UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

October 6, 1989

Project No. M-53

Pacific Sierra Nuclear Associates
ATTN: Dr. John V. Massey
General Manager
5619 Scotts Valley Drive
Scotts Valley, CA 95066

Dear Dr. Massey:

Nuclear Regulatory Commission staff has completed the initial review of your submittal entitled "Topical Safety Analysis Report for the Ventilated Storage Cask (VSC) System," PSN-89-001, Revision 0, dated February, 1989. The staff's detailed questions and comments are enclosed (see enclosure). These were compiled in accordance with topical report (TR) chapter and appendix sequences.

The TR needs to be revised to demonstrate that the VSC design meets the requirements of 10 CFR 72. Revisions should address: (1) the need to define and specify basic design criteria applicable for the design and fabrication of the VSC in a consistent and conservative manner throughout the TR; (2) the need for a consistency check of the data used in the TR and its appendices; (3) the need to refine calculations for design adequacy back-up or analyses that may have been based on non-conservative methodologies; and (4) the need for verification of QA implementation for ensuring the proper application of criteria, design data in the TR, and the correct use of welding symbols, drafting conventions, and material descriptors, etc., in the drawings.

Please respond to the questions and comments contained in the enclosure. In addition, please revise and re-edit the TR and appendices so as to incorporate all the additions, deletions or changes made as a result of this review. We would like to meet with you and your staff soon after you have had time to consider our comments. We believe that a meeting would facilitate resolution of items, which otherwise may take more time and effort to reach conclusion through correspondence or telephone calls alone.

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If your have any questions, please call me at (301) 492-0608 or K. C. Leu of my staff at (301) 492-0696.

Sincerely,

ORIGINAL SIGNED BY

John P. Roberts, Section Leader
Irradiated Fuel Section
Fuel Cycle Safety Branch
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated

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NRC STAFF COMMENTS ON

PACIFIC-SIERRA NUCLEAR ASSOCIATES

TOPICAL SAFETY ANALYSIS REPORT

FOR THE

VENTILATED STORAGE CASK SYSTEM

REVISION 0, FEBRUARY 1989

SEPTEMBER 1989

CHAPTER 1.0 GENERAL DESCRIPTION

1.0-1 Para 1.1, p. 1-1. PSN states that the VSC can be sized for various quantities of BWR and PWR assemblies. The TR is prepared for a VSC system that would hold 24 PWR assemblies. The TR does not contain rationale or calculations which demonstrate that VSC systems sized for other quantities or types of assemblies would be within the envelopes of the 24 PWR criteria, design, and performance. As a result, PSN can anticipate that NRC action on this TR will be limited to the 24 PWR design, and that approval action on other designs will have to be the subjects of separate TR (or SAR). [Basis: 10 CFR 72.24(c)]

1.0-2 Para 1.1, p. 1-1. No lifetime for the proposed VSC system components is given nor has a stated lifetime been identified elsewhere in the TR. It is recommended that the proposed lifetime be stated and also be reflected in the appropriate other sections and appendices. A design lifetime may exceed the 20 year maximum license term for an ISFSI. The design lifetime should be in excess of 20 years if it is anticipated that license renewal will be sought for actual installations. [Basis: 10 CFR 72.24(c)(1),(d)(1); 10 CFR 72.24(a),(b)]

1.0-3 P. 1-1. The use of a ferritic steel for the multi-assembly, sealed basket (MSB) is questionable for a variety of reasons including contamination control, the removal of the MSB from the ventilated concrete cask (VCC), and the removal of fuel assemblies from the internal basket of the MSB. The MSB and the internals are frequently made from stainless steel to avoid these problems. PSNA should develop arguments justifying the use of this material.

1.0-4 Fig 1.1-1, p. 1-2; App 1, drawings VCC-24-003 and VCC-24-004; App 2.1, Fig 3-1, p. 7, and para 3.2, p. 9. The air intake and outlet passages of the VCC are depicted and described in two different ways. Figure 1.1-1 and Appendix 2.1 describe and show the passages as pipe sections (presumed to be round cross sections) while the Appendix 1 drawings show the passages as being formed of welded plate. The TR should be consistent in presentation of the design, and it should be insured that the thermal analysis is valid for that design. [Basis: 10 CFR 72.24(c)(3)]

1.0-5 Fig. 1.1-1, p. 1-2. Details of the snow skirt shown here and in Appendix 1 drawings are not sufficient to permit an evaluation of the effects on natural draft flow and/or increased potential for blockage. Please provide drawings showing sufficient details of the design.

1.0-6 Does the roller skid block the air inlets? What criteria have been established for the maximum amount of time the cask may be raised on the skids? (See also comment Nos. 2.0-10, 4.0-1, 11.0-1, 11.0-9, 11.0-12, 11.0-25, 11.0-27 and 12.0-6)

1.0-7 P. 1-4. MSB sealing is missing from the step shown in the upper right corner of the figure.

1.0-8 Para 1.2.1, p. 1-5. PSN states that the MSB is designed to be compatible with future shipping casks and for a 30 ft transportation accident drop load. This NRC action only addresses the MSB as an element of an ISFSI system, which is also in accordance with the PSN submittal letter (PSN-89-007,m 2/24/89) which submitted the TR for review under 10 CFR 72. Review and licensing for use in shipping requires review under 10 CFR 71, and would require additional submittal information, such as data on the results of the 30 ft drop test (per 10 CFR 71, Subpart F).

1.0-9 Tbl 1.2-1, p. 1-6. Reference is made to the superseded edition of 10 CFR 72 ("10 CFR 72.72" when 10 CFR 72.122 is correct). All references to 10 CFR 72 should be to the version published in the Federal Register Vol. 53, No.161, Aug 19, 1988, or as repeated in the CFR revised as of January 1, 1989. All NRC staff comments are based on the current edition of 10 CFR 72.

1.0-10 Tbl 1.2-1, p. 1-6. ANSI 57.9-84 should be inserted as an applicable code for Dead Loads. Para 6.17.1.1 requires that deadloads be varied by +5% from estimated value. [Basis: Reg Guide 3.60]

1.0-11 Tbl 1.2-1, p. 1-6. Design Basis Normal Operating Temperature is governed by ACI 349-80 (ACI 349-85 has same requirements) per ANSI 57.9-84, paras 6.4.2.4.3 and 6.17.2.1. [Basis: Reg Guide 3.60]

1.0-12 Tbl 1.2-1, p. 1-6. ANSI 57.9-84 includes directions on factors to be applied to live loads (para 6.17.1.1). It should be cited at Operation Handling Loads and added at Snow and Ice Loads. [Basis: Reg Guide 3.60]

1.0-13 Tbl 1.2-2, p. 1-8. Maximum clad temperature is listed as 400°C here but in Appendix 2.2 as 340°C in Table 3-1 of MSB-87-001, Rev. 1. The maximum clad temperature limit will require justification. Information on multiple temperature limits based on fuel design, burnup, fuel age, etc. can be found in PNL-6189, May 1987 and UCID-21181, September 1987.

1.0-14 Para 1.2.1.1, p. 1-9. The TR discusses the possibility of providing a borated carbon coating to the storage sleeves for criticality control, implying that criticality requirements as would impact MSB design might vary from site to site. Please document the characteristics of the proposed borated carbon coating and its use if it is part of this design or delete reference to it to avoid confusion.

1.0-15 Para 1.2.1.1. The basis for approval for criticality safety of a TR is specified in 10 CFR 72, p. 24. PSN should demonstrate that fuel proposed for storage remains subcritical for all loading, storing and unloading conditions. The NRC staff has received PSN's criticality calculations submitted by letter dated September 6, 1989 and will provide comment on them later.

1.0-16 P. 1-9. This discussion on the shield lid design is inconsistent with MSB-87-001, Rev. 1 on page 12 of Appendix 2.2 with respect to the lid components and the thickness of the steel plates which sandwich the Rx277 neutron shielding.

1.0-17 Para 1.2.1.1, p. 1-9. The lid penetrations for vacuum drying and Helium backfilling must also be used for draining the MSB. The manner of connection to, or of insertion of an integral drain tube extending to, the lowermost level within the MSB is not described here or elsewhere in the TR, nor is it evident from the drawings. The MSB design is not practical without such provisions unless it is intended to evacuate the fluid as steam (which is not the procedure described). [Basis: 10 CFR 72.24(c)]

1.0-18 Para 1.2.1.1. Where is supporting evidence to show that the MSB ferritic steel shell was designed to withstand more than 50 years of corrosion in a coastal, marine environment?

1.0-19 Tbl 1.2-3, p. 1-10. Statement that "All filler metals shall be ASTM material" is so broad as to be meaningless. It should be replaced with an appropriate statement. [Basis: 10 CFR 72.24(c)]

1.0-20 Tbl 1.2-3. PSN has not specified that any welds in the MSB shell be radiographed. The radiograph inspection technique will uncover flaws in the weld metal as well as surface flaws, whereas the dye penetrant inspection technique will only uncover surface flaws. The NRC staff expects that welds be radiographed. For those which cannot be radiographed, the dye penetrant method combined with the helium leak test may be used. (See also comment Nos. 2.0-14, 7.0-1 and 12.0-5).

The welds which need to be specified for radiograph test are: (1) the longitudinal seam weld in the MSB shell and (2) the MSB bottom plate to the MSB shell. The welds which need to be specified for dye penetrant and helium leak test are: (1) the structural lid to

MSB shell, and (2) the structural lid valve cover to structural lid.

1.0-21 Tbl 1.2-4, p. 1-11. Maximum concrete temperatures should comply with ACI 349-80 (ACI 349-85 has same requirements), per ANSI 57.9-84 paras 6.4.2.4.3 and 6.17.2.1. [Basis: Reg Guide 3.60]

1.0-22 Tbl 1.2-4, p. 1-11. Air flow at design heat load is given as 1.4 lbm/sec here, but as 1.1 lbm/sec. in Table 4.4-1. Which value is correct?

1.0-23 Para 1.2.1.4. An additional piece of equipment which is "non-safety related" is the roller skid. PSN is not requesting that this piece of equipment be licensed. However, in order to show conceptually that such a piece of equipment could be used as described in the TR, the NRC requests that PSN define for the storage pad a tolerance of smoothness and level as well as the specific load capacity that are compatible with the roller set specified. Also provide simplified analysis of the skid to show minimum member sizes and weld sizes to withstand torsional and bending moments imposed by the jacking effect of one of the Hillman roller sets rolling over a 2 inch obstacle or uneven spot on the storage pad.

1.0-24 Para 1.2.1.2, p. 1-12. (Editorial) ISFSI stands for "Independent - - -," not "Interim - - -" [Basis: 10 CFR 72.1]

1.0-25 P. 1-15. The cask dry out procedure should be included here (Para. 3).

1.0-26 Tbl 1.2-5, p. 1-13. The statement: "but not less than 6 per day of placement" should be added to "Six compressive test specimens for each 100 cubic yards" for consistency with App 2.1, para 3.7.2.

1.0-27 Para 1.4 and Figure 1.4-1 both are in error regarding the number of casks. The number of casks which can be arranged according to Figure 1.4-1 is 69, not 68. Also the numbering sequence shown in the Figure is incorrect.

1.0-28 Para 1.4, p. 1-18. The staff review and SER will not cover the adequacy of the dimensions or quantity of casks in the illustrated "typical" storage area or of a fenced 50′ by 50′ area for further cask storage. Actual arrays are the subject of site-specific consideration. However, for a row of 12 casks a dimension of 180′ is given while for a row of 11 casks a dimension of 150′ is given. This is not consistent.

1.0-29 Para 1.4. If no calculations which prove that a "well ventilated metal wall Butler type building" can be used to house an array of casks are included in the TR, then this option can not be evaluated and not approved. We suggest that reference to this be deleted to avoid confusion.

1.0-30 Para 1.4. The typical number of years for an NRC Part 72 license is 20 years, not 25 as PSN implies.

CHAPTER 2.0 PRINCIPAL DESIGN CRITERIA

2.0-1 Para 2.1. Site specific analysis may be used to show that a specific spent fuel conforms with characteristics which must be defined in the PSN TR. Until nuclear criticality calculations are made, the TR is incomplete.

