72-1015

NAC INTERNATIONAL

Atlanta Corporate Headquarters
3930 East Jones Bridge Road, Suite 200
Norcross, GA 30092
Phone 770-447-1144
Fax 770-447-1797
www.nacintl.com

December 23, 2004

U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Attn: Document Control Desk

Subject: Submittal of NAC International Responses to the U.S. Nuclear Regulatory Commission Request for Additional Information for the Review of Proposed Amendment No. 4 to the NAC-UMS Universal Storage System (TAC No. L23760)

Docket No. 72-1015

Reference:
1. Model No. NAC-UMS, Certificate of Compliance No. 1015, Amendment No. 3, U.S. Nuclear Regulatory Commission, March 31, 2004
2. Final Safety Analysis Report for the UMS Universal Storage System, Revision 4, NAC International, November 19, 2004
3. Request for an Amendment of Certificate of Compliance (CoC) No. 1015 for the NAC-UMS® Universal Storage System to Incorporate Changes to the Technical Specifications, NAC International, August 10, 2004
4. Request for Additional Information for the Review of Proposed Amendment No. 4 to the NAC-UMS® Universal Storage System, U.S. Nuclear Regulatory Commission, November 22, 2004

NAC International (NAC) herewith submits eight copies of the Responses to Reference 4, the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI).

This submittal includes the RAI information requests with the NAC responses presented in the standard NAC RAI response format, the associated changed pages for the Final Safety Analysis Report (FSAR) for the UMS Universal Storage System, which are designated as Revision UMSS-04B, and the proposed changed pages for the Technical Specifications. The enclosed FSAR changed pages (UMSS-04B) are to be inserted as replacement, or new additional pages, as applicable, into the Reference 3 amendment request. After replacement/insertion of the changed pages provided in this submittal, the current List of Effective Pages should be used to ensure that the correct page revisions are included in the compiled amendment request package.

Consistent with NAC administrative practice, all FSAR pages changed in this submittal are uniquely identified as Revision UMSS-04B, and a revision bar marks each change on a page. Text flow changes are not marked with revision bars. Upon final approval, the changed pages will be reformatted, assigned the next appropriate revision number, and incorporated into the next revision of the FSAR.

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Based on the discussions held during three NRC/NAC conference calls, NAC has completed the preparation and submittal of these RAI responses within 30 days of receipt of the RAI to support the NRC in expediting the issuance of the Proposed Amendment No. 4 to the CoC and the accompanying Preliminary Safety Evaluation Report. It is anticipated that the rulemaking process can be completed so as to achieve an effective date for the requested amendment not later than June 1, 2005. This effective date will support the June 2005 NAC-UMS loading campaign at the Arizona Public Service Palo Verde Nuclear Generating Station.

If you have any comments or questions, please contact me on my direct line at (678) 328-1321.

Sincerely,

T. C. Thompson

Thomas C. Thompson
Director, Licensing
Engineering

Enclosures

cc: John Niles (MY) w/o Enclosures
Glenn Michael (APS) w/o Enclosures
Keith Waldrop (Duke) w/o Enclosures

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UMS RAI RESPONSES

NAC INTERNATIONAL

RESPONSE TO THE

UNITED STATES NUCLEAR REGULATORY COMMISSION

REQUEST FOR ADDITIONAL INFORMATION

(RAI – November 22, 2004)

NAC-UMS® UNIVERSAL STORAGE SYSTEM, PROPOSED AMENDMENT 4

(TAC NO. L23760, DOCKET NO. 72-1015)

DECEMBER 2004

NAC INTERNATIONAL RESPONSE
TO
REQUEST FOR ADDITIONAL INFORMATION

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Chapter 3.0 Structural Evaluation

3.1 Reinstate TS paragraph B 3.4.1.3, that was approved in Amendment No. 3 of CoC No. 1015. This TS on the design basis earthquake and coefficient of friction (COF) site parameters requires verification by the NAC-UMS System user. Higher seismic acceleration levels and lower COF values, which may cause the Vertical Concrete Cask (VCC) to slide, may be acceptable provided they are properly justified in the SAR. Alternatively, if the COF requirement is deleted, as proposed, to allow VCC sliding during earthquakes, relevant VCC structural performance criteria must be defined to address the effects of earthquakes.

