical change to the canister design, and no change to the canister materials or the loading operation

The exemption being requested includes permitting completion of a transfer and insertion of DSC 16 into an HSM on the MNGP ISFSI pad. The exemption request determined that DSC 16 is considered safer stored in the HSM rather than on the MNGP refuel floor and therefore, the best storage location is in the HSM. Further, the exemption would permit DSCs 11 – 16 to be considered fully operable for their service lifetime of 20 years, such that they would be available for movement to a permanent repository or other approved condition as determined by the 10 CFR 72 general license for the ISFSI at MNGP. This exemption request does not apply to 10 CFR 71 transport designs, and transport applications.

The DSC 16 OTCP weld has been repaired and passed the PT examinations on the final weld layer. In addition, storage in the HSM is a safer storage location than residing on the MNGP refuel floor in a TC. NSPM is providing additional controls to ensure a safe transfer of DSC 16 to the HSM.

Section 3.1 below discusses technical justification unique to the transfer of DSC 16 and section 3.2 discusses the technical justification for a 20-year service lifetime for DSCs 11 – 16. Together these technical assessments support full approval of the exemption request.

3.1 Exemption Request Justification – Transfer and Storage of DSC 16

The exemption request would permit completion of a transfer and insertion of DSC 16 into an HSM on the MNGP ISFSI pad. The basis for this request is that it is safe to transfer DSC 16 to the HSM and that a DSC residing in an HSM is in a safer configuration than storage of a DSC in a TC on the MNGP refuel floor.

NSPM will provide additional controls during the transfer of DSC 16 to provide additional assurance that DSC 16 will be safely transferred to the HSM.

3.1.1 Safe to Transfer DSC 16

Repairs to DSC 16 have been completed and all TS and design considerations met for the OTCP final two weld layers. NSPM has verified that weld flaws in the final weld layer of the OTCP of DSC 16 have been repaired, inadequate weld depths were repaired and the final layer was PT examined successfully. Therefore, the final weld layer on the OTCP for DSC 16 has fully met the TS requirements for PT examination.

The requested exemption would permit completion of a transfer from the MNGP refuel floor to HSM. The transfer is a short duration move, typically accomplished in a few hours, and will most likely be accomplished in a single shift. Actual move time outside the reactor building is typically only 2 – 3 hours. This transfer has been evaluated in the NUHOMS® Updated Final Safety Analysis Report (hereafter, UFSAR) and found acceptable.

Procedurally, NSPM requires the DSC transfer to include use of an approved haul path, verified free of obstacles, during good weather conditions. NSPM will continue to perform these safety precautions during this transfer and will provide additional controls to ensure safe travel of DSC 16.

3.1.2 Safe to Store DSC 16 in the HSM

Storage in an HSM is evaluated in the UFSAR and is the safest place for the DSC to reside. A DSC is designed to reside in the HSM. UFSAR section 2.3 states, *"HSM storage...provide*[s] *an effective means of protection against extreme seasonal weather conditions including heavy precipitation, drifting snow, ice flows, lightning strikes, strong winds and wind driven missiles, and blowing dust."* This statement is applicable to the requested exemption. Section 3.2 of this exemption request describes the basis for a 20-year service lifetime for DSCs 11 – 16 in the HSM and those justifications are applicable to transfer of DSC 16.

For DSC 16 residing in the TC after removal from the spent fuel pool, the annulus region between the DSC shell and TC is filled with water. The temperature of DSC 16 is being monitored as described in section 1.5. DSC 16 is considered to be in thermal equilibrium as temperature readings remain steady.

While the DSC is residing in the TC and moving from the refueling floor to the HSM, heat transfer has also been evaluated. An analysis was performed for normal, off-normal, and accident summer ambient conditions, including the effect of a solar heat flux applied to the cask outer surface. The DSC cavity is backfilled with helium gas to aid removal of heat from the fuel assemblies and maintain an inert atmosphere.

3.1.3 Additional Controls

NSPM will provide additional controls during the transfer of DSC 16 to the HSM. These controls are added to increase the safety of the transfer and assume a successful relocation of the DSC/TC from the refueling floor to the TT. The additional controls being provided include:

- Limit the height of the TC during transfer of DSC 16 to limit the impact of any cask drop accident. NSPM is proposing to limit the height from the bottom of the DSC to the ground as 63" during the movement of DSC 16 and 66" after arrival at the HSM to facilitate insertion of DSC 16 into the HSM. NSPM does not anticipate carrying the DSC at greater than 61" during the move, but will add administrative controls to limit the height to 63". At the HSM, the DSC must be raised to approximately 64" – 65" to properly insert the DSC into the HSM. This provides additional margin to the forces exerted on the cask provided in the current analysis. The current analysis assumes an 80" cask drop (equivalent static deceleration of 75g for horizontal side drops, and 25g oblique corner drop).

  Further, per the NRC Safety Evaluation for the 61BTH design, the NRC recognized that at no time during the transfer loading (or unloading) operations is there a need for any lifts of the TC with a loaded DSC. Therefore, the vertical end drops for the NUHOMS® System are non-mechanistic, not credible events and, therefore, no end drops are postulated. Sliding of the DSC out of the transfer cask or tilting of the transfer cask in such a way as to result in a corner drop are also non-mechanistic, highly unlikely events. Nevertheless, for conservatism a corner drop was postulated and evaluated for the NUHOMS® System. Since the end drop is not a credible event for the NUHOMS® System, the response acceleration time history from the corner drop was used for the fuel rod end drop analysis.

- Expand the distance to any non-essential vehicles during transfer of DSC 16. Currently, NSPM procedures require that all non-essential vehicles must maintain a distance of at least 12 ft. from any the loaded TC. This does not include the tugger, transfer trailer, Hydraulic Ram System and crane. NSPM will increase this distance to 30 ft. during transfer of DSC 16 to the HSM.

- Expand the distance from the travel path to hot work (fire and explosion) activities during transfer of DSC 16. Currently NSPM procedures do not permit hot work activities, including flame cutting, welding, or grinding in open air within 30 ft. of either side of travel path. NSPM will increase this distance to 50 ft. during transfer of DSC 16 to the HSM.

- Expand controls for sources of combustibles or flammable liquids. Currently NSPM procedures do not permit delivery trucks containing combustibles or flammable liquids to pass the security checkpoint during transfer operations. NSPM will require onsite sources of combustibles or flammable liquids to be locked closed during transfer of DSC 16 to the HSM.

- NSPM will add pre-staged fire suppression equipment along the travel path for additional safety precautions.
- NSPM will attempt transfer of DSC 16 during periods of low site activity in order to remove interferences from normal work week activities and limit potential personnel interactions. This cannot be assured due to other considerations such as weather and other ongoing site activity requirements.

3.1.4 Limited Risk of Other Accidents or Transients

The UFSAR discusses other accident protection provided by storage in the HSM. The UFSAR discusses the following accident/transient conditions as applicable to the HSM.

- Tornado/Winds – The risk of this event during transfer of DSC 16 to the HSM is eliminated by procedural controls. Procedural controls require good weather conditions be present prior to transfer of a DSC.
- Earthquake – The risk of this event during transfer of DSC 16 to the HSM is not credible. While the onset of an earthquake is never predictable, the risk of an earthquake occurring in this area is a very rare event and is even less likely during this short duration move time frame (approximately 2 – 3 hours).
- Flood - The risk of this event during transfer of DSC 16 to the HSM is eliminated by procedural controls. Procedural controls require good weather conditions be present prior to transfer of a DSC.
- Lightning - The risk of this event during transfer of DSC 16 to the HSM is eliminated by procedural controls. Procedural controls require good weather conditions be present prior to transfer of a DSC.
- Accidental Cask Drop – Cask drop is evaluated in UFSAR, section 8.2.5. The NRC evaluated 3 cases: (1) an 80" cask drop onto the top or bottom of the transfer cask (even though it was recognized as a non-credible event); (2) an oblique corner drop from a height of 80" at an angle of 30°; and (3) a horizontal side drop from a height of 80". The NRC evaluated the horizontal side drop and the vertical end drop as the bounding scenarios and concluded that the structural integrity of the DSC and spent fuel cladding was not compromised. NSPM will be reducing the height of the DSC while in transfer to no more than 63" thus reducing the forces exerted on the DSC

if an accidental cask drop were to occur. Therefore, the risk associated with this event is reduced by the proposed additional controls.

- DSC leakage – DSC 16 has previously been verified through TS testing as not having leakage. See Appendix D for DSC 16 TS testing values.
- Accidental Pressurization – UFSAR section 8.2.9 provides an analysis concerning accidental pressurization of the DSC. The assumptions and conclusions of that analysis are not impacted by the exemption request for transferring of DSC 16 to the HSM.

3.1.5 Repair or Replacement of DSC 16

Section 4.3 of this exemption request evaluates two alternatives associated with the non-conforming PT examination condition. Alternative 1 is to repair DSCs 11 – 16, and alternative 2 is replacement of DSCs 11 – 16. See Section 4.3 for details.

3.1.6 Conclusion

Based on the above discussion, NSPM has demonstrated that it is safe to transfer DSC 16 to the HSM and that the DSC residing in the HSM is a safer configuration than storage in a TC on the MNGP refuel floor. Transfer of DSC 16 to the HSM is safe based on:

1. Repair and verification activities performed on DSC 16,
2. Short duration of the transfer of DSC 16,
3. Additional controls put in place for the transfer of DSC 16, and
4. The safest location for DSC 16 is in the HSM.

Alternatives described in section 4.3 would unnecessarily increase the radiological dose to workers, generate additional radiological waste, potentially create foreign material and increase other operational risks to the station without a commensurate increase in safety as compared to approval of the exemption request.

3.2 Exemption Request Justification – 20-Year Service Lifetime for DSCs 11 - 16

The exemption request would also permit DSCs 11 – 16 to be considered fully operable for their service lifetime of 20 years. To permit this exemption, the design functions of the DSC (in the HSM) are evaluated to demonstrate compliance with the regulatory requirements and design of the DSC.

As described in Section 1.0 there are five (5) design functions for the DSCs derived from the GDCs stated in 10 CFR 72.124 and 10 CFR 72.128. These five design functions are:

- Criticality Safety
- Shielding (Radiological Safety)
- Heat Removal
- Confinement
- Structural Support

Each of these design functions are assessed for the impact of the requested exemption below.

Thus, the scope of the technical assessment is limited to providing assurance that the design basis functions of the closure welds are satisfied with due consideration of the nonconforming PT examinations. The closure weld functions are discussed below in terms of the confinement function and other structural functions described in the UFSAR.

3.2.1 Criticality Safety Assessment

10 CFR 72.124 requires that the ISFSI system should be designed to be maintained subcritical and to ensure that, before a nuclear criticality accident is possible, at least two unlikely, independent, and concurrent or sequential changes have occurred in the conditions essential to nuclear criticality safety. The design of the system must include margins of safety for the nuclear criticality parameters that are commensurate with the uncertainties in the data and methods used in calculations and demonstrate safety for the handling, packaging, transfer and storage conditions and in the nature of the immediate environment under accident conditions. The design must also be based on favorable geometry, permanently fixed neutron absorbing materials, or both. 10 CFR 72.236(c) requires that the cask must be designed and fabricated so that the spent fuel is maintained in a subcritical condition under credible conditions.

NSPM has determined that the elements of the criticality safety analysis are not impacted by the requested exemption. Criticality control of the spent fuel assemblies is assured through the use of fixed neutron absorber material installed in the basket assembly. The geometry of the basket must be maintained for all design loading conditions in order to support the assumptions for fuel compartment pitch and neutron absorber plate configuration. The field closure welds do not directly support the criticality design function, but do provide indirect support via the structural design function which assures the geometry of the DSC and basket is maintained within the assumptions of the criticality analyses for all loading conditions.