2.0-2 P. 2-1. The TR indicates that there is an intent to take credit for fuel burnup in the criticality safety analysis. Until a position is taken by the NRC staff on the issue of burnup credit for ISFSI's, the basis for the evaluation for nuclear criticality safety <u>may not</u> include credit for burnup. The vendor must show that the design is safe under all conditions of fuel handling and storage even if fresh fuel were inadvertently loaded into the MSB.

2.0-3 P. 2-1. In the discussion of fuel to be stored, the discussion deals with "most" of the fuel to be stored but defers specific analysis and data regarding fuel to be stored as site specific. PSN must be specific.

2.0-4 Tbl 2.1-1. In Table 2.1-1, provide units for the gamma and neutron source per assembly under fuel radiological characteristics.

2.0-5 P.2-2. Discussion on p. 2-1 indicates a maximum initial enrichment of 3.2%, but the table on p. 2-2 indicates a range of maximum initial enrichments up to 3.7%. PSN should show bounding case for which the design is appropriate and meets the requirements of 10 CFR 72.

2.0-6 Paras 2.2, and 2.2.6.1, pps. 2-1 and 2-7. Tbls 2.2-3 and 3.4-7, pps.2-8 and 3-35. The subject of this comment is the applicable design criteria for the reinforced concrete components and structures classified as important to safety, i.e., the VCC. Para 2.2 acceptably states that load combinations of ANSI/ANS 57.9-1984 are used, however para 2.2.6.1 states that the combinations are those of ACI 349-85. The sets of load combinations are not identical, those of ANSI 57.9 are acceptable. Load combinations 7 and 8 in Table 2.2-3 do not comply with ANSI 57.9-84, para 6.17.3 in that the factor for T_0 should be the product of .75 x 1.7 instead of 1.05. Load combination 7 is used in Table 3.4-7. The load combinations of ACI 349-85 which cover situations not explicitly covered by ANSI 57.9-84 may be used for the VCC (e.g., tornado winds, pressures, and missiles). By citing ACI 349-85 as the source for the load combinations (even for the combinations which are the same as in ANSI 57.9-84), the ANSI 57.9-84 requirement that the dead load be increased by 5% to simulate the most adverse loading (para 6.17.1.1) is neglected. The common load combinations should be changed to those of ANSI 57.9 and the correct sources should be cited (ANI 57.9 and ACI 349 for the supplementary combinations). It is not acceptable to selectively extract load combinations or other design guidance from multiple sources to establish minimum standards. [Basis: Reg Guide 3.60]

2.0-7 The subject of this comment is the applicable design criteria for the steel components and steel structures classified as "important to safety," i.e., 1) the MSB, 2) the MTC and 3) the steel liner and lid for the VCC. PSN has conflicting and contradictory statements in chapters 1, 2, 3, 11, and Appendices 2.1, 2.2, and 2.3 regarding which design criteria were used. The TR reference to ASME, AISC, ASTM, and ANSI 57.9 are used almost interchangeably by PSN. This ill-defined and, in the case of the MTC, undefined approach to design criteria is unacceptable.

Examples of the conflicting design criteria are:

Component	Criteria Cited	Loading	TR Reference	NRC Concern
MTC	None cited	Not defined	1-3 and Table 1.2-1	No criteria specified
	Single Failure proof non-single failure proof	Normal Operation	Table 2.2-4	No reference for "criteria" were cited. The stress allowables imply use of NUREG-0612 and ANS N14.6-1978: which are acceptable for the lifting devices/lugs only. <u>No criteria</u> are cited for <u>any</u> other components of the MTC.
	Stresses ≤ Su	Accidents	Table 2.2-4	<u>No criteria were cited</u>. The stress allowables imply that PSN intends to use ASME Code Section III, Division 1, Subsection ? Service Level D.
	?	?	Appendix 2.3	ASME, Section III, Division 1, Subsection NB.
	AISC and ASTM	?	p.3-2	This is unacceptable. Not only do the AISC and the ASTM not have any design criteria which are suitable for this component, but PSN did not identify any specific criteria for either of these organizations.

In summary, the NRC staff suggest that PSN revise all TR references to design criteria in chapters 1, 2, 3, 11, and Appendices 2.1, 2.2, and 2.3 such that a consistent and conservative set are defined for each steel component important to safety. For example, if PSN elects to use ASME, Section III, Division 1, Subsection NB for the MSB (see TR Appendix 2.2, p.4), then, with the exception of lifting lugs/devices, only one design criteria code should be used. The lifting lugs may be designed according to the "critical lift" section for NUREG-0612, ANS N14.6-1978 or NOG-1 for the MSB lugs. The NRC staff suggests that PSN consider the 15% dynamic load factor for lugs/lifting devices recommended by NUREG-0612 (See NOG-1). Also the NRC staff suggests that PSN consider local stresses in cylindrical shells due to external loadings on trunnions as outlined by the Welding Research Council Bulletin number 297. This last suggestion is made because the ANSYS STIF42 element used by PSN has only two degrees of freedom at each node and thus does not calculate any bending stresses through the thickness of the shell. The local stresses are not modeled by the element. It is possible to approximate bending using the two-dimensional isoparametric element, but only if two or more elements are used to model the thickness of the shell. In this case the user must have a post processor for the stress output which calculates bending stresses based on the product of membrane stresses and distance between two outer surfaces of the two elements (i.e., through the shell thickness). PSN did not do this.

Similarly for the MTC, if PSN elects to use ASME, Section III, Division 1, Subsection NB for the transfer cask (see TR Appendix 2.3, p.4), then with the exception of the lifting trunnions only one design criteria code should be used. In the case of the MTC, the NRC staff considers ANSI-57.9 Paragraph 6.17 to be an appropriate code for design criteria primarily because the MTC is not a pressure vessel. The ASME Code, Section III, Division 1, developed conservative design criteria based on primary membrane and bending stresses mainly due to pressure for thin-walled vessels. The MTC has no pressure stress. Paragraph 6.3.1.1 of ANSI-57.9 deals with equipment in the fuel transfer area, and cites paragraph 6.17 as appropriate for structural design. However, the NRC staff finds that both codes discussed above are acceptable. PSN should define the appropriate criteria consistently throughout the TR. [Basis: Reg Guide 3.60]

2.0-8 Table 2.2-4. The criteria cited for lifting devices for the MSB and MTC appear to have confused "non-single failure proof" for "non-critical load" and "single failure proof" for "critical load." The reference is NUREG-0612, which in turn references ANSI N14.6-1986. For critical loads, the lifting lugs/devices shall have either: (1) increased stress design factor of two or (2) a duel-load path hoist system.

2.0-9 Paras 2.2.2 and 2.2.4, p. 2-4. It is noted that different classification categories were used for the VCC for wind loading (Cat I) and snow loadings (Cat III) (per ANSI A58.1). The staff considers that Cat I is sufficient for the VCC. [The inconsistency therefore has no impact on the design validity.]

2.0-10 P. 2-4. Total blockage of all air inlets appears to be possible by flooding to a relatively low level of about one foot. Any amount of flooding will partially obstruct all air inlets. How do you preclude flooding in the cask design, since the thermal consequences have not been analyzed?

2.0-11 Para 2.2.4, p. 2-4. No criteria relative to snow height or design of the "snowskirt" (shown in Figure 1.1-1, mentioned at 11.1.2.1) or for the thermal analysis relative to the potential flat surface or snow drift heights are stated. Since most US nuclear power plants are in areas in which it would be presumed that there would be snows which would routinely exceed the height of the VCC air intakes (and off-normal and "accident" snows of much greater depth), the TR is deferring to a site specific SAR significant criteria, design, and analyses which will be needed as part of most licensing applications. [Basis: 10 CFR 72.24(a); 10 CFR 72.122(b)] Please add this matter in the TR. (See also comment Nos. 3.0-4, 4.0-1 and 11.0-7)

2.0-12 Para 2.2.5, p. 2-6. Reference should be to 10 CFR 72.102(a) to reflect the modification of 10 CFR 72.

2.0-13 Tbl 2.2-4, p. 2-10. Please reference all criteria listed in table.

2.0-14 Para 2.3.2.1. The dye penetrant method of examination of welds is not acceptable when radiography is feasible. In cases where radiography is not feasible the dye penetrant inspection combined with the helium leak test may be used.

2.0-15 P. 2-11. Should the MSB withstand such a postulated drop, procedures and/or conditions of operation should be specified so that the cask would be opened and the fuel inspected. The NRC staff would be concerned about fuel rod distortion as it might relate to criticality safety.

2.0-16 P. 2-13. Trailers, skids, cask transporter, etc. are stated as being not important to safety. Failure of such a component could cause the cask to tip over (as could subsidence or other natural cause). Cooling of the fuel with the cask in a horizontal position is an unanalyzed condition which should be considered.

2.0-17 P. 2-11. What is the basis for the 10^{-4} leak tightness specification?

2.0-18 P. 2-15. The decommissioning considerations do not include the discussion of, or procedures on, the removal of fuel from the MSB.

CHAPTER 3.0 STRUCTURAL EVALUATION

3.0-1 Fatigue evaluation was not performed for the MSB. Please perform a fatigue evaluation based on the ASME Section III Code. If PSN uses the ASME Code for the MTC, then a fatigue evaluation is required for this component also.

3.0-2 Qualification of drain line tube was not performed. Please provide.

3.0-3 All the items tabulated on drawings should be structurally qualified in the report for the design criteria shown on Table 1.2-1.

3.0-4 Para 3.1.1, p. 3-1. The design (generic or common) for the VCC "snowskirt" is not described. Per paragraph 11.1.2.1 a snowskirt may be used. From the dimensions of the VCC air intakes and design snowfalls (ANSI A58.1), it can be assumed that most potential ISFSI sites will require snowskirts. Unless further information (design criteria, generic or standard designs, and thermal analysis) is submitted, NRC action on the TR may have to include design reservations for all but snow-free sites. [Basis: 10 CFR 72.24(a); 10 CFR 72.122(b)]

3.0-5 Para 3.1.1, p. 3-1. No provisions for ensuring concentric positioning or securing the MSB within the VCC against lateral movement (as could occur during transport operations) are described or shown on the drawings. Such movement is considered to be feasible, especially since the supporting surface is lubricated (per Drawing VCC-24-002, sheet 1/2, Bill of Materials, item 7). Such provisions should be provided or the thermal calculations should include the case of maximum MSB-VCC eccentricity. A "shield(ing) ring" is mentioned in Fig 8.0-1 and para 8.1(4), step 5, but it is not otherwise described. Drawing VCC-24-001, Section AA, shows what appears to be a toroidal object below the cover, but this object is not identified in the drawings. In a tipover situation (need for such analysis is discussed in comments on Chapter 11.0) any restraint which caused the MSB to move relative to the VCC with the axes NOT remaining parallel has the potential result of extraordinary forces being exerted on the points of contact between the ends of the MSB and the VCC, especially the VCC cover. This suggests that if a position fixing shielding ring which restrains the top of the cask were placed but there were no lateral restraint for the MSB at the bottom, where there is lubricated metal to metal contact, and/or the present lack of clearance between the MSB and VCC covers is retained, the MSB could be held in place by a couple exerted by the contact forces between the MSB and VCC cover and the diagonally opposite MSB base and inner VCC bottom surface, and the vertical friction forces at those contact points. [Basis: 10 CFR 72.24(c)]

3.0-6 Para 3.1.2, p. 3-2. The basic structural criteria should be ANSI 57.9-84, para 6.17, except that design of the MSB to the ASME B&PV Code, Section III, Division 1, Subsection NB is acceptable. If codes are proposed in substitution of (rather than as supplementing) the accepted criteria, such substitutions should be specifically justified. [Basis: Reg Guide 3.60]

3.0-7 Para 3.3, p. 3-2. No basis is provided for determining the applicability of data in the reference to the concrete to be used in the VSC. See the comment relative to paragraph 4.3 and Table 4.3-1 of the TR. The concrete mix has a major impact on the properties of the concrete at elevated temperature. Review of ACI Publication SP-27, "Designing for Effects of Creep, Shrinkage and Temperature in Concrete Structures" is recommended. Concrete properties should be shown and used in the design which are based on the actual concrete mix and aggregates to be used. [Basis: 10 CFR 72.24(c)(3)]

3.0-8 Para 3.3, p. 3-2 and Para 3.4.3.1, p. 3-10. Please list (add) the reduced compressive strength of the concrete due to time and temperature and use the worst value in the calculations.