The current site parameters in TS B 3.4.1.3 establish the VCC seismic stability performance criteria against sliding. Absent these requirements, VCC sliding could potentially result in an unanalyzed condition, such as VCC collision and falling off the edge of an ISFSI pad during an earthquake. Reinstating the peak earthquake acceleration requirement provides the design basis for which the VCC structural performance can be addressed as required in 10 CFR 72.122(b)(2)(i), which states, "Structures, systems, and components important to safety must be designed to withstand the effects of ... earthquakes ..."

If the COF site parameter requirement is removed, an earthquake with sufficiently high peak acceleration, may potentially cause VCCs to collide with each other or fall off the edge of an ISFSI pad. NUREG-1536, page 3-14, states, "The applicant should demonstrate that no tipover or drop will result from an earthquake. In addition, impacts between casks should either be precluded, or should be considered an accident event for which the cask must be shown to be structurally adequate." On this basis, relevant structural performance criteria such as those for limiting the VCC lateral displacement and impact velocity must be defined in Technical Specifications to evaluate the effects of earthquakes on the NAC-UMS System.

This information is requested in accordance with the provisions of 10 CFR 72.236(b).

NAC Response

Currently, the criterion in Technical Specification B 3.4.1(3) is based on friction restraining the cask from any sliding motion during the seismic event. This is considered

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NAC Response to RAI 3-1 (continued)

to be a conservative criterion since the canister and contents are evaluated for the tip-over event.

NAC proposes that the Technical Specification paragraph B 3.4.1(3) be revised to contain, as an alternate criterion, a maximum seismic velocity of the surface of the ISFSI pad without the specification of a coefficient of friction between the pad and the VCC. Without the friction criteria, the sliding of the VCC on the pad allows the possibility of two VCCs colliding on the pad. The direct collision of two VCCs with equal velocities is considered to bound other possible collisions between VCCs. In any collision of two VCCs, it is expected that limited crushing of the concrete along the common area of contact will occur. The extent of concrete crushing is limited by the initial kinetic energy of the VCC prior to impact. By using an energy balance between the initial kinetic energy and the energy absorbed by concrete crushing, the depth of crush can be determined. Associated with the depth of the crush is a common area of contact that can be used to determine the acceleration of the VCC during the collision. The analyses of the PWR canister and basket for the tip-over in Section 11.2.12.4.1 employed a value of 40g for the loading. Section 11.2.12.4.2 is the corresponding tip-over analysis for the BWR canister and basket, which employed a value of 30g. In both of these evaluations, a uniform acceleration was used, which would represent the uniform lateral acceleration expected during a collision of two VCCs.

Associated with the dynamic event of the tip-over is the Dynamic Load Factor (DLF). Both types of impacts, whether a collision of two VCCs or a tip-over onto the pad, involve the same lateral loading of the disks. By limiting the acceleration of the VCC in the collision due to sliding to that occurring during the tip-over, the difference in the DLFs of the two impacts is insignificant. The acceleration of the VCC during the collision due to sliding can be controlled by specifying a maximum initial velocity of the

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NAC Response to RAI 3-1 (continued)

VCC prior to the collision. It should be noted that the direct collision of two VCCs with equal initial velocities implies that the ISFSI pad has accelerated two adjacent VCCs toward each other. The ability of the ISFSI pad, which has remained intact during a seismic event, to accelerate two VCCs in close proximity of each other with an equivalent phase shift of 180° indicates the conservative nature of the assumption of equal velocities for both VCCs.