3.2.2 Shielding – Radiological Safety Assessment

10 CFR 72.104(b) requires that ISFSI systems must establish operational restrictions to meet the as low as is reasonably achievable objective for radioactive materials in effluents and direct radiation levels. 10 CFR 72.106(b) requires that any individual located on or beyond the nearest boundary of the controlled area may not receive from any design basis accident the more limiting of a total effective dose equivalent of 0.05 Sv (5 rem), or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue (other than the lens of the eye) of 0.5 Sv (50 rem). The lens dose equivalent may not exceed 0.15 Sv (15 rem) and the shallow dose equivalent to skin or any extremity may not exceed 0.5 Sv (50 rem). 10 CFR 72.126(a) provides that radioactive waste storage and handling systems should be designed and tested to control external and internal radiation exposures and reliably minimize radiation exposure to personnel.

NSPM has determined that the elements of the radiological safety assessment are not impacted by the requested exemption. The top closure welds are not explicitly modeled in the shielding analyses such that a flaw or missed indication in the field closure welds has no influence on shielding effectiveness of the DSC and hence has no impact on the shielding design function.

3.2.3 Thermal Performance (Heat Removal) Assessment

10 CFR 72.236(f) requires the cask design to have adequate heat removal capacity without active cooling systems. 10 CFR 72.122(h) provides that the fuel cladding should be protected against degradation and gross rupture. 10 CFR 72.122(b) states that structures, systems, and components important to safety should be designed to accommodate the effects of, and be compatible with, site characteristics and environmental conditions associated with normal operation, maintenance, and testing; and to withstand postulated accidents. 10 CFR 72.122(f) states that systems and components that are important to safety should be designed to permit inspection, maintenance, and testing.

The NUHOMS® 61BTH system is designed to passively reject decay heat during storage and transfer for normal, off-normal and accident conditions while maintaining temperatures and pressures within specified regulatory limits.

Within the HSM (DSCs 11 – 15 and 16 after the transfer), the DSC is cooled by buoyancy-driven air flow through openings at the base of the HSM, which allows ambient air to be drawn into the HSM. Heated air exits through vents in the top of the shield block in the HSM ceiling, creating a chimney or "stack" effect. Metal heat shields are placed above and to either side of the DSC to protect the concrete surfaces of the HSM from thermal radiation effects.

NSPM has determined that the elements of the heat removal assessment are not impacted by the requested exemption. The field closure welds are not explicitly modeled in the thermal analyses such that a flaw or missed indication in the field closure welds has no influence on thermal performance of the DSC and hence has no impact on the thermal design function. However, the field closure welds indirectly support the thermal design function by virtue of their confinement function which assures the helium atmosphere in the DSC cavity is maintained in order to support heat transfer. Further discussion of the weld integrity as it relates to the confinement function is provided in section 3.2.4 below.

3.2.4 Assessment of Confinement Integrity Functions

10 CFR 72.236(e) requires that the cask must be designed to provide redundant sealing of confinement systems. 10 CFR 72.236(j) requires that the cask must be inspected to ascertain that there are no cracks, pinholes, uncontrolled voids, or other defects that could significantly reduce its confinement effectiveness. 10 CFR 72.236(l), requires the design analysis and submitted bases for evaluation acceptably demonstrate that the cask and other systems important to safety will reasonably maintain confinement of radioactive material under normal, off-normal, and credible accident conditions. 10 CFR 72.122(h)(1) requires that spent fuel cladding must be protected during storage against degradation that leads to gross ruptures or the fuel must be otherwise confined such that degradation of the fuel during storage will not pose operational safety problems with respect to its removal from storage.

To meet these requirements, the standardized NUHOMS® system employs redundant sealing. The confinement boundary for the system is comprised of the DSC shell, inner bottom cover plate, inner top cover plate, siphon & vent block, siphon & vent port cover plate, and the welds that join them together[4]. The confinement boundary is designed and tested to meet the leak tight criteria of ANSI N14.5 (1997). The operating procedures require leak tight testing (i.e., 1.0E-7 cc/sec) in accordance with Technical Specification 1.2.4a, for the inner top cover plate weld and the vent/siphon port plate weld. Confinement boundary welds made during loading of the DSC are all volumetrically inspected in accordance with Section NB of the ASME Code to help assure their structural integrity.

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[4] Only the root layer of these welds is necessary to perform the sealing (confinement) function.

NSPM has determined that the confinement integrity is not compromised or impacted by the requested exemption. Justification for each weld in the confinement barrier is provided below.

3.2.4.1 General Weld Justification

The UFSAR only describes weld failure in terms of a possible pinhole leak in individual weld layers; otherwise the UFSAR does not describe weld failure as a malfunction of a System, Structure, or Component (SSC) important to safety. Whereas this weld malfunction is described in the UFSAR (pinhole leak in one weld layer), the likelihood (probability) is not quantified. The UFSAR makes no explicit mention about how a pinhole leak in a weld layer is formed, whether it occurs during the weld formation or by subsequent canister loading operations, fatigue cycles during storage, or accidents. Rather, the UFSAR assumes/stipulates that pinholes may exist in individual layers. Thus, the existence of pinhole leaks is a non-mechanistic assumption of the UFSAR; and there is no underlying malfunction that causes its formation. The UFSAR (Section 3.3.2.1) discusses further assurance of safety by recognizing that the function of the multiple-layer welds is to reduce the chance that any pinhole leak through one layer will align with a pinhole in a successive weld layer.

The proposed exemption does not change the general integrity of the weld formation process or the fundamental nature of the independent multi-layer field welds used on the DSC top cover plates. However, the failure to perform a satisfactory PT increases the probability for existence of a latent flaw that is larger than the acceptance criterion of the examination.

Notwithstanding the noncompliant NDE of the closure welds described herein, the general integrity of the fuel itself, the DSC welds, plus the protective support functions provided by the HSM (for DSCs 11 - 16) and the TC (for DSC 16) provide assurance that the safety functions of these DSCs will be satisfied for the 20-year service life of these canisters, including any storage or transfer operations described in the UFSAR.

Specific features, quality controls, and examinations that support this assertion are listed below:

a. Integrity of Loaded Fuel: - As the first fission product barrier for nuclear fuel, it is important to note that the cladding of fuel loaded into DSCs 11 - 16 is known to be intact. In accordance with TS

(Table 1-1c), BWR fuel is considered intact if it can be characterized with no cladding damage in excess of pinhole leaks or hairline cracks. Starting with the assurance that fuel cladding is intact helps ensure that any postulated leak through an undetected flaw would yield an insignificant release of fission products to the environment. NSPM verified the fuel loaded into DSCs 11 – 16 met the requirements of Table 1-1c of the CoC.

b. General Integrity of Closure Weld Process: - Notwithstanding the nonconforming PT examinations, the weld closures of DSCs 11 - 16 were performed under a 10 CFR 50 Appendix B quality assurance program, such that the canister integrity is otherwise assured. Accordingly, welding materials were procured to quality requirements and welding processes were developed and qualified for the given configuration, and welders were appropriately qualified to the Code requirements. Welding parameters were specified in associated procedures and monitored as required. Many of the welding processes were automated, and any anomalies would have necessarily been subject to identification and disposition in accordance with the Corrective Action Program. See Appendix D for details concerning weld performance criteria.

   Further, a review of the weld head videos did not reveal any examples of poor welding techniques or welding coverage. In addition, the independent vendor that reviewed the weld head videos indicated that there were good welding practices present in all of the welds examined, and in general, visible evidence of tie-in between the weld layers and the sidewall was present.

   The significance of any latent surface defect left undetected because of the noncompliant PT is minor. Even if latent surface defects had gone undetected due to the nonconforming PT, the effect is minimized (for root and intermediate welds) because the molten pool of the subsequent weld layer would encompass those surface flaws. Further, the design basis does not take any credit for detecting any particular flaw size, and any undetected flaw in one layer is not postulated to propagate into any other weld layer.

   Even considering the possibility that any given layer of weld may have a leak through that layer, the licensing basis criterion stated in UFSAR 3.3.2.1 assures that the chance of pinholes being in alignment on successive independently-deposited weld layers is not credible.

It is also important to note that the presence of weld flaws is accounted for in the structural analysis of welds. The method of calculation of weld stresses includes a stress reduction factor of 0.80 (per ISG-15) to account for flaws in the weld since the weld was never expected to receive a volumetric examination. The stress reduction factor was reduced even further (called the modified stress reduction factor) to 0.70 to account for the nonconforming PT examination. The modified stress reduction factor and its applicability are discussed more thoroughly in section 3.2.5.

c. The welding procedures used on this campaign required a VT on the completed fit up and tack welds of ITCP, siphon cover, vent cover and OTCP; and root layer weld on OTCP prior to the performance of the PT examination. This examination of the completed weld surface provides reasonable assurance that the weld layer was completed with no significant inclusions or surface flaws.

   NSPM evaluated the process utilized for the VT inspection to determine if it might also be suspect or in any manner noncompliant. NSPM reviewed remote videotape of the VT inspections performed on the closure welds and the documentation of the VT examinations for DSCs 11 – 16. The review concluded that there is a reasonable level of confidence that the VT inspections were properly performed. The VT inspection process for these DSCs appeared to be diligent, using flashlights and the proper distance from the weld surface, while viewing at the proper angle and weld conditioning can be seen occurring. Therefore, the VT inspections for the field closure welds on DSCs 11 - 16 provide a reasonable basis that satisfactory welds were constructed with an acceptable level of quality and safety.

For the field closure welds, the multi-layer weld technique with multi-layer PT examination specified in the TS were developed as an alternative to the ASME Code, Subsection NB requirement for volumetric examination, since a volumetric examination of these field closure welds is not practical due to access limitations and other considerations. The multi-layer PT surface examination provides a method of interrogating the closure weld at discrete distances through the depth of the weld, which is intended to provide reasonable assurance that flaws of interest will be identified and that no significant subsurface flaws will be present in the finished weld. Taken in aggregate, the verifications, testing, controls, and structural assessments that were performed provide ample assurance that integrity is assured for the 20-year service life of DSCs 11 – 16.

3.2.4.2 Inner Top Cover Plate and Siphon/Vent Port Welds Justification

The ITCP, Siphon/Vent Block and associated welds provide the credited confinement boundary for the top closure on the 61BTH DSC (refer to Figure 1). The closure welds are partial penetration groove welds with 3/16" effective throat, specified as two layer minimum, and are subject to PT examination of the root and final layer. These welds are also subject to helium leak testing to the "leak tight" criterion of ANSI N14.5. Leak testing is performed after the root layer of the OTCP weld is completed such that the OTCP acts as a test lid. A vacuum is drawn through the test port plug to evacuate the space between the ITCP and OTCP to check for leakage across the confinement boundary. Since the DSC cavity is backfilled with helium and helium is injected behind the siphon and vent cover plates during performance of those closure welds, the helium leak test would effectively detect any leakage across the confinement boundary.

Satisfactory completion of two required vacuum pump-downs conducted on each DSC has demonstrated weld integrity of the ITCP confinement boundary. These pump-downs (conducted per TS 1.2.2) establish a differential pressure across the ITCP and Siphon/Vent Block welds of approximately one atmosphere, which exceeds the magnitude of the design pressure of 10 psig used in stress analyses for normal conditions (Reference UFSAR T.4.1). Although the vacuum pump-down imparts a pressure differential in a reverse direction from the confinement function, the pump-down demonstrates the basic function of the confinement barrier and the lack of a through-weld flaw in the ITCP and Siphon/Vent Block welds sufficient to cause a loss of cavity helium (when in service).

