December 2004

Revision UMSS-04B

NAC-UMS

Universal MPC System

FINAL SAFETY ANALYSIS REPORT

for the UMS Universal Storage System

Docket No. 72-1015

NAC INTERNATIONAL

Atlanta Corporate Headquarters: 3930 East Jones Bridge Road, Norcross, Georgia 30092 USA
Phone 770-447-1144, Fax 770-447-1797, www.nacintl.com

List of Effective Pages

List of Effective Pages (continued)

Chapter 2

List of Effective Pages (continued)

Chapter 3

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

Chapter 6

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

Chapter 7

Chapter 8

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

List of Effective Pages (continued)

Chapter 13

2.2.2 Water Level (Flood) Design

The Vertical Concrete Cask may be exposed to a flood during storage on an unsheltered concrete storage pad at an ISFSI site. The source and magnitude of the probable maximum flood depend on specific site characteristics.

2.2.2.1 Flood Elevations

The Vertical Concrete Cask is evaluated in Section 11.2.9 for a maximum flood water depth of 50 feet above the base of the cask. The flood water velocity is assumed to be 15 feet per second. Results of the evaluation show that under design basis flood conditions, the cask does not float, tip, or slide on the storage pad, and that the confinement function is maintained.

2.2.2.2 Phenomena Considered in Design Load Calculations

The occurrence of flooding at an ISFSI site is dependent upon the specific site location and the surrounding geographical features, natural and man-made. Some possible sources of a flood at an ISFSI site are: (1) overflow from a river or stream due to unusually heavy rain, snow-melt runoff, a dam or major water supply line break caused by a seismic event (earthquake); (2) high tides produced by a hurricane; and (3) a tsunami (tidal wave) caused by an underwater earthquake or volcanic eruption.

Flooding at an ISFSI site is highly improbable because of the extensive environmental impact studies that are performed during the selection of a site for a nuclear facility.

2.2.2.3 Flood Force Application

The evaluation of the Universal Storage System for a flood condition determines a maximum allowable flood water current velocity and a maximum allowable flood water depth. The criteria employed in the determination of the maximum allowable values are that a cask sliding or tip-over will not occur, and that the canister material yield strength is not exceeded. The evaluation of the effects of flood conditions on the system is presented in Section 11.2.9.

The force of the flood water current on the cask is calculated as a function of the current velocity by multiplying the dynamic water pressure by the frontal area of the cask that is normal to the current direction. The dynamic water pressure is calculated using Bernoulli's equation relating fluid velocity and pressure. The force of the flood water current is limited such that the overturning moment on the cask will be less than that required to tip the cask over.

2.2.2.4 Flood Protection

The inherent strength of the reinforced concrete cask provides a substantial margin of safety against any permanent deformation of the cask for a credible flood event at an ISFSI site. Therefore, no special flood protection measures for the cask are necessary. The evaluation presented in Section 11.2.9 shows that for the design basis flood, the allowable stresses in the canister are not exceeded.

2.2.3 Seismic Design

An ISFSI site may be subject to seismic events (earthquakes) during its lifetime. The seismic response spectra experienced by the cask depends upon the geographical location of the specific site and the distance from the epicenter of the earthquake. The only significant effect of a seismic event on the vertical concrete cask is a possible tip-over or a collision of two casks. However, tip-over does not occur during the design basis earthquake. For sites not implementing a friction limitation, it is possible for two casks to collide due to sliding. Seismic response of the cask is presented in Section 11.2.8.

2.2.3.1 Input Criteria

The transportable storage canister and vertical concrete cask are designed and analyzed by applying a seismic acceleration or a maximum resultant horizontal planar velocity of the ISFSI pad.

2.2.3.2 Seismic - System Analyses

The analysis for the earthquake condition applied to nuclear facilities is provided in Section 11.2.8.2. Evaluations of the consequences of a hypothetical tip-over event or a collision of two vertical concrete casks are provided in Section 11.2.12.

4.4.1.3 Three-Dimensional Transfer Cask and Canister Models

The three-dimensional quarter-symmetry transfer cask model is a representation of the PWR canister and transfer cask assembly. A half-symmetry model is used for the BWR canister and transfer cask. The model is used to perform a transient thermal analysis to determine the maximum water temperature in the canister for the period beginning immediately after removing the transfer cask and canister from the spent fuel pool. The model is also used to calculate the maximum temperature of the fuel cladding, the transfer cask and canister components during the vacuum drying condition and after the canister is back-filled with helium. The transfer cask is evaluated separately for PWR or BWR fuel using two models. For each fuel type, the class of fuel with the shortest associated canister and transfer cask is modeled in order to maximize the contents heat generation rate per unit volume and minimize the heat rejection from the external surfaces. The models for PWR and BWR fuel are shown in Figures 4.4.1.3-1 and 4.4.1.3-2, respectively. ANSYS SOLID70 three-dimensional conduction elements, LINK31 (PWR model) and MATRIX50 (BWR model) radiation elements are used. The model includes the transfer cask and the canister and its internals. The details of the canister and contents are modeled using the same methodology as that presented in Section 4.4.1.2 (Three-Dimensional Canister Models). Effective thermal properties for the fuel regions and the fuel tube regions are established using the fuel models and fuel tube models presented in Sections 4.4.1.5 and 4.4.1.6, respectively. The effective specific heat and density are calculated on the basis of material mass and volume ratio, respectively.

Radiation across the gaps was represented by the LINK31 elements or the MATRIX50 elements, which used the gray body emissivities for stainless and carbon steels. Convection is considered at the top of the canister lid, the exterior surfaces of the transfer cask, as well as at the annulus between the canister and the inner surface of the transfer cask. The combination of radiation and convection at the transfer cask exterior vertical surfaces and canister lid top surface is taken into account in the model using the same method described in Section 4.4.1.2 for the three-dimensional canister models. The bottom of the transfer cask is modeled as being in contact with the concrete floor. In the PWR configuration analysis, for the condition when the canister is filled with water at the start of the transfer operation, natural circulation of the water is taken into account by adjusting the effective conductivities in the fuel and water regions based on a classical energy balance calculation of the canister contents. Water circulation is not considered in the BWR configuration analysis. Volumetric heat generation (Btu/hr-in^3) is applied to the active fuel region based on a total heat load of 23 kW for both PWR and BWR fuel. The model considers the active fuel length of 144 inches and an axial power distribution, as shown in Figures 4.4.1.1-3 and 4.4.1.1-4 for PWR and BWR fuel, respectively.

An initial temperature of 100°F is considered in the entire model on the basis of the typical average water temperature in a spent fuel pool. For the design basis heat loads, the thermal transient analysis is performed for 20 hours (PWR) and 17 hours (BWR) with the water inside the canister, 27 hours (PWR) and 25 hours (BWR) for the vacuum condition, and 20 hours (PWR) and 16 hours (BWR) for the helium condition, followed by a steady-state analysis (in helium condition). Different time durations are used for the transient analyses for the reduced heat load cases, as specified in Section 4.4.3.1. The temperature history of the fuel cladding and the basket components, as well as the transfer cask components, is determined and compared with the short-term temperature limits presented in Tables 4.4.3-3 and 4.4.3-4.

Note that the first phase of the thermal transient analysis considers that the canister is filled with water, including the period of canister draining as described in Step 12 of Section 8.1.1. A typical transportable storage canister drain-down process (performed by suction or by a blow-down gas pressure) ranges from 1 to 2 hours. The thermal analysis basis of assuming a water condition during drain-down is acceptable due to the following conservatisms in the thermal transient analysis for the transfer operation:

(1) The system as analyzed does not include the rejection of heat from the system due to the removal of water, which has significant thermal capacitance;

(2) The energy absorbed by the change in the state of residual water to steam, as the pressure is reduced during the vacuum drying phase of the transient, is ignored in the analysis; and

(3) No contact is considered between components in the transportable storage canister in the thermal model.

8.1.1 Loading and Closing the Transportable Storage Canister

1. Visually inspect the basket fuel tubes to ensure that they are unobstructed and free of debris. Ensure that the welding zones on the canister, shield, and structural lids, and the port covers are prepared for welding. Ensure transfer cask door lock bolts/lock pins are installed and secure.
2. Fill the canister with clean water until the water is about 4 inches from the top of the canister.

   Note: Do not fill the canister completely in order to avoid spilling water during the transfer to the spent fuel pool.