Section 11.2.8.2.4 of the UMS® FSAR has been added summarizing the derivation of the energy balance used to determine the maximum velocity. The velocity establishes the maximum accelerations of the collision to those employed in the PWR and the BWR canister and basket evaluations. These velocities are determined to be 68 in/sec and 50 in/sec for the PWR and the BWR, respectively. FSAR Section 11.2.8.2.2 and Section 2.2.3 have been revised for clarity.

Technical Specification B 3.4.1(3) has been reinstated as B 3.4.1(3)(a) with a footnote added to the coefficients of friction to identify that for a condition of a degraded coefficient of friction, site-specific analysis may be performed in accordance with B 3.4.1(3)(b) to demonstrate continued acceptability of the cask storage condition. Technical Specification B 3.4.1(3)(b) is added to define the alternate criteria of the maximum ISFSI pad surface velocities based on the kinetic energy associated with the existing accident analyses of the TSC.

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3-2 Provide a SAR evaluation of the design basis earthquake level and corresponding VCC performance criteria, for limiting the VCC lateral displacement and impact velocity to justify the SAR assertion, "...no safety concern if the designed pad coefficient of friction is reduced for any reason."

Sufficient evaluation must be presented to support the SAR assertion and the proposed revision of TS 3.4.1. This information is requested in accordance with the provisions of 10 CFR 72.236(b).

NAC Response

As described in the response to RAI 3-1, the movement of the VCCs will result in a loading that is bounded by the current evaluations for the PWR and BWR basket and canister during the tip-over. The movement of a VCC during the seismic event is expected to be minimal. A statement is added in Technical Specification B 3.4.1(3)(b) to require the evaluation of VCC movement on the ISFSI pad on a site-specific basis to demonstrate that the concrete cask will not move off the ISFSI pad during the seismic event.

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4-1 State in TS LCO 3.1.2 and SAR Section 8.1.1 that the vacuum pump is not running during the 10 minute period when the pressure in the canister is being observed to be equal to or less than 10 mm Hg. Also, correct the acceptance criteria to read "with no pressure rise during the 10-minute period" rather than "with pressure remaining ≤ 10 mm of mercury during the 10-minute period."

LCO 3.1.2 and SAR Section 8.1.1 (Steps 30 and 31) do not explicitly state that the vacuum pump is to be turned off when performing the canister vacuum pressure rise check. There is also no definitive acceptance criteria established once the desired vacuum pressure is reached. For example, it would be possible to lower the vacuum to 5 mm of Hg, let it rise to 9 mm of Hg and still meet the proposed criteria of being ≤10 mm Hg.

The following wording is an alternative to that proposed in the TS and SAR:

LCO 3.1.2 - The CANISTER vacuum drying pressure shall be ≤10 mm of Hg. Vacuum pressure shall be held for a minimum of 10 minutes with the pump shut off with no increase in pressure during the 10 minute period.

Step 30 - Operate vacuum equipment until a vacuum of ≤10 mm of Hg exists in the canister then shut off vacuum equipment.

Step 31 - Verify that no water remains in the canister by holding the vacuum of ≤10 mm of Hg for a minimum of 10 minutes with no pressure increase. If water is present in the cavity, the pressure will rise as the water vaporizes. If pressure rises repeat Step 30 then hold the pressure until the conditions of LCO 3.1.2 are met.

This information is requested in accordance with the provisions of 10 CFR 72.236(f).

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4-1 (continued)

NAC Response

LCO A 3.1.2 is revised to state: "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."

FSAR Section 8.1.1, Step 30, is revised to state: "Operate the vacuum equipment until a vacuum of ≤10 mm of mercury exists in the canister and isolate the vacuum pump."

In the Technical Specification Bases in FSAR Section C 3.1.2 , APPLICABLE SAFETY ANALYSES, second paragraph (Page 12C3-14), the last sentence is revised and supplemented to state: "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."

Isolating the vacuum pump from the canister, while the vacuum pressure rise check is being performed, achieves the desired effect. Operationally, vacuum pumps are not to be turned on and off frequently and are required to be running for periods of up to 30 minutes prior to use.