Satisfactory completion of a required helium backfill pressure hold conducted on each DSC has also demonstrated weld integrity of the ITCP and Siphon/Vent Block welds confinement boundary. These backfills (conducted per TS 1.2.3a) establish and hold a differential pressure of approximately 2.5 psig across the ITCP weld. This backfill pressure hold is performed at the required helium fill pressure for placing the canister in service. Further, this backfill imparts a differential pressure in the same direction as the confinement function and uses a test medium of helium, which is an appropriately small molecule that is very effective in revealing any through-weld flaw. In this respect, the backfill pressure hold further demonstrates the basic integrity of the confinement barrier and the lack of a through-weld flaw that would lead to a loss of cavity helium in DSCs 11 - 16.

Satisfactory completion of the required helium leak test conducted on each DSC 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 ANSI N14.5-1997. 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 DSCs 11 - 16.

For the confinement boundary welds of the ITCP and siphon and vent port cover plates, helium leak testing is performed to satisfy 10 CFR 72 requirements, which is not required nor recognized by the ASME Code as a method of interrogating these welds. However, the helium leak test performed to the leak tight acceptance criterion of ANSI N14.5 provides assurance that no thru-weld flaws exist, and is a more direct indication than multi-layer PT of the integrity of the confinement boundary. Therefore, for the confinement boundary welds, the application of VT inspection for each weld layer, and helium leak testing of the completed confinement boundary provides a sufficient basis that the welds were constructed with an acceptable level of quality and safety.

3.2.4.3 Outer Top Cover Plate and Test Port Plug Welds Justification

Although the OTCP, test port plug and associated welds are not defined as confinement boundary components, they provide a redundant barrier to the release of radioactive material. However, since these welds are not subject to helium leak testing, they are not credited as part of the confinement boundary.

For the redundant closure weld of the OTCP, multiple weld layers are specified (minimum of root, intermediate and cover). The thickness of each weld layer is less than the flaw size determined by a fracture mechanics evaluation performed per ISG-15 requirements. This design ensures there is no possibility for flaws to align through successive weld layers, such that the existence of a critical flaw in the OTCP weld is not credible based simply on the multi-layer weld technique. This is similar to the arguments used in UFSAR Section 3.3.2.1 for pinhole leaks. The redundant closure weld of the TPP is not subject to significant design loading, such that a two layer weld application is sufficient to ensure the integrity of the weld. Therefore, for the redundant closure welds, the application of the weld design provides sufficient basis for an acceptable level of quality and safety in the welds.

Once in storage, there is no credible failure mechanism of the DSC top cover plate closure welds that would adversely affect DSC confinement.

This fact is supported by the ISFSI UFSAR, which identifies no long-term degradation mechanism that could cause the confinement welds to fail during the life of the DSC. Nevertheless, potential mechanisms were assessed in the NRC Safety Evaluation Report for NUHOMS® (Reference 6.4) and are summarized below:

- Top cover plate and weld material are stainless steel with an established corrosion resistance described in UFSAR section T.3.4.1. Further, the only welds subject to the outside environment are the outer layer of the OTCP weld and the TPP weld. The root layers of the ITCP, and vent/siphon port covers are subject to the inert gas environment of the DSC cavity, which will preclude corrosion.
- The mechanism of metal creep is not considered applicable to the top cover plate welds because the differential pressure across the top cover plates (between the cavity pressure and the environment) during storage conditions is minimal (less than one atmosphere).
- The mechanism of cyclic loading is not considered applicable to the top cover plate and closure welds because the extent of fatigue cycling experienced by the canister is below the threshold which the ASME B&PV Code Section III has established.

In summary, the confinement boundary integrity of DSCs 11 - 16 can be assured with confidence even if full compliance with the PT examinations was not achieved. The known quality of welding processes, plus the breadth of other required examinations and testing have demonstrated that the field weld integrity of DSCs 11 - 16 is sufficient to ensure that the confinement barriers will continue to perform their functions over the 20-year service life of these canisters. Further justification for the weld integrity is provided in section 3.2.5 below.

3.2.5 Assessment of DSC Closure Weld Structural Functions

The DSC shell, the redundant closures on each end, and the DSC internals are designed to ensure that the intended safety functions of the system are not impaired following a postulated TC drop accident. The limits established for equivalent decelerations due to a postulated drop accident are intended to be bounding. They envelop a range of conditions such as the TC handling operations, the type of handling equipment used, the TC on-site transfer route, the maximum feasible drop height and orientation, and the conditions of the impacted surface.

The ITCP, OTCP and associated welds perform structural design functions for the top closure on the 61BTH DSC. These welds are explicitly modeled in the structural analyses at their minimum effective throat thickness and are designed to accommodate loads due to normal, off-normal and accident conditions, and are required to satisfy ASME Code design criteria with the stress reduction factor applied per ISG-15.

ISG-15 recognizes the multi-layer PT examination technique as an acceptable NDE method for partial penetration closure welds. This document acknowledges that imperfections or flaws may not be identified when using a progressive PT surface examination in lieu of volumetric examination, and therefore requires that a stress reduction factor of 0.80 (i.e., 20% penalty) be applied to the closure weld design. The stress reduction factor is analogous to weld quality factors which are applied for progressive PT examination in ASME B&PV Code Section III, Subsection NG-3000. Therefore, the stress reduction factor accounts for a potential reduction in weld quality due to the partial penetration vs. full penetration weld, the surface examination vs. volumetric examination technique, and the potential for subsurface flaws to exist when only surface examinations are performed.

As described in Section 3.2.4.1 above, the UFSAR only describes weld failure in terms of a possible pinhole leak in individual weld layers; otherwise the UFSAR does not describe weld failure as a malfunction of SSCs important to safety. The proposed exemption does not change the general integrity of the weld formation process or the fundamental nature of the independent multi-layer field welds used on the top closure plates. Therefore, the proposed exemption does not increase the likelihood of the weld malfunction described in the UFSAR.

The UFSAR does not explicitly describe the function of top closure plate welds in supporting the integrity of the DSC during plant operations that might relate to malfunctions that are important to safety. However, the design functions described below are reviewed as appropriate. The redundant closure weld of the test port plug is not subject to significant design loading, such that a two layer weld application is sufficient to ensure the integrity of the weld.

3.2.5.1 <u>Inner and Outer Top Cover Plate Weld Justification</u>

The closure weld for the ITCP is described in section 3.2.4.2 above for the confinement boundary design function.

The closure weld for the OTCP is a partial penetration groove weld with 1/2" effective throat, specified as three layer minimum, and is subject to PT examination of the root, intermediate and final layers not to exceed .27" thick. The limitation of 0.27" for the thickness of the OTCP intermediate weld layers is based on the critical flaw size of 0.29" calculated for the 61BTH Type 1 DSC, and ensures that a critical flaw cannot exist in a single weld layer.

The DSC Outer and Inner Top Cover Plates, including their associated welds, provide structural support for the DSC canister. As austenitic stainless steels, these materials do not have a nil ductility transition temperature. Thus, the welds can sustain relatively large flaws without a concern for flaw growth. Additionally, flaws in austenitic stainless steels are not expected to exceed the thickness of one weld bead. In the event that a flaw were present, the multiple-layer closure weld design of the DSCs prevents the flaw from propagating and gives reasonable assurance the flaw is no larger than a weld layer.

The structural features of the DSC design depend, to a large extent, on the postulated design basis TC drop accident (described in UFSAR Section 8.2.5). The DSC shell, the redundant closures on each end, and the DSC internals are designed to ensure that the intended safety functions of the system are not impaired following a postulated TC drop accident (Reference UFSAR Section 1.2.2). The material strength of the top closure plate welds are not compromised by the proposed exemption. Therefore, the proposed activity does not affect the bounding accident (the TC drop accidents) or any of the other accidents.

As described in UFSAR Section 8.1.1.1D, the most significant operational loading condition is sliding of the DSC between the TC and the HSM during the DSC insertion/extraction process. Sliding is achieved by the push/pull forces induced by the hydraulic ram system. These forces are applied to the grapple ring assembly which is an integral part of the DSC bottom end assembly. The forces induced by the ram system are reacted by friction forces which develop between the sliding surfaces of the DSC, the TC, and HSM support rails. Thus, the limiting operational loads are applied to the bottom end assembly and the DSC shell, not the top closure weldments that are subject of the proposed exemption.

The differential pressure of approximately 15 psig applied across the ITCP during the pressure test performed subsequent to vacuum drying demonstrates the gross structural integrity (no leaking) of the ITCP weld.

ISG-15 acknowledges that flaws can exist in austenitic stainless steel welds, even when Code compliant multi-layer PT examination is performed. ISG-15 also assumes that flaws in such stainless steel welds will not extend through an individual weld layer. Therefore, it is acceptable for the closure welds to contain flaws, but not allow the flaws to propagate through multiple weld layers. In fact, the design has taken such flaws into consideration by applying a joint efficiency factor (ASME code criteria) of 0.70 to the weld stress allowable value which is more limiting than the stress reduction factor of 0.80 specified in ISG-15.

The safety significance for flaws to exist in the closure welds is minimized by the passive nature of the system design, which is not subject to significant cyclic loading (unlike Class 1 components in the reactor coolant system of a nuclear power plant). Other than vacuum drying, the thermal cycles and pressure fluctuations are mild in range and severity, and are primarily seasonal such that there is no realistic concern for fatigue failure. Therefore, any flaws that may exist in the closure welds are essentially stable for the design basis loadings associated with the system.

The design of the field closure welds satisfies ASME Code criteria with adequate margins, while conservatively applying a modified stress reduction factor of 0.70 to the Code allowable values.

AREVA Structural Evaluation

The calculation provided in Enclosure 2, AREVA calculation 11042-0204, Revision 2, "Structural and Allowable Flaw Size Evaluation of the Spent Fuel Storage Canisters with Nonconforming Closure Welds at Monticello Nuclear Generating Plant," provides a basis for accepting these welds with the nonconforming PT examinations. The calculation provides an analysis of the structural adequacy of a DSC assuming a potential weld flaw existing in both ITCP and OTCP welds that bounds those discovered on DSC 16 OTCP. The potential flaw is assumed to reside in a full circumference around the ITCP and OTCP welds (i.e. throughout the entire weld).

For the ITCP weld, the weld depth is assumed to be fully filled, with a critical flaw evaluated for a 360^{o} circumferential flaw. The calculation determined an "acceptable" allowable flaw size, that is, a flaw size that will ensure that ASME weld stress limits are still met. For a 360^{o} circumferential flaw an allowable flaw depth of 0.10" could exist and the weld would still meet ASME weld stress limits. All the component stresses remain below the stress allowable limits. The flaw is evaluated as either occurring on the surface or subsurface of the weld.

For the OTCP weld, the weld depth was reduced to 0.480" to account for the weld depth issues discovered on DSC 16, with an allowable flaw evaluated for a 360^{o} circumferential flaw. The thermal loads which are secondary loads would tend to reduce with the reduction in stiffness of the components. Conservatively all secondary stresses were scaled for the 0.480" weld. Like the ITCP weld calculation, the OTCP calculation determined an "acceptable" allowable flaw size, that is, a flaw size that will ensure the weld stress limits are still met. For a 360° circumferential flaw an allowable flaw depth of 0.27" could exist and the weld would still meet ASME weld stress limits. All the component stresses remain below the stress allowable limits. The flaw is evaluated as either occurring on the surface or subsurface of the weld.

