Omaha Public Power District

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U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk,
Director, Spent Fuel Project Office, Office of Nuclear Material Safety and Safeguards,
Washington, D.C. 20555

References:
1. Docket Nos. 50-285 and 72-054
2. "Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Updated Final Safety Analysis Report," NUH-003
3. Certificate of Compliance No. 1004 for the Standardized NUHOMS® System, Amendment 8, effective December 5, 2005

SUBJECT: Fort Calhoun Station-Request for Exemption from NUHOMS® Certificate of Compliance No. 1004, Amendment No. 8

Pursuant to the provisions of 10 CFR 72.7, "Specific exemptions," Omaha Public Power District (OPPD) requests an exemption from requirements specified in 10 CFR 72.212, "Conditions of general license issued under §72.210." The specific exemption would be from the requirements of 10 CFR 72.212(a)(2), 10 CFR 72.212(b)(2)(i)(A), 10 CFR 72.212(b)(7), and 10 CFR 72.214, all of which require the licensee to comply with the terms and conditions of the NRC issued certificate of compliance (CoC). In connection with these requirements, OPPD also requests an exemption -- to the extent necessary -- from 10 CFR 72.48(c)(1)(B), which requires that design changes do not involve changes to the terms, conditions, or specifications of the CoC. This includes exemption from Technical Specifications 1.2.1, 1.2.11, and 1.2.17a associated with the CoC No. 1004, Amendment No. 8 for the standardized NUHOMS®-32PT storage system and the OS197L Transfer Cask. Finally, OPPD requests an exemption from 10 CFR 72.48(c)(2)(viii) to use a method of thermal analysis (for the transfer trailer) that the NRC has determined during inspection activities to be a departure from methodology described in the NUHOMS® UFSAR. The transfer trailer thermal analysis has been re-performed using spent fuel attributes specific to Fort Calhoun Station instead of generic design basis attributes in order to demonstrate ample margin from the peak clad temperature limit. Details of the requested exemption are contained in Attachment 1 of this letter.

There is insufficient time for the items included in this exemption request to be addressed through the Certificate of Compliance amendment process. The requested exemption is limited to a single loading campaign of four 32PT canisters and will support the Fort Calhoun Station refueling outage, which starts September 9, 2006. The outage includes the replacement of major components of the reactor coolant system, i.e., two steam generators, the reactor vessel head, and the pressurizer. Due to the scope of these activities and the associated risks of inadvertent introduction of foreign material into the system, OPPD needs to preserve full core offload capability following the 2006 refueling outage in order to safely and efficiently address potential problems.

Approval of this exemption will allow Fort Calhoun Station to maintain full core offload capability after the 2006 refueling outage, will allow receipt and storage of new fuel, and will allow better management of decay heat loads within the Spent Fuel Pool (including minimization of fuel handling activities) until the spring 2008 refueling outage. Section VI of Attachment I describes the need for loading four canisters to provide these capabilities.

Expedited approval of this exemption request is needed in order to complete the canister loadings and thereby minimize outage scheduling and radiological impacts on required preparations for the 2006 refueling outage. These activities include preparations for the major component replacements that are taking place in the area exterior to the Auxiliary Building, immediately adjacent to the spent fuel pool and spent fuel transfer trailer travel route. Other outage preparation activities requiring use of the same area include receipt, inspection, and storage for 44 new fuel bundles and 49 new control element assemblies (control rods) before their placement into the spent fuel pool. All of these activities enhance nuclear, radiological, and industrial safety.

Please note that the only elements of the spent fuel loading operations impacted by this exemption are related to the spent fuel transfer activities. Specifically, the storage mode at the Independent Spent Fuel Storage Installation is not affected.

To support the loading of four 32 PT canisters prior to the fall 2006 Outage, OPPD requests approval of the exemption before July 7, 2006.

If you require additional information, please contact Thomas C. Matthews at (402) 533-6938.

Sincerely,

S.K. Gambhir
Division Manager - Nuclear Projects
Fort Calhoun Station

SKG/rlj

Attachments:

1. Omaha Public Power District - Fort Calhoun Station Request for Exemption from NUHOMS® Certification of Compliance No. 1004, Amendment No. 8
2. FSAR Change Notice – FCN 721004-321, Rev. 1
3. TN Calculation 1121-0504, Revision 1, OS197L 75 Ton Transfer Cask Dose Rates Calculation to be used with OPPD Exemption Request
4. TN Calculation 1121-0400, Revision 1, Calculation of OS197L Cask Shell Temperature with 11.0 and 18.4 kW Heat Loads
5. TN Calculation 1121-0401, Revision 1, OS197L 75 Ton Transfer Cask Thermal Analysis to be used with OPPD Exemption Request (18.4 kW/DSC & 11.0 kW/DSC)

cc: Director of Consumer Health Services, Department of Regulation and Licensure, Nebraska Health and Human Services, State of Nebraska

Omaha Public Power District
Fort Calhoun Station
Request for Exemption from NUHOMS® Certification of Compliance No. 1004, Amendment No. 8

Omaha Public Power District
Fort Calhoun Station
Request for Exemption from NUHOMS®
Certificate of Compliance No. 1004, Amendment 8

I. Exemption Request

Pursuant to 10 CFR 72.7, "Specific exemptions," Omaha Public Power District (OPPD) requests an exemption from the requirements of 10 CFR 72.212(a)(2), 10 CFR 72.212(b)(2)(i)(A), 10 CFR 72.212(b)(7), and 10 CFR 72.214, all of which require the licensee to comply with the terms and conditions of the NRC issued certificate of compliance. In connection with these exemptions, OPPD also requests an exemption -- to the extent necessary -- from 10 CFR 72.48(c)(1)(B), which requires a verification that design changes do not involve changes to the terms, conditions, or specifications of the CoC. Specifically, OPPD is requesting an exemption from three of the Technical Specifications that are part of Certificate of Compliance (CoC) No. 1004, Amendment No. 8 for the standardized NUHOMS®-32PT storage system [Reference 1] to be used at Fort Calhoun Station (FCS).

The affected CoC 1004 Technical Specifications (TS) are 1.2.1, 1.2.11, and 1.2.17a. These specifications address transfer cask dose rates and the canister vacuum drying time limits.

In addition, to address NRC concerns, OPPD requests exemption from 10 CFR 72.48(c)(2)(viii) to use a method of thermal analysis (for the transfer trailer) that the NRC has determined during inspection activities to be a departure from that described in the NUHOMS® UFSAR [Reference 2]. The transfer trailer thermal analysis has been re-performed using spent fuel attributes specific to Fort Calhoun Station instead of generic design basis attributes in order to demonstrate ample margin from the peak clad temperature limit.

OPPD will comply with all other Conditions of Use and Technical Specifications of CoC No. 1004, Amendment No. 8 during fuel loading at FCS.

OPPD requests that an exemption be issued before July 7, 2006, because there is insufficient time for the items included in this exemption request to be addressed through the Certificate of Compliance amendment process. Expedited approval of this exemption request is needed in order to complete canister loadings and thereby minimize outage scheduling and radiological impacts on activities whose completion are necessary preparations for the 2006 refueling outage. These activities include preparations for the major component replacements that are taking place in the area exterior to the Auxiliary Building, immediately adjacent to the spent fuel pool and spent fuel transfer trailer travel route. Other outage preparation activities requiring use of the same area include receipt, inspection, and storage for 44 new fuel bundles and 49 new control element assemblies (control rods) before their placement in the spent fuel pool. All of these activities enhance nuclear, radiological, and industrial safety.

The requested exemption term is limited to loading of four 32PT canisters with spent fuel and will apply only during loading activities (there are no exemptions necessary with respect to storage of the canisters). The requested exemption is limited to loading of four 32PT canisters with fuel having a maximum total canister heat load of 11 kW.

II. General Background

Updated FSAR (UFSAR) [Reference 2] contains two alternate versions of a Transfer Cask (TC). They are referred to as the Standardized Cask (with a solid neutron shield) and OS197/OS197H/OS197FC cask (with a liquid neutron shield). This TC is used for loading/unloading fuel into/from a canister and moving a loaded Dry Shielded Canister (DSC) from the spent fuel pool to the Horizontal Storage Module (HSM). In general the use of this cask requires a nominal 100 ton crane lift capacity.

In an effort to expand the capability of the NUHOMS® system to plants with reduced crane capacity, a light weight configuration of the OS197 TC was developed, referred to as the OS197L. The design intent of this cask is to allow for the loading/unloading and transfer of the licensed DSCs (24P, 52B, 61BT, 24PT2, 32PT and 24PHB) and maintain the bounding crane load to less than 75 tons.

TN, the certificate holder for the NUHOMS® system, utilized the 72.48 process to add the OS197L TC to the NUHOMS® system and issued an UFSAR Change Notice (FCN) that added the description, analysis description, and analysis results for the OS197L system to the CoC 1004 UFSAR. In the following discussions the UFSAR, Revision 9, including FCN 321, Revision 1, is referred to as the UFSAR.

OPPD plans to use the OS197L TC to load four 32PT canisters using the 75-ton capacity Auxiliary Building crane. This will allow Fort Calhoun Station to maintain full core offload capability after the 2006 refueling outage, will allow receipt and storage of new fuel, and will allow better management of decay heat loads within the Spent Fuel Pool (including minimization of fuel handling activities) until the spring 2008 refueling outage. Section VI describes the need for loading of four canisters to provide these capabilities.

As part of the inspection process at FCS prior to initiation of fuel loading, NRC identified and verbally communicated several issues/concerns, which were responded to by OPPD. Continued communications among NRC, TN, and OPPD management has determined that submittal of an exemption request is the optimum path for use of the OS197L TC at FCS.

For conservatism, the exemption request is based on loading of specific FCS fuel that is less reactive, and with significantly lower decay heat and source term, than the Design Basis fuel assembly in CoC 1004 for the 32PT DSC. These decay heat reductions are applied on both the total canister level and the specific Fuel Assembly (FA) level. This is addressed in Table 1 and subsequent discussion.

OPPD has determined that it is acceptable and conservative to load the FCS FAs into the 32PT DSC utilizing the OS197L TC. The FCS FAs are bounded by a substantial margin by the design basis fuel assemblies that are evaluated for the current license in the UFSAR. As such, the requested exemption will not endanger life or property or the common defense and security.

The exemption will be in the public interest in that it will allow for the safe and efficient storage of spent nuclear fuel at FCS. NRC approval of the exemption will preserve full core off-load capability, allow receipt and storage of new fuel, and will allow better management of decay heat loads within the Spent Fuel Pool (including minimization of fuel handling activities) until the spring 2008 refueling outage.

Please note that the only elements of the spent fuel loading operations impacted by this exemption are related to the spent fuel transfer activities. Specifically, the storage mode at the Independent Spent Fuel Storage Installation is not affected.

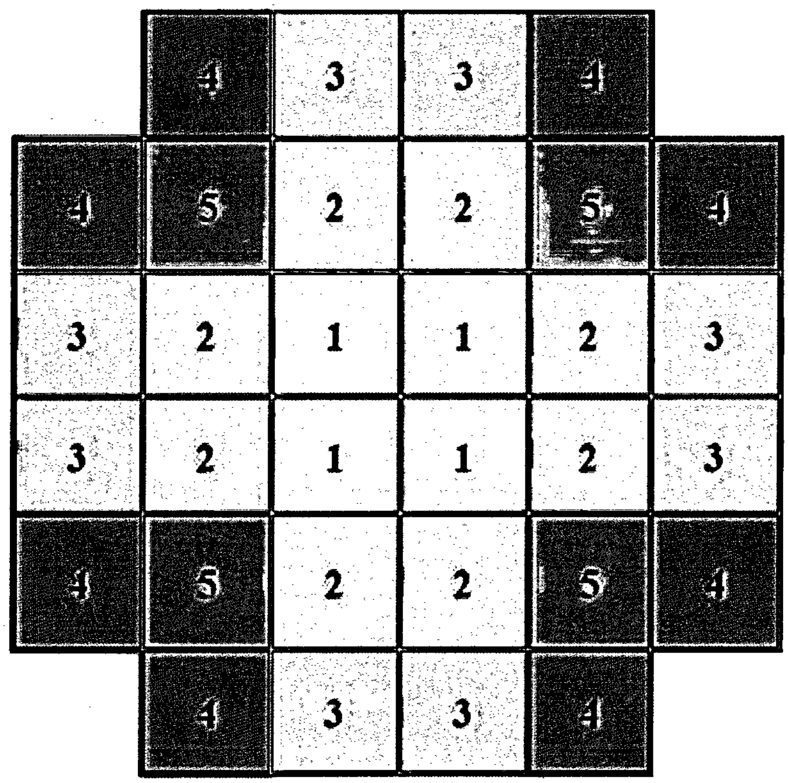
Table 1

Summary of Key Parameters for FCS CE 14 x 14 Fuel Assemblies and NUHOMS®-32PT DSC Design Basis Fuel Assemblies

	FCS CE 14 x 14 Fuel Assembly Parameters	NUHOMS®-32PT Design Basis Fuel Parameters
Maximum Total Decay Heat load per NUHOMS®-32PT DSC (kW)	11.0	24.0
Maximum Total Decay Heat Load per Fuel Assembly (kW)	0.50 maximum	Ranges from 0.60 to 1.20
Maximum Assembly Average Burnup (MWD/MTU)	42,049	45,000
Maximum Initial Bundle Average Enrichment (wt% U235)	4.5	5.0
Maximum Initial Uranium Content(MTU/Assembly)	0.377	0.475

The proposed FCS fuel assembly zoning configuration was redefined to incorporate the lower fuel assembly decay heat load (0.50 kW maximum) zoning limits and therefore results in reduced peak fuel clad temperatures. (See Figure 1 and Reference 6)

FIGURE 1 - Proposed FCS Fuel Loading Configuration (11 kW/DSC)



Heat Zone	1	2	3	4	5
# of Fuel Assemblies	4	8	8	8	4
Max Heat Load / Assembly (kW)	0.16	0.35	0.40	0.50	0.50
Max Heat Load / Zone (kW)	0.64	2.80	3.20	4.00	2.00
Max Heat Load / DSC (kW)	11.0				

Note: This is a bounding fuel load for the fuel assemblies (CE 14x14) to be loaded at FCS in the 32 PT DSC. Conservatively, the total heat generation used in the 3D DSC thermal model based on the above fuel loading configuration is 12.64 kW per DSC. The total heat load to be loaded at FCS in the Phase I campaign will be less than 11 kW per DSC.

An evaluation is presented below for the structural, thermal, and shielding NUHOMS® UFSAR sections as they are affected by the reduced parameters of the proposed FCS FAs.

Structural Evaluation

The structural evaluation of the NUHOMS®-32PT DSC is documented in the UFSAR. The design parameters for the design basis fuel assembly used in Chapter M.3 of the UFSAR (e.g., total fuel assembly weight and total decay heat load) are unchanged and bound the FCS fuel assembly. This exemption has no adverse impact on the structural evaluation.

Thermal Evaluation

The thermal evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.4 of the UFSAR. The method used for the thermal evaluation of the FCS fuel: 1) Evaluated the effective fuel properties (thermal conductivity) of the FCS fuel assembly and compared it with the NUHOMS®-32PT DSC design basis fuel [Reference 2]; and 2) Determined the margin of conservatism between the FCS FA and the Design Basis FA to demonstrate that the corresponding thermal analysis results for the NUHOMS®-32PT DSC with the FCS fuel assembly can be conservatively used for thermal evaluation of the NUHOMS®-32PT DSC design basis fuel in the UFSAR.

As shown in Table 1, the maximum decay heat per DSC and maximum assembly average burnup for the FCS FAs are all bounded by the design basis values used for the NUHOMS®-32PT thermal evaluation. (See Section V)

The FCS fuel assembly effective thermal conductivities are addressed by a review of Figures M.4-19 through M.4-21 of the UFSAR. These figures demonstrate the significantly higher thermal conductivity of the FCS CE 14 x 14 FA over that of the Design Basis WE 14 x 14. As shown in the figures, the CE 14 x 14 FA has thermal conductivity values nominally 20% or more higher than the Design Basis WE 14 x 14. This higher conductivity will reduce the ΔT across and along the FA, and result in lower fuel clad temperatures.

The maximum decay heat load for the FCS fuel assemblies proposed to be loaded in the NUHOMS®-32PT DSC is 11.0 kW per DSC. This is approximately 55% less than the design basis heat load for NUHOMS®-32PT DSC, [Reference 2] and a 77% reduction in individual FA heat load for the four center FA's, compared to the design basis configuration (Configuration 3). The FCS fuel thermal properties as described above will result in lower ΔT, across and along the FA, and therefore the thermal evaluation in the UFSAR for the design basis fuel in the NUHOMS®-32PT DSC during transfer for normal, off-normal and accident conditions remains bounding for the FCS fuel assemblies with decay heat loads less than or equal to 11.0 kW/DSC and individual FA decay heat loads limited per the proposed FCS zoning configuration.

Shielding Evaluation

Chapter M.5 of the UFSAR documents the shielding evaluation for the NUHOMS®-32PT DSC. Chapter M.5 of the FSAR states:

"The B&W 15x15 assembly is the bounding fuel assembly design for shielding purposes because it has the highest initial heavy metal loading as compared to the 14x14, other 15x15, and 17x17 fuel assemblies which are also authorized contents of the NUHOMS®-32PT DSC. In addition, the maximum Co59 content of the hardware regions for each assembly type is less than that of the B&W 15x15 Mark B fuel assembly."

The maximum initial heavy metal content of the FCS fuel assembly is 0.377 MTU per assembly while the shielding design basis fuel assembly is 0.475 MTU. In addition, the total canister decay heat load (nominally proportional to source term) is reduced from the Design Basis 24 kW to 11.0 kW. Therefore, the design basis radiation source terms for all burnup, initial enrichment and cooling time combinations allowed to be stored in the NUHOMS®-32PT DSC remain bounding for the FCS fuel assembly. As a result, all of the storage dose rates reported in the tables in the UFSAR and storage dose rate limits reported in the Technical Specifications remain bounding for FCS FAs. The exemption to TS 1.2.1 and 1.2.11 addresses OS197L TC dose rates.

III. Technical Specification Exemption Requests

A. Technical Specification 1.2.1 (Bases)

1. Exemption Request - TS 1.2.1

   Certificate of Compliance No. 1004 (CoC), Amendment No. 8, includes Technical Specification 1.2.1 which controls fuel specifications. An exemption is requested in connection with the statements in the Bases section that describe the transfer cask surface dose rates for the 24P and the 52B canisters. The exemption would allow disregarding the wording on the transfer cask surface dose rates in the Technical Specification Bases. All other elements of the Limit/Specifications and Applicability remain in force.

2. Background - TS 1.2.1

   OPPD acknowledges that the description of the transfer cask surface dose rates, described in the Bases section of Technical Specification 1.2.1 for the 24P and 52B canisters, cannot be met with the use of the bare OS197L TC, and therefore an exemption is requested. It is noted that OPPD will only load the 32PT canister, and not the 24P or the 52B DSCs.

3. Technical Justification - TS 1.2.1

   10 CFR 72.7 specifies that "... the Commission may, upon application by any interested person or upon its own initiative, grant such exemptions from the

requirements of the regulations in this part as it determines are authorized by law and will not endanger life or property or the common defense and security and are otherwise in the public interest."

The safety analysis of the NUHOMS®-32PT system is described in the current license in Appendix M of the Updated Final Safety Analysis Report (UFSAR) for the standardized NUHOMS® system [Reference 2]. The current Technical Specifications (TS) for CoC No. 1004 [Reference 1] that are issued to TN for the standardized NUHOMS® system contain the following requirements regarding the authorized content of the DSC:

Technical Specification 1.2.1, "Fuel Specifications, Functional and Operating Limits," states that "The characteristics of the spent fuel which is allowed to be stored in the standardized NUHOMS® system are limited by those included in Tables 1-1a, 1-1b, 1-1c, 1-1d, 1-1e, 1-1f, 1-1g, 1-1i, 1-1j, 1-1l, and 1-1m."

The fuel assemblies (CE 14 x 14) that OPPD proposes to load in the 32PT canister are fully compliant with the relevant Tables (1-1e, 1-1f, and 1-1g) of the Technical Specification.

In addition, the Bases section of this TS contains the following wording regarding the radiological criterion:

> "The radiological design criterion is that fuel stored in the NUHOMS® system must not increase the average calculated HSM or transfer cask surface dose rates beyond those calculated for the 24P, 24PHB, 52B, 61BT, or 32PT canister full of design basis fuel assemblies with or without BPRAs. **The design value average HSM and cask surface dose rates for the 24P and 52B canisters were calculated to be 48.6 mrem/hr and 591.8 mrem/hr respectively based on storing twenty four (24) Babcock and Wilcox 15x15 PWR assemblies (without BPRAs) with 4.0 wt. % U-235 initial enrichment, irradiated to 40,000 MWd/MTU, and having a post irradiation time of five years.** To account for BPRAs, the fuel assembly cooling required times are increased to maintain the above dose rate limits."

OPPD proposes to load only the 32PT canisters at FCS under this exemption. Specific dose rate limits for the 32PT are not included in this Bases section. Specific OS197L TC dose rate measurements will be taken as noted in connection with the proposed exemption for TS 1.2.11.

An evaluation of the required NUHOMS® UFSAR sections has been completed. The results of that evaluation for the structural, thermal, shielding, and criticality disciplines are summarized below for each of the three Technical Specifications to be exempted. An evaluation summarizing the impact on other UFSAR sections is provided for all three TSs at the end of this section.

Structural Evaluation

The structural evaluation of the NUHOMS®-32PT DSC is documented in the UFSAR. The design parameters for the design basis fuel assembly used in Chapter M.3 of the UFSAR (e.g., total fuel assembly weight and total decay heat load) are unchanged and bound the FCS fuel assembly. This TS, and the exemption, have no adverse impact on the structural evaluation.

Thermal Evaluation

The thermal evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.4 of the UFSAR. The design parameters for the design basis fuel assembly used in Chapter M.4 of the UFSAR (e.g., total fuel assembly burnup, cooling time, and decay heat) bound the proposed FCS FAs (CE 14 x 14) limited to 11.0 kW and the proposed zoning configuration. As discussed in the General Background above, significant thermal margin is present. As a result, the thermal evaluation results reported in Chapter M.4 of the UFSAR remain bounding.

Shielding Evaluation

The shielding evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.5 of the UFSAR. The design parameters for the design basis fuel assembly used in Chapter M.5 of the UFSAR (e.g., total fuel assembly burnup, cooling time, and source term) bound the proposed FCS FAs (CE 14 x 14) limited to 11.0 kW. As a result, the shielding evaluation results reported in Chapter M.5 of the UFSAR remain bounding and ALARA principles will be met.

Criticality Analysis

The criticality evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.6 of the UFSAR. The design parameters for the design basis fuel assembly used in Chapter M.6 of the UFSAR (e.g., fuel assembly configuration, enrichment, and pool boron loading) are unchanged and the DSC geometry and materials are unchanged. As a result, the criticality evaluation results reported in Chapter M.6 of the UFSAR remain bounding.

B. Technical Specification 1.2.11

1. Exemption Request - TS 1.2.11

Certificate of Compliance No. 1004 (CoC), Amendment No. 8, includes Technical Specification 1.2.11 which provides dose rate limits for the transfer cask. An exemption is requested in connection with all elements of the TS, including the Limit/Specification and Applicability. The exemption is justified because equivalent dose rate limits can be met through use of the shielding elements of the OS197L system at the FCS site using the 32PT DSC.

The exemption would be only for the 32PT DSC to be loaded with FCS FAs, and as such no exemption to TS 1.2.11a, 1.2.11b, or 1.2.11c is necessary.

2. Background - TS 1.2.11

OPPD acknowledges that the description of the transfer cask surface dose rates, described in the Technical Specification 1.2.11, does not explicitly address the supplemental shielding, and that the limits cannot be met with the use of the bare OS197L TC alone.

3. Technical Justification - TS 1.2.11

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

The safety analysis of the NUHOMS®-32PT system is described in the current license in Appendix M of the Updated Final Safety Analysis Report (UFSAR) for the standardized NUHOMS® system [Reference 2]. The intent of the TS, as stated in the Objective, is to identify a FA misload, and to support ALARA operations. These objectives are captured through use of the following dose rate measurements.

Dose rate measurements of the OS197L containing a loaded 32PT DSC will be taken at FCS at selected steps in the loading sequence. The specific dose rate parameters for the OS197L TC are contained in Table 2 and Table 3:

Table 2 Axial Dose Rate Measurement Configuration
• 32PT DSC inside OS197L inside decon sleeve/bell • Water drained from DSC • TC/DSC annulus full (within approximately 1 foot of top) • TC neutron shield full • Top Shield Plug in place and included in axial shielding • Inner Top Cover Plate in place and included in axial shielding • Automated Welding System (AWS) with integral shield in place and included in axial shielding • Measurement taken at vertical centerline of DSC, 3 feet from AWS shield
Calculated Dose Rate [Reference 4] . . . . 128 mrem/hr
Proposed Dose Rate Limit . . . . 170 mrem/hr

Table 3 Radial Dose Rate Measurement Configuration
• 32PT DSC inside OS197L inside decon sleeve/bell • Water drained from DSC • TC/DSC annulus full (within approximately 1 foot of top) • TC neutron shield full • 6 inch nominal thickness carbon steel decon sleeve/bell in place and included in radial shielding • Measurement taken at outside surface (contact) of decon sleeve/bell
Calculated Dose Rate [Reference 4] . . . . 68 mrem/hr
Proposed Dose Rate Limit . . . . 110 mrem/hr

In addition to the above dose rate measurements to be taken as a replacement to TS 1.2.11, OPPD will take additional dose rate measurements during the dry fuel loading process as part of the normal OPPD Part 50 Radiation Protection (RP) and ALARA programs. To assist in ALARA planning, Transnuclear has calculated the bare cask surface dose rates in calculation 1121-0505 Rev.0 [Reference 7]. The OS197L TC average surface dose rate for the Fort Calhoun specific fuel being loaded under this exemption (11.0 kW DSC heat load) was calculated to be 13 Rem/Hr. This is significantly lower than the 53 Rem/Hr dose rate calculated with design basis fuel. This calculation is available onsite for NRC review.

In the axial direction, the shielded configuration of the 32PT DSC inside the OS197L is unchanged from the 32PT inside the OS197. The limits are based on a calculation of the configuration [Reference 4] and the exemption explicitly states the configuration for which the dose rates were calculated and for which the measurements should be taken.

The axial measurement is the most favorable for identification of a fuel assembly misload condition. An analysis of the axial and radial dose rates for a potential fuel assembly misload of a 32PT DSC have been evaluated in TN calculation NUH06L-0502 [Reference 3]. The result of this calculation shows that a design basis assembly with design basis burnup and 1 year cooling time located in the center of the DSC cavity, would be easily detected by axial dose rate measurements from either the OS197 TC or the OS197L TC, since the calculated doses for this misloaded configuration far exceed TS 1.2.11 Limit/Specification "a" dose limits. This is expected, since the OS197 and OS197L TCs do not differ in axial shielding configuration and measurement in the axial direction eliminates the potential of other FAs to self-shield the misloaded FA.