The conversion of water in a liquid state to the vapor state is dependent on the thermodynamic properties of water. For water to remain in the liquid state at 10 mm of pressure, the temperature of the water must be less than 52°F. The temperature of the water in the canister is affected by:

1) Initial temperature of the canister when the draining process is started
2) Decay heat of the spent fuel

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NAC Response to RAI 4-1 (continued)

3) Thermal boundary conditions for the canister
4) Draining operation and vacuuming

During the transfer operations, the canister is contained in the transfer cask, which is a massive structure weighing over 100,000 pounds that effectively insulates the canister from the environment. During the time the canister is filled with water and in the transfer cask outside of the pool, the transfer cask temperature changes due to ambient temperature are small due to the large thermal mass of the transfer cask. Spent fuel pools are expected to be significantly above 65°F. This implies that even in cold environments, the ability of the environment to affect the temperature of the canister is significantly mitigated so that if the spent fuel pool were at 65°F, the temperature of the boundary of the canister would effectively remain at 65°F. With the presence of spent fuel in the canister, the input of heat to the basket or canister will not permit the water temperature to decrease from its initial temperature. Water that might be resistant to being converted to steam would be located away from the fuel, which inputs heat into the system. This location would either be on the basket disks at the outer edges of the basket or on the bottom canister plate outside the fuel region. In either case, the water is resting on a relatively massive component as compared to the mass of the water.

As the pressure is being reduced during the vacuum process, any vaporization, which absorbs energy from the remaining water and components in contact with the water, will tend to reduce the temperature of the water. The bounding condition is considered to be the water on the canister bottom plate, since the fuel heat has a minimal influence on this region as compared to the rest of the basket. With a sump in the bottom plate, one gallon of water (8.34 lbs) is considered to be a bounding condition. When the pressure is reduced to below 10 mm by the vacuuming, the water will begin to vaporize. The bounding condition is to assume that all the water is vaporized, as opposed to being

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NAC Response to RAI 4-1 (continued)

removed by suction. This would correspond to (8.34 lb) × (1,066 Btu/lb) = 8,900 Btu of energy, which could be used to reduce the temperature of a small amount of water remaining on the bottom plate.

However, the thermal capacitance of the canister and shield doors is the product of the mass and the specific heat. Using a specific heat of 0.1 Btu/lb-F and 0.113 Btu/lb-F for the stainless steel and carbon steel, respectively, and a mass of 1,800 lb and 10,000 lb for the bottom plate and the carbon steel doors, the thermal capacitance of the plate and doors is (0.1 × 1,800) + (0.113 × 10,000) = 1,310 Btu/°F. Equating the 8,900 Btu of energy to the 1,310 ΔT, where ΔT is the drop in temperature due to the energy removed due to the vaporization, the reduction in temperature is less than 10°F. This could, in a bounding condition, potentially reduce the bottom temperature to 55°F, which corresponds to a pressure of 11 mm at saturated conditions. It should be noted that this result can only occur if the canister has zero heat load and the spent fuel pool is at 65°F. Both of these assumptions are extremely conservative, even for decommissioning sites. Therefore, it is not possible for water to remain in the canister since the vacuum reached is significantly less than the bounding condition of 11 mm pressure in which all of the energy of vaporization is assumed to reduce the temperature of a minute amount of water remaining on the canister bottom.

The proposed acceptance criteria, in conjunction with the evacuation of the cavity to ≤ 3 mm Hg for backfilling with helium, will ensure that < 1 gm-mole of water or oxidizing gases will exist in the canister.

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4-2 Add a precaution in the operating procedures to state what actions need to be taken if the water temperature in the canister is near or below the saturation temperature of water at 10 mm hg which is approximately 52°F (saturation temperature of water associated with 10 mm Hg).

Loading relatively cold fuel in a cold environment may negate the effect of vaporizing the residual water if the temperature is below 52°F. Additionally, there does not appear to be any welding minimum temperature limits that would prohibit the environmental temperature from being below 52°F.

This information is requested in accordance with the provisions of 10 CFR 72.236(f).