For conservatism a weld modified stress reduction factor was applied to both the ITCP and OTCP weld calculations. Per ISG-15 the stress reduction factor of partial penetration welds with PT examination is 0.80. Since these welds are non-compliant with the PT requirements, the weld reduction factor is reduced based on the guidance of ASME Subsection NG. The permissible weld reduction factors (ASME Boiler and Pressure Vessel Code, Division 1, Subsection NG, 1998 edition through 2000 Addenda, Table 3352-1) for surface PT and surface visual examination are 0.4 and 0.35, respectively. A modified stress reduction factor of 0.70 (0.80 x 0.35/0.40) is calculated for the non-compliant weld, due to the multiple visual inspections. The original 61BTH evaluations use a reduction factor of 0.70 (for conservatism to the ISG-15 requirement for a stress reduction factor of 0.80); therefore, the allowable stress values used in the original analysis are not changed.

For further conservatism, the weld membrane stress at limiting load for OTCP and ITCP is calculated using square root sum of the squares (SRSS) method, for a 0.480" OTCP weld and 3/16" ITCP weld, while excluding the compressive loads onto the weld.

When the modified stress reduction factor and other conservatisms are included as described above are applied for normal conditions, the stress ratio of calculated stress to allowable stress is 0.52 and 0.79 for the ITCP and OTCP welds, respectively. For accident conditions, the stress ratio is 0.84 and 0.71 for the ITCP and OTCP welds, respectively. Therefore, adequate design margins exist for the ITCP and OTCP welds when evaluated against conservative stress allowable values.

The assumptions of flaw size used in the calculation bound any of the indications found on DSC 16 and would appear to also bound any latent flaw undetected in DSCs 11 – 15. Therefore, this calculation demonstrates that sufficient margin is included in the welds and a reasonable expectation of satisfactory performance of each DSC for the design service lifetime of the DSC. The DSC stress evaluation shows that the reduced weld size of 0.48" for the OTCP will have no adverse effect on the design functions of the DSC.

Potential weld flaws in the noncompliant DSCs can be characterized based on the results of the re-inspections performed on the final layer of the OTCP on DSC 16 and the observations of the actual welding process documented in the SIA report (see section 1.3.2). For the flaws identified in those re-inspections, the maximum indication was approximately 0.035" with a length of 1.6" (see section 1.3.3). The SIA report documents that the worst welding practices were observed on the OTCP weld of DSC 16, such that the balance of the ITCP and OTCP welds on the other affected DSCs are assumed to be bounded by DSC 16. The composite effect of all weld flaws reported for DSC 16 results in a conservative flaw characterization defined as a single flaw of 0.050" depth occurring around 45° of the weld circumference, which applies to both ITCP and OTCP welds for all noncompliant DSCs. In comparison, the allowable calculated flaws bound this assumed flaw by at least twice the depth for the conservatively assumed 360° flaw. Therefore, it is concluded that the flaws that may exist in the ITCP and OTCP welds of the noncompliant DSCs are stable for all design basis loading conditions, with significant margins (minimum factor of 2 on flaw depth). This conclusion applies over the entire licensed life of the affected canisters.

Furthermore, the allowable flaw size evaluation indicates that flaws that may exist in the ITCP and OTCP welds are bounded by the allowable flaw size, with significant margins with respect to flaw depth (factor of 5) and circumferential length (factor of 8).

Therefore, based on the bases discussed and the applicable considerations provided above, the structural design and redundant barrier functions are adequately maintained, without crediting the noncompliant PT examinations, for all design basis loading conditions postulated to occur over the 20-year lifetime of the affected DSCs. See Enclosure 2 for the stress calculation.

3.3 Conclusion

Based on the discussion above, the proposed activity does not adversely affect the criticality safety, shielding/radiological safety, heat removal, confinement integrity or structural support functions of the DSC as described in the UFSAR. In summary, the requested exemption is safe to grant.

The integrity of the field closure welds for DSCs 11 - 16 can be assured with confidence even though the TS required PT examinations were non-conforming. The known quality of the welding processes, the use of multi-layer weld technique, the adequate stress margin in the welds to accommodate flaws, plus the visual inspection and helium leak testing demonstrate that the field closure weld integrity of DSCs 11 - 16 is sufficient to ensure that the affected closure welds will continue to perform their design basis functions over the service lifetime of these canisters.

This exemption request further concludes, based on a preponderance of the evidence, that there is a reasonable assurance of safety for the NRC to approve the requested exemption for the 20-year service lifetime of DSCs 11 - 16. The reasonable assurance of safety is based on the following:

1. Integrity of the fuel creates a fission product barrier.
2. The quality of the welding process employed provides indication of development of high quality welds.
3. 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 high quality welds.
4. Visual inspections performed on the welds met quality requirements.
5. The helium leak and DSC backfill testing results verify confinement barrier integrity.
6. The lack of a failure mechanism that adversely affects confinement barrier integrity.
7. Stress margins are available in the welds when using assuming conservatively large flaws.

Alternatives described in section 4.3 would increase the radiological dose to workers, generate additional radiological waste, potentially create foreign material and increase other operational risks to the station without a commensurate increase in safety as compared to approval of the exemption request.

4.0 Basis for Approval

The proposed exemption is limited in scope in that it only relates to compliance with the inspection of certain field closure welds as described above. The proposed exemption is a change in compliance, but it involves no physical change to the canister design, and no change to the canister materials or the loading operation. In this regard, the proposed activity cannot affect the frequency of any accident caused by the loading process (e.g., dropped transfer cask or jammed DSC), and it has no bearing on the frequency of natural events (flood, earthquake, tornado) that are Acts of God. Therefore, the proposed activity does not result in an increase in the frequency of any previously-evaluated accident. Further, the fact that the exemption would not affect canister design and procedures would ensure that no new type of malfunction would be created.

The Technical Assessment (Section 3.0) provides the basis for the following conclusions; that a reasonable assurance of safety exists for transfer of DSC 16 to the HSM, and the 20-year service lifetime of DSCs 11 – 16. Even though regulations 10 CFR 72.212(b)(3), and (b)(11) criteria are not explicitly met, the non-conforming condition does meet the applicable criteria in 10 CFR 72.104, 10 CFR 72.124 and 10 CFR 72.236 and do meet the five necessary design functions for a DSC. Thus, the requested exemption is authorized by law; does not endanger life, property, or common defense and security; and is otherwise in the public interest as described below.

4.1 Authorized by Law

NSPM is requesting an exemption from requirements of 10 CFR 72.212(b)(3) and 72.212(b)(11). 10 CFR 72.7 gives the NRC the authority to grant exemptions from the requirements of 10 CFR Part 72 provided they do not endanger life or property or the common defense and security and are otherwise in the public interest. This exemption request documents that these criteria are met. The exemption is authorized by law.

4.2 Does Not Endanger Life, Property or Common Defense and Security

As shown in the Technical Assessment in Section 3.0 above, the transfer of DSC 16 and the weld integrity has been demonstrated by other means such that all DSC functions for criticality, shielding/radiological safety, heat removal, confinement and structural support are met during normal conditions and postulated accidents for the licensed life of these canisters.

By approval of this exemption, DSC 16 will be permitted to transfer to an HSM on the MNGP ISFSI pad and DSCs 11 - 16 will be exempted from the performance of PT examinations for the applicable welds that are required by TS 1.2.5. Once restored to regulatory conformance by this exemption, DSC 16 would be transferred using previously approved procedures and with additional controls in place to the ISFSI where it will reside in the same state as DSCs 11 - 15. Once restored to regulatory conformance by this exemption, DSCs 11 - 16 would not require any further physical work. They would remain in their place in the HSMs, continuing in their passive state.

As described above, the DSC functions remain intact with sufficient reliability. By virtue of restoring each DSC to fully compliant status with respect to TS 1.2.5, the proposed exemption restores the ISFSI to its previously described licensed configuration such that it does not endanger life, property, or common defense and security.

The technical justification in summary for the proposed exemption includes the following considerations.

- The Criticality Safety Assessment, Radiological Safety Assessment and Heat Removal Assessments are not directly impacted by the nonconforming PT examinations.
- Alternatives described in section 4.3 would increase the radiological dose to workers, generate additional radiological waste, potentially create foreign material and increase other operational risks to the station without a commensurate increase in safety as compared to approval of the exemption request.
- For transfer of DSC 16
  - Storage in an HSM is evaluated in UFSAR and is the safest place for the DSC to reside.
  - NSPM will provide additional controls to the transfer of DSC 16 to the HSM. These controls are added to increase the safety of the move.
  - Demonstrated that other accidents or transients are not credible during the short duration of a DSC transfer to the HSM.
  - Welds provide satisfactory performance based on evidence provided below for the 20-year service lifetime for DSCs 11 – 16.
- For 20-year Service Lifetime for DSCs 11 - 16
  - The weld closures of DSCs 11 - 16 were performed under a 10 CFR 50 Appendix B program, such that the canister closure weld integrity is otherwise assured. Accordingly, welding materials were procured to quality requirements and welding processes were developed and qualified for the given configuration, and welders were appropriately

qualified to the Code requirements. Welding parameters were specified in associated procedures and monitored as required.

- The welding procedures used for the subject campaign required VT on every completed layer of all field closure welds prior to the performance of the PT examinations. The acceptance criteria applied to the VT inspections are the same as those applied to the PT examination. Even though the interrogation methods (PT vs VT) are very different, the VT inspection provides reasonable assurance that each weld layer was completed with no significant surface defects.
- While nonconforming PT examinations were performed, vendor testing demonstrated that some flaws would have been identifiable even considering the substandard techniques.
- Satisfactory completion of the required helium leak test conducted on each DSC has specifically demonstrated the integrity of the primary confinement boundary (ITCP and siphon and vent cover plate) welds. This test (conducted per TS 1.2.4a) specifically demonstrates that the primary confinement barrier field welds are "leak tight" as defined in ANSI N14.5-1997. In this respect, the helium leak test demonstrates the basic integrity of the confinement barrier and the lack of any thru-weld flaws in the field closure welds that would lead to a loss of cavity helium in DSCs 11 - 16.
- The differential pressure of approximately 15 psig applied across the ITCP during the pressure test performed subsequent to vacuum drying demonstrates the gross structural integrity of the ITCP weld.
- For the redundant closure weld of the OTCP, multiple weld layers are specified (minimum of root, mid-layer and final). The thickness of each weld layer is less than the calculated minimum critical flaw size, where the flaw size is determined by a fracture mechanics evaluation performed per ISG-15 requirements, thus eliminating the potential for flaw propagation in the weld. This is similar to the argument stated in UFSAR Section 3.3.2.1 for pinhole leaks; there is no possibility for flaws to align through successive weld layers, such that the existence of a critical flaw in the OTCP weld is not credible based simply on the multi-layer weld technique. The redundant closure weld of the test port plug is not subject to significant design loading, such that a two layer weld application is sufficient to ensure the integrity of the weld. Therefore, for the redundant closure welds, the application of the weld design provides sufficient basis for an acceptable level of quality and safety in the welds.
- A calculation was performed assuming flaws larger than those discovered in the welds and reduced weld depths (OTCP only) and a modified stress reduction factor. The results of the weld calculation for the ITCP and OTCP demonstrated that each weld has sufficient margin

to ASME limits and therefore, a reasonable expectation of satisfactory performance of each DSC for the design service lifetime of the DSC.

- There are no credible failure mechanisms for the welds once the DSC is in storage. Welds use corrosion resistant material, ITCP, SPCP and VPCP welds are located in an inert environment, and all welds are located in a low pressure environment.