   Note: If fuel loading requires boron credit, the minimum boron concentration of the water in the canister must be at least 1,000 ppm (boron), in accordance with LCO 3.3. 1.
3. Install the annulus fill system to transfer cask, including the clean water lines.
4. If it is not already attached, attach the transfer cask lifting yoke to the cask handling crane, and engage the transfer cask lifting trunnions.

   Note: The minimum temperature of the transfer cask (i.e., surrounding air temperature) must be verified to be higher than 0°F prior to lifting, in accordance with Section B3.4.1 (8) of Appendix B of the Amendment 3 Technical Specifications.
5. Raise the transfer cask and move it over the pool, following the prescribed travel path.
6. Lower the transfer cask to the pool surface and turn on the clean water line to fill the canister and the annulus between the transfer cask and canister.
7. Lower the transfer cask as the annulus fills with clean water until the trunnions are at the surface, and hold that position until the clean water overflows through the upper fill lines or annulus of the transfer cask. Then lower the transfer cask to the bottom of the pool cask loading area.

   Note: If an intermediate shelf is used to avoid wetting the cask handling crane hook, follow the plant procedure for use of the crane lift extension piece.
8. Disengage the transfer cask lifting yoke to provide clear access to the canister.
9. Load the previously designated fuel assemblies into the canister.

   Note: Contents must be in accordance with the Approved Contents provisions of Section B2.0 of Appendix B of the Amendment 3 Technical Specifications.

   Note: Contents shall be administratively controlled to ensure that fuel assemblies with certain characteristics are preferentially loaded in specified positions in the basket. Preferential loading requirements are presented in Section B2.1.2 of Appendix B of the Amendment 3 Technical Specifications.

10. Attach a three-legged sling to the shield lid using the swivel hoist rings. Torque hoist rings in accordance with Table 8.1-2. Attach the suction pump fitting to the vent port.
    Caution: Verify that the hoist rings are fully seated against the shield lid.
    Note: Ensure that the shield lid key slot aligns with the key welded to the canister shell.
11. Using the cask handling crane, or auxiliary hook, lower the shield lid until it rests in the top of the canister.
12. Raise the transfer cask until its top just clears the pool surface. Hold at that position, and using a suction pump, drain the pool water from above the shield lid. After the water is removed, continue to raise the cask. Note the time that the bottom of the transfer cask clears the spent fuel pool water. Operations through Step 28 must be completed in accordance with the time limits presented in Table 8.1.1-3. The "time in water" clock is to be initiated if the lifting of the transfer cask from the pool is interrupted with the cask partially removed from the pool.

    Note: For the PWR configuration, in the event that the drain time limit is not met, either forced air or in-pool cooling, or monitoring the water temperature (see following note) is required. Forced air cooling is implemented by supplying 375 CFM air with a maximum temperature of 100°F to the 8 transfer cask lower inlets. Forced air or in-pool cooling of the canister shall be maintained for a minimum of 24 hours. After 24 hours, the cooling may be discontinued based on heat load as follows:

Time Periods for Discontinued Cooling after 24 Hours

Heat Load (kW)	For Forced Air Cooling (hrs)	For In-Pool Cooling (hrs)
$20 < L \leq 23$	4	15
$17.6 < L \leq 20$	7	18
$14 < L \leq 17.6$	11	22
$11 < L \leq 14$	14	24
$8 < L \leq 11$	20	29
$L \leq 8$	28	34

Note: Alternately, the temperature of the water in the canister may be used to establish the time for completion through Step 28 for the PWR configuration. Those operations must be completed within 2 hours of the time that the canister water reaches the temperatures shown in the following table. For this alternative, the water temperature must be determined every 2 hours beginning at the time shown in the following table after the time the transfer cask is removed from the pool.

Note: If the canister draining operation is interrupted or only partially completed, the canister shall be refilled with water prior to start of the auxiliary cooling operations (i.e., forced air or in-pool cooling), per the Note following Step 12.

Note: The time duration from completion of draining the canister through completion of LCO A 3.1.3 (Step 34) shall be monitored in accordance with LCO A 3.1.1.

29. Attach the vacuum equipment to the vent and drain ports. Dry any free standing water in the vent and drain port recesses.
30. Operate the vacuum equipment until a vacuum of ≤10 mm of mercury exists in the canister and isolate the vacuum pump.
31. Verify that no water remains in the canister by holding the vacuum of ≤10 mm of mercury for a minimum of 10 minutes. If water is present in the cavity, the pressure will rise as the water vaporizes. Continue the vacuum/hold cycle until the conditions of LCO A 3.1.2 are met.

    Precaution: If the spent fuel pool water temperature for canisters vacuum dried in the pool, or the cask preparation area ambient temperature for canisters vacuum dried outside the pool is below 65°F, the vacuum drying of the canister shall be extended below the standard pressure value of ≤10 mm Hg until a cavity pressure of ≤5 mm Hg is achieved. The dryness verification shall be performed and meet the acceptance criteria as specified in LCO A 3.1.2, but limiting any pressure rise during the 10-minute hold period to ≤5 mm Hg.
32. Evacuate the cavity until a vacuum of ≤3 mm of mercury exists and backfill the canister cavity with helium having a minimum purity of 99.9% to a pressure of one atmosphere (0 psig).
33. Restart the vacuum equipment and operate until a vacuum of 3 mm of mercury exists in the canister.
34. Backfill the canister with helium having a minimum purity of 99.9% to a pressure of one atmosphere (0 psig).

    Note: Canister helium backfill pressure must conform to the requirements of LCO A 3.1.3.

    Note: Monitor the time from this step (completion of helium backfill) until completion of canister transfer into and closure of the concrete cask in accordance with LCO A 3.1.4.
35. Disconnect the vacuum and helium supply lines from the vent and drain ports. Dry any residual water that may be present in the vent and drain port cavities.
36. Install the vent and drain port covers.
37. Complete the root pass weld of the drain port cover to the shield lid.

    Note: If the drain port cover weld is completed in a single pass, the weld final surface is liquid penetrant inspected in accordance with Step 40.

38. Prepare the weld and perform a liquid penetrant examination of the root pass. Record the results.
39. Complete welding of the drain port cover to the shield lid.
40. Prepare the weld and perform a liquid penetrant examination of the drain port cover weld final pass. Record the results.
41. Complete the root pass weld of the vent port cover to the shield lid.

    Note: If the drain port cover weld is completed in a single pass, the weld final surface is liquid penetrant inspected in accordance with Step 44.
42. Prepare the weld and perform a liquid penetrant examination of the root pass. Record the results.
43. Complete welding of the vent port cover to the shield lid.
44. Prepare the weld and perform a liquid penetrant examination of the weld final surface. Record the results.
45. Remove the welding machine and any supplemental shielding used during shield lid closure activities.
46. Install the helium leak test fixture.
47. Attach the vacuum line and leak detector to the leak test fixture fitting.
48. Operate the vacuum system to establish a vacuum in the leak test fixture.
49. Operate the helium leak detector to verify that there is no indication of a helium leak exceeding 2×10^{-7} cm^3/second, at a minimum test sensitivity of 1×10^{-7} cm^3/second helium, in accordance with the requirements of LCO 3.1.5.
50. Release the vacuum and disconnect the vacuum and leak detector lines from the fixture.
51. Remove the leak test fixture.
52. Attach a three-legged sling to the structural lid using the swivel hoist rings.

    Caution: Ensure that the hoist rings are fully seated against the structural lid. Torque the hoist rings in accordance with Table 8.1.1-2. Verify that the spacer ring is in place on the structural lid.

    Note: Verify that the structural lid is stamped or otherwise marked to provide traceability of the canister contents.
53. Using the cask handling crane or the auxiliary hook, install the structural lid in the top of the canister. Verify that the structural lid is flush with, or protrudes slightly above, the canister shell. Verify that the gap in the spacer ring is not aligned with the shield lid alignment key. Remove the hoist rings.
54. Install the automatic welding equipment on the structural lid including the supplemental shield plate.
55. Operate the welding equipment to complete the root weld joining the structural lid to the canister shell.

56. Prepare the weld and perform a liquid penetrant examination of the weld root pass. Record the results.
57. Continue with the welding procedure, examining the weld at 3/8-inch intervals using liquid penetrant. Record the results of each intermediate and the final examination.