<u>NAC Response</u>

The following precaution shall be added to the UMS® FSAR Chapter 8 Operating Procedures, following Step 31, as follows:

"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."

It should be noted that at a pressure of 5 mm Hg, the temperature corresponding to saturated steam conditions is less than 35°F. This implies that it is only possible for water to remain in the liquid state if it has a temperature less than 35°F at a pressure of 5 mm Hg. Given that the operations can only continue if the canister shell temperature is equal to or greater than 65°F, there is no mechanism that can reduce the water temperature to 35°F , even for bounding conditions as identified in the response to RAI 4-1.

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NAC Response to RAI 4-2 (continued)

The addition of this precaution will ensure that a valid dryness verification test can be successfully performed under all expected field conditions.

Regarding minimum temperature limitations applicable to canister field closure welding operations, the NAC Fabrication Specifications; the ASME Code, Section III, Subsection NB; and AWS D1.1 requirements applicable to the canister closure welding operations specify that no welding shall be performed below 0°F and that at temperatures between 0 and 32°F, preheating shall be applied such that the area 3 inches from the start of the weld shall be warm to the hand (i.e., estimated to be above 60°F). In no case shall welding be performed when joint surfaces are wet or exposed to rain, snow, high winds or inclement weather.

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4-3 Change the definition of "Operable" to include verification of the temperature difference between the air inlet and outlet for each initial canister loading before relying solely on unobstructed screens.

As proposed, the definition of "Operable" can be either the temperature difference between the air inlet and outlet or the verification of unobstructed air inlet and outlet screens. However, the latter does not preclude the possibility of thermally overloading the canister. Therefore, the latter must be preceded by verification that the canister has been loaded within its thermal design basis by measuring the temperature difference between the air inlet and outlet temperatures.

This information is requested in accordance with the provisions of 10 CFR 72.236(f).

NAC Response

The definition of "OPERABLE" has been revised in Technical Specifications Appendix A on page A1-4 and LCO A 3.1.6 to require that the system user validate the canister loaded heat as being no greater than the design basis heat load by imposing the requirement that the difference between the ISFSI average ambient temperature and the average outlet air temperature be evaluated between 5 and 30 days following placement of the VCC on the ISFSI pad. Once the system has been validated as having a heat load that is equal to or less than the design basis heat load, surveillance may be performed by temperature measurement or visual verification that the inlet and outlet screens are not blocked.

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4-4 Clarify SAR Section 8.1.1, Step 12, to ensure that any cooling of the canister after the drain time limits of Table 8.1.1-3 have been exceeded, is performed with a water filled canister.

The basis for the time limits on in-pool cooling and forced air cooling is documented in NAC Calculation EA790-3206 Rev.5, Appendix G which presumes a water filled canister. This step is meant to include an alternate cooling means when the time limits through Step 28 (draining the canister) are not met, including a partially drained canister. The NAC analysis that provides the basis for this step does not support canisters partially filled with water and gases.

This information is requested in accordance with the provisions of 10 CFR 72.236(f).

NAC Response

The following Note is added after the "Caution" of Step 28 of Section 8.1.1:

"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."

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4-5 Justify how the analysis documented in NAC Calculation EA790-3206 Rev.5, bounds the draining operation described in SAR Section 8.1.1, Step 28, which could include blowdown gas. Also, identify the possible blow-down gases and include the estimated time that the canister would be filled with this gas and any resulting temperature increase. Modify the thermal section of the SAR to reflect this information.

This information is requested in accordance with the provisions of 10 CFR 72.236(f).

NAC Response

A typical TSC drain-down process ranges from 1 to 2 hours. 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 TSC drain-down process (performed by suction, by a blow-down gas pressure, or a combination of both) ranges from 1 to 2 hours. The thermal analysis basis of assuming a water condition during drain-down is acceptable due to the following conservatism 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 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 TSC in the thermal model, nor is any conduction considered due to water in any of the gaps.