In summary, the integrity of the field closure welds for DSCs 11 - 16 can be assured with confidence even with the non-compliant PT examinations. The known quality of the welding processes, the use of multi-layer weld technique, plus the VT inspection and helium leak testing demonstrate that the field closure weld integrity of DSCs 11 - 16 is sufficient to ensure that the affected closure welds will continue to perform their design basis functions over the service lifetime of these canisters.

4.3 Otherwise In the Public Interest - Alternatives

NSPM has evaluated repair and replacement alternatives to the proposed Exemption Request; however, none of the alternatives provide the safety assurances and reduced radiological risk provided by the Exemption Request. In summary, each of these alternative steps outlined below provide additional risk to safety and to the environmental assessment. To cause the affected DSCs to become in compliance with CoC 1004, Amendment 10 would involve the repair and/or replacement and/or reloading of each DSC through the following steps:

- The various repair or unload options for DSC 16 (see section 3.1.5)
- Retrieve and transfer each affected DSC from its respective HSM (DSC 16 does not need to be retrieved)
- Perform necessary procedures to machine off the outer top cover plate and inner top cover plate down to the root weld.
- Inspect inner top cover plate, outer top cover plate and DSC for damage incurred during the machining process.
- If damage is present then, continue to open up the DSC, place each affected DSC back into the spent fuel pool, unload all fuel assemblies to the spent fuel pool, replace the used DSC with a new DSC (if DSC is unable to be reused), and reload fuel assemblies into the DSC.
- Perform necessary procedures to reweld, perform NDE and vacuum dry the DSC.
- Transfer the DSC back to the ISFSI and re-insert into the HSM.

Each alternative is discussed below using criteria of Operational Risk, Occupational Dose, Radioactive Waste Generation, and Cost.

4.3.1 Repair DSCs 11 - 16

Consideration was given to a specially-planned evolution to cut off the OTCP of DSCs 11 - 16 without reflooding the cavity. The operation would gain access to the ITCP welds, and then cut the ITCP welds down to the vicinity of the original root layer. Vent port cover and siphon port cover welds would be removed as well. This alternative would have essentially placed the DSC in its original state when it had a completed root layer on the ITCP. From that point, the DSC would have been re-welded and inspected in conformance to TS 1.2.5 and other applicable TSs.

Operational Risk of this Alternative:

For DSCs 11 - 16, this alternative would involve a first-of-a-kind operation including a great deal of precision to avoid damaging base metal on the DSC shell. Further, the specific cask configuration (cut down to the root weld without flooding the canister cavity) would have put the canisters in a condition that diverged from that described in the UFSAR, which would complicate contingency operations if fuel offloading would become necessary. Another operational risk of this alternative includes generation of significant metal shavings and cutting oils on the Reactor Building refueling floor; creating a threat of foreign material intrusion and chemical contamination to nuclear fuel and reactor plant equipment.

For DSCs 11 - 15 (now at the ISFSI), this alternative would also involve retrieving each DSC from its respective HSM, hauling each to the Reactor Building (near the Spent Fuel Pool), and performing the heavy lifts required to transfer the DSC to the refueling floor. These operations would be performed in accordance with existing procedures, so the risk of a handling accident would be small. Nevertheless, the operation would expose each canister to an HSM insertion and withdrawal cycle that would generate unnecessary stresses on the vessels. These risks are unnecessary in comparison to the requested exemption.

Occupational Dose of this Alternative:

To perform this alternative on DSCs 11 - 16, the repair activities on the refueling floor could expose workers to an occupational radiological dose of approximately 8.3 Rem (approximately 1.39 Rem per canister) above and beyond that of the Exemption. An additional occupational dose of 1.8 Rem is estimated for the associated canister handling operations to remove and restore each DSC (DSC 16 does not need to be retrieved) to its associated HSM. In sum, this alternative is estimated to expose workers to a combined dose of approximately 10.0 Rem beyond the dose associated with the requested exemption.

Radiological Waste Generation of this Alternative:

In addition to the nominal radioactive waste generated in the course of Transfer Cask handling operations at the ISFSI and Reactor Building, this alternative would generate a significant amount of potentially-contaminated metal shavings and a potentially-contaminated OTCP from each DSC that would have to be decontaminated or discarded as radioactive waste.

Cost:

Based on computations using simplified assumptions, this alternative would cost approximately $12.0 million to repair all six canisters and restore them to HSMs. The cost of radioactive waste processing and disposal is not included in this estimate.

4.3.2 Unload DSCs 11 - 16, Discard, and Replace

Consideration was given to an extensive campaign to cut open and unload all 6 DSCs in the Spent Fuel Pool (SFP) in accordance with approved procedures, then process and dispose of those 6 canisters, and reload the same quantity of spent fuel into 6 new canisters. This alternative would process DSC 16 first, then remove DSCs 11 - 15 from the HSMs and process them as well.

Operational Risk of this Alternative:

For DSCs 11 - 16, this alternative would constitute an infrequent and high-risk operation involving many of the risks discussed for the preceding alternative, plus the following additional operational risks:

(1) Foreign material and oil contamination issues associated with cutting through the OTCP, vent/siphon port covers, and the ITCP,

(2) Stressing fuel assemblies during the DSC cavity reflood,

(3) Heavy load handling over the SFP (12 lifts), and

(4) Heavy load handling of six discarded DSCs for decontamination and shipment offsite.

In the aggregate, these risks are considerable and would be unnecessary in comparison to the requested exemption.

Occupational Dose of this Alternative:

To perform this alternative on DSCs 11 - 16, the unloading activities on the refueling floor could expose workers to an occupational radiological dose of approximately 1.0 Rem per canister (above and beyond that of the Exemption). Further dose of 0.5 Rem per canister is estimated for loading a new canister, based on the dose for a typical canister loading operation. Thus, a dose estimate of 1.5 Rem is estimated for each canister, with a total combined dose estimate of 9.0 Rem above and beyond the dose estimated for the proposed Exemption. This estimate does not include the significant radiation dose that would be associated with decontaminating, shipping, processing, and disposal of the six discarded canisters associated with this alternative.

Radioactive Waste Generation of this Alternative:

In addition to the nominal radioactive waste generated in the course of TC handling operations at the ISFSI and Reactor Building, this alternative would generate a very significant amount of potentially-contaminated metal shavings and 6 contaminated (18-ton each) DSCs that would have to be decontaminated and packaged for shipment, then processed for disposal and shipped to a disposal site.

Cost:

Based on computations using simplified assumptions, this alternative would cost approximately $40.0 million to unload all six canisters, and load six new canisters into HSMs. The cost of radioactive waste processing and disposal is estimated at $0.5 million. Thus, the total cost of applying this alternative to all six DSCs could reach $40.5 million.

4.4 Conclusion

Based on the above discussion, the requested exemption is authorized by law and will not endanger life or property or the common defense and security and is otherwise in the public interest as the exemption is the least risk, least dose, least radioactive waste and least cost option. Any campaign to repair or discard and replace DSCs 11 – 16 would create operational challenges and risks associated with additional operational requirements, occupational doses, and generation of significant quantities of radioactive wastes.

5.0 Environmental Consideration

5.1 Background

The potential environmental impact of using the Standardized NUHOMS® System was initially analyzed in the environmental assessment for the final rule to add the Standardized NUHOMS® System to the list of approved spent fuel storage casks in 10 CFR 72.214 (59 FR 65898; December 22, 1994). The environmental assessment for the December 22, 1994, final rule concluded that there would be no significant environmental impact to adding the Standardized NUHOMS® System, and therefore, the NRC issued a finding of no significant impact (FONSI), which was validated through Amendment 10 of the Certificate of Compliance (see Reference 6.3).

Standardized NUHOMS® casks are designed to mitigate the effects of design basis accidents that could occur during storage. Design basis accidents account for human-induced events and the most severe natural phenomena reported for the site and surrounding area. Postulated accidents analyzed for an ISFSI include tornado winds and tornado-generated missiles, a design basis earthquake, a design basis flood, an accidental cask drop, lightning effects, fire, explosions, and other incidents.

Considering the specific design requirements for each accident condition, the design of the cask would prevent loss of confinement, shielding, and criticality control. Without the loss of confinement, shielding, or criticality control functions, the risk to public health and safety is not compromised. The NRC staff performed a detailed safety evaluation of the CoC amendment under which the subject six canisters were loaded (i.e., Amendment 10) and found that an acceptable safety margin was maintained, that the proposed changes provided reasonable assurance that the spent fuel could be stored safely, met the acceptance criteria specified in 10 CFR Part 72, and that there continued to be reasonable assurance that public health and safety will be adequately protected.

5.2 No Significant Hazards Consideration

In order to support the assertion in section 5.3 below that this exemption request meets the definition of a regulatory action eligible for a categorical exclusion or otherwise does not require an environmental review, NSPM is providing the following No Significant Hazards Consideration (NSHC). The NSHC is being performed in accordance with 10 CFR 50.92, insofar as 10 CFR 72 does not establish separate criteria. NSPM has evaluated the proposed exemption request in accordance with the standards in 10 CFR 50.92 and has determined that the requested exemption presents no significant hazards. NSPM's evaluation against each of the criteria in 10 CFR 50.92 follows.

1. **Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?**

   Response: No.

   The probability (frequency of occurrence) of any UFSAR evaluated accident occurring is not affected by the requested exemption, because MNGP continues to comply with the regulatory and design basis criteria established for dry shielded canisters.

   There is no change in consequences of postulated accidents, because the analysis indicates that there is margin to the most limiting accident (cask drop) assuming flaws in the welds and derating for a nonconforming PT examination. The results of accident evaluations remain within the NRC approved acceptance limits.

   Therefore, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. **Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?**

   Response: No.

   The exemption request does not create the possibility of a new operating mode, or accident scenario, nor does the exemption request rely on new equipment, or postulate a new equipment failure mode. In order for an activity to create the possibility for an accident of a different type, the activity would have to introduce a new material, a new man-machine interface, a new operational process, or other significant change that would initiate a new type of failure or cause a previously-described accident to propagate differently. As previously described, the proposed activity is technical in nature in that it recognizes and reconciles the non-conforming NDE, but it involves no physical change to the canister design, and no changes to the canister materials or the loading operation. Therefore, the proposed activity does not create a possibility for an accident of a different type and does not result in more than a minimal increase in the likelihood of occurrence of a malfunction of an SSC important to safety previously evaluated in the UFSAR.

3. **Does the proposed change involve a significant reduction in a margin of safety?**

   Response: No.

   The five design criteria (design functions) of the DSCs have been evaluated. The design criteria of Criticality Safety, Radiological safety, and Heat Removal are not affected by the nonconforming PT examinations. The Confinement and Structural Support design criteria have been marginally affected, but are not significantly affected and there is margin to safety in these design criteria.

   Therefore, the proposed exemption request does not involve a significant reduction in a margin of safety.

Based on the considerations above, NSPM has determined that storage of spent fuel in DSCs 11 – 16 in accordance with the exemption request does not involve a significant hazards consideration as defined in 10 CFR 50.92(c), in that it does not: (1) involve a significant increase in the probability or consequences of an accident previously evaluated; or (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or (3) involve a significant reduction in a margin of safety.

5.3 <u>Environmental Impact of the Proposed Action</u>

Based on the technical review provided in Section 3.0 above, the integrity of the closure welds on the six subject canisters is assured by means other than the nonconforming PT. Thus, the canister's confinement function and accident mitigating design functions are not compromised for the proposed exemption such that there is no environmental impact of the proposed action. Thus, the canister performance in the original environmental assessment and the applicable Amendment 10 environmental assessment is maintained and assured.