    Note: If ultrasonic testing of the weld is used, testing is performed after the weld is completed.
58. Remove the weld equipment and supplemental shielding.
59. Perform a smear survey of the accessible area at the top of the canister to ensure that the surface contamination is less than the limits established for the site. Smear survey results shall meet the requirements of Technical Specification LCO 3.2.1.
60. Install the transfer cask retaining ring. Torque bolts to 155 ± 10 ft-lbs. (Table 8.1.1-2).
61. Decontaminate the external surface of the transfer cask to the limits established for the site.

Figure 8.1.1-1 Typical Vent and Drain Port Locations

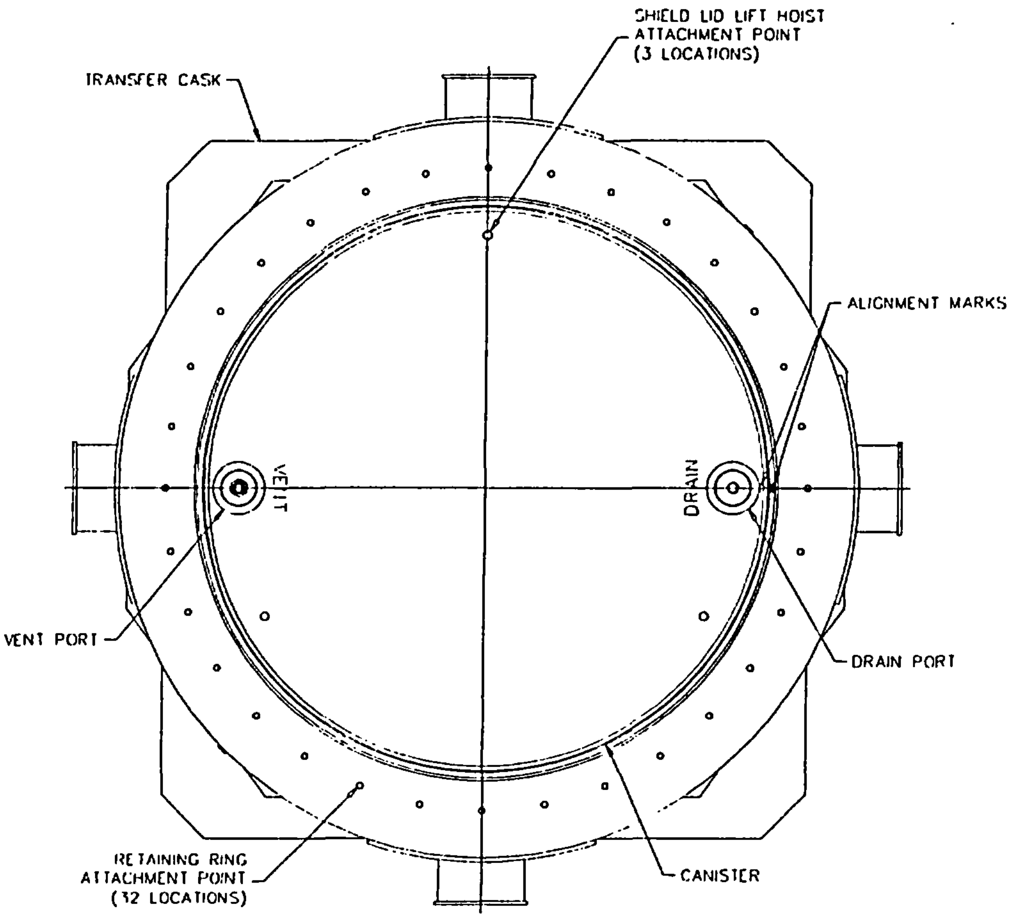


Table 8.1.1-1 List of Principal Ancillary Equipment

Item	**Description**
Transfer Cask Lifting Yoke	Required for lifting and moving the transfer cask.
Heavy-Haul Transporter (Optional)	Heavy-haul (double drop frame) trailer required for moving the loaded and empty vertical concrete cask to and from the ISFSI pad.
Mobile Lifting Frame (Optional)	A self-propelled or towed A-frame lifting device for the concrete cask. Mobile Lifting Frame is used to lift the cask and move it using two lifting lugs in the top of the concrete cask.
Helium Supply System	Supplies helium to the canister for helium backfill and purging operations.
Vacuum Drying System	Used for evacuating the canister. Used to remove residual water, air and initial helium backfill.
Automated Welding System	Used for welding the shield lid and structural lid to the canister shell.
Self-Priming Pump	Used to remove water from the canister.
Shield Lid Sling	A three-legged sling used for lifting the shield lid. It is also used to lift the concrete cask shield plug and lid.
Canister Sling	A set of 2 three-legged slings used for lifting the structural lid by itself, or for lifting the canister when the structural lid is welded to it. The slings are configured to provide for simultaneous loading during the canister lift.
Transfer Adapter	Used to align the transfer cask to the vertical concrete cask or the Universal Transport Cask. Provides the platform for the operation of the transfer cask shield doors.
Transfer Cask Extension	A carbon steel ring used to extend the height of the transfer cask when using the next longer size canister.
Hydraulic Unit	Operates the shield doors of the transfer cask.
Lift Pump Unit	Jacking system for raising and lowering the concrete cask.
Air Pad Rig Set	Air cushion system used for moving the concrete cask.
Supplemental Shielding Fixture	An optional carbon steel fixture inserted in the Vertical Concrete Cask air inlets to reduce radiation dose rates at the inlets.

Table 8.1.1-2 Torque Values

Fastener	Torque Value (ft-lbs)	Torque Pattern
Transfer Adapter Bolts (Optional)	40 ± 5	None
Transfer Cask Retaining Ring	155 ±10	0°, 180°, 270° and 90° in two passes
Transfer Cask Extension	155 ±10	None
Vertical Concrete Cask Lid	40 ± 5	None
Lifting Hoist Rings – Canister Structural Lid Lid Only Loaded Canister	 Hand Tight 800 +80, -0	None
Canister Lid Plug Bolts Shield Lid Plug Bolts	Hand Tight Hand Tight	None None
Transfer Cask Door Lock Bolts	Hand Tight	None
Canister Drain Tube	135 ± 15 (Furon metal seals) or 115 ± 5 (elastomer seals, EPDM or Viton)	None

Table 8.1.1-3 Handling Time Limits Based on Decay Heat Load with Canister Full of Water

Total Heat Load (L) (kW)	**PWR Time Limit (Hours)**	**BWR Time Limit (Hours)**
20.0 < L ≤23.0	20	17
17.6 < L ≤20.0	23	17
14.0 < L ≤17.6	27	17
11.0 < L ≤14.0	30	17
8.0 < L ≤11.0	35	17
L ≤8.0	40	17

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents (Continued)

Table of Contents (Continued)

11.2.8 Earthquake Event

This section provides an evaluation of the response of the vertical concrete cask to an earthquake imparting a horizontal acceleration of 0.26g and 0.29g at the top surface of the concrete pad. This evaluation shows that the loaded or empty vertical concrete cask does not tip over or slide in the earthquake event. The vertical acceleration is defined as 2/3 of the horizontal acceleration in accordance with ASCE 4-86 [36].

11.2.8.1 Cause of the Earthquake Event

Earthquakes are natural phenomena to which the storage system might be subjected at any U.S. site. Earthquakes are detected by the ground motion and by seismic instrumentation on and off site.

11.2.8.2 Earthquake Event Analysis

In the event of earthquake, there exists a base shear force or overturning force due to the horizontal acceleration ground motion and a restoring force due to the vertical acceleration ground motion. This ground motion tends to rotate the concrete cask about the bottom corner at the point of rotation (at the chamfer). The horizontal moment arm extends from the center of gravity (C.G.) toward the outer radius of the concrete cask. The vertical moment arm reaches from the C.G. to the bottom of the cask. When the overturning moment is greater than or equal to the restoring moment, the cask will tip over. To maximize this overturning moment, the dimensions for the Class 3 PWR configuration, which has the highest C.G., are used in this evaluation. Based on the requirements presented in NUREG-0800 [22], the static analysis method is considered applicable if the natural frequency of the structure is greater than 33 cycles per second (Hz).

The combined effect of shear and flexure is computed as:

$$\frac{1}{f^2} = \frac{1}{f_f^{\,2}} + \frac{1}{f_s^{\,2}} = \frac{1}{348.6} + \frac{1}{150.7} \quad [19]$$

or

$$f = 105.2 \text{ Hz} > 33 \text{ Hz}$$

where:

f_f = frequency for the first free-free mode based on flexure deformation only (Hz),
f_s = frequency for the first free-free mode based on shear deformation only (Hz).