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NAC Response to RAI 4-5 (continued)

Considering a 2-hour window for draining the canister, the maximum heat generated by the design basis fuel for the UMS® system is 1.6×10^5 Btu (23 kW×2 hrs×3,412). Energy absorbed in the water that raised the temperature from 100 to 200°F is 1.6×10^6 Btu (15,800 lbs×100°F×1 Btu/lb-°F) for the PWR configuration. Assuming the residual water in the canister is 1 gallon, the energy absorbed by the change in the state of water to steam is 8.1×10^3 Btu (8.345 lbs×970 Btu/lb). It is seen that the energy removed from systems during the draining process and consideration of the change of state for limited residual water are much greater than the energy added to the system. Therefore, simplifying the thermal transient analysis by modeling a step change in boundary conditions from a water solid condition to a drained state, without detailing mass flow, is acceptable to calculate limiting thermal transient temperatures.

SAR Section 4.4.1.3 is revised to add a discussion of the conservatism in the thermal transient analysis with respect to the draining operation.

In addition to the above clarification, the following revisions are incorporated to more clearly define the end of the vacuum drying time clock. Technical Specification A 3.1.1(1) and (2) are revised to read: "... and the completion of LCO A 3.1.3 ...". Surveillance SR 3.1.1.1 and SR 3.1.1.2 are revised to read: "... until completion of LCO A 3.1.3." FSAR Section 8.1.1, Step 28, second Note, is revised to read: "... through completion of LCO A 3.1.3...". FSAR Section 8.1.1, Step 34, second Note, is revised to read: "... transfer into and closure of the concrete cask ...". Technical Specification Bases C 3.1.1, Applicable Safety Analyses, last sentence, is revised to read: "... completion of LCO A 3.1.3 and for ...". The Technical Specification Bases C 3.1.1, Applicability, first sentence, is revised to read: "... the completion point of LCO A 3.1.3. The LCO is not ...". The Technical Specification Bases C 3.1.1, Surveillance SR 3.1.1.1

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NAC Response to RAI 4-5 (continued)

and SR 3.1.1.2, are revised to read: "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 ...". Technical Specification Bases C 3.1.4, Applicability, first paragraph, add the following at the end of the sentence: "... and installing the CONCRETE CASK shield plug and cask lid."

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4-6 Clarify use of the term "start time" for completion of operations through SAR Section 8.1.1, Step 28. There appears to be some inconsistency as to when the "start time" begins. The note at the beginning of Step 12 implies that "start time" is when the top of the transfer cask clears the pool surface. The note at the end of Step 12 indicates that "start time" is when the top of the canister is above the pool water surface (i.e., no longer fully submerged).

This information is requested in accordance with the provisions of 10 CFR 72.236(f).

<u>NAC Response</u>

Step 12 of Section 8.1.1 is revised to clarify that the start time corresponds to the time when the bottom of the transfer cask clears the spent fuel pool water. In addition, the following statement is added to Step 12: "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."

No change is proposed for the last Note of Step 12, which is applicable to sites implementing the alternative operation, where canister welding and preparation activities are performed with the transfer cask and canister partially submerged in the spent fuel pool/cask loading pit.

Note that the Operating Procedures in Chapter 8 of the UMS® FSAR are prepared to provide the procedures for the normal loading of the system and are not intended to address all possible operational and equipment malfunctions that could occur during the loading, testing and movement of the cask system to the ISFSI.

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4-7 Explain how the time periods shown in SAR Section 8.1.1, Step 12, were derived from NAC Calculation EA790-3206 Rev. 5.

This information is requested in accordance with the provisions of 10 CFR 72.236(f).

NAC Response

The time periods shown in FSAR Section 8.1.1, Step 12, are determined in Appendix G of NAC Calculation EA790-3206. Revision 6. Only the changed pages for Revision 6 were transmitted to the NRC on December 8, 2004, as NAC Proprietary Information, since Revision 5 of the calculation was previously submitted to the NRC.

UMS FSAR CHANGED PAGES