The proposed action would restore the six canisters to a conforming and operable status, allowing DSC 16 to be transferred to an HSM (and allowing DSCs 11 - 15 to stay in HSMs) under existing procedures. No extraordinary operations would be necessary for the exemption. Therefore, the proposed exemption would not create a new unforeseen risk of environmental impact. Therefore, the conclusions made in the original environmental assessment and Amendment 10 remain valid.

The exemption request provides the bases for acceptability of DSCs 11 – 16 based on performance of non-conforming PT examinations. The requested exemption meets the categorical exclusion of 10 CFR 51.22(c)(25) as a regulatory action eligible for a categorical exclusion or otherwise does not require an environmental review, because there is: (Note: NSPM responses are provided in brackets after each requirement)

(i) no significant hazards consideration;

[See section 5.2.]

(ii) no significant change in the types or significant increase in the amounts of any effluents that may be released offsite;

[No significant changes of effluents or types of effluents are requested to be released under this exemption request.]

(iii) no significant increase in individual or cumulative public or occupational radiation exposure;

[No significant increases in radiation to individuals or the public are requested under this exemption request.]

(iv) no significant construction impact;

[No construction is being requested or impacted under this exemption request.]

(v) no significant increase in the potential for or consequences from radiological accidents; and

[No significant increase in the potential for or consequences of a radiological accident is being requested in this exemption request.]

(vi) the requirements from which an exemption is sought involve:...

(C) inspection or surveillance requirements;...

[The exemption request seeks an exemption from performance of TS 1.2.5, an inspection or surveillance requirement for performing PT examinations.]

Further, the proposed exemption does not require any changes to the MNGP ISFSI Environmental Report and applicable Safety Analysis Report analyses remain bounding.

5.4 Environmental Impact of Alternatives to the Proposed Action

As discussed in Section 4.3, NSPM has considered two alternatives to the proposed exemption: (1) Repair DSCs 11 - 16, and (2) Unload DSCs 11 - 16, discard, and replace. The environmental impacts of these alternatives would result in both real and potential environmental impacts. NSPM has estimated that the implementation of these alternatives would result in a significant amount of occupational dose and low-level radioactive waste (LLRW) that would have to be processed and disposed.

The first alternative would involve repairing each DSC to access the ITCP, and then cut the ITCP welds down to the vicinity of the original root layer. From that point, the DSC would be re-welded and inspected in conformance to TS 1.2.5 and other Technical Specifications. Occupational doses would be significant as grinding and welding activities would be performed in the vicinity of spent nuclear fuel. Radioactive wastes would be generated from the grinding operations performed to remove the welds. Other radioactive wastes would be generated from radioactively contaminated consumables and anti-contamination clothing used during the transferring and reinspecting of each DSC from the HSM to the Reactor Building and back again. This radioactive waste would be transported and ultimately disposed of at a qualified low level radioactive waste disposal facility, potentially exposing it to the environment.

The second alternative would involve the replacement of six 18-ton canisters. Occupational doses would be significant as grinding and welding activities would be performed in the vicinity of spent nuclear fuel. Each discarded DSC would become radioactive waste. Radioactive wastes would be generated from the grinding operations performed to remove the welds from the existing canisters. Other radioactive wastes would be generated from radioactively contaminated consumables and anti-contamination clothing used during the unloading and reloading process. This radioactive waste would be transported and ultimately disposed of at a qualified LLRW disposal facility, potentially exposing it to the environment.

In addition, both of the alternatives would result in additional risks of both off-normal events and design basis accidents, such as a fuel handling or cask drop event, both of which could involve a radiological release to the environment.

5.5 Conclusion

As a result of the environmental assessment, NSPM concludes that the proposed action, which will allow NSPM to maintain DSCs 11 - 16 in their current state with noncompliant PT examinations, including the transfer of DSC 16, is in the public interest in that it avoids the adverse environmental effects associated with the alternatives to the proposed action.

6.0 References

6.1 TriVis Letter to NRC Document Control Desk, 12751-NRC-001, Report of Potential Substantial Safety Hazard in accordance with Title 10 Code of Federal Regulation, Part 21, dated December 13, 2013 (ADAMS Accession No. ML14006A004).

6.2 TriVis Letter to NRC Document Control Desk, 12751-NRC-002, Final Report of Potential Substantial Safety Hazard in accordance with Title 10 Code of Federal Regulation, Part 21, Event Number 49628, dated January 29, 2014 (ADAMS Accession No. ML14042A201).

6.3 Environmental Assessment and Finding of No Significant Impact on Proposed Amendment to 10 CFR PART 72, List of Approved Spent Fuel Storage Casks: Standardized NUHOMS® System Revision 10, Office of Federal and State Materials and Environmental Management Programs, U.S. Nuclear Regulatory Commission (NRC), dated March 2009 (ADAMS Accession No. ML091320168).

6.4 Safety Evaluation Report of Vectra Technologies, Inc. aka Pacific Nuclear Fuel Services, Inc. Safety Analysis Report for the Standardized NUHOMS® Horizontal Storage Modular Storage System for Irradiated Nuclear Fuel, US NRC Office of Nuclear Material Safety and Safeguards, December 1994.

6.5 TriVis Report, Assessment of Field Closure Weld Liquid Penetrant Examinations Performed on Dry Shielded Canisters 11 through 16 during the 2013 MNGP ISFSI Loading Campaign, Revision 1, dated February 5, 2014.

6.6 Report No. 1301415.403, Assessment of Monticello Spent Fuel Canister Closure Plate Welds based on Welding Video Records, Revision 2, Structural Integrity Associates, May 22, 2014.

6.7 NRC Spent Fuel Project Office Interim Staff Guidance (ISG)-15 Materials Evaluation, January 10, 2001.

6.8 NRC Spent Fuel Storage and Transportation Interim Staff Guidance (ISG)-18, Rev. 1, The Design and Testing of Lid Welds on Austenitic Stainless Steel Canisters as the Confinement Boundary for Spent Fuel Storage, October 3, 2008.

Appendix A

Dye Penetrant Examination (PT) Data

This appendix documents the results of the PT examinations performed during the 2013 ISFSI loading campaign at MNGP. During the performance of PT examination on DSCs 11 – 16, penetrant and developer dwell times varied by quite large margins depending on the weld being tested and which DSC was being examined. The PT examinations for DSCs 11 – 16 were signed off, indicating that acceptable results were obtained.

This appendix includes Tables A-1 and A-2 which provide the overall weld temperatures, penetrant dwell times, cleaning method, cleaning dry time and developer dwell time for the welds under the scope of this exemption request for each DSC. Each of the PT examinations indicates a deficiency in performance of the PT examination penetrant and/or developer dwell time.

The data used in these tables comes from videos of refueling floor activities as documented in the TriVis report (Reference 6.5) that show the workers performing DSC loading and closure activities, TS compliance and welding/inspection activities. These videos provide detailed indication of worker performance and are time stamped to permit the duration of timed activities. These videos are not considered quality records.

The conclusion of these data indicate that longer penetrant dwell times and developer dwell times occurred during the PT examination of the ITCP and OTCP welds (Table A-1) as compared to the PT examination of the SPCP, VPCP and TPP welds (Table A-2).

Table A-1 – PT Performance Parameters for ITCP and OTCP Welds

DSC	Weld*	Weld Temp (°F)	Penetrant Dwell Time (min:sec)	Cleaning Method (Wet or Dry)	Cleaning Dry Time (min:sec)	Developer Dwell Time (min:sec)
11	ITCP-R	106	13:00	Wet	1:59	1:31
11	ITCP-F	110	15:32	Wet	2:59	2:39
11	OTPC-R	97	17:56	Wet	3:54	2:00
11	OTPC-I	168	5:50	Wet	6:30	1:37
11	OTCP-F	207	3:03	Wet	1:08	4:13
12	ITCP-R	151	9:50	Wet	2:12	5:11
12	ITCP-F	158	6:36	Wet	3:56	3:51
12	OTPC-R	157	6:28	Wet	2:18	3:38
12	OTPC-I	156	3:23	Wet	1:16	8:38
12	OTCP-F	190	2:07	Dry	0:00	4:58
13	ITCP-R	174	7:34	Wet	2:12	2:51
13	ITCP-F	179	5:22	Wet	1:53	2:13
13	OTPC-R	194	5:47	Wet	0:38	2:31
13	OTPC-I	190	2:09	Dry	0:00	6:15
13	OTCP-F	188	2:48	Dry	0:00	5:09
14	ITCP-R	131	9:26	Wet	1:46	3:40
14	ITCP-F	145	7:54	Wet	1:51	2:33
14	OTPC-R	161	10:30	Wet	3:08	2:18
14	OTPC-I	158	6:45	Wet	2:09	2:52
14	OTCP-F	149	2:05	Dry	0:00	4:17
15	ITCP-R	151	10:21	Wet	1:58	3:22
15	ITCP-F	144	9:16	Wet	1:50	2:58
15	OTPC-R	148	2:13	Dry	0:00	1:55
15	OTPC-I	146	2:20	Dry	0:00	3:32
15	OTCP-F	175	6:13	Wet	1:50	3:09
16	ITCP-R	128	3:23	Wet	1:38	4:14
16	ITCP-F	138	2:39	Dry	0:00	6:07
16	OTPC-R	144	3:31	Dry	0:00	5:13
16	OTPC-I	149	2:00	Dry	0:00	5:21
16	OTCP-F	PT on this weld layer was not completed when inadequate PT exams discovered				

*R= root layer, I= intermediate layer, F= final layer

Table A-2 – PT Performance Parameters for SPCP, VPCP and TPP Welds

DSC	Weld*	Weld Temp (°F)	Penetrant Dwell Time (min:sec)	Cleaning Method (Wet or Dry)	Cleaning Dry Time (min:sec)	Developer Dwell Time (min:sec)
11	SPCP-R	146	1:00	Wet	0:18	0:32
11	SPCP-F	146	2:56	Wet	0:09	0:22
11	VPCP-R	146	1:00	Wet	0:18	0:32
11	VPCP-F	146	2:56	Wet	0:09	0:22
11	TPP-R	207	3:03	Wet	1:08	4:13
11	TPP-F	235	video recording obstructed, no data available			
12	SPCP-R	152	4:20	Wet	0:34	0:57
12	SPCP-F	160	4:14	Wet	0:36	1:33
12	VPCP-R	152	4:20	Wet	0:34	0:57
12	VPCP-F	160	4:14	Wet	0:36	1:33
12	TPP-R	193	3:23	Wet	1:16	8:38
12	TPP-F	190	2:07	Dry	0:00	4:58
13	SPCP-R	169	3:44	Wet	0:43	0:49
13	SPCP-F	176	3:46	Wet	0:24	0:48
13	VPCP-R	169	3:44	Wet	0:43	0:49
13	VPCP-F	176	3:46	Wet	0:24	0:48
13	TPP-R	158	2:09	Dry	0:00	6:15
13	TPP-F	162	2:48	Dry	0:00	5:09
14	SPCP-R	130	2:00	Dry	0:00	3:13
14	SPCP-F	190	1:30	Dry	0:00	1:14
14	VPCP-R	130	2:00	Dry	0:00	3:13
14	VPCP-F	190	1:30	Dry	0:00	1:14
14	TPP-R	160	6:45	Wet	2:09	2:52
14	TPP-F	145	2:05	Dry	0:00	4:17
15	SPCP-R	128	3:54	Wet	0:28	0:36
15	SPCP-F	130	1:20	Dry	0:00	2:29
15	VPCP-R	128	3:54	Wet	0:28	0:36
15	VPCP-F	130	1:20	Dry	0:00	2:29
15	TPP-R	184	1:04	Wet	0:31	0:26
15	TPP-F	244	Penetrant not applied			3:09
16	SPCP-R	131	1:14	Dry	0:00	1:36
16	SPCP-F	136	1:29	Dry	0:00	3:05
16	VPCP-R	131	1:14	Dry	0:00	1:36
16	VPCP-F	136	1:29	Dry	0:00	3:05
16	TPP-R	189	2:00	Dry	0:00	1:23
16	TPP-F	PT on this weld layer was not completed when inadequate PT exams discovered				

*R= root layer, F= final layer

Appendix B

TriVis/Sherwin PT Performance and Testing Report

TriVis issued an assessment of simulated PT conditions using the actual dwell times and development times determined from video recordings of refuel floor activities. This assessment was performed to determine if the PT examinations performed on DSC 11 - 16 field closure welds would have been capable of producing interpretable results for detection of critical weld flaws (Reference 6.5).