The radial measurement serves as an ALARA check, and misload detection through radial measurements are not reliable. The misload analysis of Reference 3 also demonstrates that a radial dose rate measurement for both the OS197 and OS197L TCs would not detect a misloading via TS 1.2.11 Limit/Specification "b" for a misloaded assembly (1 year cooled) placed at the center of the DSC. However, a misloaded assembly placed other than at the center of the DSC may be detected via the dose rate measurements of TS 1.2.11 Limit/Specification "b," depending on the FA location within the 32PT basket, for both the OS197 and OS197L TC configurations. Therefore the only reliable dose rate measurement to detect a misload is the axial measurement. The proposed radial dose rate limits are based on a calculation of the configuration [Reference 4] and the exemption explicitly states the configuration for which the dose rates were calculated and for which the measurements should be taken.

The equivalent ALARA goal is accomplished with respect to TS 1.2.11 Limit. The requirement of ALARA is reduction of exposure and the proposed dose rate limit will still assure that the 32PT used with the OS197L TC at FCS will provide equivalent or better shielding than the OS197 TC.

The exemption alternative actions will also utilize the same steps and actions of the TS Action Statement:

> "If specified dose rates are exceeded, place temporary shielding around affected areas of transfer cask and review the plant records of fuel assemblies which have been placed in DSC to ensure they conform to the fuel specifications of Section 1.2.1. Submit a letter report to the NRC within 30 days summarizing the action taken and results of the surveillance, investigation and findings. The report must be submitted using instructions in 10 CFR 72.4 with a copy sent to the administrator of the appropriate NRC regional office."

Note that the major movements utilizing the bare OS197L TC will be performed remotely to minimize dose. Remote placement of the TC inside the decon shielding or onto the TT is no more complex or difficult than placement of the TC within the fuel pool. The remote operation has already been demonstrated. In addition, should all these features fail, proper positioning of the OS197L TC when being handled by a crane can be achieved by using a combination of remote and manual alignment practices. In both cases the result is a safely landed TC.

Additionally, the unlikely event of a hung load due to crane malfunction has been addressed through contingency planning. Reliability of the crane to be used for dry fuel storage operations has been demonstrated through extensive usage during internal and NRC demonstrations. Crane operators have been trained to manually operate the crane in order to minimize radiological exposure in the event of a crane malfunction during movement of the TC. Projected personnel doses which would be received during this operation have been determined to be ALARA and within the Fort Calhoun Station administrative limits.

Therefore, the use of the OS197L TC with the dose rate measurements noted in this exemption will allow OPPD to meet the dual objectives of detecting fuel misload and maintaining dose rates ALARA.

An evaluation of the required NUHOMS® UFSAR sections was completed. The results of that evaluation for the structural, thermal, shielding, and criticality disciplines are summarized below for each of the three Technical Specifications to be exempted, followed by a combined summary of the remaining UFSAR sections.

Structural Evaluation

The structural evaluation of the NUHOMS®-32PT DSC is documented in the UFSAR. The design parameters for the design basis fuel assembly used in Chapter M.3 of the UFSAR (e.g., total fuel assembly weight and total decay heat load) are unchanged and bound the FCS fuel assembly. This TS, and the exemption, have no adverse impact on the structural evaluation.

Thermal Evaluation

The thermal evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.4 of the UFSAR. This TS and the exemption have no adverse impact on the thermal evaluation. As a result, the thermal evaluation results reported in Chapter M.4 of the UFSAR remain bounding.

Shielding Evaluation

The shielding evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.5 of the UFSAR. As stated above, the axial configuration of the OS197L TC was evaluated in [Reference 4]. The exemption explicitly defines the configuration to be measured and the dose rate limit to be used.

The radial shielding of the OS197L TC, including the decon area sleeve/bell, is documented in FCN 321, Rev. 1 [Reference 2], showing that the OS197L

TC system configuration has increased shielding. As the radial measurement is not a reliable misload detection method, and serves only as an ALARA check, the increased shielding supports this ALARA function. The exemption explicitly defines the configuration to be measured and the dose rate limit to be used [Reference 4].

Criticality Analysis

The criticality evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.6 of the UFSAR. This TS, and the exemption, have no adverse impact on the criticality evaluation. As a result, the criticality evaluation results reported in Chapter M.6 of the UFSAR remain bounding.

C. Technical Specification 1.2.17a

1. Exemption Request - TS 1.2.17a

Certificate of Compliance No. 1004 Amendment No. 8, includes Technical Specification 1.2.17a which provides time limits for vacuum drying for the 32PT. An exemption is requested in connection with the Limit/Specification wording on the start of vacuum drying. Instead, OPPD will conservatively start the time limit for vacuum drying earlier in the loading sequence and will use helium as the backfill gas. No change to the time duration or the elements of the Action Statement is requested.

The exemption would be only for the 32PT DSC and as such no exemption to TS 1.2.17, 1.2.17b, or 1.2.17c is necessary.

Justification of the specific exemption is that the start of the time limit for vacuum drying, irrespective of canister heat load, will occur at the time that the initial 750 gallons draindown from the canister is achieved. Additional water will continue to be drained to meet crane weight limits. This will occur at FCS as the OS197L TC with 32PT is lifted to the fuel pool surface and the drain down of water from the canister cavity is performed.

2. Background - TS 1.2.17a

OPPD proposes to start the vacuum drying clock (time limit) at the time that the initial 750 gallon draindown from the canister is achieved. This will ensure that the initial conditions assumed in the vacuum drying analysis are met and therefore that the fuel clad temperature limits, which are the subject of this TS, are maintained below the values listed in the UFSAR.

3. Technical Justification - TS 1.2.17a

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

The safety analysis of the NUHOMS®-32PT system is described in the current license in Appendix M of the Updated Final Safety Analysis Report (UFSAR) for the standardized NUHOMS® system [Reference 2]. This analysis includes in M.4, calculation of fuel cladding temperatures for the vacuum drying condition.

These analyses conservatively assume that the initial fuel clad temperature at the start of vacuum drying (and therefore the start of the vacuum drying duration time limit) is 215°F. OPPD proposes to start the clock at the time that the initial 750 gallons draindown from the canister is achieved, which is prior to movement of the cask/canister to the decon area. The FA and fuel cladding at this time will have just been removed from the fuel pool water within the canister (draining 750 gallons is anticipated to take approximately 1-2 hours) and the FA will be approximately half submerged. Therefore the 215°F initial fuel clad temperature assumption is bounded.

All of the operations subsequent to the start of the vacuum drying clock, which include continued draining, movement of the cask/canister to the decon area, any refilling of the canister with fuel pool water, placement of the inner top cover plate and Automated Welding System (AWS), inner top cover plate welding, and start of actual vacuum drying, do not adversely impact the analysis assumptions of M.4. The cask/canister annulus will be maintained full to assure the boundary DSC exterior temperature of 215°F maximum. Therefore the vacuum drying thermal analysis documented in M.4 bounds this sequence.

Once the cask/canister is placed in the decon area, the remaining steps for canister closure (Inner Top Cover Plate placement and welding) will be performed.

It is anticipated, based upon a review of the loading sequence, that vacuum drying can be completed within the 31 hour limit of TS 1.2.17a. Should the end of vacuum drying not be accomplished within the TS 1.2.17a time limits, the existing TS action statement shall be entered, which requires that a helium atmosphere greater than 0.1 atm be established within 2 hours. Once accomplished, the vacuum drying clock can be reset and the vacuum drying restarted.

An evaluation of the required NUHOMS® UFSAR sections has been completed. The results of that evaluation for the structural, thermal, shielding, and criticality disciplines are summarized below for the Technical Specification to be exempted, followed by a combined summary of the remaining UFSAR sections.

Structural Evaluation

The structural evaluation of the NUHOMS®-32PT DSC is documented in the UFSAR. The design parameters for the design basis fuel assembly used in Chapter M.3 of the UFSAR (e.g., total fuel assembly weight and total decay heat load) are unchanged and bound the FCS fuel assembly. This TS, and the exemption, have no adverse impact on the structural evaluation.

Thermal Evaluation

The thermal evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.4 of the UFSAR. This TS, and the exemption, have no adverse impact on the thermal evaluation. As a result, the thermal evaluation results reported in the UFSAR remain bounding. Fuel cladding temperatures during operations from the fuel pool to final vacuum drying will be maintained at or below the values listed in the UFSAR.

Shielding Evaluation

The shielding evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.5 of the UFSAR. This TS, and the exemption, have no adverse impact on the shielding evaluation. As a result, the shielding evaluation results reported in the UFSAR remain bounding.

Criticality Analysis

The criticality evaluation of the NUHOMS®-32PT DSC is documented in Chapter M.6 of the UFSAR. This TS, and the exemption, have no adverse impact on the criticality evaluation. As a result, the criticality evaluation results reported in the UFSAR remain bounding.

IV. Technical Justification – Remaining Sections of the UFSAR Associated with TS 1.2.1, 1.2.11, 1.2.17a Exemptions

Confinement Evaluation

The confinement evaluation of the system is documented in Chapter M.7 of the UFSAR. This section of the UFSAR is not adversely affected by the transfer cask dose rates or the start time/time limits for vacuum drying and therefore remains applicable when the revised cask dose rate measurements and vacuum drying start times are implemented.

Operating Systems

The operating procedures for the system are documented in Chapter M.8 of the UFSAR. This section of the UFSAR is not adversely affected by the specifics of transfer cask dose rate measurements. The transfer cask dose rates will be measured in the decon area, as listed in the discussion for the TS 1.2.11 exemption. The sequence of canister loading is unchanged by the earlier start of the vacuum drying clock, and the major sequence steps are not altered.

Test and Maintenance Program

The Test and Maintenance program for the system is documented in Chapter M.9 of the UFSAR. This section of the UFSAR is not adversely affected by the transfer cask dose rates or the start time/time limits for vacuum drying and therefore remains applicable when the revised cask dose rate measurements and vacuum drying start times are implemented.

Radiation Protection

Occupational Exposure and Off-site dose evaluations for the system are presented in Chapter M. 10 of the UFSAR. As addressed in the Shielding Evaluation discussion above, the Occupational Exposure and Off-site dose evaluations presented in Chapter M.10 of the UFSAR remain bounding.

Accident Analysis

Accident analyses for the system are presented in Chapter 11 of the UFSAR (includes FCN 321). As addressed in the discussion for the Structural Evaluation, Thermal Evaluation, Shielding Evaluation, and Criticality Evaluation above, this section of the UFSAR is not adversely affected by the transfer cask dose rates or the start time/time limits for vacuum drying. Therefore, the accident analysis results presented in the UFSAR remain bounding.

Conditions for Cask Use - Operating Controls and Limits or Technical Specification

Conditions for cask use operating controls and limits or technical specifications for the system are presented in Chapter 12 of the UFSAR which refers to the Technical Specifications for the CoC No. 1004. Except for the exemptions described above for TS 1.2.1, 1.2.11, and 1.2.17a, all other TSs remain limiting.

Quality Assurance

The Quality Assurance program to be applied to the system is described in Chapter M. 13 of the UFSAR. This section of the UFSAR is not adversely affected by the transfer cask dose rates or the start time/time limits for vacuum drying and therefore remains applicable when the revised cask dose rate measurements and vacuum drying start times are implemented.

Decommissioning

The decommissioning evaluation for the system is described in Chapter 14 of the UFSAR. This section of the UFSAR is not adversely affected by the transfer cask dose rates or the start time/time limits for vacuum drying and therefore remains applicable when the revised cask dose rate measurements and vacuum drying start times are implemented.

V. 72.48(c)(2)(viii) – Methods of Analysis Exemption Request

1. Exemption Request

Pursuant to the provisions of 10 CFR 72.7, "Specific exemptions," OPPD, Fort Calhoun Station (FCS) requests an exemption from a requirement specified in 10 CFR 72.212, "Conditions of general license issued under §72.210."

72.212 requires compliance with the requirements of 72.48 for all changes implemented using this provision. An exemption is requested from 72.48(c)(2)(viii).

2. Background - 72.48(c)(2)(viii) – Methods of Analysis Exemption

During inspection activities, the NRC determined that the thermal analysis of the OS197L TC on the transfer trailer with additional shielding utilizes a change in method of analysis, as defined in 72.48(c)(2)(viii). To address this issue, OPPD is submitting the thermal analysis for this configuration as part of the exemption [References 5 & 6].

3. Technical Justification - 72.48(c)(2)(viii) – Methods of Analysis Exemption

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

The thermal analysis submitted [Reference 5] with this exemption utilized a CFD analysis Code (FLUENT) to calculate TC surface temperatures during transfer in the transfer trailer. These TC surface temperatures were then used in [Reference 6] to calculate DSC shell and peak fuel clad temperatures within the 32PT DSC. The calculation was performed using the reduced heat load of 11.0 kW, and the reduced fuel assembly heat loads, proposed earlier. In addition, the analysis utilized the thermal conductivity values of the FCS FA (CE 14 x 14). The results of the calculation are presented below.

Table 4

Calculation of Peak FA Clad Temperature [Reference 6]

DSC Heat Load (kW)	Maximum Peak Fuel Clad Temperature (°F)	Allowable Fuel Clad Temperature (°F)
11.0	472	752

The results demonstrate that significant thermal margin (>275 °F) is present.

VI. Environmental Assessment - TS 1.2.1, 1.2.11, 1.2.17a

The following information is provided in support of an environmental assessment and finding of no significant impact for the proposed exemption:

Identification of the Proposed Action

Pursuant to the provisions of 10 CFR 72.7, "Specific exemptions," OPPD requests an exemption from requirements specified in 10 CFR 72.212(a)(2), 10 CFR 72.212(b)(2)(i)(A), 10 CFR 72.212(b)(7), 10 CFR 72.214, and 10 CFR 72.48(c)(1)(B), all of which require the licensee to comply with the terms and conditions of the COC. The exemption would be from conditions in Amendment 8 to CoC No. 1004 for the NUHOMS®-32PT storage system. Specifically, OPPD is requesting an exemption from TS 1.2.1(Bases), 1.2.11, and 1.2.17a.

In addition OPPD is requesting exemption from 72.48(c)(2)(viii), specifically to use a method of analysis that the NRC determined to be a departure from that described in the NUHOMS® UFSAR. These exemptions would allow OPPD to store fuel assemblies using the 32PT DSC and the OS197L TC.

The Need for the Proposed Action

Approval of this exemption will allow Fort Calhoun Station to maintain full core offload capability after the 2006 refueling outage, will allow receipt and storage of new fuel, and will allow better management of decay heat loads within the Spent Fuel Pool (including minimization of fuel handling activities) until the spring 2008 refueling outage. Section VI of Attachment I describes the need for loading of four canisters to provide these capabilities.

Expedited approval of this exemption request is needed in order to complete canister loadings and thereby minimize outage scheduling and radiological impacts on required preparations for the 2006 refueling outage. These activities include preparations for the major component replacements that are taking place in the area exterior to the Auxiliary Building, immediately adjacent to the spent fuel pool and spent fuel transfer trailer travel route. Other outage preparation activities requiring use of the same area include receipt, inspection, and storage for 44 new fuel bundles and 49 new control element assemblies (control rods) before their placement in the spent fuel pool. All of these activities enhance nuclear, radiological, and industrial safety.

There is insufficient time for the items included in this exemption request to be addressed through the Certificate of Compliance amendment process.

Part 10 CFR 72.7 specifies that the NRC may grant exemptions from the requirements of 10 CFR Part 72 when the exemptions are authorized by law and will not endanger life or property or the common defense and security, and are otherwise in the public interest. OPPD has concluded that the conditions for granting an exemption are met and has provided the justification in this submittal.

The Need for Loading of Four Canisters

Fort Calhoun Station's (FCS) Spent Fuel Pool (SFP) is designed with a capacity of 1083 cells. Prior to the 2006 Refueling Outage (RFO) in September, FCS has 142 empty cells. Due to several operational constraints, FCS has determined that a minimum of four (4) dry shielded canisters need to be loaded and stored via this exemption request to prudently manage adverse impacts to nuclear, radiological and industrial safety. Five operational constraints are summarized below.

Operational Constraints Requiring The Loading of Four Dry Shielded Canisters

- Full core offload capability during and following the 2006 RFO
- Management of decay heat loads if a full core offload is required
- Receipt and inspection of new fuel assemblies control rods for the 2006 RFO
- Compliance with NRC Regulatory Issue Summary 2005-05: Regulatory Issues Regarding Criticality Analyses for Spent Fuel Pools and Independent Spent Fuel Storage Installations
- Temporary storage of ultrasonic fuel cleaning filters and an incore thimble

The first operational constraint is the need for FCS to offload the 133 assembly core during and following the 2006 RFO. The large amount of Reactor Coolant System (RCS) components being replaced during the outage raises the likelihood that foreign material could be introduced and potentially deposited under the core support plate in the reactor vessel. This scenario would require the core to be offloaded to the SFP and the reactor core barrel to be removed to allow removal of the foreign material.

The second constraint is ensuring 50 additional cells are identified and empty following the 2006 RFO in order to manage decay heat loads if a full core offload is required. Technical Specifications dictate that fuel assemblies must be stored in one of two regions of the SFP based on each assembly's burn-up and enrichment. Additionally, FCS must distribute specific bundles throughout Region 2 of the SFP to adhere to NRC decay heat separation criteria and SFP concrete gamma heating operational constraints. If a post-2006 core offload is required, most of the newer fuel assemblies (Batch BB and CC) must be stored in Region 1 of the SFP and cannot be stored in a decay heat dispersion pattern. However, approximately 50 fuel assemblies (20 to 80 assemblies depending on burn-up at the time of the offload) can and should be stored within a heat dispersion pattern in Region 2 which will significantly lower the decay heat loading within Region 1. Removing 50 fuel assemblies now enables FCS to eliminate at least 50% of the fuel movements later, depending on core burn-up at the time of the offload, thereby substantially reducing the number of required fuel movements and the risk associated with these movements.

The third constraint results from the need to receive and inspect 44 new fuel assemblies and 49 new control rods for the 2006 RFO. Once inspections are complete, the assemblies and control rods are systematically transferred from the New Fuel Storage Rack into the SFP. This fuel handling operation requires more resources, presents more radiological challenges, and is more complicated than normal intra-SFP fuel movements. Consequently, it is FCS practice to perform these operations prior to a refueling outage.

The fourth constraint results from the requirements of two issues. The first requirement pertains to compliance with NRC Regulatory Issue Summary (RIS) 2005-05, "Regulatory Issues Regarding Criticality Analyses for Spent Fuel Pools and Independent Spent Fuel Storage Installations." Complying with RIS 2005-05 requires the station to ensure the first row of SFP cells adjacent to the cask pit area (CPA) is empty. Keeping these 23 cells empty addresses criticality issues related to neutronic coupling of fuel in the dry shielded canister (DSC) during dry fuel storage activities. The second requirement is to keep the same 23 cells vacant of fuel assemblies while the ultrasonic fuel cleaning (UFC) chamber is stored in the CPA. The UFC vendor recommends this constraint to minimize long-term radiation exposure to the transducer equipment. FCS plans on installing the UFC after core offload and then leaving the UFC stored in the CPA for radiological reasons.

The fifth constraint is based on the need to temporarily store ultrasonic fuel cleaning (UFC) filters and an incore thimble storage can in five (5) SFP cells.

Dose rates from filters will exceed 100Rem/hr and therefore must be stored in the SFP until sufficient decay time has elapsed. FCS currently has over twenty filters stored in all available locations on the walls of the SFP. The filters must be moved to four (4) SFP Cells in order to allow additional 2006 RFO filters to be stored in the SFP. In addition, a new storage can is being placed within a SFP cell to accommodate the incore thimbles that will be replaced during the 2006 RFO.

In summary, the operational constraints above will require the availability of 211 empty cells in the spent fuel pool at the end of the 2006 RFO. Loading only 3 canisters will provide 194 empty cells in the spent fuel pool at the end of the 2006 RFO and thus will negatively impact the management of decay heat loads. Loading 4 canisters will provide 226 empty cells in the spent fuel pool at the end of the 2006 RFO, allowing OPPD to better manage nuclear, radiological, and industrial safety by fully addressing the operational constraints.

Environmental Impacts of the Proposed Action

The NRC completed an Environmental Assessment of COC No. 1004, Amendment No. 8, in March 2005 and reached the following conclusions:

> "Considering the specific design requirements for each accident condition, the design of the cask would prevent loss of containment, shielding, and criticality control. Without the loss of containment, shielding, or criticality control, the risk to public health and safety is not compromised.
>
> The staff reviewed the proposed changes and confirmed that the changes provide reasonable assurance that the spent fuel can be stored safely and that the changes meet the acceptance criteria specified in 10 CFR Part 72. The staff documented its findings in a Safety Evaluation Report. The occupational exposure is not significantly increased, and offsite dose rates remain well within the 10 CFR Part 20 limits. Therefore, the proposed action now under consideration would not change the potential environmental effects assessed in the initial rulemaking. Therefore, the NRC staff has determined that an acceptable safety margin is maintained and that no significant environmental impacts occur as a result of the amendment. Because the proposed changes will not change the environmental requirements for the storage of spent fuel, no change in environmental impact is anticipated."

OPPD concludes that the conclusions reached by the NRC in the Environmental Assessment for Amendment No. 8 remain valid with the implementation of more explicit transfer cask dose rate measurements, the earlier start time/time limits for vacuum drying, and the use of the submitted thermal analysis of the TC on the transfer trailer.

The fuel assemblies which OPPD plans to load into the NUHOLMS®-32PT DSC are bounded by the design basis fuel assemblies for the 32PT DSC as evaluated in the UFSAR. The procedures that OPPD has used for selecting, loading and storing its spent fuel will also meet all the CoC requirements. The exemption will not significantly increase the probability or consequences of accidents. The use of remote handling techniques for the OS197L TC during loading operations will be consistent with ALARA principles and will not adversely increase occupational or public radiation exposures. There are no changes being made in the types or amounts of effluents that may be released offsite, and there is no significant increase in occupational or public radiation exposure as a result of the proposed activities. Therefore, there are no significant radiological environmental impacts associated with the proposed exemption.

With regard to potential non-radiological environmental impacts, OPPD has determined that the proposed exemption has no potential to affect any historic sites. It does not affect non-radiological plant effluents and has no other environmental impact. Therefore, there are no significant non- radiological environmental impacts associated with the requested exemption.

Environmental Impacts of the Alternatives to the Proposed Action

As an alternative to the requested exemption, the NRC could consider denial (i.e., the "no-action" alternative). Denial of the exemption would result in no change to the current environmental impacts. OPPD considers the "no-action" alternative to potentially impact OPPD's ability to provide safe, affordable, competitive, and reliable electrical power generation.

VII. References

1. Certificate of Compliance No. 1004 for the Standardized NUHOMS® System, Amendment 8, effective December 5, 2005.
2. "Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel, Final Safety Analysis Report," NUH-003, Revision 9, dated January 2006, including all issues FSAR Change Notices {Includes FCN 321, Rev. 1 (Attached)}.
3. TN Calculation NUH06L-0502, Revision 0, OS197/OS197L Transfer Cask Shielding Evaluation for Single Assembly Misloading.
4. TN Calculation 1121-0504, Revision 1, OS197L 75 Ton Transfer Cask Dose Rates Calculation to be used with OPPD Exemption Request. (Attached)
5. TN Calculation 1121-0400, Revision 1, Calculation of OS197L Cask Shell Temperature with 11.0 and 18.4 kW Heat Loads. (Attached)
6. TN Calculation 1121-0401, Revision 1, OS197L 75 Ton Transfer Cask Thermal Analysis to be used with OPPD Exemption Request (18.4 kW/DSC & 11.0 kW/DSC). (Attached)
7. TN Calculation 1121-0505, Revision 0, OS197L 75 Ton Bare Transfer Cask Dose Rates for as Loaded Configuration to be Used With OPPD Exemption Request (18.4 kW/DSC & 11.0 kW/DSC).

FSAR Change Notice – FCN 721004-321, Rev. 1

TRANSNUCLEAR AN AREVA COMPANY	FSAR Change Notice (FCN)	FCN No.:	FCN 721004-321
		72.48 Review No.:	LR 721004-321, Revision 1

Preparer/Date	Verifier/Date
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Approved: UB Chopra 3/31/06 U.B. Chopra Miguel A. Manrique FTR JRB Date: 3/31/06

Jayant Bondre Date:

A marked up copy of the applicable FSAR pages and drawings clearly showing the change implemented by the 72.48 Review must be attached to this form:

- List changed UFSAR pages (if applicable) attached to this FSAR Change Notice:
  Page 1.1-2a
  Page 1.1-2b
  Page 1.3-3
  Page 1.3-3a
  Page 3.1-4
  Page 3.2-7
  Page 4.2-9
  Page 5.1-1
  Page 7.1-1
  Page 8.1-1
  Page E-2
  Add new Appendix W (NUHOMS® OS197L Transfer Cask)
- List changed FSAR Drawings (if applicable) attached to this FSAR Change Notice:
  None

The NUHOMS®-24PTH system adds a new canister with three alternate configurations (designated as DSC Type 24PTH-S, -24PTH-L, or -24PTH-S-LC), a new module designated as HSM-H, and a modified version of OS197/OS197H transfer cask designated as OS197FC/OS197H FC.

A detailed description of the 24PTH system, including drawings, authorized payload contents and supporting safety analyses for this system are provided in Appendix P of this UFSAR.

Amendment 8 to CoC also authorized storage of low enrichment and reconstituted fuel in the 32PT DSC. In addition, the authorized contents of the 24PHB DSC were revised to include additional fuel types. A detailed description of the changes implemented to the 32PT and 24PHB DSCs are provided in Appendices M and N, respectively.

TN has added two alternate HSMs, designated as HSM Model 152 and HSM Model 202, to the standardized NUHOMS® system. These alternate HSM designs provide enhanced shielding features while meeting the heat rejection requirements. A detailed description of the HSM Model 152 and HSM Model 202 and supporting analyses are provided in Appendices R and V, respectively.

Chapters 1 though 8 and Appendices A through H of this FSAR provide the supporting licensing basis for the Standardized NUHOMS®-24P and -52B systems only.

Appendix W has been added to the UFSAR to incorporate a light weight (75 ton) version of the OS197 onsite transfer cask.