3.0-9 Para 3.4, p 3-5. ASTM A36 is not an ASME material. Please change the references accordingly.

3.0-10 Table 3.3-1. There are several incorrect references for this table. Notes 1 and 3 do not use ASME Tables I-2.2 or I-1.2. Instead they use I-[illegible] and I-2.1 respectively. Note 5 refers to ASME Table I-5.0, where PSN chose the wrong steel. The A516 Grade 70 steel is a carbon-manganese-silicone steel and as such is a "Material Group C" according to p. 98 of the ASME Code, Section III, Table I-5.0. The correct values for the mean coefficient of thermal expansion are: 5.53, 5.89, 6.26, 6.61, 6.91, 7.17, 7.41 x 10^{-6} in/in°F for 100°F through 700°F respectively. Also, the ASME Code does not cite any material properties for A-36 steel.

3.0-11 P. 3-5. What are the properties of the ferritic steel at the -40F? These are needed to assess the potential for brittle fracture.

3.0-12 Para 3.4, p. 3-7. Please correct the weld symbols shown on Figure 3.4-1.

3.0-13 Para 3.4.3. Where is the estimate of the weight of the lifting yoke for the MTC? It appears that from the weight values given, PSN shows that a 590 pound lifting yoke can meet the NUREG-0612 requirements to lift 193,000 pounds. The staff question if this is possible.

3.0-14 Page 3-13. The calculations for the lifting eye vertical plate weld for the "Stress Intensity" is incorrect. The "stress intensity" is defined by the ASME Code as the largest absolute value of the difference between the three principal stresses S_1, S_2, and S_3. PSN <u>did not</u> calculate principal stresses, nor did PSN calculate the stress intensity correctly. This particular problem is evident throughout the PSN submittal. However, lifting devices or lugs should be governed by NUREG-0612, which in turn references ANS N14.6-1986. For the case for critical lifts, a principal stress should be compared to Sy/6 <u>and</u> Su/10. [Basis: NUREG-0612, paras 5.1.1(4), 5.1.5 (3) and ANS N14.6-1986, paras 4.2.1 and 7.0.]

3.0-15 Page 3-13. The calculation for the lifting eye vertical plate is incorrect. Again, the "stress intensity" is incorrectly used and evaluated. Also the net area for tension is incorrect. No subtraction for the 2 inch hole was made in the calculation.

3.0-16 Page 3-13. The calculation for the lifting eye horizontal plate cited Wv = 21,333 lbs for the force used to calculate the bending moment M. However the normal bending stress used a moment resulting from the W_H = 12,317 force. Incorrect stress. Also the "stress intensity" is incorrectly used and evaluated.

3.0-17 Para 3.4.3.2, p. 3-13. Second formula (Normal bending stress); Lb should read Ln.

3.0-18 Page 3-13. The moment of inertia for the MSB lifting eye vertical plate appears to be too low by a factor of 2. The resulting bending stress would then be one half the value shown. Other calculations must be corrected as a result of this error.

3.0-19 Para 3.4.3.3, p. 3-16. Impact load effect due to lifting was not considered in the calculations. According to NOG-1, this value should be 15% of static load.

3.0-20 Para 3.4.3.3, p. 3-16, 3-17, and Ref. Drwg. MTC-24-001. Confirm that PSN has chosen to idealize the trunnion as a 10-inch schedule 160 pipe located with a 1 inch bevel groove weld, reinforced by a 0.5 inch fillet weld to the 1 inch thick <u>outer shell</u> of the MTC. Explain why the analysis failed to consider the details shown in the "Cut away of Trunnion," which shows the 10-inch pipe also welded to the 1 inch thick <u>inner shell</u> with a 1 inch bevel groove weld and a 0.5 inch fillet weld.

(Note: it does not seem possible to perform the 0.5 inch fillet weld between the inner and outer shell.)

The NRC staff concerns are: (1) the model used for the analysis actual trunnion design, and (2) the local and bending stresses are not well modeled (see comment No. 2.0-4 which discusses the assumptions and limitations of the ANSYS STIF42 element which PSN used to perform the analysis. Also see following comment No. 3.0-21).

3.0-21 Para 3.4.3.3, p.3-17, Fig 3.4-4, p. 3-18. Reviewing the limited information; it is believed that the finite element analysis performed to determine stresses near trunnion would not be sufficient to determine localized stresses during the lifting of MTC. More realistic stress analysis should be calculated, perhaps with the guidance of Welding Research Council bulletin publication 297 September 1987, "Local Stresses in Cylindrical Shells due to External Loadings on Nozzles."

3.0-22 Para 3.4.4.2, p. 3-20 etc. Stresses due to differential thermal expansion of the MSB and VCC are not discussed but the dimensions provided by the drawings indicate that the clear height within the VCC cask liner and lid assembly is "X" inches (Drawing VCC-24-002, sheet 1/2, "Y" inches minus the thicknesses of the cask liner bottom and the MSB base plate) and that the height of the MSB with the lifting lugs in place is also "X" inches (Drawings MSB-24-002, sheet 1/2 and LLD-24-001), leaving no space. The sequence of operations and exposure times described in Section 8.0 do not provide for the removal of the lifting lugs after MSB placement in the VCC, nor would such removal be acceptable under ALARA principles. Stresses in the VCC and MSB due to longitudinal thermal expansion should be calculated or VCC or MSB dimensions or designs should be altered to avoid such potential stresses. Note that per a comment on paragraph 3.1.1, above, the absence of sufficient clearance to prevent the MSB from jamming within the VCC can also result in severe forces on the MSB and VCC in the event of a tipover. [Basis: 10 CFR 72.24(c)]

3.0-23 Para 3.4.4.2.1, p. 3-20. Thermal stresses should be considered as stated in ANSI 57.9-84, para 6.17. [Basis: Reg Guide 3.60] Reference to secondary stresses in the AISC code are irrelevant and unacceptable. The AISC does not have suitable criteria for any of the items identified as important to safety.

3.0-24 Para 3.4.4.2.3, p. 3-28. Please provide detailed VCC finite element mathematical model (with nodes and element numbers) and the input for the thermal stress analysis.

3.0-25 Para 3.4.4.3.1, p. 3-32. Shield lid dead weight load calculation: plus (+) between (9) and (.28) should be removed.

3.0-26 Para 3.4.4.3.1, p. 3-32. It is not clear how the .5" J weld area was calculated to determine the weld stress. Please describe.

3.0-27 Tbl 3.4-7, p. 35. (edit) The Margin of Safety for Concrete Load Combination No. 1 has been miscalculated, based on the table entries.

3.0-28 Para 3.4.4.3.3, p. 3-39. (edit) A "6.5 by 9.125 inch" section is not "square."

3.0-29 Para 3.4.4.3.3, p. 3-39. The dimensions of the rails (6.5" by 9.125") are not stated in the Bill of Materials on Drawing MTC-24-001, sheet 1/2 but are shown as 6.50" by 9.00" on Drawing MTC-24-001, sheet 2/2. As the doors are given as 9.0" thick in the same Bill of Materials, the 9.125" dimension is probably intended. The inconsistency should be corrected. [Basis: 10 CFR 72.24(c)]

3.0-30 Para 3.4.4.3.3, p. 3-39. The closed shielding doors span an opening of 63" and have a combined length along each rail of approximately 83" (approximate since Drawing MTC-24-001 does not detail the length of the overlap at the door interface). The drawing also does not provide sufficient information to determine whether the sections of each door (per Section CC) are structurally integrated or may respond independently to vertical loads. The basis for the statement at page 3-39 that 48" is "the length of the closed shielding doors" and for using 48" as the rail length is consequently unclear. This should be clarified and the computations modified if appropriate. [Basis: 10 CFR 72.24(c)]

3.0-31 Para 3.4.4.3.3, p. 3-39. The applied load moment arm for calculation of the moment in the bottom plate does not appear to be the worst case. Per Figure 3.4-10 (which shows chamfered door edges) and the dimensions shown in Drawing MTC-24-001, sheets 1 and 2, the rails are "X" inches apart, the doors are "Y" inches wide (there is 1.5" total gap between the doors and the rails), and the clear opening between the bottom plates is "Z" inches. If the doors were against one rail, the point of contact on the opposite bottom plate would be at a distance of 1.5" plus the size of the chamfer (estimated by the staff as not less than .75" to clear the 0.5" fillet weld), resulting in an average moment arm of 3.75 - (3.75 - 1.5 -.75)/2 = 3.0" (less if the distance is measured to the fillet weld), while 1.875" was used in the calculations. The calculations and/or assumptions should be checked and corrected as appropriate. [Basis: 10 CFR 72.24(c)]

3.0-32 P. 3-43. The analysis for a cask or MSB drop at a temperature of -40F seems to be missing.

3.0-33 P. 3-44. Reference 4.1 analyzes 5 year old fuel. Older fuel requires lower temperature limits. Are fuel age limits placed on the VSC? Also, if the temperature range falls between 350° and 450°C, why not use 350°C as a conservative value, not 400°C?

The Ref. 4.1 analysis was based on standard fuel stored for 40 years. Also, what is the effect of storing extended burnup fuels which have higher internal pressures?

3.0-34 Para 3.4.4.3.3, p. 3-39. The loading case for the shield door rails does not include impact as part of the live load. Some impact can be anticipated in the lowering of the MTC onto its support and should be included in the calculation. As the magnitude would vary with the actual crane speeds at a site, the SAR would still be required to demonstrate that the assumed case envelops the actual situation. Inclusion of a calculated or industry guideline factor for this impact is recommended for the TR. The design of the bottom plate might be affected. [Basis: 10 CFR 72.24(c)]

3.0-35 Para 3.5, p. 3-44. The 752°F limit for fuel cladding is exceeded by calculated temperatures shown in Table 4.1-1. This indicates that PSN has not used this as the limiting design temperature. Further, selection of an average value from a range does not appear to meet the intent of a TR intended for a range of potential uses. Further consideration of the selection and use of the cladding temperature limits are recommended. [Basis: 10 CFR 72.24(c)]

3.0-36 General Comment. The above comments reveal that the VSC design as documented in the Revision 0 of the TR is in many cases incorrect and incomplete. This comment should not be construed to mean that the actual design is inadequate, rather that the supporting evidence in the TR is inadequate to be approved.

CHAPTER 4.0 THERMAL EVALUATION

4.0-1 Para 4.1, p. 4-1. The analysis does not include airflow through the "snowskirt" or situations in which the air intakes are blocked by snow depths exceeding the height of the snowskirt. There is insufficient information in the TR as to the design and use (e.g., permanent or seasonal use) of the snowskirt. The result is to leave significant additional thermal analysis to the site specific SAR. [Basis: 10 CFR 72.24(a); 10 CFR 72.122(b)] Please address this matter in the TR

4.0-2 P. 4-1. Exclusion of solar loads may be conservative for determination of the thermal stresses but it is nonconservative for determination of maximum clad temperature. The effect should either be included or the uncertainty in the maximum temperatures due to excluding solar loads should be quantified. The referenced test data may prove useful in obtaining an upper bound on solar insolation effects.

4.0-3 Para 4.1. PSN has made the statement that the 75°F ambient temperature with no solar insolation produces the maximum thermal gradient in the VCC. In the previous question, the NRC has requested the data or calculations which substantiate this statement. For instance, what is the thermal gradient and stress for the 100°F ambient without solar load and what is the thermal gradient and stresses for the 125°F ambient without solar load? The VCC must be designed for the normal, off-normal and accident thermal cases. See ANSI 57.9.

4.0-4 Tbl 4.1-1. For the two applicable cases in Table 4.1-1, provide the temperature distribution across the transfer cask (TC) cross section. It appears that the temperature of the RX-277 neutron shielding in the TC may exceed the 350°F limit set by the manufacturer. If so, justify use of this material in a thermal environment beyond its design capability. Also, evaluate any fatigue related deformation and degradation of the RX-277 due to the cyclical thermal loading which it will be subjected to each time the TC is loaded and unloaded with spent fuel.

4.0-5 Tbl 4.1-1. Provide the temperature distribution in the MSB top shield lid, including the RX-277 neutron shielding material, for all cases listed in Table 4.1-1 as well as the complete blockage of all air inlets case.