The PT examination procedure used by TriVis incorporated ASME code by Section T-621.1 of Article 6 as discussed in section 1.3.1. The PT examination materials specified in the procedure were Sherwin Hi-Temp® Penetrant Inspection System. This system is comprised of K-019 Solvent, K-017 Penetrant and D-350 Developer. This system is designed to work at temperatures above which ordinary penetrants are ineffective. D-350 Developer is recommended for temperatures between 175°F and 350°F. The PT procedure required D-350 use for surfaces in the range of 72°F to 325°F. Surface temperatures experienced during DSC field closure PT examinations are typically higher than standard temperatures for PT examinations.

The PT examination procedure specifies the following general procedural steps for performing a PT examination:

- Verify surface temperature - The surface temperatures ranged from 97°F to 244°F as identified in the PT reports.
- Pre-clean the weld area - The pre-clean method required by the procedure calls for the use of the K-019 Solvent, followed by a dry wipe and then a final wipe using a rag moistened with demineralized water.
- Allow the Pre-clean to dry - The procedural requirement is to allow two minutes for drying after the pre-cleaning step is completed.
- Apply the Penetrant – Apply K-017 Penetrant to the weld area.
- Allow Penetrant to dry – The actual dwell time required is based on the surface temperature, see Table B-1 below.
- Remove Penetrant - The penetrant removal method required by procedure calls for the technician to perform a dry wipe followed by a wipe with a clean rag moistened with K-019 Solvent, and a final wipe with a dry rag or cloth. Per video review, either a wet rag or a dry rag was used, but not both.
- Penetrant dry time - The procedural requirement is to allow two to fifteen minutes for drying after the excess penetrant has been removed, for surface temperatures in the range of 50°F to 125°F. For examinations above 125°F, the drying time is one to fifteen minutes.
- Apply the Developer– Apply D-350 Developer to the weld area.

- Allow Developer to dry - The actual dwell time has a minimum and maximum time limit and a specified surface temperature range, see Table B-2 below.

The PT examination procedure specified the following minimum dwell times for the K-017 penetrant based on the surface temperature:

Table B-1 – Penetrant Dwell Time

Surface Temperature Range	Minimum Dwell Time Required by PT Procedure
50°F to 75°F	30 minutes
76°F to 125°F	10 minutes
126°F to 200°F	3 minutes
201°F to 325°F	1 minute

And the following dwell times for the D-350 developer based on the surface temperature:

Table B-2 – Developer Dwell Time

Surface Temperature Range	Minimum Dwell Time	Maximum Dwell Time
72°F to 325°F	10 minutes	15 minutes

During the performance of PT examination on DSCs 11 – 16, penetrant and developer dwell times varied by quite large margins depending on the examiner, the weld being tested and which DSC was being examined. Appendix A includes Tables A-1 and A-2 which provide the overall weld temperatures, penetrant dwell times, cleaning method, cleaning dry time and developer dwell time for the welds under the scope of this exemption request for each DSC. Review of each of the PT examinations indicates a deficiency in performance of the PT examination penetrant, cleaning and/or developer dwell time. See Appendix A for further details.

Upon discovery of the nonconforming PT examinations, NSPM requested TriVis to perform analysis of the consequences resulting from the issue. TriVis performed testing using the most limiting surface temperatures, drying times and dwell times for each particular weld and sometimes multiple testing depending on the documented circumstances. TriVis used video and documentation to determine the limiting conditions for each weld performed on DSCs 11 – 16[5] and thus the testing parameters applied. Test specimens were used to duplicate the testing conditions. (Reference 6.5)

The results of all the testing demonstrated that flaws and hairline cracks in the test specimen and samples could be detected using the nonconforming PT examination methods.

Finally, Sherwin performed an independent PT test in their laboratory using the following parameters:

- a 130°F surface temperature,
- a one minute penetrant dwell time, and
- a one minute developer dwell time.

Sherwin performed the test with these parameters as well as with 10 minute penetrant and developer dwell times. The test was performed with the KO-17 Penetrant, KO-19 Remover and D-100 Developer (as opposed to the D-350 used during the actual PT examinations). (Reference 6.5)

Sherwin concluded that the test results indicated that, while the indications were "slightly more visible" with the 10 minute penetrant dwell time, "all the indications seemed visible" after the one minute dwell time. While this is only one sample out of many possible data points, 130°F, with a one minute penetrant dwell time and a one minute developer dwell time, was selected as one of the lowest temperature, least time combinations experienced in the PT exams thus providing a reasonably conservative approach to the test.

Based on this testing and review of the PT examinations, while not conforming to procedural and ASME code requirements, the Sherwin and TriVis testing do provide some insight into the acceptability of the welds. The PT examinations performed in the tests indicate that flaws and hairline cracks could be detected using the nonconforming PT examination methods. The vast majority of the welds were represented in the testing (see footnote 5 for exceptions).

The intent of the testing by TriVis and Sherwin was to reproduce the penetrant and developer dwell times to demonstrate that they could have been effective examinations.

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[5] The following welds were not included as part of the PT parameters testing:

a. DSC 11, TPP Weld Final: The crane obstructed the video recording, preventing any data to be provided for verification.
b. DSC 15, TPP Weld Final: The NDE technician never applied penetrant to TPP Weld Final layer. As such, the TPP Final weld layer could not be effectively demonstrated.
c. DSC 16, OTCP Weld Final and TPP Weld Final: These are the outermost welds are on DSC 16, which were accessible on the Refueling Floor and, therefore, testing was not necessary.

Appendix C

Structural Integrity Associates Weld Quality Review

NSPM contracted the support of an independent vendor to review the weld quality performed on DSCs 11 - 16. This review was provided by Structural Integrity Associates (SIA), who performed a review of weld quality and provided a report of their findings. The review was conducted by using video from the weld head of the automated welding process performed on DSCs 12 – 16 (DSC 11 was not included). The weld head videos are not considered a quality record. The results of this report were also reviewed by AREVA (the current license holder for the 61BTH DSC) and the report was reissued with their comments incorporated. (Reference 6.6)

This review determined that the quality of the welding was for the most part satisfactory, but did contain some anomalous practices. Both inner and outer cover plate closure welds were recorded in some cases, but the video coverage was incomplete for all weld beads. The video review covered a sampling of the welding performed on DSCs 12 – 16. DSC 11 had no video available. Specifically the video review covered the ITCP root and cover weld layers; and the OTCP tack, root, intermediate and cover weld layers for DSCs 13 and 16; and the OTCP tack, root, intermediate and cover weld layers for DSCs 12, 14 and 15.

It was noted that good welding practices were present in all of the welds examined, and in general, visible evidence of tie-in between the weld layers and the sidewall was present. Conversely, small undesirable weld surface conditions (anomalies, e.g., contamination on weld surface, electrode tip oxidation, uneven weld deposit, etc.) were also observed, to some extent, in all of the welds examined. The presence of such undesirable weld surface conditions do not necessarily result in weld defects. When encountered, it is required for the welding operator to stop and assess the condition and then act to mitigate as necessary.

The weld designs, the materials used, and the welding processes applied are designed for quality welds. The ER308 (or ER308/308L) dual certified filler materials are correct for the Type 304 stainless steel components. These material combinations tend to be quite forgiving in terms of achieving quality welds, especially with the machine Gas Tungsten Arc Welding (GTAW) welding process. The GTAW welding process was primarily used to weld these structures. These types of weld designs are generally considered to be readily weldable.

The results of this assessment were inconclusive regarding the overall acceptability of the welds, as some good welding practices and some undesirable welding practices were observed in the weld head videos for each DSC. The weld videos were not complete for each weld and the videos did not show the entire weld process, but were fragments in some cases. The videos showed the presence of occasional irregular surface features on the welds and are considered applicable to each DSC. This suggests that there is a potential for welding discontinuities to exist in DSCs 11 - 16. The DSC 16 outer closure weld was concluded to be the most vulnerable to potential defects, because a greater frequency of irregular surface conditions was generated during welding.

All of the welds produced similar irregular weld surface conditions (anomalies) to some extent based strictly on the weld head video clips for each canister closure weld. This does not imply that any of the welds are defective and in fact, clear evidence of sidewall and interbead tie-in is consistently observed around the entire circumference of the welds. It is entirely possible that all of the DSC welds are acceptable.

The probability for achieving quality welds is enhanced when good welding practices are followed. Good practices include proper and consistent fit-up, clean joint surfaces, minimizing weld surface irregularities, pure welding grade inert gas (argon), properly dressed and maintained tungsten electrode, proper electrode positioning, proven combinations of heat input (amps times volts divided by arc travel speed), and rates of filler wire additions. The written welding program controls, welding procedure specifications, welding procedure qualification records were all in order to produce sound welds. The component designs and manufacturing sequences are capable of producing quality welds. The final step is for the welding operators and their supervision to ensure that good welding practice is followed.

Video from the refueling floor clearly indicates that during VT and PT examinations the welder and the inspector performed weld conditioning and light repairs to welds. However, it is impossible to link a particular anomaly observed in the weld head video to a specific conditioning or repair activity being performed on the weld layers.

NSPM has concluded that this report provides a sampling of typical welding practices across the industry. Evidence of good weld being applied is ample and dominates the video. But the video also shows infrequent indications of areas where the potential for small weld flaws also exists. As stated, the results do not indicate an absolutely perfect weld was created; however, it does provide confidence that for the vast majority of the time welding was performed with the automated welding process in a manner consistent with well-done field welding practices. It is also important to note that the automated weld video can detect an anomaly on the weld surface, but it does not show what was done about it; what remediation activities were performed. So from that standpoint the review is incomplete. However, evidence from the refueling floor video indicates that weld conditioning and light repairs were performed on the welds.

Appendix D

Extent of Condition Assessment

I. Introduction

NSPM performed an extent of condition review for weld information and overall DSC condition for DSCs 11 – 15, and the inaccessible welds on DSC 16. Since DSCs 11 – 15 are inserted in their horizontal storage modules (HSMs) no direct measurements could be taken. In addition, when the PT examination non-conformance was discovered, initial welding of DSC 16 had been completed, so only the OTCP weld was accessible. Therefore, record reviews were performed to ascertain the as-left weld conditions. This appendix provides the results to the extent of condition review for DSCs.