A complete description of the new systems addressed by the above listed amendments, including supporting safety analysis, is located within self-contained Appendices to this FSAR as summarized in the following table:

Amendment No.	Description	Location of Supporting Licensing Basis
3	Addition of the NUHOMS®-61BT DSC to the contents of the Standardized NUHOMS® system	Appendix K
N/A	Addition of the NUHOMS®-24PT2 DSC to the contents of the Standardized NUHOMS® system	Appendix L
4	Addition of low burnup fuel to the contents of the NUHOMS®-24P DSC	Chapter 3
5	Addition of the NUHOMS®-32PT DSC to the Standardized NUHOMS® system	Appendix M
6	Addition of the NUHOMS®-24PHB DSC to the Standardized NUHOMS® system	Appendix N
7	Addition of damaged fuel to the contents of the NUHOMS®-61BT DSC	Appendix K
8	(a) Addition of the NUHOMS® 24PTH system to the Standardized NUHOMS® system (b) Revision of the authorized contents of the 32PT DSC to include low enrichment and reconstituted fuel (c) Revision of the authorized contents of the 24PHB DSC to include additional fuel types	Appendix P Appendix M Appendix N
N/A	Addition of an alternate version of the HSM, designated as HSM Model 152, to the Standardized NUHOMS® system	Appendix R
N/A	Addition of an alternate version of the HSM, designated as HSM Model 202, to the Standardized NUHOMS® system	Appendix V
N/A	*Addition of an alternate version of the OS197 Transfer Cask, designated as OS197L, to the Standardized NUHOMS® system*	*Appendix W*

controlled access. The necessary civil work required to prepare the ISFSI site is the same as that for an ISFSI utilizing vertical storage casks.

Two alternate designs of the standardized HSM are available for licensees' use: the original HSM, now designated as HSM Model 80 and HSM Model 102. HSM Model 102 design is similar to HSM Model 80 design except for the following two features:

- The steel encased composite door of HSM Model 80 design is replaced by a two foot thick reinforced concrete door with a steel liner on its inside surface. The steel liner mitigates DSC damage from spalled concrete due to tornado generated missile impact.
- The inlet and outlet vents, which are formed in concrete for HSM Model 80, are lined with 1½" steel plates.

The above features included with HSM Model 102 are improvements to the original HSM Model 80 design that increase the shielding capabilities of the HSM. The heat transfer capability (decay heat rejection from the DSC to the HSM and heat removal from the HSM by natural convection) of both HSM Model 80 and HSM Model 102 designs are equivalent. Appendix E drawings show both models. Each model can store a DSC with maximum weight up to 102 kips which includes 24P, 52B, 24PT2 and 61BT DSCs.

1.3.2 Transfer Systems Descriptions

1.3.2.1 On-Site TC

The transfer cask used in the NUHOMS® system provides shielding and protection from potential hazards during the DSC closure operations and transfer to the HSM. *Four* alternate configurations of the transfer cask are available for the licensees' use. The basic configuration, where the cask is provided with a solid neutron shield, is described herein as the "Standardized Cask." An alternate configuration, where a liquid neutron shield is provided instead, is described in this SAR as the "OS197, OS197H *or OS197L* Cask."

The configuration of the OS197 is a slightly modified version of the NRC approved cask (with a liquid neutron shield) as described in the NUHOMS®–24P Topical Report (1.10). The standardized transfer cask documented in this SAR has a gross weight of less than 90.7 Te (100 tons) and is limited to on-site use under 10CFR72. The OS197 and OS197H transfer casks, which are also limited to on-site use under 10CFR72, have a maximum gross weight of 94.6 Te (104.25 tons) and 113.4 Te (125 Tons), respectively. In addition, the licensee may also elect to utilize a future transfer cask having a gross weight of about 113.4 Te (125 tons) which can be used on-site under 10CFR72, but is also suitable for future off-site shipment of intact NUHOMS® canisters under 10CFR71. Where applicable, any other NRC licensed NUHOMS® transfer or transportation cask is acceptable for use with the standardized NUHOMS® system subject to an application specific safety evaluation.

The third configuration of the transfer cask, designated as OS197FC/OS197H FC, is a modified version of OS197/OS197H equipped with a modified lid to allow air circulation through the TC/DSC annulus, and is described in Appendix P.

A fourth configuration of the transfer cask, designated as OS197L TC, is a lighter version of the OS197L TC. It is designed for use by facilities with a crane capacity of 75 tons and is described in Appendix W.

Once inside the HSM, the DSC and its payload of SFAs is in passive dry storage. Safe storage in the HSM is assured by a natural convection heat removal system, and massive concrete walls and slabs which act as biological radiation shields. The storage operation of the HSMs and DSCs is totally passive. No active systems are required.

3.1.2.1 Handling and Transfer Equipment

The handling and transfer equipment required to implement the NUHOMS® system includes a cask handling crane at the reactor fuel pool, a cask lifting yoke, a transfer cask, a cask support skid and positioning system, a low profile heavy haul transport trailer and a hydraulic ram system. This equipment is designed and tested to applicable governmental and industrial standards and is maintained and operated according to the manufacturer's specifications. Performance criteria for this equipment, excluding the fuel/reactor building cask handling crane, is given in the following sections. The criteria are summarized in Table 3.1-7.

On-Site Transfer Cask: The on-site transfer cask used for the NUHOMS® system has certain basic features. The DSC is transferred from the plant's fuel pool to the HSM inside the transfer cask. The cask provides neutron and gamma shielding adequate for biological protection at the outer surface of the cask. The cask is capable of rotation, from the vertical to the horizontal position on the support skid. The cask has a top cover plate which is fitted with a lifting eye allowing removal when the cask is oriented horizontally. The cask is capable of rejecting the design basis decay heat load to the atmosphere assuming the most severe ambient conditions postulated to occur during normal, off-normal and accident conditions. For the NUHOMS®-24P, 24PHB DSC or the NUHOMS®-24PT2 DSC, the standardized transfer cask has a cylindrical cavity of 1.73m (68 inches) diameter and 4.75m (186.75 inches) in length and a maximum dry payload capacity of 42,321 Kg (93,300 pounds). For the NUHOMS®-52B or NUHOMS®-61BT, the standardized transfer cask is fitted with an extension collar to accommodate the longer BWR DSC and fuel. Alternatively, the OS197 and OS197H transfer casks with a full length cavity of 5.0m (196.75 inches) may be used for the NUHOMS®-24P, 24PHB (with cask spacer), NUHOMS®-52B, NUHOMS®-61BT DSCs, NUHOMS®-24PT2 DSC (with cask spacer) or NUHOMS®-32PT DSC (with cask spacer). The OS197 and OS197H casks can carry a maximum dry payload of 44,100 kg (97,250 lb) and 52,600 kg (116,000 lb), respectively. These payload capacities are based on a transfer cask weight of 111,250 pounds. The cask and the associated lifting yoke are designed and operated such that the consequences of a postulated drop satisfy the current 10CFR50 licensing bases for the vast majority of plants. *Appendix W provides a detailed description of the OS197L transfer cask.*

The NUHOMS® transfer cask is designed to meet the requirements of 10CFR72 (3.6) for normal, off-normal and accident conditions. The NUHOMS® transfer cask is designed for the following conditions:

summarizes the stress criteria for DSC non-pressure boundary components (except for support rods). The spacer discs are designed using the component stress criteria from ASME Code Subsection NB (for Service Levels A, B, C) and ASME Code Appendix F (Service Level D, Elastic and Elastic/Plastic analysis). The support rods are designed using the criteria of ASME Code Subsection NF for linear type component supports (for Service levels A, B, C) and ASME Code Appendix F (for Service Level D stress or stability criteria). For Service Level A the limits of NF-3322 are used. For Service Levels B and C the factors of Table NF-3523(b)-1 are used. For Service Level D, the criteria from Appendix F is used. The 24P guide sleeves and oversleeves are designed using the stress criteria of ASME Code Subsection NB and ASME Code Appendix F, and the stability criteria of Subsection NF and Appendix F, as applicable. All non-pressure boundary partial penetration and fillet welds are designed using the stress criteria of ASME Code Subsection NF and ASME Code Appendix F.

Other components of the DSC include the support ring, the lifting lugs, the shield plugs, the grapple ring and grapple ring support plate, and all welds associated with these components. The support ring is designed using the ASME Code Subsection NB criteria. The associated weld to the DSC shell is a partial penetration weld evaluated to the ASME Code Subsection NF and Appendix F requirements, as applicable. The lifting lugs and associated welds are designed using Subsection NF allowables. The grapple ring, grapple ring support plates and associated welds are designed using the ASME Code Subsection NB design criteria. The shield plugs are non-pressure boundary components and need only to maintain their structural integrity. The shield plugs are evaluated using Subsection NB primary stress limits. The shield plugs stiffener welds in the long cavity basket are full penetration welds designed to Subsection NF.

3.2.5.3 On-site Transfer Cask

The on-site transfer cask is a non-pressure retaining component which conservatively is designed by analysis to meet the stress allowables of the ASME Code (3.14) Subsection NC for Class 2 components. The cask is conservatively designed by utilizing linear elastic analysis methods. The load combinations considered for the transfer cask normal, off-normal, and postulated accident loadings are shown in Table 3.2-7. Service Levels A and B allowables are used for all normal operating and off-normal loadings. Service Levels C and D allowables are used for load combinations which include postulated accident loadings. Allowable stress limits for the upper lifting trunnions and upper trunnion sleeves are conservatively developed to meet the requirements of ANSI N14.6-1993 (3.37) for a non-redundant lifting device for all cask movements within the fuel/reactor building. The maximum shear stress theory is used to calculate principal stresses in the cask structural shell. The appropriate dead load and thermal stresses are combined with the calculated drop accident scenario stresses to determine the worst case design stresses. The transfer cask structural design criteria are summarized in *Table 3.2-11* and *Table 3.2-12*. The transfer cask accident analyses are presented in Section 8.2. The effects of fatigue on the transfer cask due to thermal cycling are addressed in Section 8.2.10. Appendices K, L, *M* and N address the effects of handling the NUHOMS®-61BT, -24PT2, *32PT* and 24PHB DSC in the transfer cask, respectively. The effects of handling *the licensed (≤24.0 kW) DSCs (24P, 52B, 61BT, 24PT2, 32PT and 24PHB)* in the *OS197L TC* are addressed in Appendix *W*.

OR

- The coarse and fine aggregates to be one or a mix of the following: limestone, dolomite, marble, basalt, granite, rhyolite, gabbro. Determination of the aggregate constituents shall be done in accordance with the same methods described above.

For all PWR and BWR HSM components the above aggregate requirements can be waived if the criteria established by Appendix D for strength reduction is further validated by strength tests performed on the actual concrete mix to be used for construction subjected to elevated temperatures established by the design. Alternatively the minimum compressive strength requirements for the concrete may be increased to account for an appropriate reduction in concrete strength. This approach removes the need to reevaluate the HSM design analyses.

4.2.3.3 <u>On-Site Transfer Cask</u>

The on-site transfer cask is a nonpressure-retaining cylindrical vessel with a welded bottom assembly and bolted top cover plate. The transfer cask is designed for on-site transport of the DSC to and from the plant's spent fuel pool and the ISFSI as shown in Figure 4.2-10 and Figure 4.2-11. The transfer cask provides the principal biological shielding and heat rejection mechanism for the DSC and SFAs during handling in the fuel/reactor building, DSC closure operations, transport to the ISFSI, and transfer to the HSM. The transfer cask also provides primary protection for the loaded DSC during off-normal and drop accident events postulated to occur during the transport operations. The NUHOMS® transfer cask is illustrated in Figure 1.3-6. Drawings of the transfer cask are contained in Appendix E.

The transfer cask may be fitted with a shielded collar to extend the cask cavity length to accommodate the longer NUHOMS®-52B DSC as shown in Figure 4.2-12. The collar is a heavy forged steel ring with a bolt circle to match that of the transfer cask top flange and cover plate. Alternatively, a NUHOMS® transfer cask with a longer cavity length may be used for DSCs with PWR (with cask spacer) or BWR fuel.

The transfer cask to be used by a utility may be any one of the designs documented in Appendix E, including the standardized cask, OS197, OS197H *or OS197L*. The licensee may also use any other previously NRC reviewed and approved design such as the transfer cask designs documented in the NUHOMS®-24P Topical Report [4.13], the Oconee Nuclear Station ISFSI Safety Analysis Report [4.16], and the Calvert Cliffs ISFSI Safety Analysis Report [4.17], provided it is demonstrated prior to use that the limiting conditions of use as described in CoC 1004 can be met.

The transfer cask is constructed from three concentric cylindrical shells to form an inner and outer annulus. These are filled with lead and a neutron absorbing material. The two inner shells are welded to heavy forged ring assemblies at the top and bottom ends of the

5. OPERATION SYSTEMS

This Chapter presents the operating procedures for the standardized NUHOMS® system described in previous chapters and shown on the drawings in Appendix E for the 24P and 52B systems. The operating procedures for the 61BT, 24PT2, 32PT, 24PHB and 24PTH systems are described in Appendices K. L, M, N and P, respectively. The procedures include preparation of the DSC and fuel loading, closure of the DSC, transport to the ISFSI, DSC transfer into the HSM Model 80 and Model 102, monitoring operations, and DSC retrieval from the HSM Model 80 and Model 102. The operating procedures involving the HSM-H, HSM Model 152, and HSM Model 202 are described in Appendices P, R, and V, respectively. The standardized NUHOMS® transfer equipment, and the existing plant systems and equipment are used to accomplish these operations. Procedures are delineated here to describe how these operations are to be performed and are not intended to be limiting. Standard fuel and cask handling operations performed under the plant's 10CFR50 operating license are described in less detail. Existing operational procedures may be revised by the licensee and new ones may be developed according to the requirements of the plant, provided that the limiting conditions of operation specified in Technical Specifications, Functional and Operating Limits of the NUHOMS® CoC (5.6) are not exceeded.

Appendix W.8 provides a description of the changes in operational sequences when each of the licensed DSCs ≤24.0 kW (24P, 52B, 61BT, 24PT2, 32PT and 24PHB) are transferred in an OS197L TC.

5.1 Operation Description

The following sections outline the typical operating procedures for the standardized NUHOMS® system. These generic NUHOMS® procedures have been developed to minimize the amount of time required to complete the subject operations, to minimize personnel exposure, and to assure that all operations required for DSC loading, closure, transfer, and storage are performed safely. Plant specific ISFSI procedures are to be developed by each licensee in accordance with the requirements of 10CFR72.24 (h) and the guidance of Regulatory Guide 3.61 (5.7). The generic procedures presented here are provided as a guide for the preparation of plant specific procedures and serve to point out how the NUHOMS® system operations are to be accomplished. They are not intended to be limiting, in that the licensee may judge that alternate acceptable means are available to accomplish the same operational objective.

The generic operating procedures presented herein also do not address the use of auxiliary equipment which is optional or represents a level of detail which a licensee may choose to implement based on licensee preference. Examples of such auxiliary items are the Neutron Shield Overflow Tank (used with OS197 or OS197H Cask only), TC/DSC Annulus Pressurization Tank, and the Shield Plug Restraints.

7. RADIATION PROTECTION

The analysis presented in this Chapter is specifically applicable to the *storage of the* NUHOMS®-24P and –52B *DSCs* in the HSM Model 80 and Model 102 *and transfer in the standardized cask, OS197 or OS197H TCs*. Appendices J, K and L provide similar evaluations for the NUHOMS®-24P long cavity, -61BT and -24PT2 systems, respectively. Appendices R and V provide an evaluation of these various DSCs stored in the HSM Model 152 and HSM Model 202, respectively.

Shielding analysis of the licensed DSCs (≤24.0 kW) (24P, 52B, 61BT, 24PT2, 32PT and 24PHB) when transferred in OS197L TC are provided in Appendix W.

7.1 Ensuring That Occupational Radiation Exposures Are As-Low-As-Reasonably-Achievable (ALARA)

7.1.1 Policy Considerations

The licensee's existing radiation safety and ALARA policies for the plant should be applied to the ISFSI. The ALARA program should follow the general guidelines of Regulatory Guides 1.8, 8.8, 8.10 and 10CFR20. ISFSI personnel should be trained and updated on ALARA practices and dose reduction techniques. Implementation of ISFSI systems and equipment procedures should be reviewed by the licensee to ensure ALARA exposure during all phases of operations, maintenance and surveillance.

7.1.2 Design Considerations

The design of the NUHOMS® DSC and HSM comply with 10CFR72 ALARA requirements. Features of the NUHOMS® system design that are directed toward ensuring ALARA are:

A. Thick concrete walls and roof on the HSM to minimize the on-site and off-site dose contribution from the ISFSI.

B. A thick shield plug on each end of the DSC to reduce the dose to plant workers performing drying and sealing operations, and during transfer and storage of the DSC in the HSM.

C. Use of a heavy shielded transfer cask for DSC handling and transfer operations to ensure that the dose to plant and ISFSI workers is minimized.

D. Fuel loading procedures which follow accepted practice and build on existing experience.

E. A recess in the HSM access opening to dock and secure the transfer cask during DSC transfer so as to reduce direct and scattered radiation exposure.

8. ANALYSIS OF DESIGN EVENTS

In previous chapters of this SAR, the features of the standardized NUHOMS® system which are important to safety have been identified and discussed. The purpose of this chapter is to present the engineering analyses for normal and off-normal operating conditions, and to establish and qualify the system for a range of credible and hypothetical accidents. As stated in Chapter 1, the analyses presented in this section are applicable to the standard length 24P and 52B canisters. An evaluation of the long cavity 24P canister, for the same design criteria, is provided in Appendix H and J. Appendices K, L, M, N and P provide the evaluation for the NUHOMS®-61BT 24PT2, 32PT, 24PHB and 24PTH DSC, respectively. Also, as noted in Chapter 1, the structural, thermal, and shielding evaluations for the HSM-H, HSM Model 152, and HSM Model 202 are provided in Appendices P, R, and V, respectively. Evaluations for other canisters and modules may be included as additional appendices at a later time.

The structural and thermal analysis of the licensed DSCs (≤24.0 kW) (24P, 52B, 61BT, 24PT2, 32PT and 24PHB) when transferred in OS197L TC are provided in Appendix W.3 and W.4, , respectively.

In accordance with NRC Regulatory Guide 3.48 (8.1), the design events identified by ANSI/ANS 57.9-1984, (8.2) form the basis for the accident analyses performed for the standardized NUHOMS® system. Four categories of design events are defined. Design event Types I and II cover normal and off-normal events and are addressed in Section 8.1. Design event Types III and IV cover a range of postulated accident events and are addressed in Section 8.2. These events provide a means of establishing that the NUHOMS® system design satisfies the applicable operational and safety acceptance criteria as delineated herein.

It is important to note that, given the generic nature of this SAR, the majority of the analyses presented throughout this chapter are based on bounding conservative assumptions and methodologies, with the objective of establishing upper bound values for the responses of the primary components and structures of the standardized NUHOMS® system for the design basis events. Because of the conservative approach adopted herein, the reported temperatures and stresses in this chapter envelope the actual temperatures or states of stress for the various operating and postulated accident conditions. More rigorous and detailed analyses and/or more realistic assumptions and loading conditions would result in temperatures and states of stress which are significantly lower than the reported values.

8.1 Normal and Off-Normal Operations

Normal operating design conditions consist of a set of events that occur regularly, or frequently, in the course of normal operation of the NUHOMS® system. These normal operating conditions are addressed in Section 8.1.1. Off-normal operating design conditions are events that could occur with moderate frequency, possibly once during any calendar year of operation. These off-

This appendix contains the following items:

E.1 Drawings for NUHOMS® Dry Shielded Canisters(1)

- E.1.1 Standardized NUHOMS®-24P DSC Drawings
- E.1.2 Standardized NUHOMS®-52B DSC Drawings
- E.1.3 Standardized NUHOMS®-24P Long Cavity DSC Drawings

E.2 Drawings for NUHOMS® Horizontal Storage Module(2) (HSM Model 80 and Model 102 only)

E.3 Drawings for NUHOMS® On-Site Transfer Cask(3)

(1) The drawings for the NUHOMS®-61BT, 24PT2 and 32PT DSCs are contained in Appendices K, L and M, respectively. The drawings for the NUHOMS®-24PHB DSCs are contained in Appendices E and N. The drawings for the NUHOMS®-24PTH system (24PTH DSC, HSM-H and OS197FC transfer cask) are contained in Appendix P.

(2) The drawings for the NUHOMS® HSM Model 152 are contained in Section R.1.5 of Appendix R.

(3) *The drawings for the NUHOMS® OS197L transfer cask are contained in Section W.1.5 of Appendix W.*

APPENDIX W

NUHOMS® OS197L TRANSFER CASK

TABLE OF CONTENTS

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LIST OF FIGURES

W.1 General Description

Appendix W to the NUHOMS® Updated Final Safety Analysis Report (UFSAR) addresses the Important to Safety aspects of adding the OS197L TC to the Standardized NUHOMS® system described in the UFSAR. The OS197L TC is added to the UFSAR as an alternative to the OS197 and OS197H TCs. The primary reason for adding the OS197L TC design is to include a transfer cask that can be used by facilities with a crane capacity of 75 tons.

The OS197L TC accommodates both PWR (187") and BWR (197") length Dry Shielded Canisters (DSCs), including the 24P, 52B, 24PT2, 61BT, 32PT and 24PHB DSCs.

The format of this Appendix follows the guidance provided in NRC Regulatory Guide 3.61 [1.1]. The analyses presented in this Appendix demonstrate that the OS197L TC system meets all the requirements of 10 CFR 72 [1.2].

Several sections of this Appendix have been identified as "No Change." For these sections, the description or analysis presented in the corresponding sections of the UFSAR for the Standardized NUHOMS® system is also applicable to the OS197L TC. In addition, tables and figures presented in the UFSAR which remain unchanged due to the addition of the OS197L TC to the Standardized NUHOMS® system are not repeated in this Appendix. Table W.1-2 provides a summary of the sections of the main body of the UFSAR applicable to the OS197 TC and addresses the impact of the OS197L TC on these sections.

Note: References to sections or chapters within this Appendix are identified with a prefix W (e.g., Section W.2.3 or Chapter W.2). References to sections or chapters of the UFSAR outside of this Appendix (i.e., main body of the UFSAR) are identified with the applicable UFSAR section, chapter number or Appendix number (e.g., Section 2.3, Chapter 2 or Appendix K). The references used in this Appendix are identified as [X.X] (e.g., [1.1] is reference 1.1 at the end of Chapter W.1).

OS197 and OS197H TCs in the remainder of this Appendix will be referred to as OS197 TC.

W.1.1 Introduction

As stated in Section 1.2.1, the body of this UFSAR is dedicated to three on-site transfer cask types: the Standard cask, NUHOMS®-OS197 and NUHOMS®-OS197H TCs. The purpose of this Appendix is to provide the safety analysis of the design of a fourth type of on-site transfer cask, designated as the NUHOMS® OS197L TC, for use with the standardized NUHOMS® system.

W.1.2 General Description of the NUHOMS® OS197L TC

The 68 metric ton (Te) (75 tons) OS197L TC on-site transfer cask is designed to accommodate plants whose crane capacity can not accommodate the use of the 94.6 Te (104.25 tons) OS197 TC or the 113.4 Te (125 Tons) OS197H TC cask for fuel transfer. The major differences between the OS197L TC and the OS197/OS197H casks are:

- Reduced cask weight
  - No lead shielding (one 2.68" nominal thickness steel shell instead of a combination of a 0.5" nominal thickness steel inner liner, 3.5" nominal thickness lead shield and 1.5" nominal thickness steel structural shell)
- One piece solid trunnion configuration for the upper and lower cask trunnions
- Two piece neutron shield (inner and outer shell of 1/4" nominal thickness versus an outer shell of 3/16" nominal thickness)

The OS197L TC key design parameters are compared to the OS197 TC in Table W.1-1.

The OS197L TC used in the NUHOMS® system provides shielding and protection from potential hazards during the DSC fuel loading/unloading operations and transfer to the HSM. The design and configuration of the OS197L TC is a modified version of the NRC approved OS197 and OS197H TCs described in Section 1.3.2.1 of the UFSAR and is limited to on-site use under 10CFR72. The OS197L TC can be configured to meet a gross weight limit of 68 Te (75 tons).

Figure W.1-1 provides an overview of the OS197L TC. The OS197L TC configuration also requires the use of additional shielding in the decontamination area (see Figure W.1-2) and on the skid/trailer (see Figure W.1-3).

W.1.2.1.1 <u>Transfer Equipment</u>

Transport Trailer: The NUHOMS® OS197L TC transport trailer consists of a heavy industrial trailer with a payload capacity of 136 Te (150 tons), including the skid and loaded cask. The OS197L TC transport trailer is the same as the one shown in Figure 1.3-7 of the UFSAR.

Cask Support Skid: The OS197L TC support skid differs from the OS197 TC support skid shown in UFSAR Figure 1.3-8 as described below:

1. The OS197L TC support skid has permanently mounted 2.5" thick side shielding and accommodates an additional 3" thick side shielding bolted to the permanent shielding when transferring the OS197L TC.
2. The OS197L TC also has a 2.5" shielding inner top cover and an additional 3" shielding outer top cover to shield the upper sections of the cask.

The OS197L TC support skid utilized for the standardized NUHOMS® system is illustrated in Figure W.1-3.

Hydraulic Ram: The high capacity hydraulic ram system is similar to the hydraulic ram system described in the UFSAR. The capacity of this ram is increased in order to increase the ram capacity margin (and to accommodate other future DSC designs). There is no change to the maximum ram forces allowed (80 kips) during system operation.

A picture of the OS197L TC system is provided in Figure W.1-4.

W.1.2.2 Operational Features

The primary operations with the OS197L TC (in sequence of occurrence) for the NUHOMS® system are the same as the systems operation described in Section 1.3.3 of the UFSAR except as noted below for operations 8 and 13 (of Section 1.3.3):

Lifting Cask from Pool: The loaded OS197 TC is lifted out of the pool and placed (in the vertical position) in a decontamination area shield on the drying pad in the decon pit. Prior to the lift, the DSC water is pumped out and a helium or nitrogen gas blanket is provided for the fuel assemblies. The OS197 TC neutron shield and the TC/DSC annulus is maintained full.

Placement of Cask on Transport Trailer Skid: The OS197 TC is then lifted onto the cask support skid. The neutron shield may be drained during this operation if water is maintained in the DSC/cask annulus with an interim cover. The plant's crane is used to downend the cask from a vertical to a horizontal position. Inner top shielding is added to the skid and the cask is also covered with an additional outer top shielding. The outer top additional shielding is to be installed inside the fuel handling building if the floor loads can accommodate it (if floor loading is a concern, the additional shielding may be placed on the skid outside the fuel handling building). The neutron shield is filled, if previously drained, prior to draining of the annulus and replacement of the interim cover with the standard cask cover. The cask is then secured to the skid and readied for the subsequent transport operations.

W.1.3 Identification of Agents and Contractors

Transnuclear, Inc. (TN) provides the design, analysis, licensing support and quality assurance for the NUHOMS® OS197L TC. Fabrication of the NUHOMS® OS197L TC is done by one or more qualified fabricators under TN's quality assurance program described in Chapter W.13. This program is written to satisfy the requirements of Subpart G of 10CFR72, [1.2] and covers control of design, procurement, fabrication, inspection, testing, operations and corrective action.

TN provides specialized services for the nuclear fuel cycle that support transportation, storage and handling of spent nuclear fuel, radioactive waste and other radioactive materials. TN is the holder of NUHOMS® CoC 1004 [1.3].