4.0-6 Tbl 4.2-1. Provide the thermal properties assumed for the RX-277 shield material in Table 4.2-1 and the justification for these thermal properties in light of the possible degradation of this material under high ambient temperature, postulated accident, and operational conditions.

4.0-7 Para 4.3, p. 4-3 and Tbl 4.3-1, p. 4-6. Concrete temperature limits should be as set forth in ACI 349-80, Appendix A (identical to ACI 349-85), as stated in ANSI 57.9-84, para 6.17.2.1. Use of higher temperatures than 150°F for normal operation or any other long term period, 200°F for local areas, or 350°F for accidents or other short term periods may be allowed if satisfactory evidence is provided to evaluate strength reduction and that reduction is applied, and to show that the temperatures will not cause deterioration of the concrete with or without load. As a matter of staff policy, temperatures to 200°F will be accepted without request for submission of test results or other evidence of suitability, if the concrete otherwise meets the requirements of ACI 349-80(or -85); and, the use of concrete with acceptable appropriately selected aggregates and mix for elevated temperature use and which otherwise meets the requirements of ACI 349-80 (or -85) may be proposed for long term temperature use at not greater than 300°F without submission of tests and evidence on the specific mix. As a result, all of the temperature limits greater than 200°F in the TR should be reduced to 200°F, or should be accompanied by analysis supporting the extent of reduction in strength which is to be applied to the concrete design, or should be accompanied with use of acceptable selected aggregates, submission of test results and evidence of the suitability of the specific mix to be used (and possibly, reduction of allowable strength. Appendix 2.1 should reflect any selection of materials or mix design necessary to provide the proposed concrete temperature suitability. [Basis: Reg Guide 3.60]

4.0-8 P. 4-3, 4-4. The maximum clad temperature for the 100°F ambient case is close to the temperature limit. What are the error bars to the temperature values given in the table? With the values given, the limit would be exceeded for an ambient temperature of about 115°F.

4.0-9 P. 4-3. What is the basis for the statement made in the last sentence of Section 4.2 that maximum temperatures would be slightly reduced if temperature dependent properties were used?

4.0-10 Para 4.4.1.6 In section 4.4.1.6, the determination of the cask surface heat transfer coefficient, h, based on three cask tests is an insufficient and misleading basis for selecting a value of 2.0. The data from the three tests showed that h decreases with increasing heat source, cask diameter, cask surface temperature (directly related to the previous two variables), and emissivity. In actuality, other parameters also affect the value of h such as ambient air temperature and even the relative location of a given cask in an array of casks. The use of a single constant value of h for all operational and postulated accident conditions in calculating the thermal response of the VSC must be justified in such a way that the value conservatively bounds any value of h which might exist during all these conditions. Therefore, the NRC suggests that PSN perform all thermal calculations with a more defensible value of h such as 1.0.

4.0-11 Provide the results of an analysis of the internal pressurization of the TC volume containing the RX-277 shield that accounts for the thermal evolution of gases and vapor from this material during its heatup when transferring fuel. This analysis should evaluate the structural integrity of the TC. Perform the same analysis for the RX-277 in the MSB which will be subjected to a continuous long term thermal environment.

4.0-12 Tbl 4.1-1, p. 4-4. Comparing the 75°F ambient case to the 100°F ambient case with solar heat load, the MSB shell temperature increases by 30°F. Given the steady-state two dimensional nature of the MSB thermal model, one would expect the maximum clad temperature to increase by the same amount, yet it increases by only 26°F. To what do you attribute this lower increase in maximum clad temperature?

4.0-13 Tbl 4.3-1, p. 4-6. Concrete temperature limits of 160°F bulk and 250°F local are higher than ACI-349 allowables. What is the basis for raising temperature limits above those permitted by ACI-349, which is reference by ANSI-57.9 as the appropriate criteria?

4.0-14 P. 4-3. Maximum clad temperature limit of 752°F requires justification.

4.0-15 P. 4-8. Please provide detailed calculations of the form losses for the air flow analysis. Several items are of particular interest including:

- o treatment of step in air outlet as a 90° bend; this appears to be two 90° bends
- o treatment of area expansion in air outlets
- o treatment of potential eccentricity of MSB in VCC cavity; how is concentric position maintained? to what tolerance?

4.0-16 P. 4-15. Addition of a coating to the MSB surfaces will increase thermal resistance. How is the effect of this added thermal resistance incorporated into the MSB analysis?

4.0-17 P. 4-17. While the primary means of heat transfer from the fuel assemblies to the MSB shell is likely to be radiation, conduction and convection in the helium also play a role. The use of an area weighted average effective conduction coefficient appears to be non-conservative, since a value close to the higher value of 0.64 results. The potential non-conservatism of the helium conductivity model should be addressed in a quantitative manner.

Also, provide a specific reference (including page number) for the applicable heat transfer coefficient (equation 4.8).

4.0-18 Para 4.4.1.6. It is noted that the axial peaking factor of 1.2 at the cask outside diameter is very likely quite non-conservative when applied to equation 4.3.2. For decay heat a more realistic value is closer to 1.1, and in addition the effect of axial peaking is diminished with radial distance from the heat source.

4.0-19 Para 4.4.2, p. 4-23. The design of the air outlet may be susceptible to degraded performance under certain wind conditions. The long horizontal runs at the end of the air pathway may contribute to this susceptibility. How will you assure that the stagnant air analysis which was performed will be conservative under all wind conditions?

4.0-20 Para 4.4.5, p. 4-23. What procedures or controls insure that the pressure is 14.6 psia at normal operating conditions?

4.0-21 Fig 4.4-6, p. 4-26. Time scale for this plot does not appear to be correct. Shouldn't the time unit be years, not hours?

CHAPTER 5.0 SHIELDING EVALUATION

5.0-1 Provide an evaluation of the known relative accuracy and expected conservatism of the direct and scattering neutron and gamma dose rate calculations performed for Section 5. Since different computer codes (i.e. ANISN-PC and QAD-CGGP) are used as well as several manual calculation methods, a comparison of each methodology should be presented in terms of accuracy and conservatism.

5.0-2 Tbl 5.3-1. Provide the basis for the RX-277 hydrogen density used in shielding calculations and listed in Table 5.3-1. Justify this value in terms of the projected temperatures which this material will be subjected to and manufacturer's test data on reduced hydrogen content at elevated temperatures. Both the RX-277 in the TC and in the MSB must be considered.

5.0-3 Table 5.3-1 shows a different elemental composition of RX-277 neutron shielding material than the manufacturer lists. Table 5.3-1 shows that this material contains Potassium which does not show up in the manufacturer's Bulletin S-73N technical data description of RX-277 while the manufacturer indicates that there is 2.13 w/o Silicon in this material, but Table 5.3-1 of the topical report does not indicate any Silicon. Explain and resolve this conflict in shielding material composition and, if there is an error, analyze the effect on the gamma and neutron dose rates which were calculated for the MSB, TC, and VCC.

5.0-4 Para 5.4.1, p. 5-14. Provide the detailed analyses which utilized the "manual" method for calculating the complex geometry direct neutron dose rates which is discussed in Section 5.4.1 on page 5-14 of the topical report.

5.0-5 Para 5.4.2. Provide all the detailed calculations that substantiate the scattered dose results presented in Figure 5.4-3 and evaluation of section 5.4.2. These calculations should include inputs, assumptions, methodology, all computer code output and results. A comparison with more rigorous dose scattering calculation methodology should be included to substantiate the conservatism of this method.

5.0-6 Fig 5.4-3. Provide all the detailed calculations that were used to generate Figure 5.4-3. This should include inputs, methodology, assumptions, all computer code inputs, outputs, and results.

5.0-7 Provide details and procedures which would be used for installing the RX-277 shield material into the TC and MSB. Show how a minimum homogeneous hydrogen and boron content will be assured during fabrication and that no air gaps will be allowed.

5.0-8 Perform an activation analysis of the materials which constitute the MSB, MTC, and VCC and are subject to either long term or periodic neutron irradiation from the spent fuel. This calculation should determine the equilibrium activities of all dose-significant radioisotopes produced by neutron capture and the associated dose to both workers and the public from these sources during fuel loading, transfer to the VCC, long term storage, ultimate disposal of the spent fuel to a repository, and decommissioning of the MSB, MTC, and VCC components.

5.0-9 The top surface doses and site boundary doses appear to be very sensitive to radiation streaming and skyshine. It is not clear that the manual albedo method used to estimate radiation streaming or the method to method estimate skyshine doses have been adequately demonstrated to be adequate for evaluation of this design.

5.0-10 Fig 5.4-3. Is dose-vs-distance curve for an array of 68 VSC-24 Casks? Please provide the single cask dose-vs-distance data which were used to construct this graph.

5.0-11 In Section 5.3.2, what is meant by the term "constituent radionuclides" as it pertains to shield composition?

5.0-12 It is required by 10 CFR 72 that provisions for ease of decommissioning be considered in ISFSI design. This matter is not addressed by the TR. Please provide decontamination (e.g., maximum allowable surface contamination on MSB) and decommissioning design criteria and describe how the VSC design meets these criteria.

5.0-13 The third paragraph of Section 5.4.2 refers to "current NRC guidelines for additional dose due to waste storage facilities at nuclear power plants." Please provide the reference for these guidelines.

CHAPTER 6.0 CRITICALITY EVALUATION

6.0-1 P. 6-1. The NRC staff is not prepared to issue a safety evaluation of a design based on burnup credit and administrative controls.

6.0-2 P. 6-1. Has Westinghouse 15 x 15 fuel been determined to be the most reactive fuel to be stored, or is evaluation of other fuel types considered to be site specific?

6.0-3 P. 6-4. Does the statement that "PSN uses a validated and verified version of the Monte Carlo computer program, KENO," mean that the code has been verified to give results consistent with other installations of the code, i.e., it has been verified to have been correctly installed, or does the statement mean that a set of critical experiments relevant to the fuel characteristics, and geometry of the MSB have been evaluated using the same methodology employed for the criticality evaluation of the VSC system? If the latter is the case then the basis for the method bias and the library bias should be presented.

6.0-4 P. 6-4. The discussion indicates that the criticality calculations of the VSC system are performed with a homogenized fuel assembly region. Was the method validation performed using the same homogenization procedure?

6.0-5 P. 6-1. It is unclear from the text or Fig. 6.3-1 whether water is included within the fuel assemblies for the criticality calculations.

6.0-6 P. 6-4. A data point should be included in the figure for the reference fuel burnup (35,000 MWD/MT) case.

CHAPTER 7.0 CONFINEMENT

7.0-1 Para 7.1.3.1, p. 7-4. The NRC staff does not accept dye penetrant testing of the longitudinal weld for the MSB shell or the circumferential weld for the bottom plate to the shell. These should be radiographed. The weld for the top structural lid should be leak tested with helium and dye penetrant tested for surface flaws.

7.0-2 Para 7.1.3.3,. p. 7-5 and 7-6. See above.

7.0-3 Para 7.2, p. 7-6. The requirement that "storage confinement systems must have the capability for continuous monitoring in a manner such that the licensee will be able to determine when corrective action needs to be taken to maintain safe storage conditions" is not addressed, but should be. [10 CFR 72.122(h)(4)]

7.0-4 P. 7-7. The procedure for draining the MSB and vacuum drying should be included here or on page 8-4.

CHAPTER 8.0 OPERATING PROCEDURES

8.0-1 Para 8.0, p. 8-1. The diagrams and narrative descriptions of procedures in Section 8.0 do not satisfy the guidance of Reg Guide 3.48 (paras 5.1.1 and 5.1.2) for flowsheets as part of the the operation description, in that the level of information is not sufficient and controls are not included. The level of information is generally sufficient for the scope of this TR except as specifically noted below but it is not adequate for a SAR submission.

8.0-2 P. 8-2. The first block under MSB loading is probably mislabeled. Should it read "Drain MSB Gap"? Also weld inspection should be added to the figure.

8.0-3 P. 8-4. The fuel loading procedure description is incomplete.