The frequency f_f is computed as:

$$F_f = \frac{\lambda^2}{2\pi L^2}\sqrt{\frac{EI}{M}} = \frac{4.730^2}{2\pi(226)^2}\sqrt{\frac{(3.38\times10^6)\times(1.4832\times10^7)}{2.005}} \quad [19]$$

$$f_f = 348.6 \text{ Hz}$$

where:

$\lambda = 4.730$,

$L = 226$ in, length of concrete cask,

$E = 3.38 \times 10^6$ psi, modulus of elasticity for concrete at 200°F,

$$I = \text{moment of inertia} = \frac{\pi\left(D_o^4 - D_i^4\right)}{64} = \frac{\pi\left[(136\text{ in})^4 - (79.5\text{ in})^4\right]}{64} = 1.4832\times10^7 \text{ in}^4,$$

$$\rho = \frac{140}{1728\times386.4} = 2.096\times10^{-4} \text{ lbm/in}^3 \text{, mass density,}$$

$$M = \pi(68^2 - 39.75^2)\times(2.096\times10^{-4}) = 2.005 \text{ lbm/in}$$

The frequency accounting for the shear deformation is:

$$f_s = \frac{\lambda_s}{2\pi L}\sqrt{\frac{KG}{\mu}} = \frac{3.141593}{2(3.141595)(226)}\sqrt{\left(\frac{(0.6947)(1.40\times10^6)}{2.096\times10^{-4}}\right)} \quad [19]$$

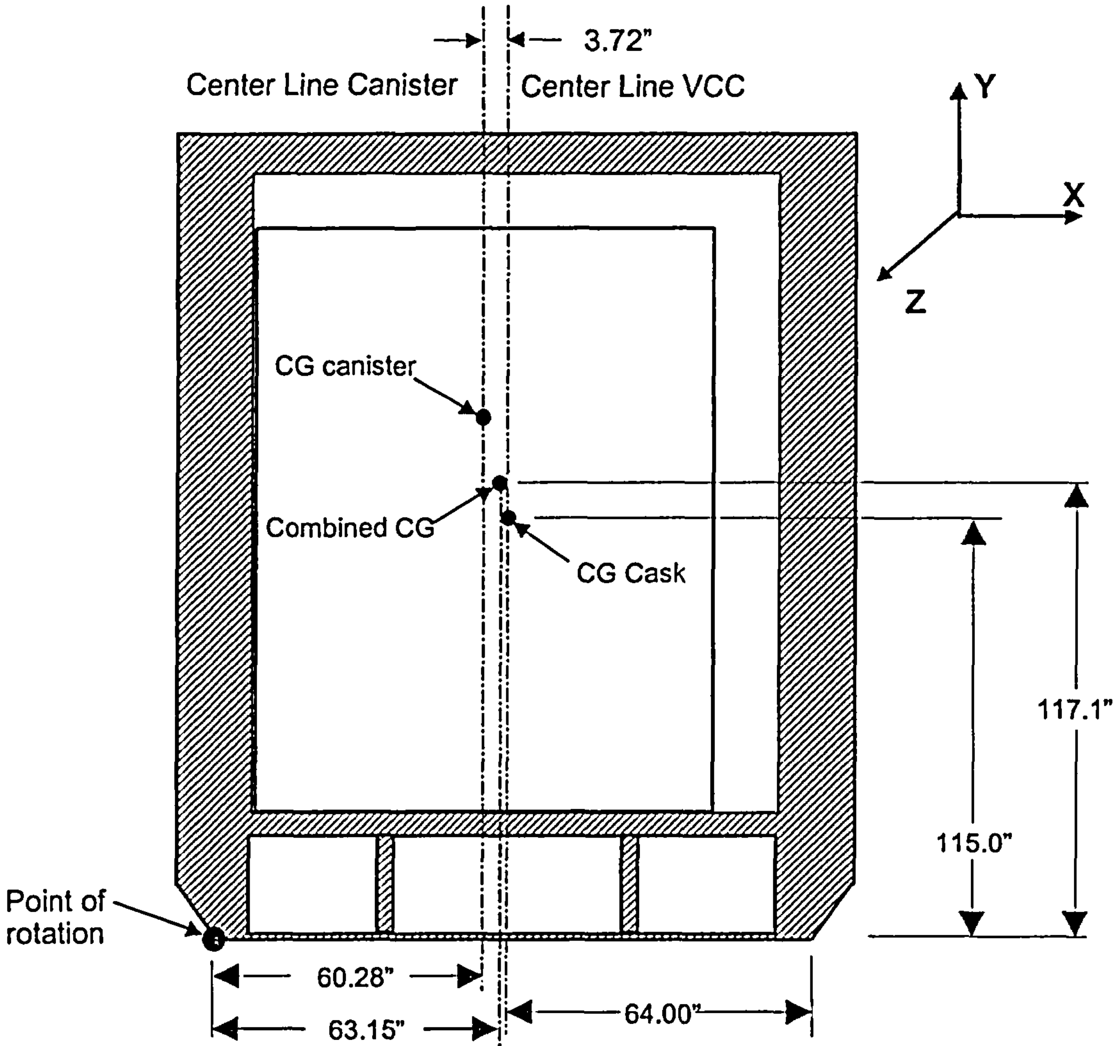
$$f_s = 150.7 \text{ Hz}$$

where:

$\lambda_s = \pi$,

$L = 226$ in, length of concrete cask,

$$K = \frac{6(1+\nu)(1+m^2)^2}{(7+6\nu)(1+m^2)+(20+12\nu)m^2}, \text{ shear coefficient,}$$



substituting for G_h and G_v gives:

Case 1

$$(1-a)\frac{b}{d} \geq 0.566 \times a$$

$$a \leq \frac{b/d}{0.566 + 1.0(b/d)}$$

Case 2

$$(1-0.4a)\frac{b}{d} \geq 1.077a$$

$$a \leq \frac{b/d}{1.077 + 0.4(b/d)}$$

Because the canister is not attached to the concrete cask, the combined center of gravity for the concrete cask, with the canister in its maximum off-center position, must be calculated. The point of rotation is established at the outside lower edge of the concrete cask.

The inside diameter of the concrete cask is 74.5 inches and the outside diameter of the canister is 67.06 inches; therefore, the maximum eccentricity between the two is:

$$e = \frac{74.50\text{ in} - 67.06\text{ in}}{2} = 3.72\text{ in.}$$

The horizontal displacement, x, of the combined C.G. due to eccentric placement of the canister is:

$$x = \frac{70{,}701(3.72)}{310{,}345} = 0.85\text{ in.}$$

Therefore,

$$b = 64 - 0.85 = 63.15\text{ in.}$$

$$d = 117.1\text{ in.}$$

1) $a \leq \dfrac{63.15/117.1}{0.566 + 1.0 \times 63.15/117.1}$

$a \leq 0.49g$

2) $a \leq \dfrac{63.15/117.1}{1.077 + 0.4 \times 63.15/117.1}$

$a \leq 0.42g$

Therefore, the minimum ground acceleration that may cause a tip-over of a loaded concrete cask is 0.42g. Since the 0.26g design basis earthquake ground acceleration for the UMS® system is less than 0.42g, the storage cask will not tip over.

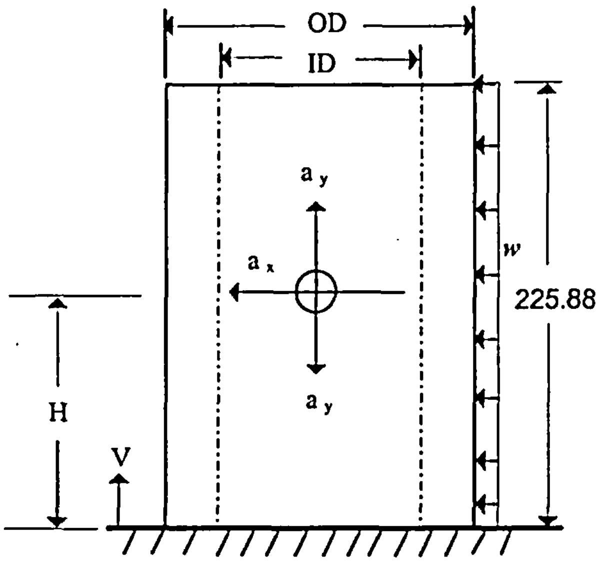
The factor of safety is 0.42 / 0.26 = 1.61, which is greater than the required factor of safety of 1.1 in accordance with ANSI/ANS-57.9.