W.1.4 Generic Cask Arrays

No change.

W.1.5 Supplemental Data

The following TN drawings are enclosed:

1. NUHOMS® OS197L Onsite Transfer Cask, Cask Body Assembly, Drawing NUH-03-8008-SAR.

2. NUHOMS® OS197L Onsite Transfer Cask, Light Neutron Shield Assembly, Drawing NUH-03-8009-SAR.

3. NUHOMS® OS197L Onsite Transfer Cask, OS197L Main Assembly, Drawing NUH-03-8010-SAR.

W.1.6 References

[1.1] U.S. Nuclear Regulatory Commission, Regulatory Guide 3.61, Standard Format and Content for a Topical Safety Analysis Report for a Spent Fuel Dry Storage Cask, February, 1989.

[1.2] 10CFR72, Rules and Regulations, Title 10, Chapter 1, Code of Federal Regulations - Energy, U.S. Nuclear Regulatory Commission, Washington, D.C., "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste."

[1.3] NUHOMS® Certificate of Compliance for Dry Spent Fuel Storage Casks, Certificate Number 1004, Amendment No. 8, December 2005 (Docket 72-1004).

Figure Withheld Under 10 CFR 2.390

R FCN 721004-321	3/15/06
DESCRIPTION	DATE

TRANSNUCLEAR
AN AREVA COMPANY

FINAL SAFETY ANALYSIS REPORT
NUHOMS® OS197L
ONSITE TRANSFER CASK
CASK BODY ASSEMBLY

DRAWING NO.	SCALE	SHEET
NUH-03-8008-SAR	NONE	1 OF 8

Figure Withheld Under 10 CFR 2.390

MADE FROM DRAWING
NUH-03-8008, REV 0

DRAWING NO.	SHEET	REVISION	DATE
NUH-03-8008-SAR	2 OF 8	0	3/15/10

2 1 A

Figure Withheld Under 10 CFR 2.390

MADE FROM DRAWING
NUH-03-8008, REV 0

DRAWING NO.	SHEET	REVISION	
NUH-03-8008-SAR	3 OF 8	0	3/15/04

Figure Withheld Under 10 CFR 2.390

VIEW Z-Z

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NUH-03-8008-SAR	4 OF 8	0	3/15/06

2 1 A

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NUH-03-8008, REV 0

DRAWING NO.	SHEET	REVISION	
NUH-03-8008-SAR	5 OF 8	0	3/15/04

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NUH-03-8008, REV 0

DRAWING NO	SHEET	REVISION	DATE
NUH-03-8008-SAR	6 OF 8	0	3/15/06

Figure Withheld Under 10 CFR 2.390

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NUH-03-8008, REV 0

NUH-03-8008-SAR	7 OF 8	0	3/15/04

2 1 A

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NUH-03-8008, REV 0

DRAWING NO	SHEET	REVISION
NUH-03-8008-SAR	8 OF 8	0

Figure Withheld Under 10 CFR 2.390

R FCN 721004-321	3/15/06
DESCRIPTION	DATE

TRANSNUCLEAR
AN AREVA COMPANY

FINAL SAFETY ANALYSIS REPORT
NUHOMS® OS197L
ONSITE TRANSFER CASK
LIGHT NEUTRON SHIELD ASSEMBLY

DRAWING NO	SCALE	SHEET
NUH-03-8009-SAR	NONE	1 OF 6

2 1 A

Figure Withheld Under 10 CFR 2.390

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NUH-03-8009, REV 0

DRAWING NO	SHEET	REVISION	DATE
NUH-03-8009-SAR	2 OF 6	0	3/15/06

2 1

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NUH-03-8009, REV 0

DRAWING NO	SHEET	REVISION	DATE
NUH-03-8009-SAR	3 OF 6	0	3/15/06

A

2 1

Figure Withheld Under 10 CFR 2.390

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NUH-03-8009, REV 0

DRAWING NO	SHEET	REVISION	DATE
NUH-03-8009-SAR	4 OF 6	0	3/15/06

2 1 A

Figure Withheld Under 10 CFR 2.390

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NUH-03-8009, REV 0

DRAWING NO	SHEET	REVISION	SAR
NUH-03-8009-SAR	5 OF 6	0	3/15/06

Figure Withheld Under 10 CFR 2.390

MADE FROM DRAWING
NUH-03-8009, REV 0

DRAWING NO.	SHEET	REVISION	DATE
NUH-03-8009-SAR	6 OF 6	0	3/15/04

A

2 1

Figure Withheld Under 10 CFR 2.390

DESCRIPTION	DATE
TRANSNUCLEAR AN AREVA COMPANY	
FINAL SAFETY ANALYSIS REPORT NUHOMS® OS197L ONSITE TRANSFER CASK OS197L MAIN ASSEMBLY	
NUH-03-8010-SAR	NONE · 1 OF 2

Figure Withheld Under 10 CFR 2.390

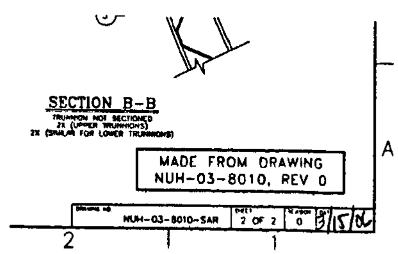


Table W.1-1
Comparison of Key Parameters of NUHOMS® OS197 Versus OS197L TCs

Characteristic	OS197 TC	OS197L TC	Same? (Yes/No) Note No.
Physical Data			
Outside Diameter	85.50"	80.36"	No (1)
Outside Length	207.22"	207.22"	Yes
Cavity Diameter	68"	68"	Yes
Cavity Length	197.75"	197.75"	Yes
Ram Access Penetration Diameter	22"	22"	Yes
Weight, Empty	106,670 lbs (includes cask top cover plate assembly and neutron shield without water)	57,400 lbs (includes cask top cover plate assembly and neutron shield without water)	No (2)
Cask Materials			
Outer Jacket	3/16" thick plate, ASTM A240, Type 304	1/4" thick plate, ASTM A240, Type 304	No (3)
Neutron Shielding	3" of Water in annulus	3" of Water in annulus	Yes
Structural Shell	1-1/2" thick plate, ASME SA-240 Type 304	2.68" thick plate, ASME SA-240 Type 304	No (4)
Gamma Shielding	3.56" thick, ASTM B29 Chemical Copper Lead	No lead shielding	No (4)
Inner Liner	1/2" thick plate, ASME SA-240 Type 304	No separate inner liner (consists of structural shell)	No (4)
Top Cover Assembly	Consists of 3" thick ASME SA-240, Type 304 structural plate with a thin 1/4" thick shell encapsulating a solid Neutron Absorbing Material (NS-3)	Consists of 3" thick ASME SA-240, Type 304 structural plate with a thin 1/4" thick shell encapsulating a solid Neutron Absorbing Material (NS-3) During downending inside the fuel building, an interim aluminum cover may be used to reduce crane loading	Yes
Top Flange	ASME SA-182, Type F304N	ASME SA-182, Type F304N	Yes
Upper Lifting Trunnion	ASME SA-564, Grade 630 steel trunnion with sleeve encapsulating a solid Neutron Absorbing Material (NS-3)	Solid monolithic Trunnion made of ASME SA-182, Type FXM-19	No
Lower Support Trunnion	ASME SA-240, Type F304 steel trunnion with sleeve encapsulating a solid Neutron Absorbing Material (NS-3)	Solid monolithic Trunnion made of ASME SA-182, Type F304	No
Canister Rails	ASTM A240 Nitronic 60	ASTM A240 Nitronic 60	Yes
Bottom End Plate	2" thick, ASME SA-240, Type 304	2" thick, ASME SA-240, Type 304	Yes
Bottom Support Ring	ASME SA-182, Type F304N	ASME SA-182, Type F304N	Yes
Ram Access Penetration Ring	ASME SA-182, Type F304N	ASME SA-182, Type F304N	Yes
Cask Payload			
DSC Type	24P, 52B, 61BT, 24PHB, 24PT2, 32PT	24P, 52B, 61BT, 24PHB, 24PT2, 32PT	Yes
Heat Load	24 kW	24 kW	Yes

Notes:

1. The diameter of the OS197L TC is smaller, reflecting the reduced radial shielding. The 2.68" thick SS structural shell replaces the combined thickness of ½" of inner liner, 3.50" of lead, and 1.50" of structural shell, a reduction of approximately 5.5" diametrical.
2. The reduced weight of the OS197L TC reflects the reduced radial shielding. Utilizing the yoke (approximate weight 5,000 lbs.) results in an estimated maximum hook weight of 148-149 kips.
3. The outer panel of the neutron shield is increased in thickness to stiffen the assembly.
4. The reduced shielding is a result of the lead shielding that is eliminated and the combined inner liner and structural shell.

Table W.1-2
OS197L TC UFSAR Sections Affected

Seq	Section/Page	Description	OS197L
1	1.1(3)/1.1-3	Description of TC for transport of DSC	No Change
2	Figures 1.1-2/1.1-6	NUHOMS® System Components including TC	See Section W.1
3	Figures 1.1-3/1.1-7	NUHOMS® System Components including TC	See Section W.1
4	1.2.3/1.2-3	Description of Operating and Handling Systems including TC	Changes addressed in Section W.1.
5	Table 1.2-2/1.2-8	Key Design Parameters for NUHOMS® System	See Section W.1
6	Table 1.2-3/1.2-9	NUHOMS® System Operations Overview	See Section W.8
7	Section 1.3.2.1/1.3-3	Description of On-Site TC	See Section W.1
8	Section 1.3.2.2/1.3-4	Description of Transfer Equipment (Trailer and Skid)	See Section W.1
9	Table 1.3-1/1.3-10	Components, Structures and Equipment for the Standardized NUHOMS® System	See Section W.1
10	Figure 1.3-6/1.3-18	NUHOMS® On-Site TC	See Section W.1
11	Figure 1.3-8/1.3-20	Cask Support Skid for NUHOMS® System	See Section W.1
12	Figure 1.3-10/1.3-22	NUHOMS® System Operational Overview	See Section W.1
13	2.0	Site Characteristics	No Change
14	3.1.2.1/3.1-4	On-Site Transfer Cask	No change to loading conditions See Section W.1 for OS197L description.
15	Table 3.1-7/3.1-13	NUHOMS® Transfer Equipment Criteria	No Change
16	3.2.5.3/3.2-7	On-Site Transfer Cask Load Combinations and Structural Design Criteria	No Change to load combinations or criteria. See Section W.3 for OS197L structural results
17	Table 3.2-1/3.2-11	Summary of NUHOMS® Component Design Loadings	No Change
18	Table 3.2-7/3.2-20	On-Site Transfer Cask Load Combinations and Service Levels	No Change
19	Table 3.2-11/3.2-25	Structural Design Criteria for On-Site Transfer Cask	No Change
20	Table 3.2-12/3.2-26	Structural Design Criteria for Bolts	No Change
21	3.3.5.2/3.3-31	Radiological Protection-Shielding	See Section W.5
22	Table 3.3-1/3.3-36	NUHOMS® System Components Important To Safety	See Table W.2-1.
23	3.4.4.1/3.4-2	Classification of Structures, Components, and Systems- Transfer Cask and Yoke	No Change
24	3.4.4.2/3.4-2	Classification of Structures, Components, and Systems- Other Transfer Equipment	No Change
25	Table 3.4-1/3.4-4	NUHOMS® Major Components and Safety Classification	See Table W.2-1
26	4.2.1/4.2-1	Storage Structures – Structural Specifications	No Change
27	4.2.3.3/4.2-9	Individual Unit Description - On-Site Transfer Cask	See Sections W.1 and W.3 for trunnion load test.
28	Figure 4.2-10/4.2-21	Composite View of NUHOMS® Transfer Cask-24P	See Section W.1
29	Figure 4.2-11/4.2-22	Composite View of NUHOMS® Transfer Cask-52B	See Section W.1

Seq	Section/Page	Description	OS197L
30	Figure 4.2-12/4.2-23	NUHOMS® On-Site Transfer Cask with BWR Collar	No Change
31	Figure 4.2-15a/4.2-26a	NUHOMS® 75 Ton Transfer Cask Lifting Yoke	No Change

Table W.1-2
OS197L TC UFSAR Sections Affected

Seq	Section/Page	Description	OS197L
32	4.5/4.5-1	Transfer Cask and Lifting Hardware Repair and Maintenance	No Change
33	4.7.3.2/4.7-5	Individual Unit Descriptions - Transfer Cask	See Section W.1
34	4.7.3.8/4.7-10	Individual Unit Descriptions – Cask Support Skid	See Section W.1
35	4.9/4.9-1	ASME Code Exceptions List for the Transfer Cask	See Section W.3
36	Table 4.9-1/4.9-3	ASME Code Exceptions List for the Transfer Cask	See Section W.3
37	5.0/5.1-1	Operation Systems	See Section W.8
38	6.0	Waste Confinement and Management	No Change
39	7.1/7.1-1	Radiation Protection-design Considerations	See Section W.5
40	7.3.2.2.F/7.3-6	Transfer Cask Surface Dose Rates	See Section W.5
41	Tables 7.3-2 through 7.3-5/7.3-9 through 7.3-14	Shielding Analysis Results	See Section W.5
42	7.4.1/7.4-1	Operational Dose Assessment	See Section W.5
43	Table 7.4-1/7.4-3	NUHOMS® System Operations – Occupational Dose Calculations	See Section W.5
44	8.0	Analysis of Design Events	See: Section W.3 – Structural Section W.4 – Thermal Section W.11 – Accident
45	9.0	Conduct of Operations	No Change
46	10.0	Operating Controls and Limits	No Change
47	11.0	Quality Assurance	No Change
48	Appendix A	Details of Shielding Models of the NUHOMS® System	See Section W.5
49	Appendix B	Details of Heat Transfer Analysis of the NUHOMS® System	No Change
50	Appendix C.1	Deleted	No Change
51	Appendix C.2	Transfer Cask Drop Analysis	See Section W.3
52	Appendix C.3	Transfer Cask Side Drop Analysis	See Section W.3
53	Appendix C.4.1	DSC Fatigue Evaluation	No Change
54	Appendix C.4.2	Transfer Cask Fatigue Evaluation	No Change
55	Appendix C.5	Transfer Cask Structural Analysis NRC Question Resolutions	See Section W.3 for DBT events
56	Appendix C.6	References	No Change
57	Appendix D	Review of Concrete Behavior under Sustained elevated Temperature	No Change
58	Appendix E	Drawings	See Section W.1.5
59	Appendix F	NUHOMS® 24P Topical Report – NRC Questions	No Change

Seq	Section/Page	Description	OS197L
60	Appendix G	Deleted	No Change
61	Appendix H	NUHOMS® 24P – Long Cavity DSC Evaluation for Storing PWR fuel Without BPRA's	No Change
62	Appendix I	Deleted	No Change
63	Appendix J	NUHOMS® 24P – Long Cavity DSC Evaluation for Storing PWR fuel With BPRA's	No Change

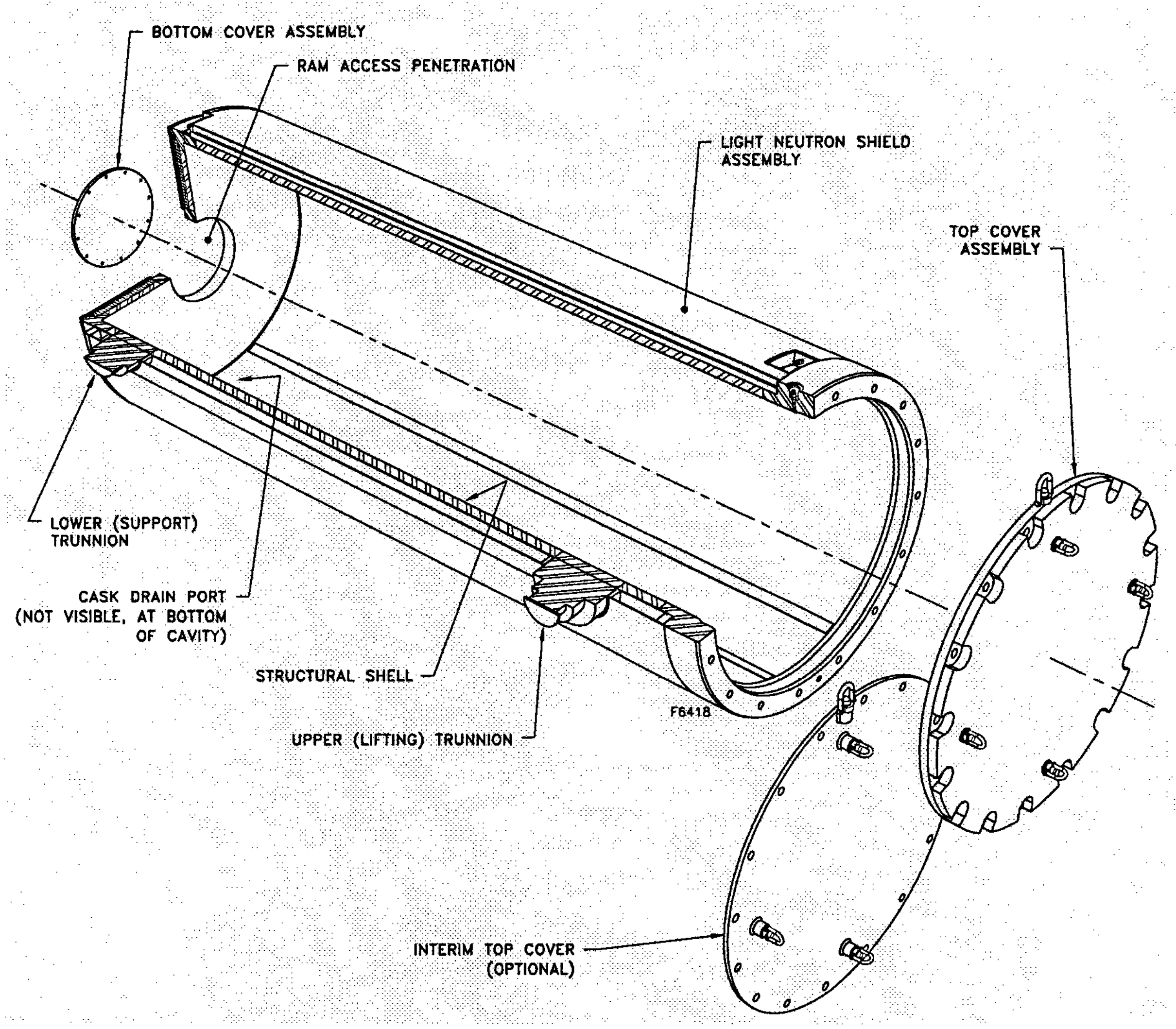


Figure W.1-1
OS197L TC Configuration

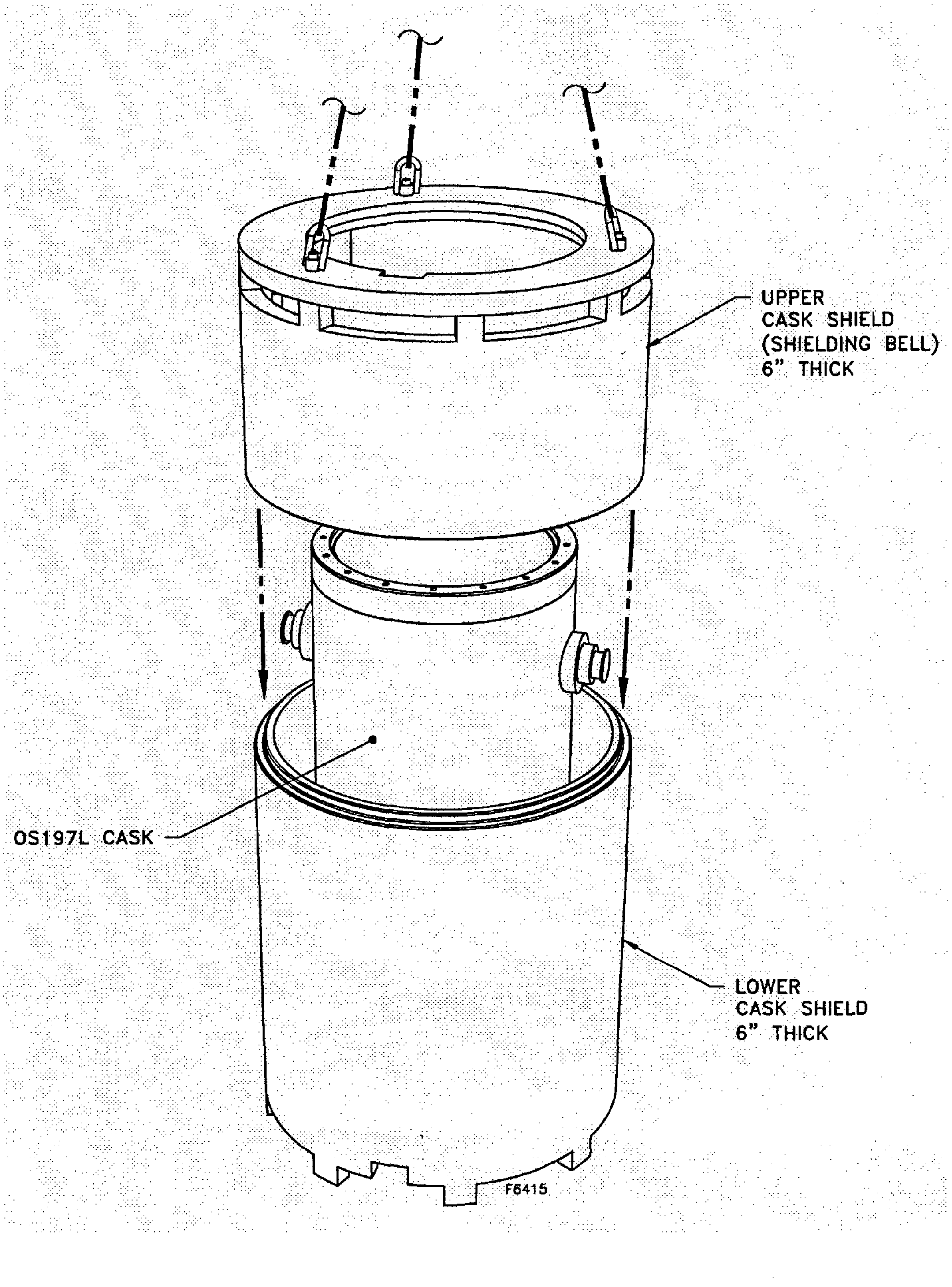


Figure W.1-2
NUHOMS® OS197L TC System Decontamination Area Shielding

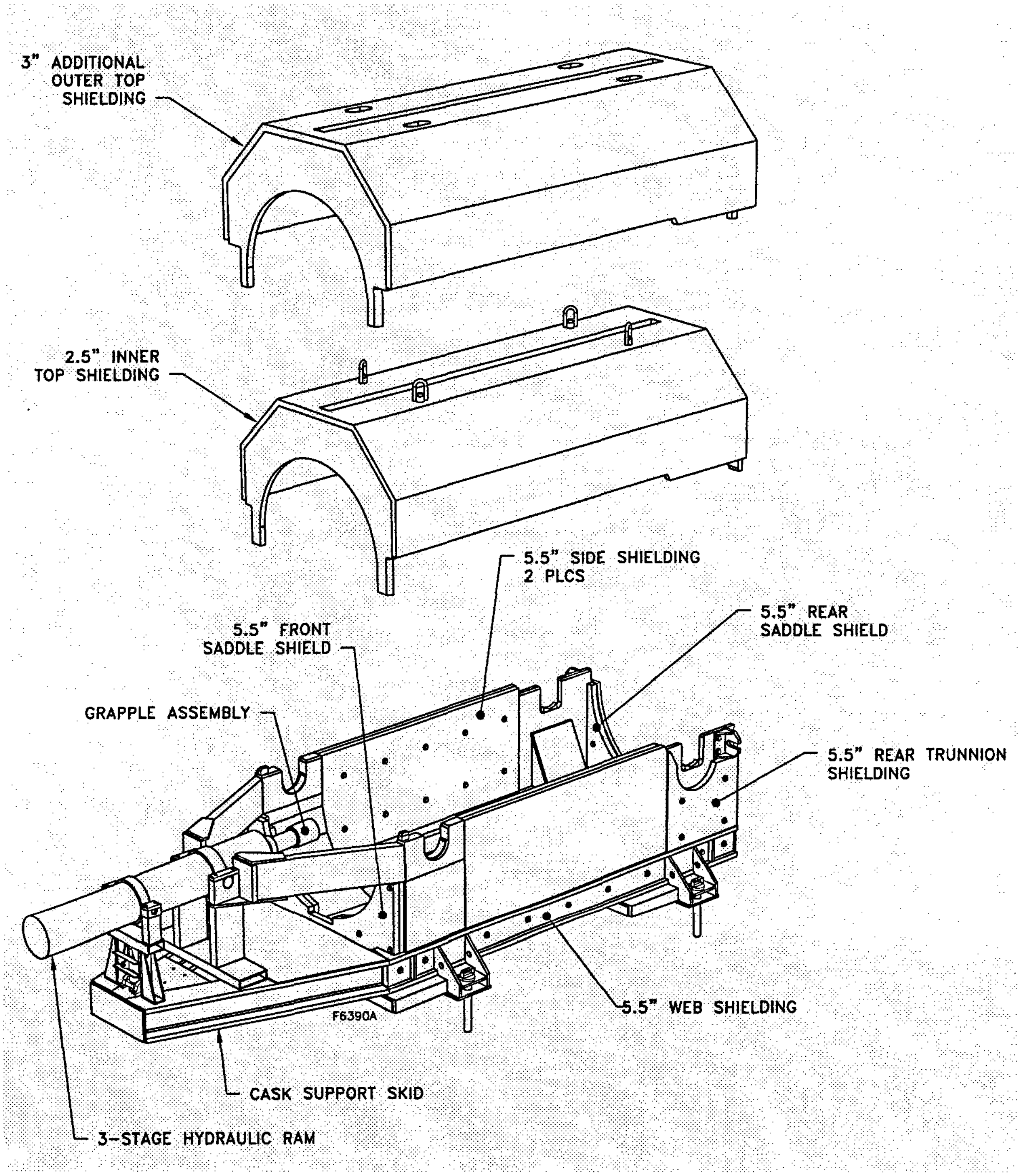


Figure W.1-3
OS197L Transfer Equipment Schematic

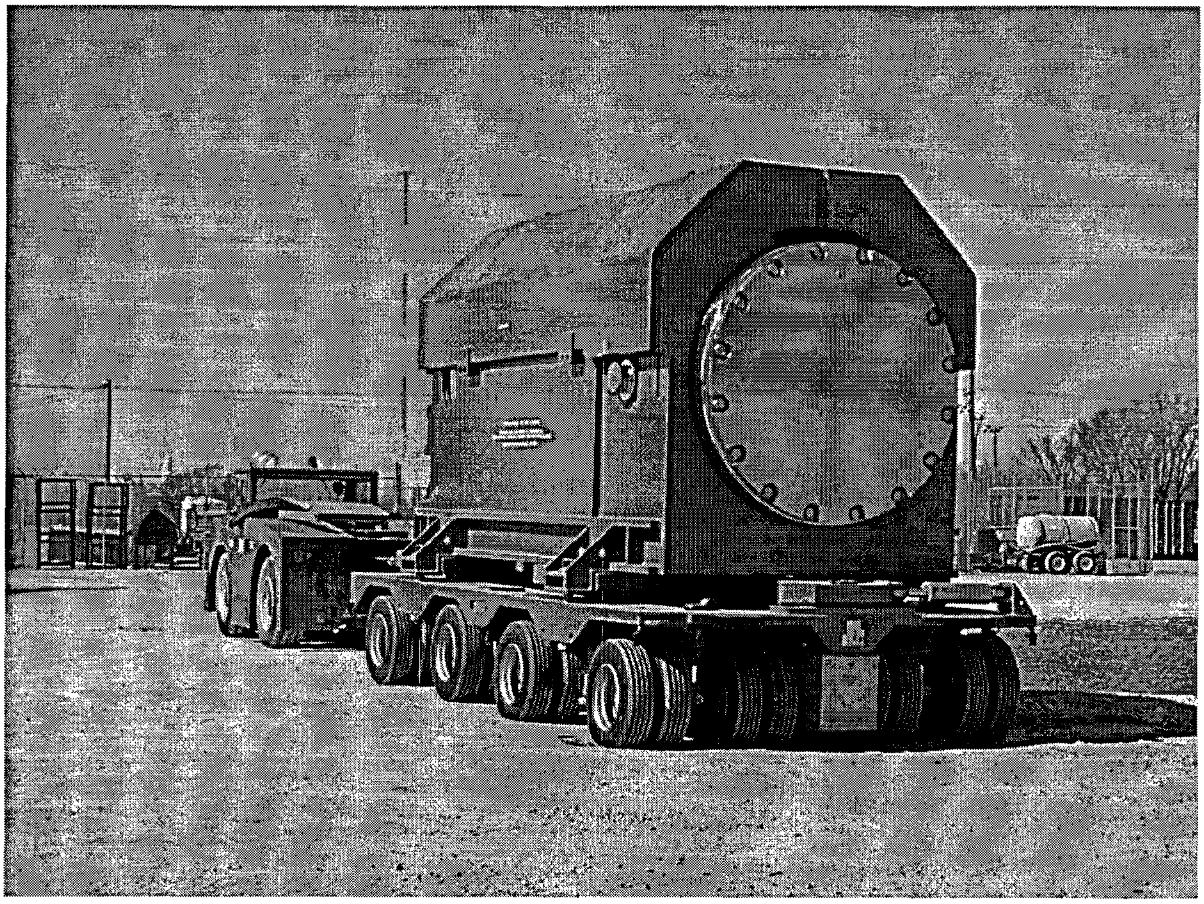


Figure W.1-4
OS197L TC System on Transfer Trailer with Shielding

W.2 Principal Design Criteria

This section provides the principal design criteria for the NUHOMS® OS197L TC System. The principal design criteria for the NUHOMS® OS197L TC are the same as the NUHOMS® OS197 TC as described in Chapter 3. Section W.2.1 presents a general description of the spent fuel to be stored. Section W.2.2 provides the design criteria for environmental conditions and natural phenomena. Section W.2.3 provides a description of the systems which have been designated as important to safety. Section W.2.4 discusses decommissioning considerations. Section W.2.5 summarizes the NUHOMS® OS197L TC design criteria.