8.0-4 Para 8.1(2) and (2), p. 8-4. It is recommended that the operation of installing the plexiglass ring be performed prior to lifting the MTC with MSB into the fuel pool, and using the hose connection on the ring for the initial filling as well as the continuing replenishment of clean water in the MTC-MSB annulus. This could reduce need for human operations over the fuel pool and some exposure. [Basis: 10 CFR 72.24(e)]

8.0-5 Para 8.1(3), p. 8-4. The operation of removing the plexiglass ring and the associated time should be included in the sequence. [Basis: 10 CFR 72.24(h)]

8.0-6 Para 8.1(3), p. 8-4. The operation of welding the structural lid to the shielding lid at the valve penetration and the associated time should be included in the sequence. [Basis: 10 CFR 72.24(h)]

8.0-7 Para 8.1(3), p. 8-4. The operations and times for performing dye penetrant testing of the first and final passes of the structural lid to shielding lid at the valve penetration, structural lid to MSB shell, and valve cover to structural lid welds should be included. [Basis: 10 CFR 72.24(h)] Also see comments in chapter 1 regarding suitability of the dye penetrant method of weld testing. Basically PSN must commit to a helium leak test to verify confinement integrity.

8.0-8 Para 8.1(4), p. 8-4. The operations and times for rerigging the crane to lift the MSB should be included. [Basis: 10 CFR 72.24(h)]

8.0-9 Para 8.1(4), p. 8-4. The operations and times for placement of the VCC cask lid should be included. [Basis: 10 CFR 72.24(h)]

8.0-10 Para 8.3, p. 8-5; App 2.1, para 3.2, p. 9. Appendix 2.1 notes that the VCC cask cover is to be welded in place. If this is the plan, then that operation should be included in the sequence of operations at paragraph 8.3 and in Figure 8.0-1, and the field weld should be shown in the VCC drawings at Appendix 1.0. [Basis: 10 CFR 72.24(c) and (h)]

8.0-11 Para 8.4, p. 8-6. All operations and their times which involve personnel exposure at or around the VSC should be included in para 8.1. Para 8.4 contains such procedures which are not included in para 8.1. [Basis: 10 CFR 72.24(h)]

8.0-12 Para 8.4, p. 8-6. Are the 1-inch diameter pins which are to lock the MTC to the VCC actually 1-inch bolts? The large mass of the MTC/MSB and the close observation distance required to assure alignment as the MTC approaches the VCC could cause operational difficulty.

8.0-13 What the objective of the "visual surveillance" is, i.e., what is to be observed and what actions are required if the cask is outside acceptable limits. PSN should also show why a weekly visual observation is adequate. What, for instance is the time constant for the adiabatic heat up case? This was not done by PSN.

CHAPTER 9.0 ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

9.0-1 Para 9.1. What test procedure will PSN use to show that the required air flow, and hence cooling rate is achieved? There is no mention made of any testing for this purpose.

9.0-2 Para 9.2, p. 9-2. The requirement that "storage confinement systems must have the capability for continuous monitoring in a manner such that the licensee will be able to determine when corrective action needs to be taken to maintain safe storage conditions" is not addressed, but should be. [10 CFR 72.122(h)(4)]

9.0-3 Para 9.2. Topic 1 refers to weekly surveillance, but does not specify what is to be observed. See question for paragraph 8.4, p. 8-7, regarding visual surveillance.

CHAPTER 10.0 RADIATION PROTECTION

10.0-1 Tbl 10.3-2. There is an apparent discrepancy between the design limit maximum expected dose rates in Table 10.3-2 for the MSB outside surface of shield plug and structural lid (200 and 100 mrem/hr, respectively) and the dose rates presented in Figure 5.4-2 for locations 3 and 2 (440 and 210 mrem/hr, respectively). Explain the acceptability of calculated dose rates exceeding the design limits and incorporate the calculated dose rates in the occupational exposure calculations presented in Section 10.3.

10.0-2 In Section 10.3.3, second paragraph, recommend changing the term "dose burdens are" to "collective dose is". (Note: the term "burden" is usually in radiation protection to denote internal dose.) The same comment applies to Page 10-5.

10.0-3 In Table 10.3-3, the fifth column is labeled as having units of "manrem". This should be "millirem".

CHAPTER 11.0 ACCIDENT ANALYSIS

11.0-1 Section 11 indicates that a blockage of one half of all the air inlets to the VCC is expected to occur once a year and that a complete blockage of all the air inlets is not considered to be feasible. However, this same section evaluates postulated accidents that are not expected to occur during the lifetime of the cask. In addition, it is noted that no provisions are made for periodic inspection and surveillance of the air inlets to ensure that they are not blocked. In light of the above and the fact that other ISFSI designs have included an analysis of complete inlet blockage as a postulated accident, perform an analysis of the thermal response of the VSC with 100 % of the air inlets blocked and provide the resulting steady state temperature distribution and structural evaluation of the elevated MSB internal pressure loads associated from the temperature distribution. This calculation should include the adiabatic heatup rate of key components.

11.0-2 Tbl 11.0.-1, p. 11-2. Add to the list of Off-Normal Events: During the cask unloading sequence (per para 8.2), following raising the MSB into the MTC, the MTC shielding doors jam in a partially closed position. The design of the MTC door closing system (Drawings MTC-24-001, sheets 1/2 and 2/2) suggests that jamming in conjunction with door closing is a possibility. This could result from the play between the doors and the rails, possible play in the piston position (not detailed structurally), and possible flexibility in compression of the piston to door linkages. [Basis: 10 CFR 72.122(b)]

11.0-3 Tbl 11.0.-1, p. 11-2. Add to the list of Postulated Events: VCC with MSB topples onto side as a result of an accident involving the transporting semitrailer. It is considered that the possibility of toppling onto the side is too great to be dismissed. Such toppling might result from vehicle accidents or from failure of the road under the extreme loading. In view of the included analysis for "MSB in Shipping Cask Drop" (para 11.2.3), analysis for this accident would primarily require verification of the integrity of the VCC (especially the cask lid) under the accident loadings. [Basis: 10 CFR 72.122(b)]

11.0-4 Para 11.1.1. Please evaluate the thermal stress distribution throughout the VCC under off-normal and accident conditions and include the computer input, output, model and summary of thermal stresses in to the report. Note: The off-normal conditions are, per the TR, $T = 100^{o}F$ and $T = -40^{o}F$, and the accident case is $T = 125^{o}F$. [Basis: Para 6.17.3.1 eqs. (c), (d), (e), (f), and (g) of ANSI 57.9]

11.0-5 Para 11.1.1.2, p. 11-3. Is detection of severe temperature conditions necessary? If not, then perhaps this section should be revised.

11.0-6 Fig. 11.1-1, p. 11-3. The Figure shows a maximum fuel temperature of 714°F while the text lists 729°F as the maximum. Which is correct? These values are different from those on p. 4-4.

11.0-7 Para 11.1.2.1, p. 11-6. Use of a "snowskirt" is mentioned. A snowskirt is also identified on some sketches (Figure 1.1-1; App 2.1, Figure 3-1). It is recognized that the height or need for a snowskirt is site dependent, however there should be some design criteria, generic design, and thermal analysis with snowskirt included in the TR if additional analyses and design are not to be necessary for every site with any snow potential. Such sites would include as a minimum any with a design ground snow load of 5 pounds-force per square foot or more per ANSI A58.1 (this includes most US nuclear power plants). Operating procedures should include any actions specific to the snowskirt, such as seasonal placement and removal and any special inspection provisions. [Basis: 10 CFR 72.24(a); 10 CFR 72.122(b)]

11.0-8 Para 11.1.2.4, p. 11-6. Screens for the vents are mentioned but are not included in the drawings (VCC-24-001, -002, -003, -004, and -005) at Appendix 1, or described or included in the full list of drawings for the VCC at Appendix 2.1. It is uncertain how the lower vents would be screened such that they could be readily inspected, due to the use of the skid channel for VCC movement. Screens are recommended and should be included in the drawings. [Basis: 10 CFR 72.24(c)]

11.0-9 P. 11-6. complete blockage of all air inlets is a postulated accident design event which must be considered. One potential cause of such an accident is flooding. The analysis of this accident will provide the operator with essential information on the amount of time for corrective action before accident temperature limits are exceeded. This data should be used to determine limiting conditions for operation, which should then be incorporated in Chapter 12.

11.0-10 Para 11.1.2.2, p. 11-6. What surveillance requirements are in place which will assure that internal blockages are detected?

11.0-11 Para 11.1.2.3, p. 11-6. In the case of potential blockage the area flow may be strongly asymmetric, cooling one side of the MSB much more effectively than the other. Please address the sensitivity of maximum clad and concrete temperatures to asymmetric cooling.

11.0-12 Para 11.1.2. Does raising the cask on the roller skids cause partial or complete blockage of the air inlets?

11.0-13 Para 11.1.2.4, p. 11-6. It should not be presumed that all blockage would occur outside of the position of screens over the vents (presuming screens are used, see above comment). Blockage may result from the long time accumulation of airborne fine materials, waterborne sediment, and animals and birds bypassing damaged screens. It is recommended that means for more comprehensive unblocking be described, such as (if determined to be suitable for the system): running water through upper vents and sequentially blocking all but one of the lower vents (as by baulks inserted into the skid channels), compressed air, removing the VCC cover, etc. [Basis: 10 CFR 72.24(d)]

11.0-14 Para 11.1.3.3. If the MSB became jammed during lowering, a configuration with significant blockage of all air outlets could exist. What are the thermal consequences to correct the situation before thermal limits are exceeded?

11.0-15 P. 11-11. The text notes that temperature-time profiles for the MSB shell and fuel cladding were obtained. However, these are not provided.

11.0-16 Para 11.2.2, p. 11-11. PSN has stated that the maximum anticipated heat load is due to the 125^{O}F ambient temperature plus solar heat load. Where are the results of this accident analysis? Please show the results for thermal stresses in the VCC when using the ANS 57.9 load combinations. Please show the results of the thermal stresses in the MSB if ANS 57.9 is used as the design criteria for the MSB. (If the ASME Code, Section III, Division 1, is used, then by definition an accident thermal case need not be evaluated.)

11.0-17 Para 11.2.2.1, and Tbl 11.0-1. Table lists event as 10 hours of full solar load while text lists 14 hours. Which is correct?

11.0-18 Para 11.2.3.2, p. 11-13. Statements are made by PSN that indicate the impact time history is 3.3 x 10^{-4} seconds. This is used together with natural frequency calculations to justify using a dynamic amplification factor of unity. Please provide details of both of these calculations.

11.0-19 Para 11.2.4.2, p. 11-22. 150.52ft^2 should read 191.6ft^2 in the calculation.

11.0-20 P. 11-22. Sliding coefficient is quoted as concrete on concrete. Isn't there a steel plate on the bottom of the cask? Please clarify.

11.0-21 Para 11.2.4.2, p. 11-23. Please use reduced concrete strength to calculate coefficient (k). Also please describe how $180(fc)^{0.5}$ = 2.85, if fc = 4000?

11.0-22 Para 11.2.4.2, p. 11-23. Was an analysis performed for the DBT 3960-lb missile impacting the VCC horizontally at the top of the VCC? If so, please show the results. If not, show that the top portion of the VCC at the centerline of the air outlet ducts is capable of withstanding the impact. The NRC concern is that the air outlet ducts comprise 320^{o} of the VCC structure at the top. Only one hook rebar appears to be used in each of the four 10^{o} sectors. Show that this is satisfactory. [Basis: 10 CFR 72.24(d)(2)]

11.0-23 P. 11-24. Fourth line under <u>Overall Damage Prediction</u> should read <u>conservation</u> of momentum....

11.0-24 Para 11.2.4.2, p. 11-26. The calculations are in error. It should be noted that the units of slugs are pounds x $second^2$/feet, which affects the units in the impulse of missile versus impulse of force on the cask equation. By an alternative analysis: the increase in potential energy of the cask brought to the balance point is 327,000 foot pounds, the kinetic energy of the missile is 2,100,000 foot pounds, and cask overturning is a distinct possibility. Analysis for overturning is considered appropriate (note that such an analysis is also requested as appropriate to a potential transportation accident). Also there is no Figure 2.2.1.1. [Basis: 10 CFR 72.24(d)]

11.0-25 Para 11.2.6, p. 11-28. It is stated that two different types of floods are analyzed, yet only the fully immersing flood is discussed. The small flood which blocks the air inlets also needs to be analyzed.