Since an empty vertical concrete cask has a lower C.G. as compared to a loaded concrete cask, the tip-over evaluation for the empty concrete cask is bounded by that for the loaded concrete cask.

11.2.8.2.2 Sliding Evaluation of the Vertical Concrete Cask

For sites imposing the restriction that the Vertical Concrete Cask does not slide during a seismic event, the force holding the cask (F_s) has to be greater than or equal to the force trying to move the cask.

$a =$ 0.50 g, horizontal direction,
a_y = 0.50 g, vertical direction,
H = 117.1 in., fully loaded C.G.,
W_{vcc} = 325,000 lbf, bounding cask weight
OD = 136 in., concrete exterior diameter,
ID = 79.50 in., concrete interior diameter,
$A = \pi (OD^2 - ID^2) / 4 = 9{,}562.8\ in.^2$,
$I = \pi (OD^4 - ID^4) / 64 = 14.83 \times 10^6\ in.^4$,
$S_{outer} = 2I / OD = 218{,}088.2\ in.^3$,
$S_{inner} = 2I / ID = 373{,}035.0\ in.^3$,
$w = a_x W_{vcc} / 225.88 \approx 720\ lbf/in.$
$M = w (225.88)^2 / 2 = 1.84 \times 10^7$ in.-lbf,
the maximum bending moment at the support.



The calculated compressive stresses are used in the load combinations for the vertical concrete cask as shown in Table 3.4.4.2-1.

11.2.8.2.4 Vertical Concrete Cask Sliding

For sites permitting the movement of the vertical concrete cask during the seismic event, it is possible that two vertical concrete casks may impact each other during the seismic event.

The bounding condition for the impact of the vertical concrete cask is for one cask to directly impact an adjacent cask with the direction of motion through the centerline of the casks. In this fashion, all the kinetic energy is absorbed in the crushing of the concrete or in the elastic deformation of the concrete. For an incremental thickness of crush (dy), the increment in the crush energy (dE_c) is:

$$dE_c = L \times \sigma \times L_c \times dy$$

where:

L = axial length of contact between the two vertical concrete casks (inch)
L_c = the width of the contact, (inch)
σ = crush strength (psi)

The width of the crush for a specific crush depth (y) varies as the crush increases and is expressed as:

$$L_c(y) = 2\left(R_o^2 - (R_o - y)^2\right)^{1/2}$$

where:

R_o = outer radius of the vertical concrete cask, (inch)

The crushing will continue until the energy absorbed by crush is equal to the initial kinetic energy, which is associated with the initial velocity V_o. The total sum of all the increments from the initiation of crush to the final value of D_f (depth of crush) is the integral of the above expression, and it is equated to the kinetic energy.

$$0.5 \times W\left(\frac{V_o^2}{g}\right) = \sigma \times L \int_0^{D_f} L_c dy$$

where:

W = weight of the vertical concrete cask (lb)
g = 386.3 in/sec^2

Evaluating this integral leads to:

$$0.5 \times W\left(\frac{V_o^2}{g}\right) = \sigma \times L \times R_o^2 \times F(\beta)$$

where:

$$F(\beta) = \left[\frac{\pi}{2} - (1-\beta)\left(1-(1-\beta)^2\right)^{1/2} - \sin^{-1}(1-\beta)\right]$$

and

$\beta = D_f/R_o$

The D_f is computed by incrementing β from zero until the kinetic energy equals the crush energy. For the PWR and the BWR, velocities of 68 in/sec and 50 in/sec are computed, respectively. These result in the following accelerations and crush depths using the weights and heights of the five classes of the vertical concrete cask.

Vertical Concrete Cask Acceleration/Crush Summary

	Class 1	Class 2	Class 3	Class 4	Class 5
VCC Side Impact Acceleration (g)	32.5	32.6	32.7	26.3	26.3
Design Basis Tip-over Acceleration (A_d) in (g)	40	40	40	30	30
Dynamic Load Factor (DLF) for the Tip-over Evaluation	1.19	1.11	1.2	1.05	1.04
A_d/DLF	33.6	36.0	33.3	28.6	28.8
Crush (in)	.3	.3	.3	.2	.2

As indicated in the preceding table, the accelerations resulting from the impact are less than the factored accelerations (A_d/DLF) of the basket used in the PWR and BWR basket and canister evaluations. Therefore, the stresses and displacements of the basket and canister resulting from the tip-over evaluation bound the stresses and displacements resulting from a side impact of two vertical concrete casks.

11.2.8.3 Corrective Actions

Inspection of the vertical concrete casks is required following an earthquake event. As sliding may occur, the positions of the concrete casks shall be verified or the casks shall be repositioned to ensure they maintain the 15-foot center-to-center spacing on the ISFSI pad as established in Section 8.1.3. The temperature monitoring system should be checked for operation.

11.2.8.4 Radiological Impact

Minor radiological consequences may result if the concrete casks are required to be repositioned on the ISFSI pad.

THIS PAGE INTENTIONALLY LEFT BLANK

C 3.1 NAC-UMS® SYSTEM Integrity

C 3.1.1 CANISTER Maximum Time in Vacuum Drying

BASES

BACKGROUND

A TRANSFER CASK with an empty CANISTER is placed into the spent fuel pool and loaded with fuel assemblies meeting the requirements of the Approved Contents limits. A shield lid is then placed on the CANISTER. The TRANSFER CASK and CANISTER are raised out of the spent fuel pool. The TRANSFER CASK and CANISTER are then moved into the cask decontamination area, where dose rates are measured and the CANISTER shield lid is welded to the CANISTER shell and the lid weld is examined, pressure tested, and leak tested. The water is drained from the CANISTER, and CANISTER cavity vacuum drying is performed. The CANISTER cavity is then backfilled with helium. Additional dose rates are measured, and the CANISTER vent port and drain port covers and structural lid are installed and welded. Non-destructive examinations are performed on the welds. Contamination measurements are completed prior to moving the TRANSFER CASK and CANISTER in position to transfer the CANISTER to the CONCRETE CASK. After the CANISTER is transferred, the CONCRETE CASK is then moved to the ISFSI. Average CONCRETE CASK dose rates are measured at the ISFSI pad.

Limiting the elapsed time from the end of CANISTER draining operations through dryness verification testing and subsequent backfilling of the CANISTER with helium ensures that the short-term temperature limits established in the Safety Analyses Report for the spent fuel cladding and CANISTER materials are not exceeded and that the test duration of 30 days (720 hours) considered in PNL-4835 for zirconium alloy clad fuel for storage in air is not exceeded.

APPLICABLE SAFETY ANALYSIS

Limiting the total time for loaded CANISTER vacuum drying operations ensures that the short-term temperature limits for the fuel cladding and CANISTER materials are not exceeded. If vacuum drying operations are not completed in the required time period, the CANISTER is backfilled with helium, the TRANSFER CASK and loaded CANISTER are placed in the spent fuel pool and the TRANSFER CASK and loaded CANISTER are kept in the pool for a minimum of 24 hours.

(continued)

APPLICABLE SAFETY ANALYSIS (continued)	Analyses reported in the Safety Analysis Report conclude that spent fuel cladding and CANISTER material short-term temperature limits will not be exceeded for total elapsed time in the vacuum drying operation and in the TRANSFER CASK with the CANISTER filled with helium. Since the rate of heat up is slower for lower total heat loads, the time required to reach component limits is longer than for the design basis heat load. Consequently, longer time limits are specified for heat loads below the design basis for the PWR and BWR fuel configurations as shown in LCO 3.1.1. As shown in the LCO, for total heat loads not specified, the time limit for the next higher specified heat load is conservatively applied. Analysis also shows that the fuel cladding and CANISTER component temperatures are well below the allowable temperatures for the time durations specified from the end of in-pool cooling, or end of forced air cooling, of the CANISTER through the completion of LCO A 3.1.3 and for the time specified in LCO 3.1.4 for the CANISTER in the TRANSFER CASK when backfilled with helium.
LCO	Limiting the length of time for vacuum drying operations for the CANISTER ensures that the spent fuel cladding and CANISTER material temperatures remain below the short-term temperature limits for the NAC-UMS® SYSTEM.
APPLICABILITY	The elapsed time restrictions for vacuum drying operations on a loaded CANISTER apply during LOADING OPERATIONS from the completion point of CANISTER draining operations through the completion point of LCO A 3.1.3. The LCO is not applicable to TRANSPORT OPERATIONS or STORAGE OPERATIONS.
ACTIONS	A note has been added to the ACTIONS, which states that, for this LCO, separate Condition entry is allowed for each NAC-UMS® SYSTEM. This is acceptable, since the Required Actions for each Condition provide appropriate compensatory measures for each NAC-UMS® SYSTEM not meeting the LCO. Subsequent NAC-UMS® SYSTEMS that do not meet the LCO are governed by subsequent Condition entry and application of associated Required Actions.