W.2.1 Spent Fuel To Be Stored

The NUHOMS® DSCs are designed to handle a total of 24 or 32 PWR fuel assemblies and 52 or 61 BWR fuel assemblies with the same characteristics as those described in Chapter 3 (24P and 52B DSCs) and Appendices K.2 (61BT DSC), L.2 (24PT2 DSC), M.2 (32PT DSC), and N.2 (24PHB DSC).

W.2.1.1 General Operating Functions

No change.

W.2.2 Design Criteria for Environmental Conditions and Natural Phenomena

The NUHOMS® OS197L TC is handled and utilized in the same manner as the existing NUHOMS® OS197 TC System. The environmental conditions, natural phenomena and design criteria are the same as described for the NUHOMS® OS197 TC in Chapter 3. Design criteria for the NUHOMS® DSC and HSM remain unchanged.

W.2.2.1 Tornado Wind and Tornado Missiles

No change.

W.2.2.2 Water Level (Flood) Design

No change.

W.2.2.3 Seismic Design

No change.

W.2.2.4 Snow and Ice Loading

No change.

W.2.2.5 Combined Load Criteria

No change.

W.2.3 Safety Protection Systems

W.2.3.1 General

Table W.2-1 provides the safety classification of the OS197L TC system components.

W.2.3.2 Protection By Multiple Confinement Barriers and Systems

No change.

W.2.3.3 Protection By Equipment and Instrumentation Selection

No change.

W.2.3.4 Nuclear Criticality Safety

W.2.3.4.1 Control Methods for Prevention of Criticality

No change.

W.2.3.4.2 Error Contingency Criteria

No change.

W.2.3.4.3 Verification Analysis-Benchmarking

No change.

W.2.3.5 Radiological Protection

No change.

W.2.3.6 Fire and Explosion Protection

No change.

W.2.4 Decommissioning Considerations

No change.

W.2.5 Summary of NUHOMS® OS197L TC Design Criteria

The principal design criteria for the NUHOMS® OS197L TC are the same as those presented for the NUHOMS® OS197 TC in Chapter 3. The NUHOMS® OS197L TC is designed to handle a DSC loaded with PWR or BWR fuel assemblies identical to those stored in a NUHOMS® OS197 TC as described in Chapter 3 and Appendices Chapters K.2, L.2, M.2 and N.2.

Table W.2-1
OS197L TC System Components and Safety Classification

OS197L TC System Components	Safety Classification
Onsite Transfer Cask	
– Structural Shell and Cover Plates	Important to Safety[1]
– Upper and Lower Trunnions	Important to Safety[1]
– Decontamination Area Shield	Not Important to Safety[1]
– Trailer Shielding	Important to Safety[1]
Transfer Equipment	
– Cask Lifting Yoke	Safety Related[2]
– Transport Trailer/Skid	Not Important to Safety[1]
– Ram Assembly	Not Important to Safety[1]
– Dry Film Lubricant	Not Important to Safety[1]

Notes:

(1) Structures, systems and components "important to safety" are defined in 10CFR 72.3 as those features of the ISFSI whose function is (1) to maintain the conditions required to store spent fuel safety, (2) to prevent damage to the spent fuel container during handling and storage, or (3) to provide reasonable assurance that spent fuel can be received, handled, packaged, stored, and retrieved without undue risk to the health and safety of the public.

(2) Yoke and rigid or sling lifting members are classified as "Safety Related" in accordance with 10CFR50.

W.3 Structural Evaluation

This section describes the structural evaluation of the NUHOMS® OS197L Transfer Cask (TC). The OS197L TC is a modified version of the OS197/OS197H TCs (henceforth referred as the OS197 TC) designed to enable "under-the-hook" lift weights of 75 tons. The OS197L TC may be used for transfer of loaded DSCs currently licensed under CoC 1004 (24P, 52B, 61BT, 24PT2, 32PT and 24PHB) [3.1]. The structural evaluation for the OS197L TC is based on the OS197 TC evaluations documented in Chapter 8, and additional evaluations as described in Appendices K, L, M and N for payloads associated with the 61BT, 24PT2, 32PT and 24PHB DSCs, respectively. The additional evaluations provided in this section address specific design differences between the OS197L TC and the OS197 TC.

W.3.1 OS197L TC Description

The specific design differences in the OS197L TC relative to OS197 TC are summarized below:

- The 1.5" thick structural shell and the 0.5" thick inner liner (both SA-240 stainless steel) are replaced with a single thicker 2.68" thick shell of the same material. This represents an increase in the TC shell structural capacity relative to the OS197 TC.
- The encapsulated 3.56" thick lead thickness in the OS197 TC is eliminated to achieve the desired weight reduction.
- A neutron shield assembly is provided with the inner and outer shells made from ¼" thick plate material instead of a neutron shield assembly that is integral to the structural shell on the inside and a 3/16" thick outer shell. The neutron shield materials (type 304), total annulus water thickness of 3" and the configuration of the internal stiffening elements remain unchanged.
- The two-piece upper trunnions assemblies made from SA-564 Type 630 steel trunnion and welded into a forged Type 304 steel trunnion sleeve with encapsulated NS-3 for the OS197 TC are replaced with one solid trunnion design made from SA-182 Type FXM-19 stainless steel. This modified trunnion design results in a stronger trunnion as it eliminates the SA564, Type 630 to SA 240, Type 304 weld.
- The two-piece lower trunnions made from Type 304 stainless with encapsulated NS-3 are replaced with solid Type 304 forgings.

Specific evaluations are performed to address the modified OS197L TC trunnion configuration. The evaluations also address the effect on local shell stresses. Thermal stresses of the cask are also evaluated. All other structural analyses for the OS197 TC bound the OS197L TC because the cask structural shell capacity of the OS197L TC is higher than that provided by the OS197 and the top and bottom forging assemblies are unchanged.

W.3.2 Design Criteria

The structural design criteria for the OS197L TC are the same as that applicable to the OS197 TC as summarized in Chapter 3. Similar to the OS197 TC, the OS197L TC is designed to meet the stress allowables of the ASME Code [3.2] Subsection NC for Class 2 components. The OS197 TC criteria summarized in Table 3.2-1 (component design loadings, as applicable), Table 3.2-7 (load combinations), Table 3.2-11 (stress criteria) and Table 3.2-12 (bolts design criteria) are applicable to the OS197L TC. The OS197 TC ASME Code exceptions described in Table 4.9-1 is also applicable to the OS197L TC.

The test load criteria for the upper trunnions of the OS197L TC are the same as described in Section 4.2.3.3, except that the test load is conservatively equal to 300% of the design load (instead of 150% for the OS197 TC).

W.3.3 OS197L TC Weight

The dry weight of the OS197L TC is presented in Table W.3-1. The total weight of the cask, including neutron shield water, is approximately 62,000 lbs. This compares with the corresponding weight of 111,250 lbs for the OS197 TC. To provide flexibility during transfer from the decontamination area to the trailer, a 1" thick aluminum cask top lid that weights approximately 500 lbs may be used in lieu of the stainless cask top lid.

The OS197L TC weights as described in Table W.3-1 are to be used in conjunction with the payload weights for the various DSCs as described in the applicable sections in Chapter 8 (Tables 8.1-4 and 8.1-5 for the 24P and 52B DSCs), and Appendices K.3, L.3, M.3 and N.3. Each specific user is to evaluate the total under-the-hook lift weights against plant specific crane capacity limits in accordance with the requirements of 10CFR71.212.

W.3.4 Mechanical Properties of Materials

The materials properties for the OS197L TC are specified in Section 8.1, Table 8.1-3.

W.3.5 General Standards for Casks

The OS197L is fabricated using the same materials as the OS197 TC. Thus, there are no changes to the documentation in Chapter 4 and Appendices K.3, L.3, M.3 and N.3 relative to chemical and galvanic reactions.

The evaluation of the OS197L TC is based on critical lift weights of 250,000 lbs.

The thermal analysis of the OS197L along with a summary of the effect on pressures and temperatures is described in Section W.4.

W.3.6 Normal/Off-Normal Structural Evaluation

W.3.6.1 Evaluation of the One-Piece OS197L Trunnions

As discussed above, the OS197L TC upper trunnions consist of one piece solid trunnion forgings made from SA-182 Type FXM-19 stainless steel which results in a stronger trunnion design as it eliminates the SA564 (trunnion) to Type 304 (trunnion sleeve) weld and associated inconel weld.

Loads considered in the stress evaluation include lifting, transfer handling, HSM loading/unloading and seismic. The trunnions are evaluated for a maximum TC loaded weight during lifting and handling of 125 tons. For critical lifts, the maximum TC loaded weight is increased by a factor of 1.15. This results in critical lift load of 144 kips/trunnion. The trunnion evaluations are performed using hand calculations and applying the ANSI N14.6 [3.3] design criteria, including load testing. In addition, an ANSYS model of the cask, including the upper and lower trunnions, is developed to determine cask shell stresses at the trunnion-shell interface as well as within 3" to 4" away from the trunnions. These stresses are evaluated against the ASME stress criteria in Table 3.2-11. The ANSYS model of OS197L TC is shown in Figure W.3-1 and Figure W.3-2.

In addition, a thermal stress analysis of the OS197L TC with the trunnions is performed. The stresses obtained from the thermal stress analysis are combined with the mechanical stresses to determine total stresses at and near (within 3" to 4") of the trunnion-structural shell interface.

The stress distribution in the region of the upper trunnion is shown in Figure W.3-3. The structural analyses results of the OS197L TC trunnions are summarized in Table W.3-2 through Table W.3-4. The maximum stress ratio is 0.74, therefore the OS197L TC trunnion configuration has significant margin with respect to ASME/ANSI N14.6 code allowables.

W.3.6.2 Thermal Stress Analysis of OS197L

A conservative thermal profile was developed for the purpose of calculating bounding thermal stresses in the OS197L TC components. The thermal stress analysis is performed using the same three-dimensional ANSYS model shown in Figure W.3-1. The calculated maximum thermal stress intensity in the OS197L is 17.4 ksi and occurs in the structural shell away from the trunnion region. Conservatively combining this thermal stress intensity with the maximum mechanical stresses which occur in the trunnion region results in an enveloping (structural shell top and bottom forgings) combined stress intensity for normal and off-normal conditions of 37.5 ksi, which is well below the allowable stress intensity for primary plus secondary stress of 56.1 ksi at temperature.

W.3.7 Applicability of OS197 TC Accident Drop Evaluations to the OS197L TC

The fully loaded weight of the OS197L TC is bounded by the OS197 TC loaded weight. Therefore, an evaluation was performed to determine if the bounding accelerations used for the postulated accident drop evaluations of the OS197 TC remain applicable to the OS197L TC.

As reported in Section 8.2.5.1C, the g loads for the OS197 TC were determined to be 59 g for the end drop, 49 g for the side drop and 25 g for a corner drop. Based on these accelerations, bounding accelerations of 75g for the horizontal (side) and vertical drops and 25g for the corner drop were used for the OS197 TC drop evaluations. The OS197 TC evaluations are documented in Chapter 8. Using the same methodology as that described in Section 8.2.5.1C for the OS197 TC, the equivalent loads for the OS197L TC are 75 g for an end drop, 61 g for a side drop and 25 g for a corner drop. Therefore, the 75g accident drop evaluation results for the side and end drops and the 25g evaluations for the corner drop performed for the OS197 TC and reported in Section 8.2 remain bounding and are applicable to the OS197L TC. These g-loads are conservative with respect to shell stresses since the thicker OS197L TC shell has a higher load capacity than the OS197 TC shell configuration. Hence, all the cask accident drop results reported in Section 8.2, and Appendices K.3, L.3, M.3 and N.3 remain bounding and, thus, are not affected.

W.3.8 Effect of Increased OS197L Temperatures on DSC Shell and Basket Components

Table W.4-4 shows maximum temperature increases for the various DSCs allowed for transfer in the OS197L TC (24P, 52B, 61BT, 24PT2, 32PT and 24PHB). The maximum temperature increase applicable to the DSC shell and basket internals is approximately 13°F for normal conditions, 22°F for off-normal and less than 18°F for accident conditions. This magnitude increase will not appreciably affect the material properties or the allowables used for the evaluation of these DSCs as documented in Chapter 8 and Appendices K.3, L.3, M.3 and N.3. Therefore, the documented results of these DSCs are not affected due to use of the OS197L TC.

W.3.9 References

[3.1] NUHOMS® Certificate of Compliance for Dry Spent Fuel Storage Casks, Amendment No. 8, December 2005, Docket No. 72-1004.

[3.2] American Society of Mechanical Engineers, ASME Boiler and Pressure Vessel Code, Section III, Division 1, 1983 Edition with Winter 1985 Addenda.

[3.3] American National Standard, "For Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 Kg) or More," ANSI N14.6-1986, American National Standards Institute, Inc. New York, New York (1993)

Table W.3-1
Summary of OS197L TC Weights

Item	Weight (lbs)
OS197 Maximum Dry Weight including Neutron Shield Assembly and Top Cask Lid	57,400
Neutron Shield Water	4,600
Top Cask Lid	5,150

Table W.3-2
Summary of Maximum Stress Ratios for Critical Lifts

Enveloping Stress Ratios Critical Lift Load Combinations		P_m			$P_m + P_b$			$P_m + P_b + Q$			Notes
		Calculated	Allowable	Ratio	Calculated	Allowable	Ratio	Calculated	Allowable	Ratio	
Level A (A1/A2/A3)	**Cask Shell, ANSYS Evaluations / ASME Criteria**										
	at Trunnion(s)	5.86 ksi	18.7 ksi	0.31	18.1 ksi	28.1 ksi	0.65	33.8 ksi	56.10	0.60	Type 304 @ 400°F
	near Trunnion(s)(1)	4.21 ksi	18.7 ksi	0.23	16.6 ksi	28.1 ksi	0.59	28.1 ksi	56.10	0.50	
	Trunnion Evaluations, Hand Calculations (ASME–Lower; ANSI N14.6–Upper)										
		P_m			$P_m + P_b$			$P_m + P_b + Q$			ASME Criteria
	Lower Trunnion	2.55 ksi	20.3 ksi	0.13	4.81 ksi	30.5 ksi	0.16	n/a	n/a	n/a	Type F304N
		Shear Stress			Normal Stress						N14.6 Criteria
	Upper Trunnion	2.86 ksi	4.07 ksi	0.70	5.01 ksi	6.78 ksi	0.74	n/a	n/a	n/a	Type FXM-19

Table W.3-3
Summary of Maximum Stress Ratios for Level A Load Combinations

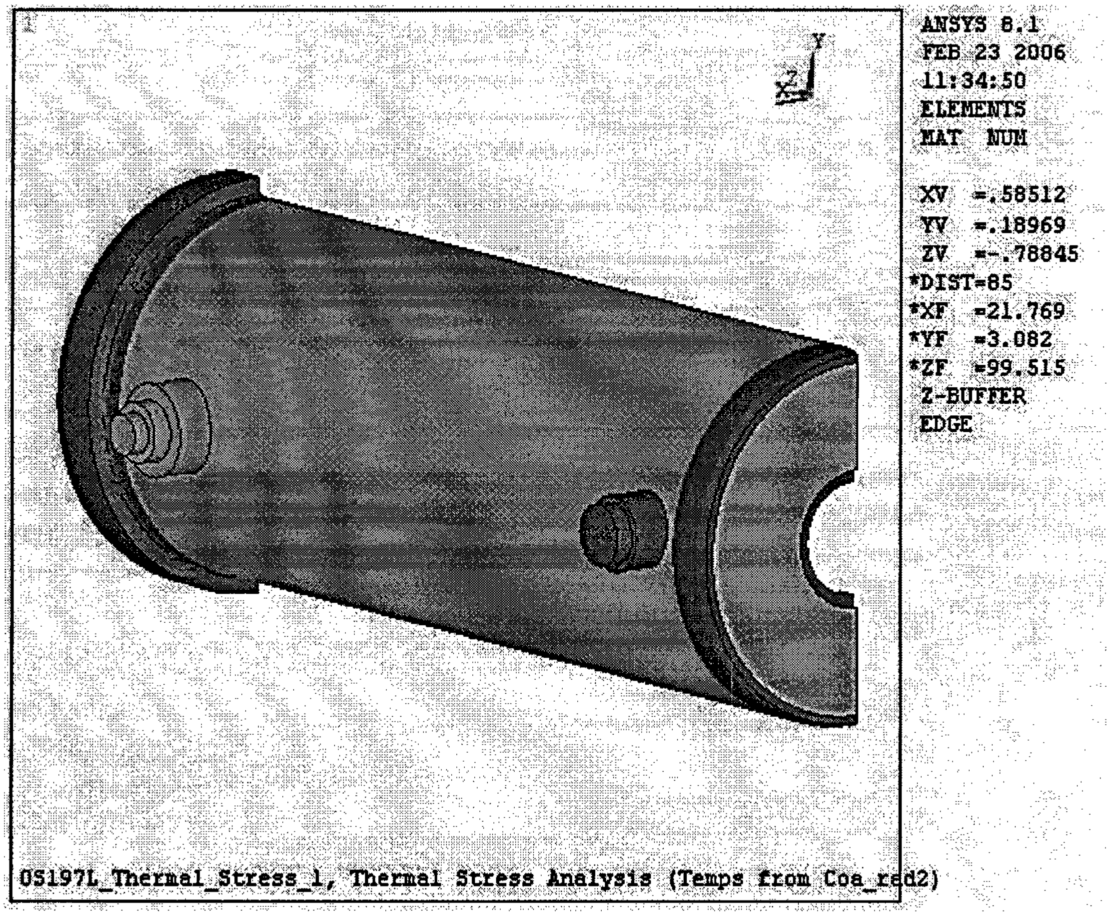
Enveloping Stress Ratios - Level A (non-Critical Lift) Combinations

Enveloping Stress Ratios Non-Critical Level A Comb.		P_m			$P_m + P_b$			$P_m + P_b + Q$			Notes
		Calculated	Allowable	Ratio	Calculated	Allowable	Ratio	Calculated	Allowable	Ratio	
Level A (A4/A5)	Shell at Upper Trunnion/Lower Trunnion	6.05 ksi	18.7 ksi	0.32	20.1 ksi	28.1 ksi	0.72	35.8 ksi	56.1 ksi	0.64	ANSYS
	Shell near Upper Trunnion/Lower Trunnion(1)	4.44 ksi	18.7 ksi	0.24	14.7 ksi	28.1 ksi	0.56	27.4 ksi	56.1 ksi	0.49	Analysis
	Upper Trunnion (FXM-19)	2.51 ksi	30.2 ksi	0.08	2.96 ksi	45.3 ksi	0.07	n/a	n/a	n/a	Hand
	Lower Trunnion (Type F304N)	2.41 ksi	20.3 ksi	0.12	4.55 ksi	30.5 ksi	0.15	n/a	n/a	n/a	Calculations
			Max:	0.32		Max:	0.72		Max:	0.64	

Table W.3-4
Summary of Maximum Stress Ratios for Level C Load Combinations

Enveloping Stress Ratios For Level C Combinations		P_m			$P_m + P_b$			$P_m + P_b + Q$			Notes
		Calculated	Allowable	Ratio	Calculated	Allowable	Ratio	Calculated	Allowable	Ratio	
Level C (C1/C2)	Shell at Upper Trunnion/Lower Trunnion	5.12 ksi	18.7 ksi	0.27	17.3 ksi	28.1 ksi	0.62	not required for Level C			ANSYS
	Shell near Upper Trunnion/Lower Trunnion(1)	3.23 ksi	18.7 ksi	0.17	11.9 ksi	28.1 ksi	0.43	n/a	n/a	n/a	Analysis
	Upper Trunnion (FXM-19)	1.44 ksi	36.2 ksi	0.04	2.33 ksi	54.4 ksi	0.04	n/a	n/a	n/a	Hand
	Lower Trunnion (Type F304N)	1.19 ksi	24.4 ksi	0.05	2.25 ksi	36.5 ksi	0.06	n/a	n/a	n/a	Calculations
			Max:	0.27		Max:	0.62				

Note: (1) 4" from upper trunnion/shell interface and 3" from lower trunnion/shell interface.

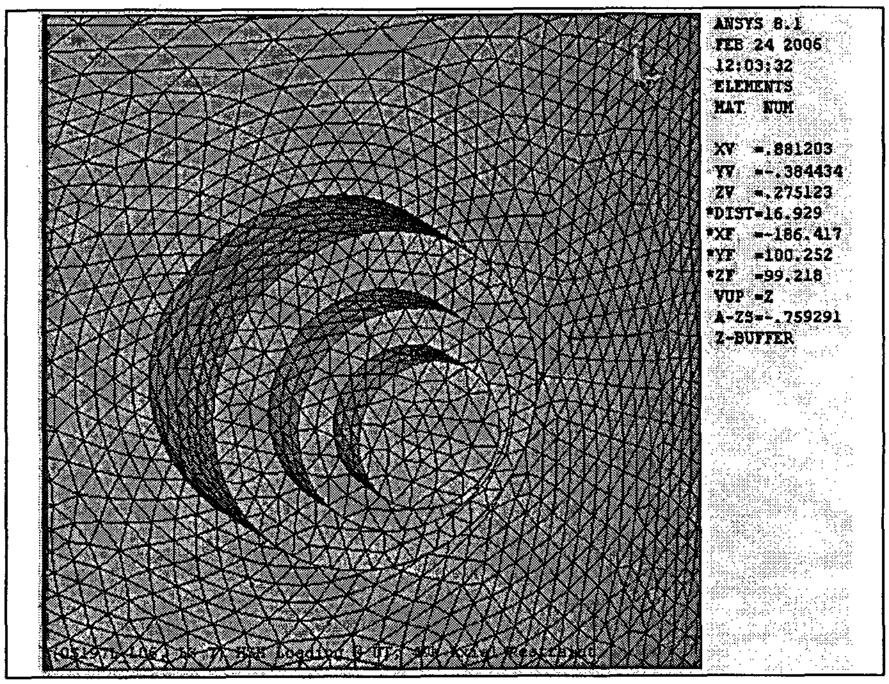


Note:

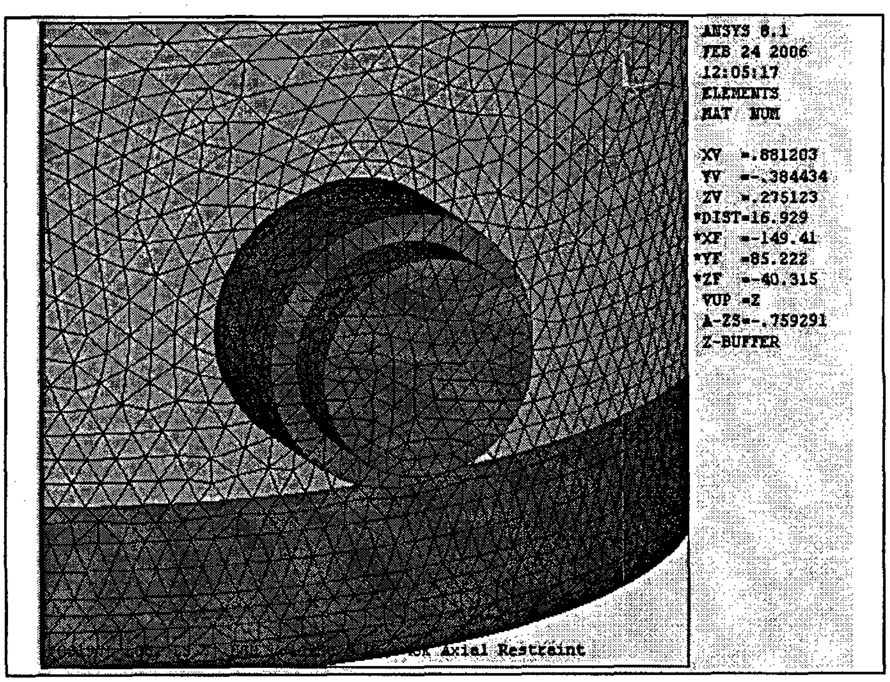
Material properties were assigned as follows:

Purple = SA-182 Type F304N (forgings)
Gray = SA-240 Type 304
Blue= SA-182 Type FXM-19 (Type XM-19 Forging)

Figure W.3-1
OS197L TC ANSYS Stress Analysis Model



Upper Trunnion



Lower Trunnion

Figure W.3-2
OS197L TC ANSYS Analysis Model – Upper and Lower Trunnions Detail

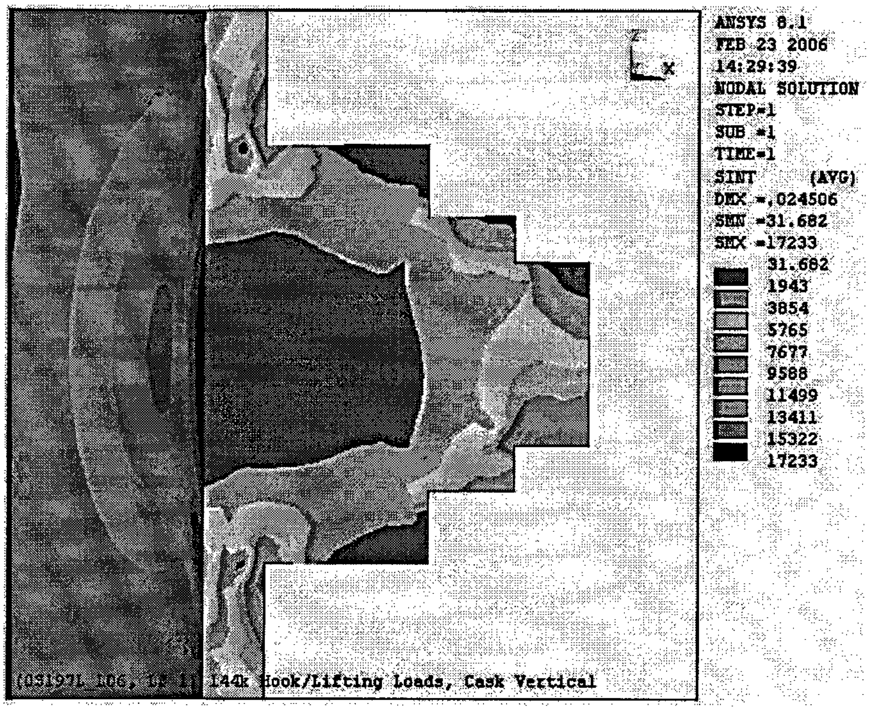


Figure W.3-3
ANSYS Model Stress Analysis Results – Upper Trunnion Region

W.4 Thermal Evaluation

W.4.1 Discussion

This chapter documents the thermal evaluation of the OS197L TC for the loading and transfer of the DSCs currently licensed under CoC 1004 (52B, 24P, 61BT, 24PT2, 32PT and 24PHB).