11.0-26 Para 11.2.4.2, p. 11-27, 11-29, 11-31, and 11-32. The total weight of 244000 lbs. (VCC+MSB+Fuel+Lids) was used in the calculations on page 11-27 through 11-32 but the listed total weight is 257,310 lbs. (See Table 3.2-1 page 3-3 and Section 3.4.3 page 3-6) Please correct the calculations in chapter 11 accordingly.

11.0-27 Para 11.2.6, p. 11-28 discusses two flood cases: immersion threatening VSC tipover and a small flood which could block all air inlets and then proceeds to only address the first scenario. This second scenario should be addressed. [Basis: 10 CFR 72.24(d)]

11.0-28 Para 11.2.6.2, p. 11-29. For the calculations of drag force (fd): Term v^2 is missing. Two (2) is not a subscript, it is an exponent for the stream velocity. Please correct the typographical errors.

11.0-29 Para 11.2.7.2, p. 11-30. Please use the reduced concrete strength when calculating the modulus of elasticity for the concrete, prior to calculating the natural frequency of the cask.

11.0-30 Para 11.2.7.2, p. 11-30. The drawings at Appendix 1 do not indicate that there is any structural lateral constraint which would hold the MSB in a concentric position within the VCC. The drawings do indicate that the MSB rests on a lubricated surface (the MSB base plate) within the VCC. As a result, it is in error to regard the VCC-MSB combination as a rigid body for all of the seismic analyses. The situations in which the MSB impacts the sidewall of the VCC after development of a differential velocity, and jams in a suspended position within the VCC (due to the close tolerance between the MSB and VCC and potential friction or other lateral restraint) should be examined. The impact case could be bounded by the side drop analysis of the MSB and the requested overturning analysis of the VCC-MSB, but that should be demonstrated. Non-concentricity would also affect calculations involving the location of the center of gravity, but probably would not impact the results. The jamming case has the potential for resulting in extreme forces at the points of contact. Appendix 2.1, paragraph 3.2, indicates that there are to be lateral restraints, however no drawings or descriptions (and no analyses) are provided in the TR.[Basis: 10 CFR 72.24(d)]

11.0-31 Para 11.2.7.2, p. 11-30. (edit) In the formula for f_n, the term $K_n/2\pi$ should not be within the brackets for square root (correct as used on page 11-31).

11.0-32 Para 11.2.7.2, p. 11-30. It is considered possible that the lowest natural frequency may be more dependent on the elasticity of the foundation and soil than on the rigidity of the VCC. This could impact the result of the overturning analysis, however analysis for overturning is already requested for the transportation case and may be appropriate for the tornado missile case. [Basis: 10 CFR 72.24(d)]

11.0-33 Para 11.2.8.2. Please provide the detailed pressurization accident calculations for review. This should include consideration of potential temperature increases from the initial loading condition.

11.0-34 Fig 11.2-2 and Tbl 11.2-1. Please provide a node and element numbering diagram as well as the complete and original input/output data so that the results as shown in Table 11.2-1, may be verified

11.0-35 Fig 11.2-3 and Tbl 11.2-2 and 11.2-3. Please provide a node and element numbering diagram as well as the complete input/output data so that the results, as shown in Tables 11.2-2 and 11.2-3, may be verified.

11.0-36 Tbl 11.2-4. Please provide the calculations and necessary figures so that the results shown in Table 11.2-4 may be verified.

11.0-37 Tbl 11.2-5. Please provide the calculations and necessary figures so that the results shown in Table 11.2-5 may be verified.

11.0-38 Evaluate the effects of a maximum postulated transfer cask drop on the structural and associated shielding integrity of the RX-277 neutron shield. Include a calculation of potential neutron streaming through any drop-induced cracks in the shield or shield relocation. This evaluation and calculation should assume RX-277 mechanical and shielding property degradation after being subject to the periodic thermal loads of being used to move fuel as well as the MSB top lid RX-277 thermal loads.

CHAPTER 12.0 OPERATING CONTROLS AND LIMITS

12.0-1 Para 12.2.1.2. The location of 5 feet from the bottom of the cask does not correspond with location for the highest temperature according to figure 11.1-1. The location for the measurement should be changed accordingly. Regarding the actions suggested to control the VCC temperature, should the thermal analysis not be proved, PSN should develop a procedure for applying cooling as well as calculations which show how much water a temperature per unit time is required.

12.0-2 Para 12.2.2. Because PSN has used service level D of the ASME Code for accidental drop, the NRC staff requires that a limiting condition for operation include removing the MSB for maximum a drop of 12 inches in either direction.

12.0-3 Para 12.2.2.2. After loading the MSB vacuum pressure during drying should be changed to 3 Torr for not less than 30 minutes following stepped evacuation. The cask should be evacuated and backfilled with helium two times to help reduce the concentration of residual oxygen. See PNL-6365, "Evaluation of Cover Gas Impurities and Their Effects on the Dry Storage of LWR Spent Fuel."

12.0-4 P. 12-6. What is the basis for the 450°F internal gas temperature? If the MSB is not flushed, there will be residual air in it that will contribute to fuel oxidation. Has this been evaluated?

While residual air or moisture does not appear to represent a threat to operation, given the small amount of fuel oxidized, it may be a problem during unloading the MSB. Has this been evaluated?

12.0-5 Para 12.2.2.4. The NRC staff does not accept the dye penetrant test method for inspecting weld integrity. When possible the welds should be radiographed. When radiography is not possible, it is acceptable to use helium leak detection, followed by a dye penetrant method for surface flaws. (See comment 7.0-1 and 1.0-20)

12.0-6 Para 12.2.3. Surveillance to detect blockage of air inlets is also necessary on a periodic basis to assure that adequate air flow is maintained. The frequency of such surveillance should be tied to the consequences of a blockage event, and should include surveillance of internal passages.

12.0-7 What is the maximum time that is permissible regarding fuel clad temperature for the accident case of the MSB hanging up in the MTC? What is the maximum time that is permissible regarding local and bulk concrete temperature for the same accident case, i.e., the MSB hangs up part way inside the VCC? These times should be included as a part of a limiting condition for operation.

12.0-8 Para 12.2.1.1. Procedures for leak rate testing need to be provided so that the feasibility of such testing can be determined.

12.0-9 Para 12.2.1.2. In addition to limiting the surface temperature of the cask, it is also necessary to assure that the MSB and fuel are being adequately cooled. It will be necessary to include additional limitations such as air temperature increase from inlet to outlet to assure that the air flow is sufficient to provide the amount of cooling determined by analysis.

12.0-10 Para 12.2.1.2. It is not clear what the acceptance criteria are for concrete surface temperature which is stated to be monitored once, 72 hours after the cask is placed in service. It is unlikely that the ambient temperature at this time will be 100°F, so meeting the 150°F limit does not demonstrate that the analysis is correct or conservative. Measurements and criteria which confirm the analysis are appropriate.

12.0-11 Para 12.2.3, p. 12-9. Capability for monitoring and requirements for monitoring should be addressed to meet the requirements of 10 CFR 72.122 (h)(1) and (4).

12.0-12 Para 12.2.2.1. The 1 kW per assembly is a requirement which must be met by all fuel assemblies to be stored. The analysis presented will not support any assemblies having a heat rate greater than 1 kW. Additional criteria may also be required to meet limits established as discussed in Comment 12.0-4.

12.0-13 P. 12-3. The last two paragraphs describe actions taken for "hot" ambient conditions. Water cooling of the concrete is feasible, but what precautions will be taken to ensure that the steel will not be exposed to the water or to steam? If the thermal performance is uncertain, the design should be more conservative. One way would be to limit the total heat load. The last line of the page gives an action time of 2 years if temperatures cannot be controlled within limits. What is the basis for this time period?

CHAPTER 13.0 QUALITY ASSURANCE

The NRC staff has received your letter dated September 6, 1989, providing responses to our previous QA comments issued to you on April 11, 1989.

Our review comments, if any, on your QA submittal will be provided later.

APPENDIX 1.0 DRAWINGS

A1.0-1 Drwg VCC-24-001, Rev. 0, sheet 1/1.

1) Section B-B cross sectional line was not shown in Section A-A.

2) Washers were not shown in detail A.

3) Using bolts (item 2) as shown on detail A may cause difficulties during the operation. Such as: may not have enough threads for sufficient engagement if the concrete side of the nut were to be tightened more than it needed; changing a bolt is impossible; etc. It is recommended that item 2 of the Bill of Materials and Detail A be revised to not use double ended bolts, since the inside nut is not secured (as by welding) except by the concrete. Loosening of the inside nut could result in excess time for installation or removal. The use of studs or single ended bolts with heads welded to item 4 in lieu of the double ended bolts could be alternatives.

4) (Edit) Note number 2 should be boxed in.

A1.0-2 Drwg VCC-24-001, MSB-24-001, etc. No provisions for holding the MSB laterally within the VCC are shown in either the drawings for the VCC or the MSB. If such provisions are intended, they should be shown. Appendix 2.1, paragraph 3.2, indicates that there are to be lateral restraints, however no drawings or descriptions (and no analyses) are provided in the TR.

A1.0-3 Drwg VCC-24-001. No small animal and bird screens are shown for the air inlets or outlets, but these should be provided.

A1.0-4 Drwg VCC-24-001, Top View. It is not clear how the MTC alignment plates are secured to the VCC.

A1.0-5 Drwg VCC-24-002, Rev. 0, sheet 1/2.

1) (Edit) Item 6 does not properly line up in section A-A.

2) Please complete and correct the weld symbol between items 1 and 2 in detail B.

3) On drawing VCC-24-001 sheet 1 Quantity of item 2 was called to be 8 whereas only 6 bolts were shown on VCC-24-02 sheet 1/2. Please correct the drawing based on the calculations in TR.

A1.0-6 Drwg VCC-24-002, sheet 1/2, Detail B. Item 1 to Item 2 weld symbol lacks size and uses the wrong symbol (the symbol indicates a fillet weld but the drawing shows a single bevel corner weld).

A1.0-7 Drwg VCC-24-002 sheet 1/2, Detail B. An item 4 should be included in the detail.

A1.0-8 Drwg VCC-24-002, Rev. 0, sheet 2/2.

1) Again there is a discrepancy between the number of bolt holes shown on the top view of the cover plate (item 6; it is believed that cover plate and the cask lid are the same), Section B-B and the number of bolts called on drawing VCC-24-001, sheet 1.

2) 23.1" dimension detail C is different from the 23.2" dimension shown on drawing VCC-24-003, Rev. 0, sheet 1/1 in top view. Please correct the dimension.

A1.0-9 Drwg VCC-24-002, sheet 2/2, View D-D. (Edit) The note should be amended to include: ". . . avoid 11 inch square holes <u>and the sloping air duct</u>," or words to that effect.

A1.0-10 Drwg VCC-24-003, Rev. 0, sheet 1/1.

1) Quantities are not tabulated in the bill of material table.

2) Wire mesh should be added to protect the air inlet.

3) Please correct the fillet weld (.25) symbol between items 2 and 3 in Section A-A.

4) Tubular section (item 2) was not called in the generic top view and in the section A-A.

5) Vertical extension of item 1 was not shown in view C-C.

A1.0-11 Drwg VCC-24-003, sheet 1/1. In the Top View, Section A-A is shown as a view rather than as the section actually depicted in the Section A-A drawing.

A1.0-12 Drwg VCC-24-003, sheet 1/1, Section A-A. The 1.5" clearance at the lower end of the tube does not appear to correspond to the dimensions and angle shown in the Section and the dimensions and material thicknesses shown in VCC-24-001, Section A-A and VCC-24-005.

A1.0-13 Drwg VCC-24-003, sheet 1/1, View D-D. Item 4 should be shown in the view.

A1.0-14 Drwg VCC-24-004, Rev. 0, sheet 1.

1) Please specify "outside top" as item 2.

2) Please show the weld symbols between the items shown on the drawings.

3) Section A-A should show plates in section.

A1.0-15 Drwg VCC-24-005, sheet 1/2, Detail A. Symbol indicates square welds but single bevel butt welds are depicted.

A1.0-16 Drwg VCC-24-005, Rev. 0, sheet 2/2.

1) (Edit) Note 1 was already listed on the sheet 1/2, therefore notes 1 and 2 or sheet 2/2 should read 2 of 3.