(continued)

ACTIONS (continued)

A.1
If the LCO time limit is exceeded, the CANISTER will be backfilled with helium to a pressure of 0 psig (+1,-0).

AND

A.2.1.1
The TRANSFER CASK containing the loaded CANISTER shall be placed in the spent fuel pool having a maximum water temperature of 100°F. For in-pool cooling operations with the TRANSFER CASK and loaded CANISTER submerged, the annulus fill system is not required to be operating. If only the loaded CANISTER is submerged for in-pool cooling, the annulus fill system is required to be operating.

AND

A.2.1.2
The TRANSFER CASK and loaded CANISTER shall be maintained in the spent fuel pool with the water level above the top of the CANISTER, and a maximum water temperature of 100°F for a minimum of 24 hours prior to the restart of LOADING OPERATIONS.

OR

A.2.2.1
A cooling air flow of 375 CFM at a maximum temperature of 76°F shall be initiated. The airflow will be routed to the annulus fill/drain lines of the TRANSFER CASK and will flow through the annulus and cool the CANISTER.

AND

A.2.2.2
The cooling air flow shall be maintained for a minimum of 24 hours prior to restart of LOADING OPERATIONS.

(continued)

SURVEILLANCE REQUIREMENTS

SR 3.1.1.1

The elapsed time shall be monitored from completion of CANISTER draining through completion of LCO A 3.1.3. Monitoring the elapsed time ensures that helium backfill and in-pool or forced air cooling operations can be initiated in a timely manner during LOADING OPERATIONS to prevent fuel cladding and CANISTER materials from exceeding short-term temperature limits.

SR 3.1.1.2

The elapsed time shall be monitored from the end of in-pool cooling or forced air cooling through completion of LCO A 3.1.3. Monitoring the elapsed time ensures that helium backfill and in-pool or forced air cooling operations can be initiated in a timely manner during LOADING OPERATIONS to prevents fuel cladding and CANISTER materials from exceeding short-term temperature limits.

REFERENCES

1. FSAR Sections 4.4 and 8.1.

C 3.1 NAC-UMS® SYSTEM Integrity

C 3.1.2 CANISTER Vacuum Drying Pressure

BASES

BACKGROUND	A TRANSFER CASK with an empty CANISTER is placed into the spent fuel pool and loaded with fuel assemblies meeting the requirements of the Approved Contents Limits. A shield lid is then placed on the CANISTER. The TRANSFER CASK and CANISTER are raised out of the spent fuel pool. The TRANSFER CASK and CANISTER are then moved into the cask decontamination area, where dose rates are measured and the CANISTER shield lid is welded to the CANISTER shell and the lid weld is examined, pressure tested, and leak tested. The water is drained from the CANISTER, and CANISTER cavity vacuum drying is performed. The CANISTER cavity is then backfilled with helium. Additional dose rates are measured, and the CANISTER vent port and drain port covers and structural lid are installed and welded. Non-destructive examinations are performed on the welds. Contamination measurements are completed prior to moving the TRANSFER CASK and CANISTER in position to transfer the CANISTER to the CONCRETE CASK. After the CANISTER is transferred, the CONCRETE CASK is then moved to the ISFSI. Average CONCRETE CASK dose rates are measured at the ISFSI pad. CANISTER cavity vacuum drying is utilized to remove residual moisture from the CANISTER cavity after the water is drained from the CANISTER. Any water not drained from the CANISTER cavity evaporates due to the vacuum. This is aided by the temperature increase, due to the heat generation of the fuel.
APPLICABLE SAFETY ANALYSIS	The confinement of radioactivity (including fission product gases, fuel fines, volatiles, and crud) during the storage of design basis spent fuel in the CANISTER is ensured by the multiple confinement boundaries and systems. The barriers relied on are: the fuel pellet matrix, the metallic fuel cladding tubes where the fuel pellets are contained, and the CANISTER where the fuel assemblies are stored. Long-term integrity of the fuel and cladding depends on storage in an inert atmosphere. This is accomplished by removing water from the CANISTER and backfilling the cavity with helium. The thermal analysis assumes that the CANISTER cavity is dried and filled with helium.

(continued)

APPLICABLE SAFETY ANALYSIS (continued)	The heat-up of the CANISTER and contents will occur during CANISTER vacuum drying, but is controlled by LCO 3.1.1. Dryness of the CANISTER (e.g., no free water) is verified by holding a vacuum of ≤10 mm Hg for a period of not less than 10 minutes. The vapor pressure of water at 70°F is approximately 20 mm Hg. Selecting a pressure that is 1/2 of the vapor pressure at 70°F ensures that all of the free water in the CANISTER is removed without excursion to a low vacuum condition that could lead to icing. The actual temperature in the loaded CANISTER is expected to be above 70°F, which would result in a higher vapor pressure. Consequently, the vacuum pressure of 10 mm Hg is conservatively selected. Holding the vacuum pressure of ≤10 mm of mercury for 10 minutes, with the CANISTER isolated from the vacuum pump, demonstrates that there is no free water in the CANISTER, since the presence of any significant free water would result in the vacuum pressure increasing in a short period of time to the vapor pressure corresponding to the average temperature of the CANISTER and contents.
LCO	A vacuum pressure of ≤10 mm of mercury, as specified in this LCO, indicates that liquid water has been vaporized and removed from the CANISTER cavity. Removing water from the CANISTER cavity helps to ensure the long-term maintenance of fuel cladding integrity.
APPLICABILITY	Cavity vacuum drying is performed during LOADING OPERATIONS before the TRANSFER CASK holding the CANISTER is moved to transfer the CANISTER into the CONCRETE CASK. Therefore, the vacuum requirements do not apply after the CANISTER is backfilled with helium and leak tested prior to TRANSPORT OPERATIONS and STORAGE OPERATIONS.
ACTIONS	A note has been added to the ACTIONS, which states that, for this LCO, separate Condition entry is allowed for each CANISTER. This is acceptable, since the Required Actions for each Condition provide appropriate compensatory measures for each CANISTER not meeting the LCO. Subsequent CANISTERs that do not meet the LCO are governed by subsequent Condition entry and application of associated Required Actions.

(continued)

CANISTER Maximum Time in the TRANSFER CASK
C 3.1.4

APPLICABILITY	For LOADING OPERATIONS, the elapsed time restrictions on the loaded CANISTER apply from the completion point of the CANISTER helium backfilling through completion of the transfer from the TRANSFER CASK to the CONCRETE CASK and installing the CONCRETE CASK shield plug and cask lid. For TRANSFER OPERATIONS, the elapsed time restrictions on the loaded CANISTER apply from the completion point of the closing of the TRANSFER CASK shield doors through completion of the unloading of the CANISTER from the TRANSFER CASK. For UNLOADING OPERATIONS, the elapsed time restrictions on the loaded CANISTER apply from the completion point of the closing of the TRANSFER CASK shield doors through initiation of CANISTER cooldown.
ACTIONS	A note has been added to the ACTIONS, which states that, for this LCO, separate Condition entry is allowed for each NAC-UMS® SYSTEM. This is acceptable, since the Required Actions for each Condition provide appropriate compensatory measures for each NAC-UMS® SYSTEM not meeting the LCO. Subsequent NAC-UMS® SYSTEMS that do not meet the LCO are governed by subsequent Condition entry and application of associated Required Actions. A note has been added to Condition A that reminds users that all time spent in Condition A is included in the 600-hour cumulative limit. If the LCO 3.1.4 cumulative time is not exceeded: <u>A.1.1</u> The TRANSFER CASK containing the loaded CANISTER shall be placed in the spent fuel pool having a maximum water temperature of 100°F. For in-pool cooling operations with the TRANSFER CASK and loaded CANISTER submerged, the annulus fill system is not required to be operating. If only the loaded CANISTER is submerged for in-pool cooling, the annulus fill system is required to be operating. <u>AND</u> <u>A.1.2</u> The TRANSFER CASK and loaded CANISTER shall be kept in the spent fuel pool for a minimum of 24 hours prior to restart of LOADING OPERATIONS, TRANSFER OPERATIONS or UNLOADING OPERATIONS.