The OS197L TC is a modified version of the OS197/OS197H TCs (henceforth referred to as OS197 TC) designed to allow use with crane load limit of 75 tons. From a thermal analyses perspective, the following relevant modifications are implemented in the OS197L TC relative to the OS197 TCs:

- The 1.5" thick structural shell, the encapsulated 3.56" thick lead and the 0.5" thick inner liner (both SA-240, Type 304 stainless steel) in the OS197 are replaced with a single 2.68" thick shell made of SA-240, Type 304 stainless steel material.

- The neutron assembly that is integral to the structural shell on the inside and includes a 3/16" thick outer shell in the OS197 TC is replaced with a neutron shield assembly consisting of inner and outer shells made from ¼" thick plate material in the OS197L TC. The neutron shield materials, total water annulus thickness of 3" and the configuration of the internal stiffening elements remain unchanged.

- Supplemental shielding is used around the OS197L TC as part of the OS197L TC system, when the TC is in the vertical orientation in the decontamination area and when the TC is in the horizontal orientation on the transfer trailer/skid.

  The OS197L TC shielding system in the decontamination area consists of a two-part, 6" thick cylindrical shaped upper and lower shields made from A-36 steel with rectangular openings at the top and at the bottom that allow free convection boundary layer development along the DSC shell.

  The OS197L TC shielding system on the transfer skid consists of a series of plates that are attached to the sides and ends of the transfer skid. Two upper sections fit like a clamshell over the cask and skid after the cask is placed on the transfer skid. Clearances provided at the support legs of the skid and other openings at the ends of the skid permit cooling airflow to enter the enclosure and pass around the enclosed cask and exit via a long slot opening at the top of the upper sections of the shielding.

The OS197 TC and the bare OS197L TC have comparable radial thermal resistances (the thermal resistance provided by the lead to shell gaps in the OS197 TC is compensated by the gap between the neutron shield assembly and the structural shell in the OS197L TC).

W.4.2 Summary of Thermal Properties of Materials

The thermal properties of the materials used in the thermal evaluation are the same as those specified in Appendix M, Section M.4.2. Effective thermal conductivity of water and air-filled neutron shield with axial stiffeners are listed in Appendix M, Section M.4.9.

W.4.3 Specifications for Components

Mechanical properties of the materials are the same as those described in Section 8.1, Table 8.1-3.

W.4.4 Thermal Analysis of an OS197L TC Containing a 32PT DSC with 24 kW Heat Load

A two-dimensional model of the OS197L TC and 32PT DSC shell with 24 kW heat load was developed using ANSYS to provide temperature distributions for the TC and DSC shell. The 2D model considers the hottest cross-section of the fuel and conservatively neglects heat transfer in the axial direction. The TC thermal model and analysis methodology are consistent with the methodology described in Appendix M.4.4 for the OS197 TC with a 32PT DSC payload with changes implemented to account for the configuration changes in the OS197L TC relative to the OS197 TC. The OS197L TC model is shown in Figure W.4-1 and Figure W.4-2.

The heat flux applied to the OS197 TC model is identical to that described in Appendix M.4.4.1.6 for OS197 TC with a 32PT DSC.

The following table summarizes the OS197L TC dimensions used in the thermal analyses.

Dimensions used in OS197L TC ANSYS Thermal Analysis Model

DSC/Cask Component	OS197L
DSC Shell Outside Diameter, in.	67.17
DSC Shell Thickness, in.	0.5
Cask Inner Radius, in.	34.0
Structural Shell Thickness, in.	2.68
Structural Shell Outside Radius, in.	36.68
Structural Shell-Neutron Shield Inner Panel Gap, in.	0.03
Neutron Shield Inside Radius, in.	36.71
Neutron Shield Inner Panel Thickness, in.	0.25
Neutron Shield Inner Radius, in.	36.96
Neutron Shield Thickness, in.	3.0
Neutron Shield Outside Radius/Neutron Shield Outer Panel Inner Radius, in.	39.96
Neutron Shield Outer Panel Thickness, in.	0.25
Neutron Shield Outer Panel Outside Radius, in.	40.21

The results of the thermal analysis of the OS197L TC with a 32PT DSC payload but without the supplemental skid shielding are summarized in Table W.4-1. A plot of the OS197L TC model temperature distribution for the 100°F ambient condition with insolation is shown in Figure W.4-3. The temperatures incorporating the effect of the skid shielding are discussed in Section W.4.4.3.

The thermal performance of the OS197L TC (without supplemental skid shielding) is very similar to the OS197/OS197H as demonstrated by a comparison of the maximum 32PT DSC shell temperatures in Table W.4-2.

W.4.4.1 Effect of the Decontamination Shield on OS197L TC Thermal Performance

An evaluation is performed using manual calculations to confirm that the radial gap between the OS197L TC and the inner diameter of the decontamination shield is sufficiently large, and that the size of the top and bottom cut out openings are of sufficient size as to not adversely affect the thermal performance of the OS197L TC. The evaluation is based on analysis of the free convection turbulent boundary layer development along the outer OS197L TC surface during vacuum drying and helium backfilling operations. The results of the evaluation confirm that the DSC shell-decontamination shield gap and the area of the inlet and outlet openings are adequate and, thus, the decontamination area shield does not adversely impact the cask boundary conditions assumed in the thermal analysis.

W.4.4.2 Effect of Draining Neutron Shield during Transfer from Decon Area to Trailer

To reduce cask weight during transfer from the decon area to the trailer, the neutron shield may be drained. To maintain DSC shell temperatures within previously analyzed conditions for the DSC vacuum drying, backfilling, and welding operations, the DSC/cask annulus is maintained full during this transfer. The DSC/annulus is maintained at atmospheric pressure by venting.

W.4.4.3 Effect of the Supplemental Skid Shielding on OS197L TC Thermal Performance

As discussed above, supplemental shielding is installed on the OS197L skid to compensate for the reduced shielding capability of the bare OS197L TC. While the skid shielding prevents direct insolation heating of the cask surface, it also affects the convection and radiation heat transfer from the cask. To address the effect of the supplemental skid shielding on the thermal performance of the OS197L TC with a 32PT DSC payload, a computational fluid dynamics (CFD) analysis is performed for the OS197L TC with the supplemental shielding.

The FLUENT Code CFD methodology is used to define the boundary condition temperatures for the OS197L TC on the transfer trailer. The use of FLUENT is appropriate to model the natural convection driven air flow inside the trailer shielding as it flows around the cask.

Since the OS197L TC is provided with side and top shielding, the cask boundary sees a temperature which exceeds the ambient temperature. To define an appropriate boundary condition for the cask, the CFD analysis evaluated a prototypic segment of the cask and skid geometry, including the air flow paths into the cask/skid shielding enclosure. The shielding enclosure is provided with openings between the skid beams and the trailer deck to allow air to enter the enclosure. Air exits the enclosure through an opening at the top of the enclosure.

The analysis of the OS197L TC employed the following:

1) The analysis involved the passive cooling of a cylindrical, heat dissipating body housed within an enclosure wherein the cooling airflow enters at the bottom of the enclosure and exits at the top.

2) The analysis used the FLUENT CFD Code Version 6.2 [4.1].

3) The analysis employed second order discretization solution schemes for energy, momentum, and turbulence.

Table W.4-3 summarizes the thermal analysis results of the OS197L TC with a 32PT DSC payload, including the effect of the skid shielding.

W.4.4.4 Evaluation of DSC (24P, 52B, 61BT, 24PT2 and 24PHB DSCs) Shell Temperatures inside OS197L TC

The 32PT DSC shell temperatures when transferred inside the OS197L TC are determined as discussed in Section W.4.4.2. These results are used as discussed below to estimate the DSC shell temperatures for all licensed DSCs with ≤24.0 kW heat load inside the OS197L TC. This approach is conservative since the analyzed 32PT DSC has the shortest DSC cavity and thus the highest heat flux for a given heat load.

The DSC shell temperatures determined in Sections 8.1, 8.2, Appendices K.4, L.4 and N.4 for normal, off-normal and accident conditions are applicable for transfer inside OS197 TC. These average DSC temperatures are increased by the same ratio as the 32PT DSC for transfer inside the OS197L TC with allowance for specific canister heat loads and ambient temperatures as applicable. The maximum temperature rise of the DSC components is conservatively assumed equal to the corresponding average DSC shell temperature increase.

These results are summarized in Table W.4-4.

W.4.4.5 Evaluation of Maximum Fuel Cladding Temperatures inside OS197L TC

To calculate the maximum fuel cladding temperature for each DSC when transferred inside the OS197L TC, a methodology identical to that described above in Section W.4.4.3 above is used.

A summary of the maximum fuel cladding and DSC component temperatures evaluated for the various DSC types allowed for transfer in the OS197L TC is shown in Table W.4-4. In all cases, calculated fuel cladding temperatures are less than the regulatory limit.

W.4.4.6 Evaluation of DSC Internal Pressures

The maximum DSC internal pressures during transfer in the OS197L are calculated based on results for the DSC in OS197 TC. The increase is based on the change in the helium backfill temperature due to the increased temperature of the cask, due to the skid supplemental shielding. This temperature increase is conservatively assumed equal to DSC component temperature increase shown in Table W.4-4.

The internal pressure for each DSC type is calculated as

$$P_{DSC\ in\ OS197L} = P_{DSC\ in\ OS197} \cdot T_{DSC\ He\ av\ in\ OS197L} / T_{DSC\ He\ av\ in\ OS197},$$

where
$T_{He\ av\ in\ OS197}$, °R - average helium temperature in DSC during transfer in OS197 TC,
$T_{He\ av\ in\ OS197L}$, °R - average helium temperature in DSC during transfer in OS197L TC,
$T_{He\ av\ in\ OS197L} = T_{He\ av\ in\ OS197} + \Delta T_{He\ av}$.

Table W.4-5 lists maximum DSC internal pressure for each DSC authorized for transfer within the OS197L TC in comparison with the design pressures.

As seen from Table W.4-5, the DSC internal pressure during transfer in OS197L TC is within design limits for all the DSCs.

Therefore, all DSCs considered in Table W.4-5 are qualified for transfer in OS197L TCs.

W.4.4.7 Thermal Performance of OS197L TC during Fire Accident Conditions

The fire transient analysis is performed for the OS197L TC on the transfer trailer, using the same assumptions as for the OS197 TC fire accident analysis as described in Appendices K.4, L.4, M.4 and N.4. The calculated maximum temperatures are summarized in Table W.4-6. No credit was taken for the trailer shielding in this analysis. This is conservative because the shielding on the trailer will not, in reality, be impacted by the fire condition.

W.4.4.8 References

[4.1] FLUENT™ CFD Code Version 6.2, Fluent Inc., 10 Cavendish Court, Lebanon, NH 03766.

Table W.4-1
32PT DSC Shell and OS197L TC Component Maximum Temperatures without Supplemental Shielding

Operating Conditions	T_{amb}, °F	$T_{str\ sh\ max}$, °F	$T_{inn\ NS\ p\ max}$, °F	$T_{out\ NS\ p\ max}$, °F	$T_{sh\ max}$,[2] °F
Normal, transfer	100	309	280	239	431
	100, insolation[1]	311	281	258	448
Off-normal, transfer	117	314	285	244	435
Accident, transfer (Loss of supplemental skid shielding and liquid neutron shield)	117, insolation	573	548	265	607

where:

$T_{str\ sh\ max}$ – cask structural shell maximum temperature,

$T_{inn\ NS\ p}$ – cask inner NS panel maximum temperature,

$T_{out\ NS\ p\ max}$ – cask outer NS panel maximum temperature,

$T_{sh\ max}$ – DSC shell maximum temperature.

Notes:

1. Temperature values with insolation are provided for comparison with OS197 TC cases.
2. Values shown are for 32PT DSC shell. For increases in maximum shell temperature for all DSCs, see Table W.4-4.

Table W.4-2
32PT DSC Shell Maximum Temperatures for OS197L (without Supplemental Skid Shielding) and OS197 TCs

Operating Conditions	T_{amb}, °F	OS197L	OS197
		$T_{sh\ max}$, °F	$T_{sh\ max}$, °F
Normal, transfer	100, insolation	448	445
Off-normal, transfer	117	435	433
Accident, transfer (Loss of sun shade and liquid neutron shield)	117, insolation	607	600

where:

$T_{sh\ max}$ – DSC shell maximum temperature.

Table W.4-3
32PT DSC Shell and OS197L TC Component Maximum Temperatures
(Supplemental Skid Shielding Effect Included)

Operating Conditions	T_{amb}, °F	$T_{str\ sh\ max}$, °F	$T_{inn\ NS\ p\ max}$, °F	$T_{out\ NS\ p\ max}$, °F	$T_{sh\ max}$, °F [(1)]
Normal, transfer	100	353	324	283	444
Off-normal, transfer	117	358	329	288	454
Accident, transfer (Loss of supplemental skid shielding and liquid neutron shield)	117, insolation	573	548	265	607

where:

$T_{str\ sh\ max}$ – cask structural shell maximum temperature,

$T_{inn\ NS\ p}$ – cask inner NS panel maximum temperature,

$T_{out\ NS\ p\ max}$ – cask outer NS panel maximum temperature,

$T_{sh\ max}$ – DSC shell maximum temperature.

Notes:

1. Values shown are for 32PT DSC shell. For the maximum shell temperature of all DSCs allowed for transfer in OS197L, see Table W.4-4.

Table W.4-4
Summary of Maximum Fuel Cladding and DSC Component Temperature Increase during Transfer in OS197L TC

	DSC Type	24P	52B	24PT2S/L	61BT	24PHB	32PT
	Heat load, kW	*24*	*19.24*	*24*	*18.3*	*24*	*24*
Normal	T_{amb}	100	100	100	100	100	100
	$\Delta T_{DSC\ comp\ max}$(1)	*13*	*10*(4)	*13*	*10*(4)	*13*	*13*
	$\Delta T_{fuel\ max}$(2)	*8*	*7*	*7*	*10*	*4*	*9*
	$T_{fuel\ max}$	*743*	*769*	*735*	*648*	*726*	*729*
	$T_{fuel\ limit}$	1058	1058	1058	1058	752	752
Off-Normal	T_{amb}	125	125	125	125	117	117
	$\Delta T_{DSC\ comp\ max}$(1)	*22*(5)	*18*(4, 5)	*22*(5)	*19*(4, 5)	*22*(5)	*19*
	$\Delta T_{fuel\ max}$(2)	*14*	*12*	*12*	*15*	*7*	*15*
	$T_{fuel\ max}$	*749*	*774*	*740*	*655*	*729*	*730*
	$T_{fuel\ limit}$	1058	1058	1058	1058	1058	752
Accident	T_{amb}	125	125	125	125	117	117
	$\Delta T_{DSC\ comp\ max}$(1)	*18*(4)	*16*(4)	*18*(4)	*16*(4)	*18*(4)	*10*
	$\Delta T_{fuel\ max}$(2)	*11*	*10*	*≤18*	*15*	*6*	*10*
	$T_{fuel\ max}$	*882*(6)	*915*(6)	*798*	*824*(6)	*744*	*873*
	$T_{fuel\ limit}$	1058	1058	1058	1058	1058	1058

Notes:

1. Increase in DSC shell temperature in OS197L TC relative to the OS197 TC. Conservatively, it is assumed that the temperature for the DSC internal basket components increases by the same delta. The delta (increase) is evaluated as: $\Delta T_{DSC\ comp} = \Delta T_{sh\ av} = T_{sh\ av\ OS197L} - T_{sh\ av\ OS197}$.
2. $\Delta T_{fuel\ max} = T_{fuel\ max\ DSC\ in\ OS197L} - T_{fuel\ max\ DSC\ in\ OS197}$
3. Not used.
4. $\Delta T_{fuel\ max}$ account for T_{amb} and heat load difference
5. Adjustment to 24 hour average ambient temperature difference applied.
6. Accident storage case is conservatively used for evaluation.

Table W.4-5
Maximum DSC Internal Pressure during Transfer in OS197L TC

	DSC Type	24P	52B	24PT2S/L	61BT	24PHB	32PT
	Heat load, kW	***24***	***19.24***	***24***	***18.3***	***24***	***24***
Normal	P_{DSC},psig	7.4	6.5	8.2	9.3	6.6	4.5
	$P_{DSC\ limit}$,psig	10.0	10.0	10.0	10.0	15.0	15.0
Off-normal	P_{DSC},psig	10.9[1]	8.5	10.6[1]	12.1	11.8	15.5
	$P_{DSC\ limit}$,psig	10.0	10.0	10.0	20.0	20.0	20.0
Accident	P_{DSC},psig	57.2	31.7	58.4	46.9	64.4	105.0
	$P_{DSC\ limit}$,psig	60.0	60	60.0	65.0	68.0	105.0

Note:

1. The maximum calculated pressure exceeds the design pressure. This is acceptable based on paragraph NB-3223(a) of ASME Section III, Subsection NB. See Tables 8.1-6 and J.4-2 for the 24P DSC and Section L.4.4.4.8 for the 24PT2 DSC.

Table W.4-6
Maximum Component Temperatures for OS197L TC during Fire Accident

Component	Maximum Temperature at 2000 Min, °F	Allowable Temperature, °F
DSC Shell	571	*
Cask Structural Shell	506	*

* The components perform their intended safety function within the operating range. Bounded by the accident transfer (loss of sunshade and liquid neutron shield) case.