II. Scope of Review

The extent of condition review looked at DSCs 11 – 16 documentation including information and data related to overall condition of the DSCs. Specifically of interest was information associated with the welds covered in this exemption request. Items covered in this review are as follows:

- Welding procedures available at the job site
- Weld surface preparations completed – weld surface is dry, free of oil, grease, weld spatter, rust, slag, sand, discontinuities, or other extraneous material.
- Verification of weld crown height – ITCP, Vent/Siphon Port
- VT examination of Welds - Inner Top Cover Plate (ITCP), Outer Top Cover Plate (OTCP), Vent/Siphon Port
- Hydrogen Monitoring performed while welding
- Pressure testing of DSC shell to ITCP weld
- Vacuum drying and verification
- Helium backfilling, pressure verification and leak testing
- Weld depth measurements – OTCP

Other items such as verification of other TS requirements were also performed but are not discussed herein as they are not applicable to welding PT examinations.

III. Review Results

In summary, the review indicated that compliance with procedural and TS requirements were completed satisfactorily. Some details of the extent of condition findings are provided below in the following series of tables.

- *Table D-1 – Welding Administrative Requirements Compliance* – This table demonstrates that administrative requirements for welding were met for each DSC.
- *Table D-2 – Technical Specification Required Testing of Welds* – This table lists the following Technical Specifications and the resulting data used to demonstrate compliance with the TS.
    - *TS 1.1.11 – Hydrogen Monitoring*
    - *TS 1.1.12.4 – Pressure Test of the DSC cavity to ITCP weld*
    - *TS 1.2.2 – DSC vacuum drying test*
    - *TS 1.2.3a – DSC Backfill Pressure Test*
    - *TS 1.2.4a – DSC Helium Leak Test*
- *Table D-3 - Weld Depth Measurements for Outer Top Cover Plate Welds* – This table provides weld depth measurements for four locations on each OTCP (0^o, 90^o, 180^o and 270^o). These four locations are specified by procedure. The DSC design requires a minimum of 0.500" weld depth to meet acceptance criteria.

Table D-1 – Welding Administrative Requirements Compliance

Procedural Requirement	DSC					
	11	12	13	14	15	16
Welding procedures available at the job site	X	X	X	X	X	X
Weld surface preparations completed (all welds)	X	X	X	X	X	X
Verification of weld crown height (all welds)	X	X	X	X	X	X
VT examination of welds (all welds)	X	X	X	X	X	X

Table D-2 – Technical Specification Required Testing of Welds

Procedural Requirement	DSC					
	11	12	13	14	15	16
TS 1.1.11 - Hydrogen Monitoring performed while welding	X	X	X	X	X	X
TS 1.1.12.4 – Pressure test DSC cavity to ITCP weld. Pressurize to between 29.2 psia and 30.7 psia and hold for minimum of 10 minutes.	X	X	X	X	X	X
Hold time (minutes)	10	10	10	11	11	11
TS 1.2.2 (Initial pump down) - DSC kept at or below 2.8 torr for at least 30 minutes	X	X	X	X	X	X
Initial vacuum reading (torr)	1.40	1.13	1.807	1.199	1.49	1.191
Final vacuum reading (torr)	2.044	1.90	2.53	2.02	2.08	2.011
Hold time (minutes)	30	31	31	31	31	30
TS 1.2.2 (Final pump down) - DSC kept at or below 2.8 torr for at least 30 minutes	X	X	X	X	X	X
Initial vacuum reading (torr)	1.23	1.373	1.872	1.33	1.90	1.330
Final vacuum reading (torr)	1.77	1.859	2.50	1.84	2.34	1.770
Hold time (minutes)	30	33	32	30	31	34
Gauge Error	.011	.0042	.016	.005	.017	.011
TS 1.2.3a - DSC backfilled to pressure of 17.2 psia ± 1.0 psi for at least 30 minutes.	X	X	X	X	X	X
Initial pressure reading (psia)	17.283	17.203	17.234	17.20	17.12	17.031
Final pressure reading (psia)	17.272	17.207	17.210	17.22	17.141	17.04
Pressure Gauge error	0.00	.000174	.00029	.0006	.00012	0.00
Hold time (minutes)	30	30	31	31	31	34
TS 1.2.4a - verified that DSC leakage rate is limited to ≤ 1.0 x 10^{-7} cubic centimeters/sec	X	X	X	X	X	X
Leakage rate (cc/s)	9.5E-10	1.0E-9	1.4E-9	6.6E-10	5.4E-9	1.5E-9

Table D-3 - Weld Depth Measurements for Outer Top Cover Plate Welds

DSC	Measurement Location (Degrees)	Initial Depth (in.)	Final Crown depth (in.)	Weld Depth (initial depth - post-grind depth) (in.)
11	0	0.622	0.045	0.577
	90	0.640	0.022	0.618
	180	0.660	0.031	0.629
	270	0.628	0.044	0.584
12	0	0.624	0.091	0.533
	90	0.635	0.101	0.534
	180	0.642	0.075	0.567
	270	0.685	0.048	0.637
13	0	0.611	0.064	0.547
	90	0.622	0.090	0.532
	180	0.608	0.086	0.522
	270	0.614	0.054	0.560
14	0	0.642	0.111	0.531
	90	0.636	0.092	0.544
	180	0.633	0.121	0.512
	270	0.636	0.081	0.555
15	0	0.674	0.133	0.541
	90	0.637	0.075	0.562
	180	0.653	0.123	0.530
	270	0.632	0.058	0.574
16	0*	0.639	0.080	0.559
	90*	0.635	0.047	0.588
	180*	0.652	0.126	0.526
	270*	0.622	0.025	0.597

* DSC 16 weld depth measurements were re-verified at each of these cardinal locations. The 0° location was originally measured as 0.507" and re-verified as 0.488." The 90° location was originally measure as 0.514" and re-verified as 0.503." The 180° location was originally measure as 0.524" and re-verified as 0.525." The 270° location was originally measure as 0.548" and re-verified as 0.543." Weld repair brought the weld depth measurement at each location to values greater than 0.500" as indicated in Table D-3.

Appendix E

Summary of Nuclear Oversight (NOS) Review Findings

NSPM directed the NOS department to perform an independent extent of condition review of the DSC loading activities associated with DSCs 11 -16. NOS reviewed video and documentation from the loading activities and provided a report of their results. The scope of this review is described in more detail in section 1.3.4.

NOS identified the following issues and the disposition of each issue as a result of this review:

- NOS questioned whether a pressure test on the inner lid met ASME code requirements. A note indicated that the TS pressure test requirement was met by performing certain steps was out of place in the procedure and should have been placed next to another set of steps. Engineering determined that all the pressure testing was completed and acceptable to satisfy TS requirements. This is a documentation issue and does not affect any DSC design or TS requirements.
- NOS discovered that an optional helium "sniff" test calibration check for the vent port cover for DSC 13 was not performed, but was documented in the procedure as completed. A helium leak test required by TS 1.2.4a demonstrates the basic integrity of the confinement barrier and the lack of any through-weld flaws in the field closure welds that would lead to a loss of cavity helium in DSCs 11 - 16. This mandatory test is not to be confused with the optional helium "sniff" test performed after completion of the ITCP weld, but prior to the installation of the OTCP, where a less sensitive discretionary check for gross leakage may be performed, intended to detect leaks at the earliest possible opportunity, thereby providing additional confidence that the credited helium leak test will be successful. Therefore, it was concluded that the sniff tests are optional to the overall helium leak test that was performed satisfactorily and TS requirements were satisfied. This is a procedural compliance issue and does not affect any DSC design or TS requirements.
- NOS discovered that DSC helium leak test calibration intervals were not met for DSCs 12, 14, 15 and 16 ITCP welds. The calibration procedure required a 60 second stabilization period after the test was performed. Contrary to this requirement, stabilization times were less than 60 seconds (varied between 27 and 47 seconds). Engineering determined that these procedural errors did not affect the helium leak test performance. This is a procedural compliance issue and does not affect any DSC design or TS requirements.

- NOS discovered valve manipulations during the vacuum dryer tests for DSCs 13 and 15 did not follow procedural requirements. Engineering determined these valve manipulations were performed to valves outside the boundary (beyond the isolation) of the vacuum dryer tests and therefore, had no effect on the results. This is a procedural compliance issue and does not affect any DSC design or TS requirements.
- NOS determined that a valve was closed at a higher pressure than the procedure permitted while vacuum drying DSC 13. The procedure stated to open valve when the pressure was reading less than 0.4 psia to bring pressure gauges in line for the test. Contrary to this, the valve was opened at 3.540 psia. The procedure step originally had a pressure of less than 5 psia required for valve closure, but a temporary procedure change reduced this pressure to less than 0.4 psia. Instruments were subsequently calibrated and found to be in tolerance indicating correct readings were made on DSCs 11 - 16. This is a procedural compliance issue and does not affect any DSC design or TS requirements.
- NOS identified discrepancies related to measure and test equipment identification in the procedures. The issue was limited to equipment identification numbering in the procedure. All testing could be traced to calibrated instrumentation. This is a documentation issue and does not affect any DSC design or TS requirements.
- NOS identified that an independent verification was not completed for verification of helium purity requirements for DSC 12. Engineering verified that all helium bottles used met helium purity requirements. This is a documentation issue and does not affect any DSC design or TS requirements.
- NOS identified that a temporary procedure change was not issued for a minor data label correction for DSCs 13 -16. The vacuum dryer procedure listed “start time” twice rather than “start time” and “stop time.” Procedure was changed (hand markup) for DSC 12 without issuing a temporary procedure change. This is a documentation issue and does not affect any DSC design or TS requirements.
- A subcontractor used their own procedure for helium leak testing of the siphon and vent port covers and the shell to ITCP weld. The completed procedure does not reference use of the subcontractor procedure. This is a documentation issue and does not affect any DSC design or TS requirements.
- For the DSC Loading Dry Run and loading of DSC 11 the Heat Load Zoning Configuration has been entered as "2". Review of the Cask Load Report indicates that it should be "3". This identifies the fuel load configuration described in the CoC 1004, Amendment 10, TS. This is a documentation issue and does not affect any DSC design or TS requirements.

- For DSC 11, circle and slash place keeping in the loading procedure was not performed well, steps are missing indication when repeated. This is a documentation issue and does not affect any DSC design or TS requirements.
- For DSCs 13 and 14, a dynamometer is shown as a part of the rigging and listed in the table of equipment to be used. The instrument serial number has not been recorded. This is a documentation issue and does not affect any DSC design or TS requirements.
- For DSC 13, the loading procedure requires that the highest dose from the survey be reported. Dose levels were reported, then lined out and an entry showing that the TS limits were not exceeded. The final entry did not comply with the procedural requirement to document the dose. This is a documentation issue and does not affect any DSC design or TS requirements.
- For DSC 13, the loading procedure required that personnel be briefed on the results of the radiation survey. The step was marked "N/A." A radiation survey was performed and the crew should have been briefed on the results. This is a documentation issue and does not affect any DSC design or TS requirements.
- For DSC Loading Dry Run, the shield plug was inserted into the DSC with the DSC/TC placed in the SFP. The loading procedure does not document removal of the shield plug from the DSC after it was removed from the SFP. The work instruction did include a verification that the shield plug was removed, but there were no procedure steps that documented this activity. It is an important step as this would have been a heavy loads movement. This is a documentation issue and does not affect any DSC design or TS requirements.
- For DSC Loading Dry Run, the transfer cask inspections and pre-job testing procedure requires inspection of the Ram Access Cover O-ring. This Inspection identified unacceptable results. The O-ring was replaced. However, the steps in the procedure were not updated to show that the inspection points were satisfied. This is a documentation issue and does not affect any DSC design or TS requirements.

Each of these issues as described above has been entered into the MNGP corrective action program, dispositioned as either a documentation issue or a procedural compliance issue that does not affect any DSC design or TS requirements and is being tracked for resolution. Therefore, there is no additional effect on the physical status of any DSC.