2) (Edit) Item 5 was not tabulated in the bill of material.

3) Quantity of item 1 seems to be incorrect.

4) Items 3 and 4 were not shown on the drawings.

5) Please identify the item tabulated below the item 4 in the bill of materials.

6) Please tabulate all the reinforcement bars in the bill of material table.

7) Nelson studs should be shown atop the bottom plate in view B-B.

8) It does not seem practical to locate the spiral reinforcement inside of the vertical reinforcement bars. If PSN intends to locate the hoop bars inside the vertical bars, a note should be made describing the fabrication. Confirm intent.

A1.0-17 Drwg MSB-24-001, Rev. 0, sheet 1/1.

1) (Edit) For item 4 referenced drawing number in the description section of the bill of material table should read MSB-24-003 instead of MSB-003.

A1.0-18 Drwg. MSB-24-002, Rev. 0, sheet 1/2.

1) In the description section of the bill of material of item 3, the diameter given should be less than the outer diameter, and also correct the dimension on drawing MSB-24-001, Rev. 0, Sheet 1 item 3.

2) Fillet weld between item 4 and the shield lid in detail A should be as shown on page 3-7 in the report.

3) (Edit) Please add "ITEM 4" to structural lid side view.

A1.0-19 Drwg MSB-24-002, sheet 1/2. Confirm that the 1/4" fillet weld at the structural lid opening is the sole rigid connection between the structural lid and the shield lid top plate.

A1.0-20 Drwg. MSB-24-002, Rev. 0, sheet 2/2.

1) Please correct the weld symbol in detail C. (The "J" weld symbol is inverted.)

2) (Edit) Please add "Item 5" to top view of structural lid valve cover detail. Also see dimension of 4.5 inches in description block sheet 1 of 2 and correct as appropriate.

3) (Edit) Please show the tapered line on the top view of the structural lid valve cover detail.

4) Section E-E of Structural Lid valve cover (Item 5) detail does not reflect the view shown in detail A on sheet 1/2. Please correct as appropriate.

A1.0-21 Drwg MSB-24-003. Item "2" in Section C-C is not consistent with "Top Plate" at Top View.

A1.0-22 Drwg MSB-24-003. Include information on how the evacuation and pressure or backfill paths are separated between the support plate and the bottom plate.

A1.0-23 Drwg MSB-24-003. Include information on how the drain line is connected to the bottom plate.

A1.0-24 Drwg MSB-24-003. Include information on how item 7 (per Drwg MSB-24-001) is to be connected to the support plate (during closure/inserted into MSB in conjunction with lowering the support plate).

A1.0-25 Drwg. MSB-24-003, Rev. 0, sheet 1/1.

1) (Edit) Section B-B should be rotated 90° to the left to show the section view from the top view.

2) Item 3 is not shown properly in Section C-C.

3) Please correct the fillet weld type symbol in Section B-B. The joint is not shown as a fillet weld.

4) Material specification of items 1, 3, and 8 in the bill of materials should be A516 GR.-70 and not A-36. It should be noted that A-36 is not listed in the appendices of the ASME code, code PSN are using.

5) Item seven (7) was not shown anywhere on the drawing.

A1.0-26 Drwg MSB-24-004, sheet 1/3. The welding of the four assembly sleeves in Detail A does not appear to be practical. Or are only two sleeves welded together, instead of four? The welding symbol should be shown corresponding to a practical means of fabrication.

A1.0-27 Drwg MSB-24-004, sheet 1/3, Detail C. Wrong symbols used for the two bevel welds and the fillet weld. Drawing should be corrected.

A1.0-28 Drwg MSB-24-004, sheet 1/3. The welding of the support bar to the assembly sleeves or to the support plate in Detail D does not appear to be practical unless short welds are proposed for welding Item 4 to either Item 1 or to Item 2. Welding symbols should be shown which correspond to a practical means of fabrication.

A1.0-29 Drwg MSB-24-004, sheet 1/3, Details A, B, C, and D. Confirm that the intent is to bevel the outer corners of the storage sleeves in lieu of using flare welds.

A1.0-30 Drwg MSB-24-004, sheets 1/3 and 3/3. The junction of the support plate and support wall in Detail C on 1/3 is contrary to that shown in Top View, Basket Support Detail on 3/3. The drawings should be revised for consistency.

A1.0-31 Drwg MSB-24-004, sheets 1/3 and 3/3. The support plate (item 2) is given as having a specified width in the Bill of Materials and is shown as having a chord length greater than that width in three places on sheet 3/3. This discrepancy should be corrected.

A1.0-32 Drwg. MSB-24-004, Rev. 0, sheet 1/3.

1) Item 2 is not shown in Section A-A.

2) 1.45" vertical dimension does not line-up with the item 4 side in detail D.

3) ([illegible] Please check weld dimensions for the intermittent weld symbo[illegible] Detail D and add "TYP." to one pointing between items 4 and 1.

4) (Edit) "TYP." was written at the wrong place in the weld symbol between item 4 and 2 at Section A-A.

5) Please identify item 2 on detail C and correct the extension of item 2 beyond item 3 and show the weld symbol for the connection between items 2 and 3.

6) The weld between item 1 should be shown in detail D.

A1.0-33 Drwg. MSB-24-004, Rev. 0, sheet 2/3. Please show the weld symbols in storage sleeve top view or add to the note that full depth penetration welds are required.

A1.0-34 Drwg. MSB-24-004, Rev. 0, sheet 3/3.

1) (Edit) The tapered lines are missing on the support wall side view (item 3).

2) (Edit) Please remove arrow sign which is part of item 4 in support bar top view.

3) Show weld connection for top view between items 2 and 3.

4) The support wall side view should be rotated 90^{0}.

5) The support bar "side view" is actually a front view.

A1.0-35 Drwg LLD-24-001, Rev. 0, sheet 1/1.

1) (Edit) Please change sheet number from 1 to 1/1.

2) No washers were shown in the details, and neither listed in the bill of material table. Confirm intent.

3) Material type of item 3 in the bill of material table is missing.

4) Weld size (.75) should be on the other side of the bevel groove weld symbol. The weld symbol indicates a 0.75" long weld is to be used, which is insufficient. The symbol should be revised to show the true intent.

5) Item 10 in detail should read 1.

A1.0-36 Drwg MTC-24-001, sheet 1/2.

1) Bill of material table should be complete. Material specifications of items 2,6,15,16,17,18, and 19 are not complete. On page 3-17 of the TR, the grade of item 18 (A-204) is called to be GR.C but the rest of the item grade were not tabulated.

2) Please check the quantity and the OD of the item 14 in the bill of material.

3) Please correct the weld symbols in the cut away of trunnion section.

4) The end cover for the trunnion (see view B-B) was not tabulated in the bill of material table.

5) Weld between item 19 and the end cover for the trunnion was not shown.

6) Item 7 in Section C-C was shown as two pieces. What is the intent of the vertical lines?

7) Section D-D of Section C-C was not shown.

8) Please provide information about hydraulic piston (items 11, 13).

9) Please remove one of the "SEE" word in description column of item 12 in the bill of materials.

10) Please provide information about the hydraulic piston mount, and re-direct the arrow from item 12 to point to the mount.

11) Identify the yoke (currently shown as item 12) as the piece connecting the hydraulic piston with the shield doors.

12) Please identify item 23 in some additional views or details.

A1.0-37 Drwg MTC-24-001, sheet 1/2. The construction of the shielding doors is unclear. Section CC appears to show each door as composed of separate steel plates. The Bill of Materials only states the dimensions of each door. The actual construction or means of integrating separate components to form the doors has an impact on the validity of the structural assumptions and calculations (as at page 3-39).

A1.0-38 Drwg MTC-24-001, sheets 1/2 and 2/2. It is recommended that item 6 of the Bill of Materials and Detail A be revised to not use double ended bolts, since: 8 of the 16 bolts would have to be removed from the MTC and replaced each operation (as the Plexiglas ring has only 8 bolt holes), the inside nut is not secured (as by welding, unless it is intended to be integrated by lead casting), and excess time (in violation of ALARA principles) would be required to replace the bolts and then install the outer washers and nuts for placement of the cask lid. The use of studs in lieu of bolts and additional holes in the Plexiglas, or of threaded holes in the upper shell plate could be alternatives.

A1.0-39 Drwg MTC-24-001, sheets 1/2 and 2/2. It is not apparent that normal fabrication practice will ensure correct and adequate placement of the neutron absorber rods in the annulus between the outer and middle shells, especially in the volume below the trunnions. A note on fabrication procedures to achieve this should be included.

A1.0-40 Drwg MTC-24-001, sheet 1/2. Bill of materials shows inconsistent dimensions for item 2 and for item 3 (which is to fit within item 2).

A1.0-41 Drwg MTC-24-001, sheet 1/2. The top view appears to show a frame at the level of the top of the doors which is not shown in Section C-C and whose components are not identified. Clarification is needed.

A1.0-42 Drwg MTC-24-001, sheet 1/2. Bill of materials item 12 indicates that hydraulic piston mounts are shown in details, but they are not shown at all (the piston-door drive connection appears to be erroneously labeled as the mounts in Top View). The Bill of Materials or drawings should be corrected.

A1.0-43 Drwg MTC-24-001, sheet 1/2. The weld symbol for joining items 3 and 18 in "Cut Away of Trunnion" should show a bevel weld on the near side.

A1.0-44 Drwg MTC-24-001, sheet 1/2. The weld symbol for joining items 1 and 18 in "Cut Away of Trunnion" should show a bevel weld for the 1" first weld.

A1.0-45 Drwg MTC-24-001, sheet 1/2. The trunnion as shown in "Cut Away of Trunnion" should be trimmed so that it does not form a projection into the diameter of the volume to be occupied by the MSB.

A1.0-46 Drwg MTC-24-001, sheet 1/2. The trunnion cover-sleeve assembly shown on "Cut Away of Trunnion" is inadequately detailed and identified in the Bill of Materials. The outer plate is apparently welded to the cylindrical section but no weld symbol is shown. The outer plate is not included in the Bill of Materials. The plate within the trunnion to which the cover is bolted is not identified, detailed, or listed in the Bill of Materials, nor is the manner of securing it to the trunnion shown.

A1.0-47 Drwg MTC-24-001, sheet 1/2. Confirm that there is no intent to provide any radiation shielding material within the trunnion.

A1.0-48 Drwg MTC-24-001, sheet 1/2. Bill of materials item 5 appears to be in error. Please provide correct description.

A1.0-49 Drwg MTC-24-001, sheet 1/2. The shield doors (item 7) and the rails (item 8) on which they are to glide are A36 steel, "coated." It should not be presumed that the coating will endure the sliding of the doors with the contact pressures involved. With the immersion of the MTC with every use cycle, rusting of the door and rail contact surfaces can be presumed. Provide calculations which demonstrate that the pistons are sized to overcome the potential static resistance of the doors resting on oxidized surfaces, and that the variations in resistance to sliding between the contacts on each side of the doors will not contribute to jamming of the doors. Alternatively, a sliding contact interface should be provided which can endure the usage conditions without degradation.

A1.0-50 Drwg MTC-24-001, sheet 2/2.

1) Washers were not shown at detail A

2) Please identify alignment guide detail as item 24.

3) Weld size (1.0) should be on the other side of the V (groove) weld symbol in detail A.

4) Fillet weld size (.5) should be on the other side of the fillet weld symbol in Section E-E.

5) Viton Gasket and .5" Hose Coupling were not tabulated in the bill of material table.

6) Please provide more details about item 8 components.

A1.0-51 Drwg MTC-24-001, sheet 2/2, Section E-E. The height of the rail block (shown as 9.00) should be greater than the door thickness (given as 9.0 in the Bill of Materials on Drwg MTC-24-001, sheet 1/2). The dimensions of this section are given as 6.5 by 9.125 on page 3-39.

A1.0-52 The drawings of the "Dry Spent Fuel Cask Transporter (Optional Design 1)" and "VSC Transporter (Optional Design 2)" should be deleted from Appendix 1.0 and anywhere else in the report as they require a capability to lift the VCC by lugs or other attachments to the top of the VCC for which no designs are submitted.