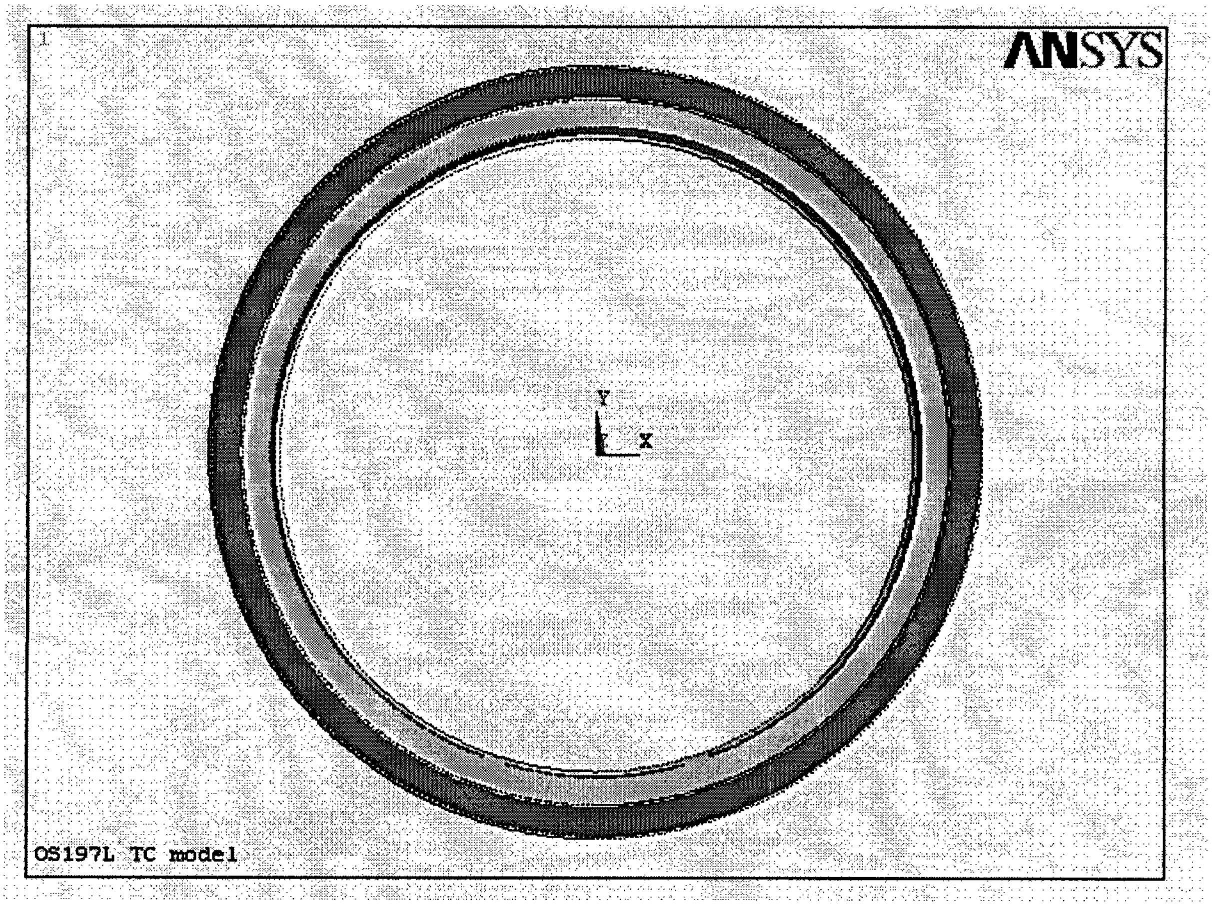


Figure W.4-1
OS197L TC ANSYS Model

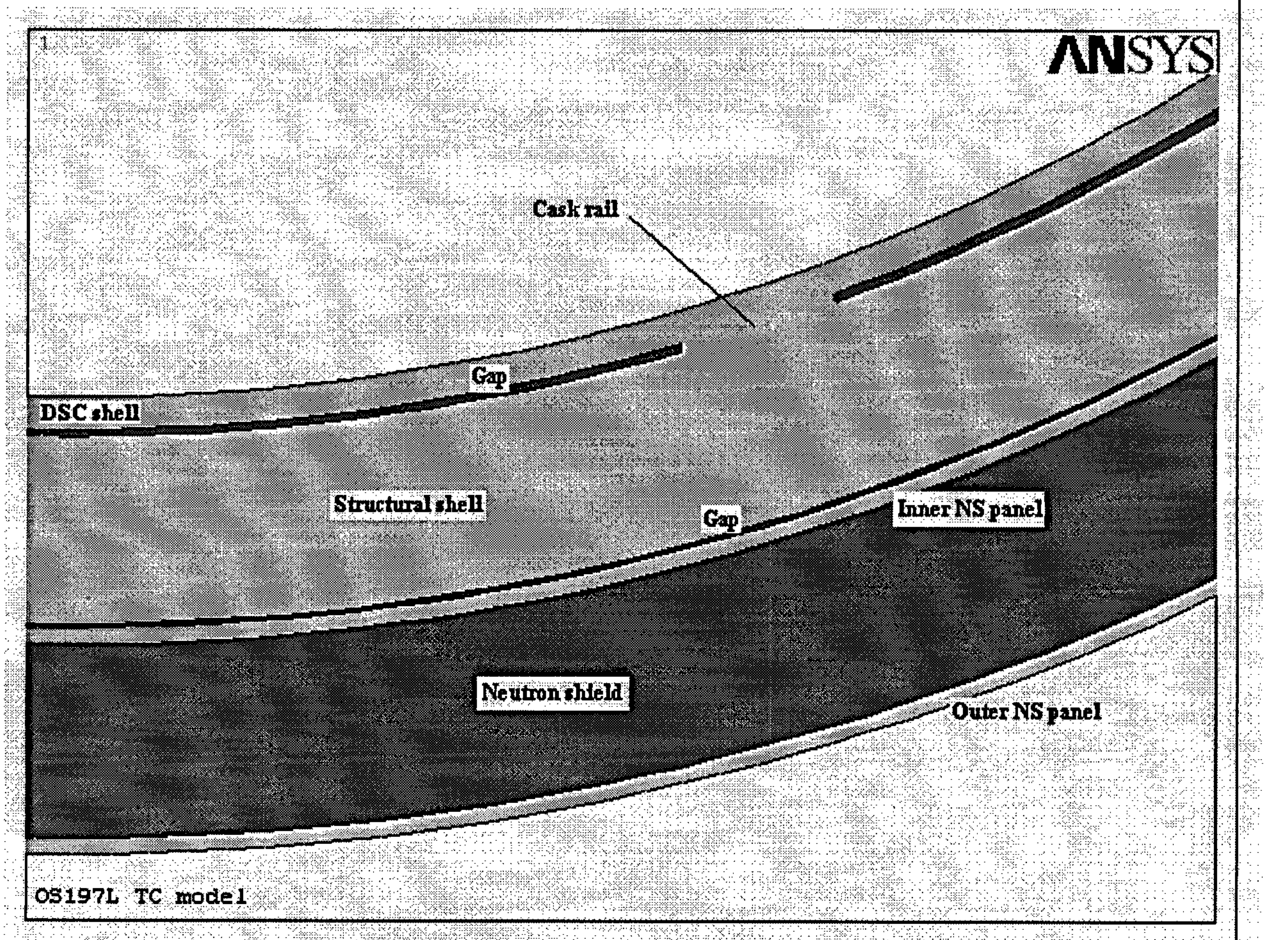


Figure W.4-2
Details of OS197L TC ANSYS Model

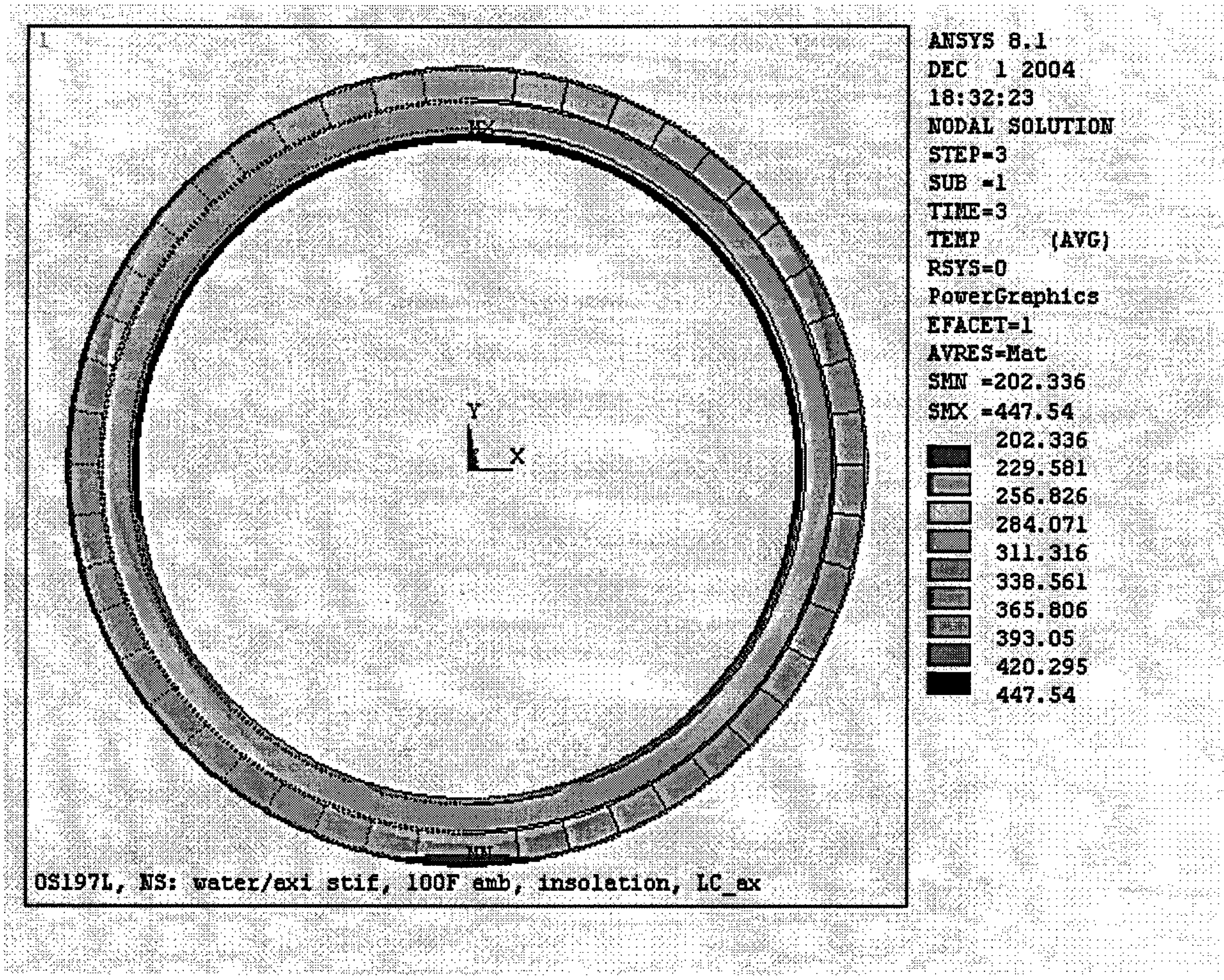


Figure W.4-3
Temperature Plot for 32PT DSC (24 kW) in OS197L TC without Supplemental Shielding, T_{amb}=100°F, Insolation

W.5 Shielding Evaluation

This Appendix presents the shielding evaluation of the OS197L TC when used for fuel loading and transfer of the DSCs currently licensed under CoC 1004 (52B, 24P, 61BT, 24PT2, 32PT and 24PHB).

The shielding analysis is performed for the 32PT DSC design basis source terms. The results for normal operations demonstrate that exposures for OS197L TC activities with operational personnel present are bounded by OS197 TC exposures (remote crane operation is used and no personnel are present while the cask is on the crane hook).

W.5.1 Methodology

Two radiation transport codes are used in the shielding analysis performed in the OS197L TC calculation: ANISN [5.1] and MCNP 5 [5.2]. ANISN is primarily used for the scoping analysis to determine (a) spectral distribution on the side of the transfer cask, (b) burn-up, enrichment, cooling time combination(s) which would result in the highest dose rate, and (c) optimum layout of shielding materials to meet certain restrictions on dose rates, etc. After desired optimal parameters are established with ANISN calculations these parameters are incorporated in a more rigorous, 3 dimensional models used in MCNP runs to calculate the final results.

The MCNP analysis is performed for the 32PT-DSC as a typical payload in order to quantify the effect on dose rates of the use of the OS197L TC. The resulting analysis demonstrates that the OS197L TC dose rates with the decontamination area shielding and the trailer shielding are similar and less than the dose rates for the OS197 TC.

W.5.2 Model Specification

See Figure 5.1 for a description of the 3-D OS197 TC model which used a 3" steel shell which corresponds to the cask shell and the neutron shield inner shell. The OS197L TC neutron shield outer shell is also 1/16" thicker than that used in the model. The 3-D MCNP analysis model of a 32PT DSC inside an OS197L TC is similar to that used in Appendix P.5 for the OS197 TC with a 24PTH DSC. In this model, the 32PT DSC design basis source terms are used as a baseline analysis for the OS197L TC. The data obtained is compared against a 2-D DORT model for the OS197 TC with the 32PT DSC source terms as described in Appendix M.5. This comparison is used to document that the additional decontamination area and trailer shielding, in conjunction with the OS197L TC, provide an equivalent level of shielding as the OS197 TC. The increased surface dose rates for the OS197L TC while on the crane hook will not impact operational dose rates since crane operations will be performed by remote crane control and using cameras and laser alignment systems.

W.5.3 Shielding Evaluation

The use of the OS197L (75 ton) TC is not expected to have any significant adverse impact on personnel dose rates during normal operation since crane operations will be performed remotely. The maximum dose rates on the side of the cask for normal conditions (neutron shield in place and filled with water) are shown in Table W.5-1. For the transfer from the decon area to the trailer with an empty neutron shield and a filled DSC/cask annulus, the dose rates are conservatively estimated using the dose rates for the accident condition (no neutron shield), shown in the first table in Section W.11.1.4 for accident dose rates.

The dose rates associated with the OS197L TC during the short time duration lifts from the pool to the decontamination area (54 rem/hr surface dose) and from the decontamination area to the trailer (138 rem/hr surface dose rate, second table in Section W.11.1.4, OS197L) are significantly higher compared to OS197 TC operational doses (346 mrem/hr surface dose). All operations associated with these two cask movements will be performed using remote crane operation using a laser/optical targeting system and cameras for confirmation of the cask location without the need for personnel in the vicinity of the cask. Should a failure of the crane occur during these operations, procedures will be in place to manually position the load in a safe, shielded location. Therefore, the dose received by operations personnel resulting from this high dose operation will be minimal as these operations are short duration and are performed remotely with no personnel in the vicinity.

The dose rates associated with the cask in the decontamination area and on the trailer (122 mrem/hr surface dose), are approximately one-third of the dose rates for the current configuration and relative to the precision of shielding analysis, can be considered to have similar shielding (346 mrem/hr surface dose, identified as OS197 TC in Table W.5-1). The data provided for the UFSAR configuration above, is the data using the specific model used in the UFSAR. The data provided for the OS197 TC configuration credits some additional shielding that was not credited in the UFSAR analysis. The above data is for a 32PT-DSC payload but is provided for evaluation of relative doses. The relative effect of the OS197L TC configuration and the decontamination area/trailer shielding configurations with respect to the OS197 TC configurations shown above is representative of the relative effect for all CoC 1004 licensed DSC payloads for the OS197L TC.

The loss of neutron shield accident dose rates are addressed in Appendix W.11. These dose rates bound the doses from accident fire condition because the shielding on the trailer is not affected by the fire condition.

W.5.3.1 Solid One Piece Trunnion Dose Rate Evaluation

Analyses are performed to compare the effect of the solid steel trunnion design to the original trunnion design (multiple pieces) which used NS-3 neutron absorber to reduce neutron dose. The result of this analysis indicates that this change does result in an increase in neutron dose, however, since the majority of the dose contribution is gamma; the overall dose is reduced in the solid steel trunnion configuration. A comparison of the dose rates is provided in Table W.5-2.

In summary, the use of a one-piece trunnion reduces the total calculated dose rate by a factor greater than ten, thus providing a beneficial impact on occupational dose rates.

W.5.3.2 Removable Two Piece Neutron Shield Dose Rate Evaluation

The two piece neutron shield provides the same level of shielding as the OS197 TC neutron shield. The water cavity thickness is unchanged. The outer shell of the OS197L TC neutron shield is slightly thicker than that used in the OS197 TC (.25" versus .18"). The addition of the seam between the two halves would reduce gamma dose in the vicinity of the seam but would increase neutron dose due to less water in the vicinity. As discussed for the trunnion modification above, since the total dose is primarily gamma, the increase in steel will result in a net decrease in total dose in the vicinity of the seams.

W.5.4 References

[5.1] One-Dimensional Discrete Ordinates Transport Code System with Anisotropic Scattering," CCC-254, Oak Ridge National Laboratory, RSICC Computer Code Collection, April 1991.

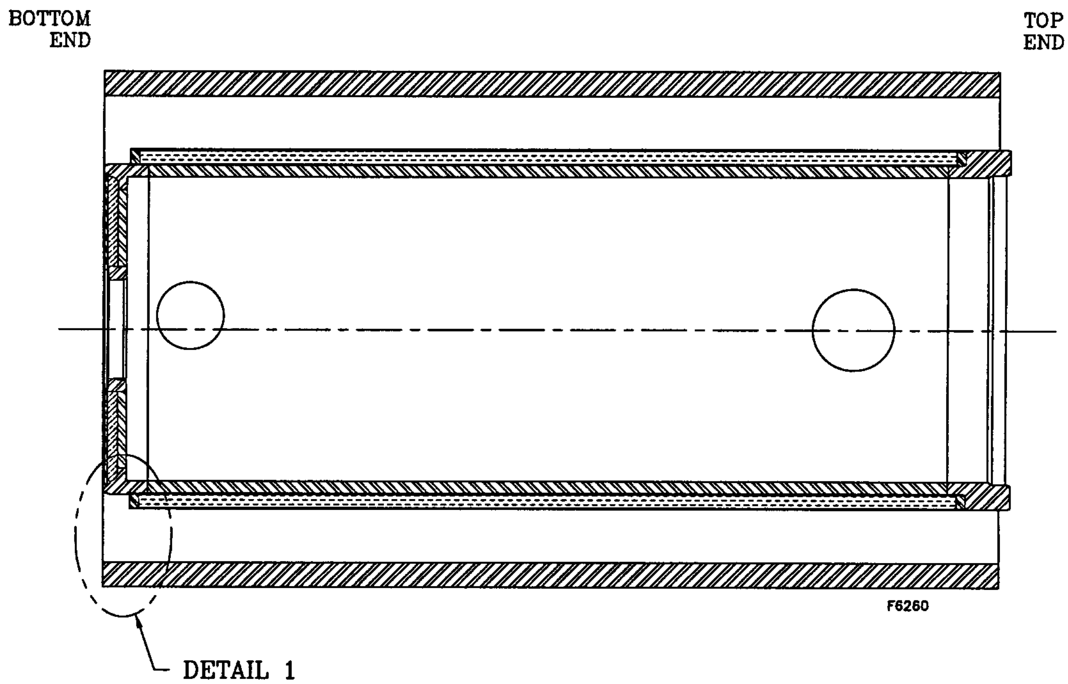
[5.2] A General Monte Carlo N-Particle Transport Code, Version 5, Volume II: User's Guide, LA-CP-03-0245, 2003.

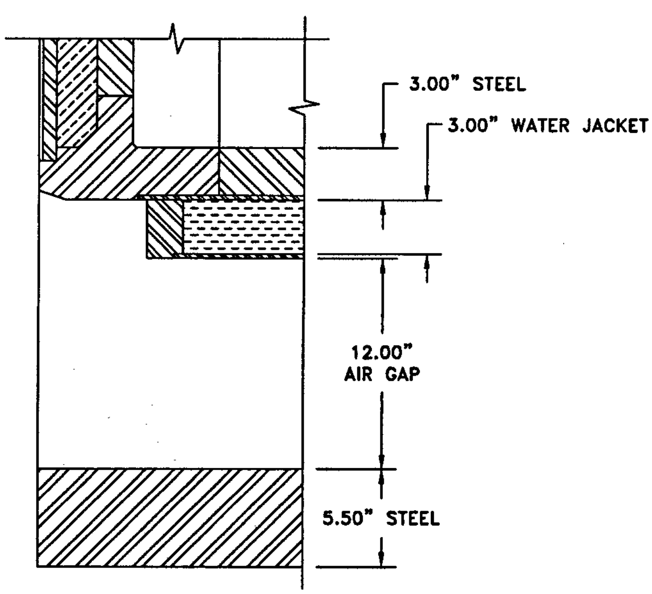
Table W.5-1
OS197L TC Normal Condition Dose Rates

Transfer Cask Configuration	Dose Rate Component	Dose Rates at Different Distances from Side Surface – Normal Condition Neutron Shield Filled			
		On Side Surface	4.57 meters (15')	100 meters	609.9 meters (2000')
		Dose Rate, mrem/hr	Dose Rate, mrem/hr	Dose Rate, mrem/hr	Dose Rate, mrem/hr
UFSAR (Table M.5-5 and Section M.11.2.5.3)	Neutron	261	Not Calc.	Not Calc.	Not Calc.
	Gamma	784	Not Calc.	Not Calc.	Not Calc
	Total	950	Not Calc	Not Calc	0.01
OS197 TC	Neutron	102	7.20	0.006	7.09e-6
	Gamma	248	20.3	0.03	5.29e-5
	Total	346	25.9	0.03	5.67e-5
OS197L TC Bare Cask	Neutron	247	18.2	0.018	2.19e-5
	Gamma	53,031	3906	4.52	9.70e-3
	Total	53,249	3922	4.53	9.70e-3
OS197L TC with Decon Area or Trailer Additional Shielding	Neutron	28	2	0.002	1.31e-6
	Gamma	94	11	0.02	2.44e-5
	Total	122	13	0.02	2.57e-5

Table W.5-2
Dose Rate Results for Two Trunnion Designs (mrem/hr)

Trunnion Type	Neutron Dose Rate	Gamma Dose Rate	Total Dose Rate
Original Upper	0.2	621	**621.2**
Solid Steel Upper	51.1	.14	**51.24**
Original Lower	1.0	1702	**1703**
Solid Steel Lower	79.5	1.3	**80.8**





DETAIL 1

Figure W.5-1
OS197L TC and Decontamination Area Shielding Model Geometry

W.6 Criticality

The modifications associated with the OS197L TC will not have a significant adverse impact on the criticality analyses performed for the OS197 TC. The changes are in an area of relatively insignificant importance to criticality – no change in the fuel geometry / poison loading / or borated water concentration. The changes only affect the outer surface of the cask. The UFSAR shows that a reflective boundary, simulating an infinite cask array, was employed that further reduces the sensitivity of the analysis to TC design changes. In addition the outside diameter of the OS197 TC and OS197L TC are basically the same. Therefore, these changes will have a negligible impact on the criticality analyses.

W.7 Confinement

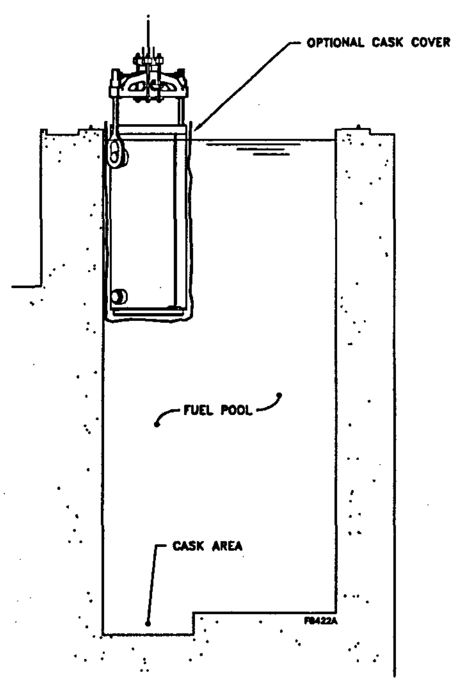
There are no confinement features associated with the OS197L TC on-site transfer cask since the cask is designed as a non-pressure retaining system. The DSC is the confinement system.

W.8 Operating Procedures

The following is a description of the operational sequences for use of the OS197L TC. In general, the steps are similar to those for the OS197 TC, described in detail in Chapter 5 of the UFSAR, and Chapter 8 of the canister-specific appendices (e.g., M.8 for the 32PT DSC). This chapter highlights the differences in operational steps when using OS197L TC relative to the OS197 TC. Figures are provided to illustrate these steps.

Note: The applicable Technical Specification requirements for loading/unloading operations as listed in UFSAR Chapter 5 or Chapter 8 of the canister specific appendix are also applicable for this chapter when using OS197L TC.

Placement of the DSC into the OS197L TC and preparations for placement of the TC into the fuel pool are the same as for the OS197 TC. The DSC/TC annulus is filled with clean water and sealed with the annulus seal. The TC neutron shield is also filled with clean water. As there is no fuel in the DSC at this time, the 75 ton limit is not approached, and the DSC may be filled with fuel pool water prior to lowering into the pool. This may be done either prior to the lift to the fuel pool, or the OS197L TC lowered to within a few feet of submergence and the DSC filled at that time. The OS197L TC with DSC is then lowered to the fuel pool bottom and landed, and the yoke removed. Sequence 1 below shows the cask as it enters the pool.

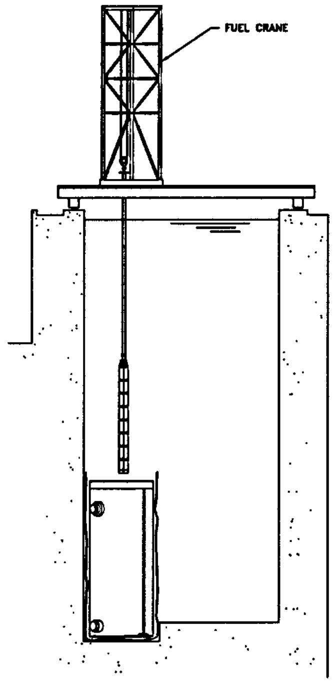


(1) OS197L IS BROUGHT TO SURFACE

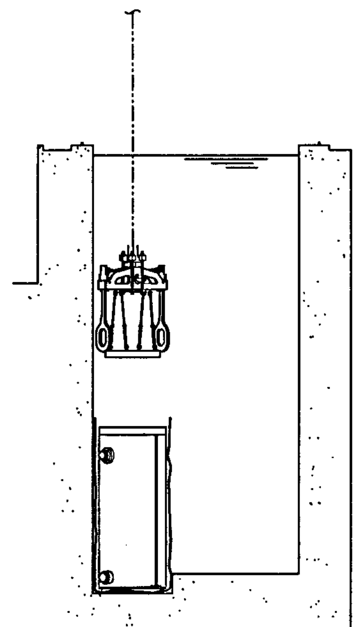
ALARA practices implemented during the TC movement are intended to reduce operational exposure, including temporary contamination barriers. In this case an optional flexible plastic/fabric cask protective cover may be used to keep the cask surface from being contaminated in the fuel pool. The protective cover is intended to prevent fuel pool water from coming in contact with the exterior surface of the cask, and would be removed as the cask is lifted from the fuel pool. As an alternate to the cask protective cover, the trailer bed could be lined with plastic/fabric to provide a barrier for any cask surface contamination. This barrier, in combination with the other parts of the transfer trailer, would prevent dispersal of any loose (smearable) material on the surface of the cask during transfer from the fuel handling/reactor building to the ISFSI and back. The use of the optional cask protective cover is shown in Sequence 5, where if used, it would be removed as the cask is lifted from the pool.

The use of the flexible plastic/fabric cask protective cover has no impact on the structural, shielding, or thermal analysis since it is only used in the pool and has minimal weight. During this time the DSC/cask annulus is filled with water and this defines the DSC shell temperature. The use of a protective cover with the OS197L TC will not adversely impact the criticality analyses performed for the OS197 TC. Specifically the possible use of unborated water between the cover and the cask exterior has a negligible effect on the criticality analysis as the unborated water is outside the cask neutron shield. The use of a protective cover with the OS197L TC will not adversely impact the mechanical interfaces. The cover will be used only in the fuel pool, and thus will have no interface with the trailer or HSM. It is anticipated that the cover will have a thickness less than 1/16" and will be compatible with fuel pool chemistry.

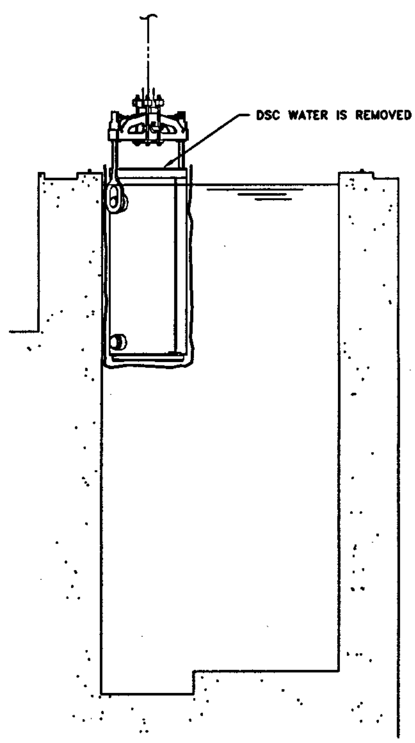
Selected Fuel Assemblies (FA's) are then placed into the DSC. Following fuel verification, the top shield plug is lowered into place and set. The yoke is then lowered and connected to the OS197L TC. The cask is then lifted until the cask top just breaks the surface of the fuel pool. At this time the water weight in the DSC and cask is offset by the buoyancy of the OS197L TC and allows for the hook weight to remain below 75 tons. However, further raising of the DSC and cask would exceed the 75 ton limit. This is shown as Sequences 2 through 4.



(2) FUEL ASSEMBLIES ARE LOADED INTO OS197L



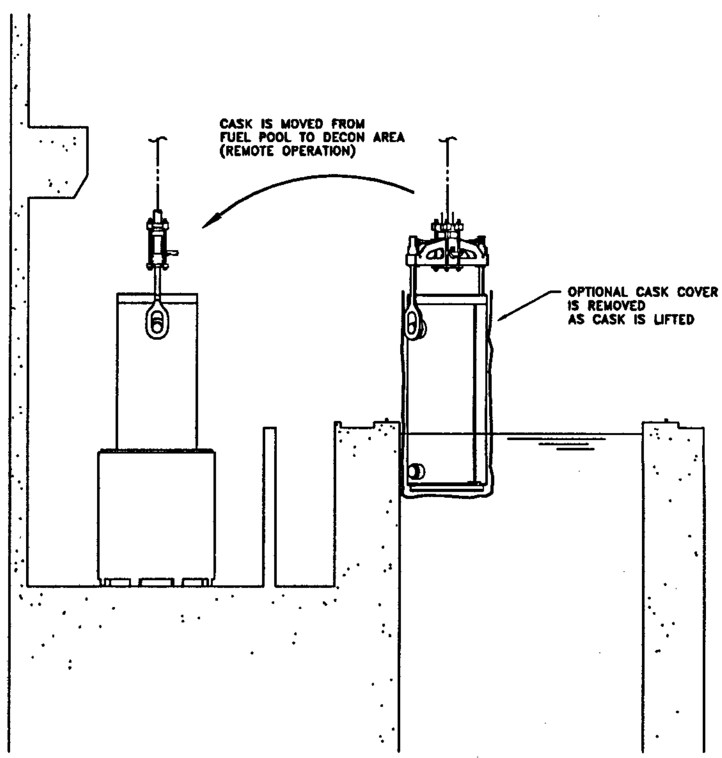
(3) TOP SHIELD PLUG IS LOWERED INTO DSC



(4) OS197L IS BROUGHT TO SURFACE, AND WATER WITHIN THE DSC IS PUMPED OUT

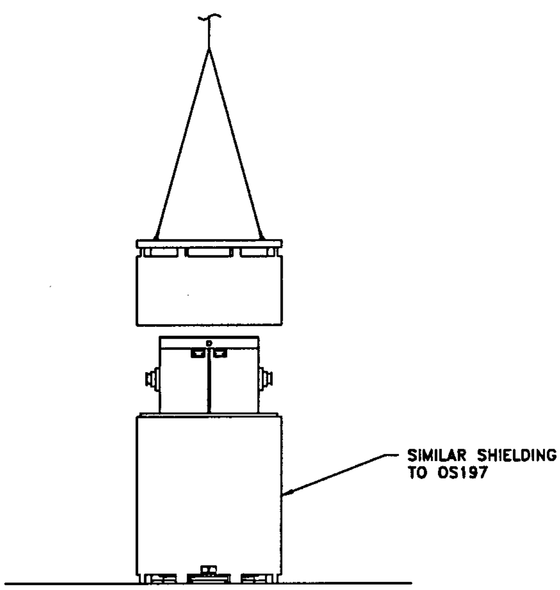
Connections are then made to the DSC siphon and vent ports and the water within the DSC removed (pumped out). During this water removal, a nitrogen or helium gas blanket will be supplied through the vent port as the water is drained. The neutron shield will not be drained during this step and the DSC/cask annulus will be maintained full. This is shown as Sequence 4.