(continued)

ACTIONS (continued)	OR A.2.1 A cooling air flow of 375 CFM at a maximum temperature of 76° F shall be initiated. The airflow will be routed to the annulus fill/drain lines in the TRANSFER CASK and will flow through the annulus and cool the CANISTER. AND A.2.2 The cooling air flow shall be maintained for a minimum of 24 hours prior to restart of LOADING OPERATIONS, TRANSFER OPERATIONS or UNLOADING OPERATIONS. If the LCO 3.1.4. 600-hour cumulative time limit is exceeded: B.1 The CANISTER shall be placed in a CONCRETE CASK. OR B.2 The CANISTER shall be placed in a TRANSPORT CASK. OR B.3 The CANISTER shall be unloaded. The 5-day Completion Time for Required Actions B.1, B.2, and B.3 assures that the PNL-4835 30-day test duration used to establish the LCO limit will not be exceeded, taking into account the 600 hours allowed by the LCO.
SURVEILLANCE REQUIREMENTS	SR 3.1.4.1 The elapsed time from entry into the LCO conditions of Applicability until placement of the CANISTER in a CONCRETE CASK or TRANSPORT CASK, or until CANISTER cooldown is initiated for UNLOADING OPERATIONS shall be monitored. This SR ensures that the fuel cladding and CANISTER component temperature limits are not exceeded.
REFERENCES	1. FSAR Sections 4.4, 8.1 and 8.2.

PROPOSED TECH SPEC
APPENDIX A CHANGES

LIST OF EFFECTIVE PAGES (updated by Revision UMSS-04B)

Appendix A

NAC-UMS® SYSTEM	NAC-UMS® SYSTEM includes the components approved for loading and storage of spent fuel assemblies at the ISFSI. The NAC-UMS® SYSTEM consists of a CONCRETE CASK, a TRANSFER CASK, and a CANISTER.
OPERABLE	The CONCRETE CASK heat removal system is OPERABLE if: 1. System validation is performed by taking temperature measurements on a one time per canister basis, between 5 and 30 days following placement of the CONCRETE CASK on the ISFSI pad. The difference between the ISFSI ambient temperature and the average outlet air temperature shall be ≤102°F for the PWR CANISTER, or ≤92°F for the BWR CANISTER, for each canister loaded. 2. Once validated using temperature difference measurements, system surveillance monitoring may be performed by temperature measurements or visual inspection of inlet and outlet screens to verify that they are not obstructed.
SITE SPECIFIC FUEL	Spent fuel configurations that are unique to a site or reactor due to the addition of other components or reconfiguration of the fuel assembly at the site. It includes fuel assemblies, which hold nonfuel-bearing components, such as a control element assembly, a burnable poison rod insert, a solid stainless steel rod insert, an in-core instrument thimble or a flow mixer, or which are modified as required by expediency in reactor operations, research and development or testing. Modification may consist of individual fuel rod removal, fuel rod replacement of similar or dissimilar material or enrichment, the installation, removal or replacement of burnable poison rods or solid stainless steel rods, or containerizing damaged fuel. Site specific fuel includes irradiated fuel assemblies designed with variable enrichments and/or axial blankets, fuel that is consolidated and fuel that exceeds design basis fuel parameters.

(continued)

A 3.1 NAC-UMS® SYSTEM Integrity

A 3.1.1 CANISTER Maximum Time in Vacuum Drying

LCO 3.1.1 The following limits for vacuum drying time shall be met, as appropriate:

1. The time duration from completion of draining the CANISTER through completion of vacuum dryness testing and the completion of LCO A 3.1.3 shall not exceed the following time limits:

PWR

Total Heat Load (L) (kW)	Time Limit (Hours)	Total Heat Load (L) (kW)	Time Limit (Hours)
20 < L ≤ 23	27	11 < L ≤ 14	40
17.6 < L ≤ 20	30	8 < L ≤ 11	52
14 < L ≤ 17.6	33	L ≤ 8	103

BWR

Total Heat Load (L) (kW)	Time Limit (Hours)	Total Heat Load (L) (kW)	Time Limit (Hours)
20 < L ≤ 23	25	11 < L ≤ 14	45
17 < L ≤ 20	27	8 < L ≤ 11	72
14 < L ≤ 17	33	L ≤ 8	600

(continued)

2. The time duration from the end of 24 hours of in-pool cooling or of forced air cooling of the CANISTER through completion of vacuum dryness testing and the completion of LCO A 3.1.3 shall not exceed the following limits:

PWR Forced Air

Total Heat Load (L) (kW)	Time Limit (Hours)
20 < L ≤ 23	3
17.6 < L ≤ 20	6
14 < L ≤ 17.6	9
11 < L ≤ 14	16
8 < L ≤ 11	27
L ≤ 8	78

PWR In-Pool

Total Heat Load (L) (kW)	Time Limit (Hours)
20 < L ≤ 23	12
17.6 < L ≤ 20	15
14 < L ≤ 17.6	18
11 < L ≤ 14	24
8 < L ≤ 11	36
L ≤ 8	87

BWR Forced Air

Total Heat Load (L) (kW)	Time Limit (Hours)
20 < L ≤ 23	2
17 < L ≤ 20	3
14 < L ≤ 17	8
11 < L ≤ 14	18
L ≤ 11	41

BWR In-Pool

Total Heat Load (L) (kW)	Time Limit (Hours)
20 < L ≤ 23	10
17 < L ≤ 20	11
14 < L ≤ 17	17
11 < L ≤ 14	26
L ≤ 11	52

APPLICABILITY: During LOADING OPERATIONS

(continued)

ACTIONS

-----NOTE-----

Separate Condition entry is allowed for each NAC-UMS® SYSTEM.

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. LCO time limits not met	A.1	Fill CANISTER with helium	2 hours
	AND		
	A.2.1.1	Place TRANSFER CASK with helium filled loaded CANISTER in spent fuel pool.	2 hours
		AND	
	A.2.1.2	Maintain TRANSFER CASK and CANISTER in spent fuel pool for a minimum of 24 hours	26 hours
	OR		
	A.2.2.1	Commence supplying air to the TRANSFER CASK annulus fill/drain lines at a rate of 375 CFM and a maximum temperature of 76°F	2 hours
		AND	
	A.2.2.2	Maintain airflow for a minimum of 24 hours	26 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.1.1	Monitor elapsed time from completion of CANISTER draining operations until completion of LCO A 3.1.3.	As required to meet the time limit
SR 3.1.1.2	Monitor elapsed time from the end of in-pool cooling or of forced-air cooling until completion of LCO A 3.1.3.	As required to meet the time limit

A 3.1 NAC-UMS® SYSTEM Integrity

A 3.1.2 CANISTER Vacuum Drying Pressure

LCO 3.1.2 The CANISTER vacuum drying pressure, ≤10 mm of mercury (Hg), shall be held for a minimum of 10 minutes with the pump isolated, with the pressure remaining ≤10 mm Hg during the 10-minute period.

APPLICABILITY: During LOADING OPERATIONS

ACTIONS

-----NOTE-----
Separate Condition entry is allowed for each NAC-UMS® SYSTEM.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. CANISTER vacuum drying pressure limit not met	A.1 Establish CANISTER cavity vacuum drying pressure within limit	25 days
B. Required Action and associated Completion Time not met	B.1 Remove all fuel assemblies from the NAC-UMS® SYSTEM	5 days

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.2.1	Verify CANISTER cavity vacuum drying pressure is within limits	Prior to TRANSPORT OPERATIONS.