A1.0-53 Drwg HRS-24-001. It is recognized that the TR does not propose the design for the Hydraulic Roller Skid (HRS) for NRC approval. However the design presented is reviewed as evidence submitted to show that the VSC system, which relies on transfer of the VCC by support at its base, is practical. Although NRC approval of a TR is not a certification of practicality, requiring proof of practicality is considered to be within the scope of the NRC action. An apparently key element in the VSC system is the ability to move the VCC by the HRS (especially since no provisions for lifting by crane are proposed). The information on the HRS provided is insufficient to confirm this capability with regard to mobility over the necessary surfaces and junctions between different surfaces on the hillman rollers. Compatibility with concrete pavement and with movement from the trailer to the pavement and vice versa should be shown. This can involve capability for vertical steps (as at a bridging plate) and for turns, and bearing pressures of the wheels. If special concrete surface qualities and flatness are required for use of the rollers, they should be stated in the TR. If there are angle, flexibility, and vertical step limits for bridging ramps or for direct trailer to slab transfer, they should be identified. (See also, question 1.0-17).

A1.0-54 Drwg HRS-24-001, Rev. 0, sheet 1/1.

1) (Edit) "PLAN VIEW" should read "SIDE VIEW".

2) Section A-A at the side view was not shown.

3) Item 3 pointing to the I beam should be item 2 at the side view.

4) (Edit) Please add "TYP." for 2" DIA. HOLE at the top view.

5) There are numerous errors in the use of solid and phantom lines, which should be corrected.

6) Please provide information about hillman rollers (item 1) and hydraulic piston (item 6).

7) Qualification of the hydraulic roller skid was not performed in the report.

8) (Edit) The side view does not line-up with the top view.

APPENDIX 2.0 SPECIFICATIONS

APPENDIX 2.1 FABRICATION SPECIFICATION FOR THE VENTILATED CONCRETE CASK

A2.1-1 Para 3.1, P. 6. The stated requirement that the VCC is to be constructed to the requirements of ACI-301 and ACI-318 should be replaced with the requirement that VCC material and construction are to meet the requirements of ACI 349. ANSI 57.9-84 (which is incorporated in Reg Guide 3.60 by reference) cites ACI 349-80 as the basis for both design and materials (e.g., at paragraphs 6.4..2.4.3 and 6.17.2.1.2). The use of ACI 349-85 in lieu of ACI 349-80 is acceptable to the NRC staff. The use of ACI-318-83 (or later revision) is also acceptable to the NRC staff but only for the purposes of construction and fabrication, not for design. The NRC staff believes that taken together the ACI-349-80 and ACI-318-83 are adequate for design and construction respectively. In no case may other standards such as ACI-301 be used in lieu of ACI-349-80 and ACI-318-83. [Basis: 10 CFR 72.24(c)(4); Reg Guide 3.60]

A2.1-2 Para 3.2, P. 6. The VCC description does not include the snowskirt, which is expected to be necessary for most potential ISFSI sites. It is recommended that the specification include the snowskirt (and that the generic or standard design be included in the VCC drawings and identified as optional, or excised for VCC procurements for snowfree sites).[Basis: 10 CFR 72.24(a); 10 CFR 72.122(b)]

A2.1-3 Para 3.2, P. 9. The VCC description includes: "The MSB is held in place in the concrete cask by the eight spacers located at the bottom and the shielding ring located at the top." No provisions for ensuring concentric positioning or securing the MSB within the VCC against lateral movement are described or shown on the drawings. A "shield(ing) ring" is mentioned in Fig 8.0-1 and para 8.1(4), step 5, but it is not otherwise described. Drawing VCC-24-001, Section AA, shows what appears to be a toroidal object below the cover, but this object is not identified. Provision for centering the MSB during placement in the VCC and for maintaining it in a concentric position, even in a tipover or side drop case, appear to be desirable. Mention of such provisions without designs and analyses is insufficient. The provisions should be included in the drawings at Appendix 1.0 and in the analyses for Chapter 11.0. Provision in the TR of the drawings listed in Table 5-1 of Appendix 2.1 but not currently included may resolve this question: however, structural analysis should also be provided. [Basis: 10 CFR 72.24(c); 10 CFR 72.122(b)(2)]

A2.1-4 Para 3.3, pps. 9-11. There is no evidence that concrete aggregates have been specifically selected for high temperature application, yet concrete temperature limits in excess of those permitted by ACI 349-80 (or 349-85 or 318-83), Appendix A, have been stated as criteria (paragraph 4.3 and Table 4.3-1). See the recommended corrective action at the comment on paragraph 4.3. [Basis: 10 CFR 72.24(c); 10 CFR 72.122(b)(2)]

A2.1-5 Para 3.3, pps. 9-11. The NRC staff considers that acceptable alternatives to the standards for material stated in ANSI 57.9-84, ACI 349-80 or 349-85, are the latest versions of those standards (e.g., stating "ASTM C150-86" or "the latest version of ASTM C150" in lieu of requiring compliance with ASTM C150-76a). This may be used to modify the TR (prior to NRC action) if desired, but is not required.

A2.1-6 Para 3.3.5, p. 11. Storage of ingredient materials should be not less than that necessary to meet the requirements of ACI 349-80 (and 349-85), paragraph 3.7. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2)]

A2.1-7 Para 3.4.1, p. 11. ACI 349-80 (and 349-85), Chapter 4, provides a full description of mix design without reference to ACI 301, and should be used. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2)]

A2.1-8 Para 3.4, pps. 11-12. There is no evidence that concrete mix design has been specifically selected for high temperature application, yet concrete temperature limits in excess of those permitted by ACI 349-80 (or 349-85 or 318-83), Appendix A, have been stated as criteria (paragraph 4.3 and Table 4.3-1). See the recommended corrective action at the comment on paragraph 4.3. [Basis: 10 CFR 72.24(c); 10 CFR 72.122(b)(2)]

A2.1-9 Para 3.5, p. 13 and para 3.8.3.4, p. 18. The statement on addition of water at the job site is not considered to be acceptable. Water may be added at the job site in accordance with the provisions incorporated in ASTM C94-86b, paragraph 11.7. An exception to the requirements of ASTM C94 is not appropriate (see comment above on acceptability of later editions of standards). [editorial comment: the reference to ASTM "4-74a" was probably intended to read "94-74a"] The hot weather temperature limit included at paragraph 3.5 is considered to be acceptable. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2)]

A2.1-10 Para 3.7.2, p. 14. (edit) The test specimens should be made in accordance with ASTM C31, since ASTM C39 only addresses the method of test.

A2.1-11 Para 3.8.1, p. 15. Formwork should meet the requirements of ACI 349-80 (or 349-85). Reference to ACI 301 is not necessary. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2)]

A2.1-12 Para 3.8.1, p. 16. Note 3) should be modified to state that in no case will the number of specimens be less than that required by paragraph 3.7.2, since the two requirements appear to contradict.

A2.1-13 Para 3.8.2, p. 17. Placing reinforcement should be required to meet ACI 349-80 (or 349-85), Chapter 7. The additional constraints stated are acceptable. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2)]

A2.1-14 Para 3.8.3.4, pps. 17-18. Placing concrete should be required to meet ACI 349-80 (or 349-85), Chapter 5. The additional constraints stated are acceptable except see the above note (for para 3.5) on addition of water. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2)]

A2.1-15 Para 3.8.3.7, p. 19. Curing concrete should be required to meet ACI 349-80 (or 349-85), Section 5.5. Specification of the curing methods to be used is recommended. The additional constraints are acceptable. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2)]

A2.1-16 Para 3.9, p. 19. Inclusion of provisions for the concrete described and the use of concrete temperature limits above 200°F requires submission of test results with the TR or SAR on the actual mixes and aggregates to be used showing suitability for use at the elevated temperatures and the extent of any strength reduction to be used for design. Selection of aggregate, or extrapolations of prior tests on other mixes, for high temperature use is not acceptable as evidence of suitability for the higher temperatures with these admixtures. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2); ACI 349-80, Section A.4]

A2.1-17 Para 3.9.1, p. 19. (edit) The reference to Section "3.1" should probably be to Section 3.4.

A2.1-18 Para 3.9.3, p. 19. (edit) Paragraph heading with no text.

A2.1-19 Para 3.9.3, p. 19. Satisfaction of the requirements of ASTM C494 and ASTM C1017, "Chemical Admixtures for Use in Producing Flowing Concrete," should be included in the specifications. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2)]

A2.1-20 Para 3.9.4, p. 19. The above comment on Appendix 2.1, paragraph 3.4.1, also applies to 3.9.4.

A2.1-21 Para 3.9.9, p. 21. See the comment on paragraph 3.5 on addition of water at the job site.

A2.1-22 Para 3.10.2, p. 21. The AISC specification, "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" primarily applies to design criteria and materials. However PSN cited the ASME Code Section III, Division 1, Subsection NC as the design criteria for the Steel Liner for the VCC. What is the intent? [Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.17.2.1.2)] Welding associated with the VCC should be in accordance with AWS Structural Welding Code-Steel, ANSI/AWS D1.1. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paragraph 6.4.2.4.3(b))]

A2.1-23 Para 3.11, p. 22. (edit) The paragraph indicates that the drawings contain construction tolerances, which are not shown in the VCC drawings included at Appendix 1.0.

A2.1-24 Para 3.12, p. 22. (edit) The paragraph indicates that the cask lid is to be coated on both sides. Drawing VCC-24-001, etc. indicate that the cask lid is to be painted (which would be presumed to be both sides in the absence of modifiers) and that the interior (which would include the inside surface of the cask lid) is to be coated with the lubricant. The discrepancy should be resolved. Painting of the exterior surfaces, with touchup after the cask lid has been welded in place would appear to be appropriate.

A2.1-25 Para 3.13.2, p. 23. Inclusion of provisions for adding a serial number unique to each VCC is recommended to aid accountability. [Basis: Reg Guide 3.60 (ANSI 57.9-84, paras 6.4.1.7 and 6.11)]

A2.1-26 Section 5.0 and Tbl 5-1, pps. 35 and 36. The listed drawings V24-006, 007, 008, and 009 are not included in the TR. Drawings V24-008 and V24-009 could be especially useful if they resolve questions (raised in other comments) on the lateral restraint of the MSB within the VCC. Please supply the omitted drawings. [Basis: 10 CFR 72.24(c)(3)]

APPENDIX 3.0 FUEL REGION THERMAL CONDUCTIVITY

A3.0-1 (Second Page) The value 0.590 in the denominator of the equation should be defined.

A3.0-2 (Last Page) The conclusion giving the value of the change in maximum clad temperature due to a change in effective conductivity from "x" to "y" provides a sensitivity of the results to the value of conductivity. This is the real result and conclusion, and the same type of conclusion should be drawn elsewhere in the report. That is, a quantitative sensitivity, rather than a statement of non-significance is appropriate. This type of quantitative information is essential to completion of the review.

APPENDIX 4.0 COMPUTER PROGRAM INPUT AND OUTPUT

A4.0-1 None of the ANSYS computer run input/output records are complete. It is not possible to check the type of element used, loading, boundary conditions, material properties, output options, etc. For this reason, the NRC staff requests that one complete copy of each run be made available to the reviewers. The staff has evaluated response number 4 of the PSN-89-081 letter, dated September 6, 1989. The PSN response is not adequate because it does not, in fact, provide the actual input file for any of the ANSYS runs. Please provide the input/output files as requested.

A4.0-2 Para A.4.4. Why was the VCC not analyzed for thermal stresses for the extreme temperature care of 125°F ambient, the off-normal case of -40°F, and the normal case of 75°F? Please include a complete computer listing of each of the 4 thermal cases, including full input and output.

A4.0-3 The calculated dose rates in the QAD and ANISN outputs provided in Appendices 4.6 and 4.7 do not correspond to the dose rates reported in Section 5 of the topical report. Provide all the QAD and ANISN input and output listings and associated hand calculations which were used to calculate every dose rate presented in Section 5. All calculations which were performed to generate the QAD and ANISN input should also be provided.

A4.0-4 Appendix 4.7 of the topical report provides an input/output listing for the ANISN-PC VCC radial analysis. This listing indicates the approximation of the Boltzmann Transport Equation used in the ANISN calculation. Justify the use of this approximation over a more exact representation such as P2 S8 in terms of the relative accuracy and applicability to this particular shielding problem and computer code.