After water has been pumped out from the DSC (approximately 13,600 lbs.), the OS197L TC will be lifted from the fuel pool to the decontamination area. The 75 ton cask itself has significantly reduced shielding and employs draining of the water in the DSC to achieve the 75 ton limit. However, the OS197L TC operations utilize additional shielding and measures to achieve shielding capacity similar to the OS197 TC. The OS197L TC system consists of the bare cask and the upper and lower cask shielding utilized in the decontamination area, and the additional shielding provided on the cask support skid. The bare cask is in this reduced shielding configuration ONLY during the movement of the cask from the fuel pool to the decontamination area and from the decontamination area to the transfer trailer. Both of these operations are of short time duration (i.e. minutes). During bare cask movement from the fuel pool to the decontamination area and from the decontamination area to the trailer, remote crane operation and/or an optical targeting system with remote camera monitoring will be used to minimize personnel exposure to the reduced shielding configuration. This remote operation is shown in Sequence 5.



(5) FROM FUEL POOL TO DECONTAMINATION AREA,
OS197L IS PLACED IN SHIELDING SLEEVE
(PART OF OS197L)

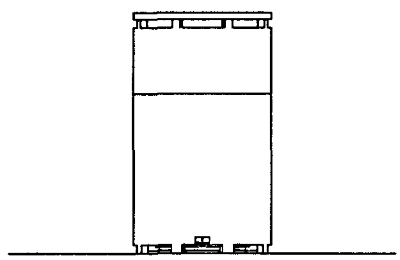
In the decontamination area, the bare cask is placed in a shielding sleeve (lower cask shield) which provides shielding below the trunnions. An upper cask shield (shielding bell) is then placed on top of the shielding sleeve to shield the upper section of the cask. The shielding sleeve and shield bell are nominally 6" thick carbon steel. Placement of the cask in the shielding sleeve and placement of the shielding bell on the cask is performed using remote crane operation and/or an optical targeting system with remote camera monitoring. The OS197L TC system configuration of the cask and shielding sleeve and bell is shown as Sequences 5 and 6.



(6) TOP SHIELDING BELL COMPONENT OF OS197L IS PLACED (REMOTE OPERATION)

The combination of the bare OS197L TC and these shielding structures provide a similar level of shielding as the OS197 TC in the radial direction. As stated in the Technical Specification 1.2.11 basis, which defines transfer cask dose rate limits, the determination of the cask dose rate limits is based on the shielding analysis documented in the UFSAR. This UFSAR analysis modeled both the axial and radial shielding of the OS197 TC, and therefore, similar shielding levels shall be used when measuring dose rates for comparison to the TS. The configuration of the OS197L TC system in the decontamination area, within the shielding sleeve and bell, is one configuration for which the TS requirements for dose rates apply.

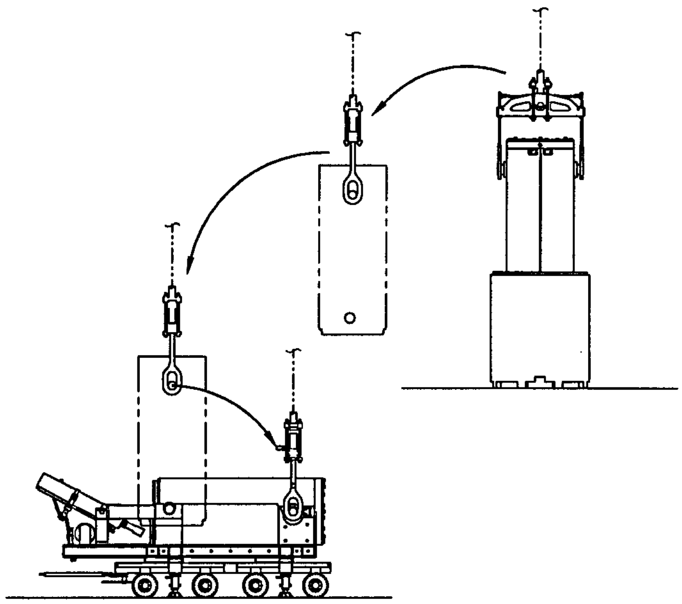
While in the shielding sleeve and bell, the canister is completely drained, vacuum dried, and helium backfilled, and all top covers welded in place. The OS197L TC neutron shield will remain filled and vented, similar to OS197 TC operations, during these steps. During these operations, the cask and the shielding sleeve and bell provide occupational radiation shielding for personnel necessary to perform the canister closure operations. These operations are essentially unchanged from those listed in the UFSAR, Section 5.0 and the canister specific Appendices, such as M.8 for the 32PT. The shielding sleeve and the bell are designed to not interfere with the NUHOMS® AWS system or other equipment of the canister sealing operations. This is shown in Sequence 7.



(7) CANISTER IS PREPARED FOR CLOSURE OPERATIONS

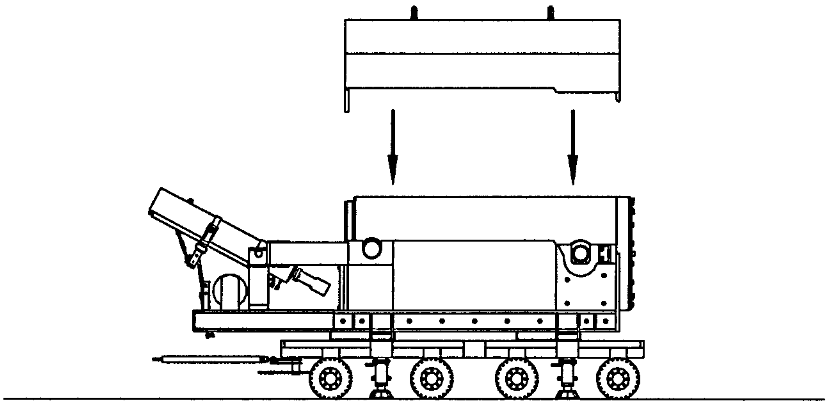
Once the DSC is sealed, the DSC/cask annulus will be drained and the cask top cover installed prior to downending onto the transfer trailer. In the event that the neutron shield is to be drained to reduce weight during the transfer from the decon area to the trailer, the DSC annulus will remain filled and the interim cover will be installed using a gasket to prevent annulus water from leaking during downending operations. The annulus will remain vented to the atmosphere through the annulus fill port in the cask side and/or through fittings in the interim cask cover. Again during the downending process, the bare OS197L TC movement is of short time duration and is performed using remote crane operation and/or an optical targeting system with remote camera monitoring. This remote operation is shown in Sequence 8.

Note: See UFSAR Section W.8.1.5 regarding the use of a reduced weight interim cask cover.



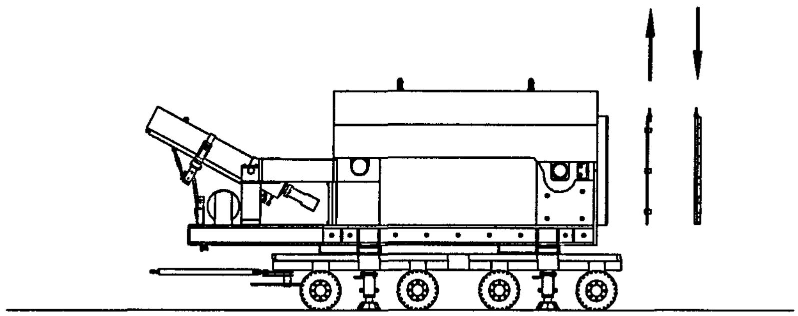
(8) CASK IS MOVED FROM DECON AREA TO TRANSFER TRAILER (REMOTE OPERATION)

Once on the transfer trailer, the skid provides 5.5" of carbon steel shielding to the sides of the cask up to the trunnions. A 2.5" thick carbon steel shield will be placed over the cask/skid inside the fuel building, after which a 3" thick carbon steel shield will be placed over the 2.5" thick shield providing a total of 5.5" of shielding on the skid. These shields may be placed on the skid inside the fuel handling building, or if load limits exist within the building, the 3" outer shield may be placed on the skid once the trailer exits the building. Placement of the inner shield on the skid inside the fuel handling building will be performed in accordance with the plants heavy loads procedures, and is evaluated within the plant 72.212 (50.59) for the dry fuel loading process. Sequence 9 shows this remote operation. If the neutron shield was drained during transfer from the decon area to the trailer (with the annulus filled), the neutron shield will be refilled and the annulus drained. The interim cover plate will then be replaced with the standard cask cover plate prior to exiting the fuel handling building.



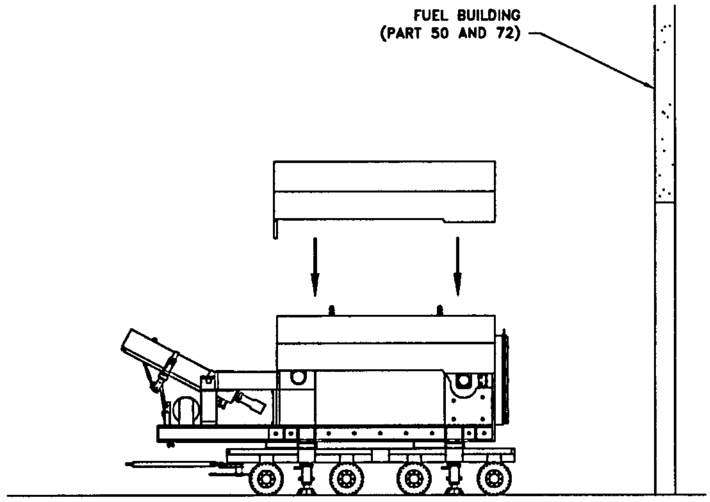
(9) INSTALLATION OF SUPPORT SKID INNER TOP SHIELDING

If fuel assembly weights are of a magnitude that would exceed the 75 ton limit, the standard cask top cover may be replaced with a reduced weight interim cover during transfer from the decontamination area to the trailer. Following placement of the cask on the trailer, and placement of the inner top shield on the transfer trailer, the interim cask top cover would be removed and the standard top cask cover installed prior to exiting the spent fuel/reactor building. This is shown in Sequence 10.



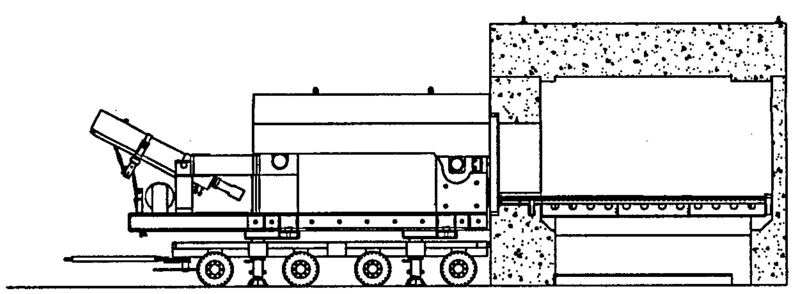
(10) INTERIM CASK TOP COVER IS REPLACED WITH STANDARD TOP COVER

Following placement of the standard cask top cover, the trailer with the OS197L TC may be moved out of the fuel building and the outer top trailer shielding installed outside, if the fuel building weight limits preclude placement of the outer top trailer shielding inside the fuel building. This is shown in Sequence 11. The OS197L TC system shielding (6" of shielding) provided in the decontamination area and the 5.5" provided on the trailer, along with the shielding provided by the bare OS197L TC, provides a level of shielding equivalent to that provided by the standard OS197 TC (with lead shielding) and is the bounding condition of the two from a dose perspective (decon area and transfer trailer). Therefore the Technical Specification 1.2.11 limits for cask dose rates are to be measured in the trailer configuration.



(11) INSTALLATION OF PART 72 SUPPORT SKID OUTER TOP SHIELDING

The transfer trailer, with loaded OS197L TC including the supplemental shielding, is then moved to the ISFSI and the Cask docked with the HSM. The DSC is then inserted into the HSM using the same methods as the OS197 TC. This is shown in Sequence 12.



(12) TRANSFER TRAILER IS DOCKED TO HSM AND CANISTER IS TRANSFERRED

W.8.1 Operational Differences between OS197L and OS197 TCs

Listed below are each of the UFSAR sections for preparation and loading of fuel assemblies into the HSM using the NUHOMS® OS197L TC system. In each section, which mirrors that of Section 5 of the UFSAR and Section 8 of the canister-specific appendices (e.g., M.8 for the 32PT DSC) the differences specific to the OS197L TC are listed.

W.8.1.1 UFSAR Section 5.1.1.1 – Preparation of the Transfer Cask and DSC

- The transfer cask may be filled in the fuel pool or prior to placement in the fuel pool.
- A decontamination cover may be provided to limit the potential for contamination of the exterior of the cask. Decontamination of the cask external surface as the cask is removed from the pool, if necessary, should be performed ALARA, due to the high cask dose rate for the bare cask in the 75 ton configuration on the crane.

W.8.1.2 UFSAR Section 5.1.1.2 – DSC Fuel Loading

- A preliminary measurement of Technical Specification 1.2.11 or 1.2.11.a limits for the dose rates at 3 feet from the top of the cask with the shield plug installed and water in the DSC cavity is performed.
- Water is pumped out of the DSC when the cask breaks the surface of the fuel pool to reduce cask weight.
- A helium or nitrogen back fill will be provided during initial draining to eliminate exposure of the fuel to air. The shield plug restraints will be installed to prevent shield plug movement.
- The decontamination cover, if provided, is removed from the cask while the cask is removed from the pool. This may be performed by connecting the decontamination cover to a fixed point above the pool to strip the cover without the need for personnel in the area.
- Personnel are evacuated from the area, as specified by plant's ALARA practices, due to the high cask dose rates. Crane operations will be performed remotely using cameras and laser/target positioning.
- The cask is placed into the decontamination area shielding sleeve once removed from the fuel pool. A decontamination area shielding bell is then placed over the side of the cask above the upper trunnions. The shielding sleeve and bell provide the additional shielding to produce similar shielding as the OS197 TC.

W.8.1.3 UFSAR Section 5.1.1.3 – DSC Drying and Backfilling

- Technical Specification 1.2.11 or 1.2.11.a limits for DSC dose rates at 3 feet from the top of the cask with the Automated Welding System (AWS) installed on the inner top cover plate are to be verified after the cask is placed in the decontamination area shields. This configuration offers shielding similar to that of the OS197 TC. Verification of TS dose limits is performed to determine if a fuel misload has not occurred.

W.8.1.4 UFSAR Section 5.1.1.4 – DSC Sealing Operations

- No change
- If the neutron shield is to be drained to reduce weight during the transfer from the decon area to the trailer, the DSC/cask annulus will be maintained full and the interim cask cover will be installed with a gasket to prevent annulus water leakage during downending. The annulus will be vented to atmosphere through a cask fitting or a fitting on the interim cask cover.

  CAUTION: During the DSC closure operations, the opening at the top and bottom of the decontamination area shielding shall be monitored (visual inspection) to assure no significant blockage of openings. Although blockage is improbable as all 16 openings would require sealing, personnel shall perform visual inspection of shielding sleeve and bell openings during the operations when DSC is in the sleeve.

W.8.1.5 UFSAR Section 5.1.1.5 – Transfer Cask Downending and Transport to ISFSI

- Crane operations for removal of the decontamination area shielding bell, engagement of the yoke to the cask trunnions, movement of the cask to the trailer, lowering of the cask onto the trailer and placement of the trailer shielding on the cask will be performed remotely using cameras and laser/target positioning, due to bare cask dose rates. The additional trailer shielding may be placed on the trailer at this time or the outer top shield may be placed on the trailer once the trailer exits the auxiliary building, as applicable based on site specific weight restrictions.
- If fuel assembly weights are of a magnitude that would exceed the 75 ton limit, the standard cask top cover may be replaced with a reduced weight interim cover during transfer from the decontamination area to the trailer. If water from the neutron shield was drained for transfer from the decon area to the trailer, the neutron shield will be refilled after the cask is placed on the trailer and after placement of the inner shield cover on the trailer. The DSC/cask annulus will then be drained. Following placement of the cask on the trailer, and placement of the inner top shield on the transfer trailer, the interim cask top cover would be removed and the standard top cask cover installed prior to exiting the spent fuel/reactor building.
- The OS197L TC system shielding (6" of shielding) provided in the decontamination area and the 5.5" provided on the trailer, along with the shielding provided by the bare OS197L TC, provides a level of shielding similar to that provided by the standard OS197 TC (with lead shielding) and is the bounding condition of the two (decon area and transfer trailer). Therefore the Technical Specification 1.2.11 limits for cask dose rates are to be measured in the trailer configuration.
- The interim top cask cover, is an aluminum plate (nominal 1" thick and 78.62" diameter) that interfaces with the cask top bolting, similar to the standard top cask cover. Following placement of the cask on the trailer, and placement of the inner top shield on

the transfer trailer, the interim cask top cover would be removed and the standard top cask cover installed prior to exiting the spent fuel/reactor building. The aluminum cover plate is approximately 4, 000 lbs. lighter than the standard cover. The function of the interim cask top cover is to provide some additional shielding in the axial direction, but more importantly to provide assurance that the DSC will remain within the TC under events that are beyond design basis. The interim cask top cover will also prevent any shifting of the DSC within the TC prior to placement of the standard cask cover. The interim cask top cover will not be used outside the fuel building. The interim top cover will be placed on the cask with a gasket if the DSC/cask annulus is to be maintained full. The 1" aluminum cover will see minimal stress due to the hydraulic head of the annulus water level.

The interim cover will itself have lifting points that meet ANSI N14.6 and is anticipated to weigh less than 500 lbs.

The effect on personnel doses will be minimal since the timeframe for use of this cover is short and significant shielding is provided at the top of the canisters.

The use of this cover will not impact the criticality analysis and will provide a slight improvement in thermal performance (heat rejection from the DSC).

W.8.1.6 UFSAR Section 5.1.1.6 – DSC Transfer to the HSM

- Following placement of the standard cask top cover, the trailer with the OS197L TC may be moved out of the fuel building and the outer top trailer shielding installed outside, if the fuel building weight limits preclude placement of the outer top trailer shielding inside the fuel building.
- Install the cask top centerline alignment target, through the trailer shielding.
- CAUTION: During the actual movement of the Transfer Cask on the transfer trailer to the ISFSI, the gap between the transfer deck and bottom of the skid shall be monitored (visual inspection) to assure no significant blockage of airflow. Although blockage is improbable as over 60 feet of gap would require sealing, personnel shall maintain a visual scan of the trailer.

The operational differences specified above for loading operations will also apply for unloading operations.

W.9 Acceptance Criteria and Maintenance Program

All acceptance criteria and maintenance requirements for the OS197L TC are identical to those of the OS197 and OS197H TCs described throughout the body of this UFSAR.

W.10 Radiation Protection

As discussed in Section W.5, use of the OS197L TC does not significantly affect personnel dose rates (during closure operations, handling, or storage) or site boundary dose rates. The OS197L TC is used only for loading/unloading and transfer operations, and the storage conditions are unchanged. Therefore, the personnel doses, occupational exposures and site bounding dose rates documented for each DSC/HSM storage configuration in Section 7.4 and Appendices K.10, L.10, M.10 and N.10 remain unchanged and are applicable to operations using the OS197L TC.

The use of the OS197L TC is not expected to have any significant impact on personnel dose rates during normal operation since the operations for placement and removal of bare OS197L TC from the fuel pool into the decontamination area shielding sleeve, placement and removal of the decontamination area shielding bell, engagement of the yoke to the cask trunnions, movement of the cask to the trailer, lowering of the cask onto the trailer and placement of the trailer shielding on the cask will be performed remotely using cameras and laser/target positioning.

W.11 Accident Analyses

This section describes the postulated accident events that could occur during fuel loading, draining, drying, welding and transfer of the DSC using a NUHOMS® OS197L TC. Sections which do not affect the evaluation presented in Chapter 8 or Appendices K.11, L.11, M.11 and N.11 for various DSC designs are identified as "No change." Detailed analysis of the events are provided in other sections and are referenced herein.

W.11.1 Postulated Accidents

Only those accidents affecting the OS197L TC are addressed in this section. There is no change to accident evaluations affecting other NUHOMS® components.

W.11.1.1 OS197L TC Missile Impact Analysis

This event is described in Section 8.2.2.4. The OS197L TC uses a 2.68" steel shell in lieu of a 1.5" steel shell with a nominal 3.5" lead annulus and a 0.5" inner liner for OS197 TC. The missile impact analyses for the OS197 TC are therefore bounding for the OS197L TC.

W.11.1.2 Earthquake

This event is described in Section 8.2.3.D. The OS197L TC configuration (cg location, cask length, trunnion location and bottom forging configuration) does not significantly differ from that of the OS197 TC. The OS197L TC remains stable when subjected to the design basis earthquake.

W.11.1.2.1 OS197L TC in a Vertical Configuration during Vacuum Drying and Welding Operations

The bottom forging on which the cask is resting during vertical cask operations, is the same size and configuration as the OS197 TC. The OS197L TC cg location is not significantly altered by the change in the cask shell configuration. The addition of the decontamination area shield will provide a larger diameter, more stable shell, outside the cask envelope, thereby potentially enhancing the OS197L TC seismic capacity.

W.11.1.2.2 OS197L TC in a Horizontal Configuration during Transfer Operations

The cask seismic stresses for the OS197L TC are bounded by the OS197 TC stresses due to the similar configurations of the cask ends (top and bottom forgings and covers) and larger thickness structural shell.

The trailer with the OS197L TC, with the additional shielding, remains stable for the design basis seismic accelerations.

W.11.1.3 OS197L TC Accidental Cask Drop

This event is described in Sections 8.2.5.2.B, D and E.

See Section W.3.1.3 for a discussion of the OS197L TC drop accident. This drop accident is bounded by the results for the OS197 TC drop accident discussed in Section 8.2.

W.11.1.4 Loss of Neutron Shield

This event is described in Section 8.2.5.3.

For the accident condition (the unlikely cask drop scenario) a complete loss of the OS197L TC neutron shield is postulated similar to the OS197 TC evaluation described in Section 8.2.5.3. In addition, since the trailer shield is not important to safety, the analysis conservatively assumes that all the trailer shielding is lost. However, the trailer shield is fabricated using two sets of plate shields (the inside shield is 2.5" thick, the outside shield is 3" thick) which may be damaged in a drop but are unlikely to separate completely from the skid and cask.

Assuming the non-mechanistic drop scenario occurs and the trailer shields and the cask are dislodged completely from the trailer and skid, recovery actions are required to manipulate the shields or providing supplemental shielding to reduce dose rates to a reasonable value until a long term recovery plan is in place.

OS197L TC ACCIDENT CONDITION DOSE RATES

Transfer Cask Configuration	Dose Rate Component	Dose Rates at Different Distances from Side Surface – Accident Condition No Neutron Shield			
		On Side Surface	4.57 meters (15')	100 meters	609.9 meters (2000')
		Dose Rate, mrem/hr	Dose Rate, mrem/hr	Dose Rate, mrem/hr	Dose Rate, mrem/hr
UFSAR (Table M.11-2)	Neutron	3,780	Not Calc.	Not Calc.	Not Calc.
	Gamma	1,070	Not Calc.	Not Calc.	Not Calc
	Total	4,640	Not Calc	Not Calc	0.01
OS197 TC	Neutron	1,282	66	0.067	1.87e-5
	Gamma	291	30	0.04	5.14e-5
	Total	1573	84	0.10	6.48e-5
OS197L TC (Bare Cask)	Neutron	3,691	187	0.20	1.06e-4
	Gamma	134,328	11,576	12.7	3.19e-2
	Total	138,019	11,763	12.9	3.20e-2

The dose rates provided for the UFSAR configuration above, are based on 32PT DSC with design basis source terms inside OS197 TC. The shielding analysis for the OS197L TC configuration presented in W.5 credits some additional shielding such as the 32PT DSC basket aluminum rails and other basket structures that were not included in the OS197 TC evaluation (see Appendix M.5.4) due to limitation of the previous analysis methods. The above data for the OS197L TC bare cask is for a 32PT DSC payload but is provided for evaluation of relative doses. The relative effect of the OS197L TC configuration and the decontamination area/trailer shielding configurations with respect to the OS197 TC configurations shown above is representative of the relative effect for all CoC 1004 licensed DSC payloads for the OS197L TC.

The dose rates on the ends of the OS197L TC will be the same as the OS197 TC since the top and bottom forging and cover plate configurations have not been modified.

As shown in the table below, the dose rates at the site boundary, assuming a 100 meter site boundary, would be approximately 13 mrem/hr during the timeframe that the cask trailer shield is dislodged from the cask and until the trailer shield is repositioned.

The 8 hours of recovery period assumed is appropriate because the repositioning of the trailer shields will be performed using lifting hardware pre-positioned prior to transfer operations. This will facilitate quick positioning using a crane to minimize the need for personnel to approach the cask.

A comparison of the OS197 TC and OS197L TC accident dose analyses using the 32PT DSC as a representative payload is provided below:

Cask	Contact Dose (mrem/hr)	Dose at 15 feet (mrem/hr)	Dose at 100 meters (mrem/hr)	Dose at 2000 feet (mrem/hr)	Recovery Period Assumed (hours)	Total Person-Dose at 100 meters (mrem)	Total Person-Dose at 2000 feet (mrem)
UFSAR (Section M.11.2.5.3)	4,640	700	5.25	.011	8	N/A	0.09
OS197 TC	1,573	84	0.10	6.48e-5	8	0.8	5.184e-4
OS197L TC	138,019	11,763	12.9	0.032	8	103.2	0.25

The increase in dose rates at the site boundary (100 meters) is significant (approximately 130 times) between the OS197 TC and OS197L TC values. However, the total dose at 100 meter site boundary still remains very low (103 mrem) and below the regulatory limit of 5,000 mrem.

A review of the UFSAR shows that the TC payload that produces the highest 100 meter dose rate is the 24PHB DSC (Appendix N.11). This is a 7 mrem/hr dose rate (Section N.11.2.5.3). Using the ratio of UFSAR dose rate and OS197L TC dose rate from the table above results in a factor of 12.9/5.25=2.45. Applying this factor to the 7 mrem/hr dose rate for the 24PHB DSC results in a 100 meter dose rate for a 24PHB DSC within the OS197L TC of 2.45x7=18 mrem/hr. This dose rate, applied over the 8 hour period, results in a total person-dose of 18x18=144 mrem. The 144 mrem is approximately 3% of the 5000 mrem limit for offsite exposure.

W.12 Operating Controls and Limits

The addition of OS197L TC to the standardized NUHOMS® system does not result in any change to the Technical Specifications, Functional and Operating Limits described in NUHOMS® CoC 1004 Amendment 8.

W.13 Quality Assurance

Chapter 11 provides a description of the Quality Assurance Program to be applied to the safety-related and important-to-safety activities associated with the standardized NUHOMS® system. The addition of OS197L TC to the NUHOMS® system does not require any changes to the quality assurance requirements stipulated in Chapter 11.

W.14 Decommissioning

No change to the decommissioning evaluation presented in Section 9.6 due to the addition of the OS197L TC to the NUHOMS® system.