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.1.6.1	For each CONCRETE CASK and CANISTER, perform a one-time verification that the difference between the average CONCRETE CASK air outlet temperature and ISFSI average ambient temperature is ≤ 102°F (for the PWR CANISTER) and ≤ 92°F (for the BWR CANISTER) between 5 and 30 days following placement of the CONCRETE CASK on the ISFSI pad.	5 days ≤ 30 days
	After the one-time temperature difference measurements are validated, system surveillance monitoring may be performed by temperature measurements or by visual inspection of inlet and outlet screens to verify that they are not obstructed.	24 hours

PROPOSED TECH SPEC
APPENDIX B CHANGES

LIST OF EFFECTIVE PAGES (updated by Revision UMSS-04B)

Appendix B

B 3.4 Site Specific Parameters and Analyses

This section presents site-specific parameters and analytical bases that must be verified by the NAC-UMS® SYSTEM user. The parameters and bases presented in Section B.3.4.1 are those applied in the design basis analysis. The parameters and bases used in the evaluation of SITE SPECIFIC FUEL are presented in the appropriate sections below.

B 3.4.1 Design Basis Site Specific Parameters and Analyses

The design basis site-specific parameters and analyses that require verification by the NAC-UMS® SYSTEM user are:

1. The temperature of 76°F is the maximum average yearly temperature. The 3-day average ambient temperature shall be 106°F or less.

2. The allowed temperature extremes, averaged over a 3-day period, shall be greater than –40°F and less than 133°F.

3. a) The design basis earthquake horizontal and vertical seismic acceleration levels at the top surface of the ISFSI pad or at the center of gravity of the loaded concrete cask on the ISFSI pad are bounded by the values shown:

Configuration	Coefficient of Friction	Horizontal g-level in each of Two Orthogonal Directions	Corresponding Vertical g-level
Standard	0.35	0.26g	0.26g
Standard	0.40	0.29g	0.29g

Note: For a condition of a degraded coefficient of friction, site-specific analysis may be performed in accordance with 3.4.1(3)(b).

b) Alternatively, the design basis earthquake resultant planar velocity of the ISFSI pad and the tip-over evaluation may be limited so that the acceleration resulting from the collision of two sliding casks and the tip-over remains bounded by the accident condition analyses presented in Chapter 11 of the FSAR.

Site-specific analysis by the cask user shall demonstrate that a cask does not slide off the ISFSI pad.

(continued)

B 3.4.1 Design Basis Site Specific Parameters and Analyses (continued)

4. The analyzed flood condition of 15 fps water velocity and a height of 50 feet of water (full submergence of the loaded cask) are not exceeded.

5. The potential for fire and explosion shall be addressed, based on site-specific considerations. This includes the condition that the fuel tank of the cask handling equipment used to move the loaded CONCRETE CASK onto or from the ISFSI site contains no more than 50 gallons of fuel.

6 In cases where engineered features (i.e., berms, shield walls) are used to ensure that requirements of 10 CFR 72.104(a) are met, such features are to be considered important to safety and must be evaluated to determine the applicable Quality Assurance Category on a site specific basis.

7. TRANSFER CASK OPERATIONS shall only be conducted with surrounding air temperatures ≥ 0°F.

8. The VERTICAL CONCRETE CASK shall only be lifted by the lifting lugs with surrounding air temperatures ≥ 0°F.

B 3.4.2 Maine Yankee Site Specific Parameters and Analyses

The design basis site-specific parameters and analyses that require verification by Maine Yankee are:

1. The temperature of 76°F is the maximum average yearly temperature. The 3-day average ambient temperature shall be 106°F or less.

2. The allowed temperature extremes, averaged over a 3-day period, shall be greater than –40°F and less than 133°F.

3. The design basis earthquake horizontal and vertical seismic acceleration levels at the top surface of the ISFSI pad are bounded by the values shown:

Configuration	Coefficient of Friction	Horizontal g-level in each of Two Orthogonal Directions[1]	Corresponding Vertical g-level (upward)
Maine Yankee	0.50	0.38	0.38 × 0.667 = 0.253g

[1] Earthquake loads are applied to the center of gravity of the concrete cask on the ISFSI pad.

4. The analyzed flood condition of 15 fps water velocity and a height of 50 feet of water (full submergence of the loaded cask) are not exceeded.

5. The potential for fire and explosion shall be addressed, based on site-specific considerations. This includes the condition that the fuel tank of the cask handling equipment used to move the loaded CONCRETE CASK onto or from the ISFSI site contains no more than 50 gallons of fuel.

6. Physical testing shall be conducted to demonstrate that the coefficient of friction between the concrete cask and ISFSI pad surface is at least 0.5.

(continued)

B 3.4.2 Maine Yankee Site Specific Parameters and Analyses (continued)

7. In addition to the requirements of 10 CFR 72.212(b)(2)(ii), the ISFSI pad(s) and foundation shall meet the design basis earthquake horizontal and vertical seismic acceleration levels at the top surface of the ISFSI pad as specified in B 3.4.2 (3).

   The surface of the ISFSI pad shall have a broom finish or brushed surface as defined in ACI 116R-90 and described in Sections 7.12 and 7.13.4 of ACI 302.1R.

8. In cases where engineered features (i.e., berms, shield walls) are used to ensure that requirements of 10 CFR 72.104(a) are met, such features are to be considered important to safety and must be evaluated to determine the applicable Quality Assurance Category on a site specific basis.

9. TRANSFER CASK OPERATIONS shall only be conducted with surrounding air temperatures ≥ 0°F.

B 3.5 CANISTER HANDLING FACILITY (CHF)

B 3.5.1 TRANSFER CASK and CANISTER Lifting Devices

Movements of the TRANSFER CASK and CANISTER outside of the 10 CFR 50 licensed facilities, when loaded with spent fuel are not permitted unless the movements are made with a CANISTER HANDLING FACILITY designed, operated, fabricated, tested, inspected and maintained in accordance with the guidelines of NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants" and the below clarifications. This Technical Specification does not apply to handling heavy loads under a 10 CFR 50 license.

B 3.5.2 CANISTER HANDLING FACILITY Structure Requirements

B 3.5.2.1 CANISTER Station and Stationary Lifting Devices

1. The weldment structure of the CANISTER HANDLING FACILITY shall be designed to comply with the stress limits of ASME Code, Section III, Subsection NF, Class 3 for linear structures. The applicable loads, load combinations, and associated service condition definitions are provided in Table B3-2. All compression loaded members shall satisfy the buckling criteria of ASME Code, Section III, Subsection NF.
2. If a portion of the CANISTER HANDLING FACILITY structure is constructed of reinforced concrete, then the factored load combinations set forth in ACI-318 (1995) for the loads defined in Table B3-2 shall apply.
3. The TRANSFER CASK and CANISTER lifting device used with the CANISTER HANDLING FACILITY shall be designed, fabricated, operated, tested, inspected and maintained in accordance with NUREG-0612, Section 5.1.

(continued)

B 3.5.2.1 CANISTER HANDLING Station and Stationary Lifting Devices (continued)

4. The CHF design shall incorporate an impact limiter for CANISTER lifting and movement if a qualified single failure proof crane is not used. The impact limiter must be designed and fabricated to ensure that, if a CANISTER is dropped, the confinement boundary of the CANISTER would not be breached.

B 3.5.2.2 Mobile Lifting Devices

If a mobile lifting device is used as the lifting device, in lieu of a stationary lifting device, it shall meet the guidelines of NUREG-0612, Section 5.1, with the following clarifications:

1. Mobile lifting devices shall have a minimum safety factor of two over the allowable load table for the lifting device in accordance with the guidance of NUREG-0612, Section 5.1.6(1)(a) and shall be capable of stopping and holding the load during a Design Basis Earthquake (DBE) event.
2. Mobile lifting devices shall conform to the requirements of ANSI B30.5, "Mobile and Locomotive Cranes," in lieu of the requirements of ANSI B30.2, "Overhead and Gantry Cranes."
3. Mobile cranes are not required to meet the requirements of NUREG-0612, Section 5.1.6(2) for new cranes.

Table B3-2 Load Combinations and Service Condition Definitions for the CANISTER HANDLING FACILITY (CHF) Structure

Load Combination	ASME Section III Service Condition for Definition of Allowable Stress	Comment
D* D + S	Level A	All primary load bearing members must satisfy Level A stress limits
D + M + W'[1] D + F D + E D + Y	Level D	Factor of safety against overturning shall be ≥ 1.1

D	=	Crane hook dead load
D*	=	Apparent crane hook dead load
S	=	Snow and ice load for the CHF site
M	=	Tornado missile load of the CHF site[1]
W'	=	Tornado wind load for the CHF site[1]
F	=	Flood load for the CHF site
E	=	Seismic load for the CHF site
Y	=	Tsunami load for the CHF site

Note:
1. Tornado missile load may be reduced or eliminated based on a PRA for the CHF site.