

April 30, 2009

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

Attn.: Document Control Desk

Subject: Submittal of Supplemental Information to the Request for an Amendment of Certificate of Compliance (CoC) No. 1025 for the NAC International Multi-Purpose Canister (NAC-MPC) System to Incorporate Dairyland Power Cooperative La Crosse Boiling Water Reactor Spent Fuel as Approved Contents

Docket No. 72-1025, TAC No.L24303

- References:**
1. Certificate of Compliance No. 1025, Amendment 5, for the NAC-MPC System, U.S. Nuclear Regulatory Commission (NRC), July 24, 2007
 2. Final Safety Analysis Report for the NAC-MPC System, Revision 7, NAC International, January 2008
 3. Request for an Amendment of Certificate of Compliance (CoC) No. 1025 for the NAC International Multi-Purpose Canister (NAC-MPC) System to Incorporate Dairyland Power Cooperative La Crosse Boiling Water Reactor Spent Fuel as Approved Contents, NAC International, January 16, 2009
 4. Submittal of NAC Proprietary Information Calculation Packages and Data Input and Output Files Supporting the Request for an Amendment of Certificate of Compliance (CoC) No. 1025 for the NAC International Multi-Purpose Canister (NAC-MPC) System to Incorporate Dairyland Power Cooperative La Crosse Boiling Water Reactor Spent Fuel as Approved Contents, NAC International, February 11, 2009
 5. Submittal of Supplemental Information to the Request for an Amendment of Certificate of Compliance (CoC) No. 1025 for the NAC International Multi-Purpose Canister (NAC-MPC) System to Incorporate Dairyland Power Cooperative La Crosse Boiling Water Reactor Spent Fuel as Approved Contents, NAC International, April 1, 2009

NAC International, Inc. (NAC) herewith provides a second supplement to Reference 3 incorporating the following changes:

- Changed concrete pad compressive strength from 4,000 psi to 6,000 psi and added justification for the 6-foot soil depth being conservative.



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This supplement has been prepared as a result of coordination of 10 CFR 50 and 10 CFR 72 efforts, and its incorporation and approval will result in increased conservatism and significant cost savings to the licensee.

To support the requested changes, NAC has reperformed the concrete cask tip-over analysis and changed the resulting peak accelerations accordingly. These revised peak acceleration values remain less than the g loads used in the canister and basket analyses. Therefore, these structural analyses are not revised.

Changes are marked with revision bars on the MPC-LACBWR Revision 09B pages. Please note that some MPC-LACBWR Revision 09B pages with no revision bars are included as backing pages. A List of Effective Pages is provided to help facilitate review of the amendment request.

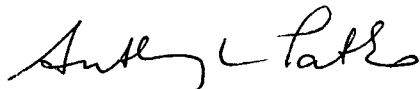
In this supplement, the requested change of the concrete pad compressive strength is described in Chapter 11, Appendix 11.A; Chapter 12, Appendix 12.B; and in Appendix B to the proposed Technical Specifications. The justification for the 6-foot soil depth being conservative is provided in Chapter 11, Appendix 11.A.

This submittal includes eight copies of this transmittal letter and the proposed MPC-LACBWR Revision 09B changed pages and the changed page for the proposed MPC-LACBWR Technical Specifications, Appendix B. Attachment 1 to this transmittal letter contains a detailed description of all requested changes.

Upon final approval of Reference 3 and its two supplements, the MPC-LACBWR changed pages will be reformatted, assigned the next appropriate revision number, and incorporated into an updated NAC-MPC FSAR.

If you have any comments or questions, please contact me on my direct line at (678) 328-1274.

Sincerely,



Anthony L. Patko
Director, Licensing
Engineering

Attachment 1: List of Changes, MPC-LACBWR Amendment, Revision 09B

Attachment 1

List of Changes

MPC-LACBWR Amendment, Revision 09B

Revision of Appendices 11.A and 12.B;
Revision of Appendix B of the
Technical Specifications

List of Changes, MPC-LACBWR Amendment, Revision 09B

Note: The List of Effective Pages was revised to incorporate the following changes.

Appendix 11.A

- Page 11.A.2-24, Section 11.A.2.12.2.1, Analysis of the MPC-LACBWR Concrete Cask – added two new sentences to address soil depth at the MPC-LACBWR site and modifications that were made to concrete strength, density and elastic modulus of the soil underneath the concrete pad
- Page 11.A.2-25 – 1st table at top of page – revised to add line for Concrete Pad Compressive Strength; also changed 1st column heading from “Soil Property” to “Property”, line one “Density” to “Soil Density” and line two “Elastic Modulus” to “Soil Elastic Modulus”; 2nd table – changed peak acceleration numbers; last paragraph, 2nd sentence – changed “DLF of 1.09 (25/22.9)” to “DLF of 1.02 (25/24.6)”
- Page 11.A.2-26 – 1st line of page – changed “at top of the canister” to “at the top of the canister”
- Page 11.A.2-27 – 1st full paragraph, 1st sentence – changed “20.5g” to “21.9g”; 1st paragraph below table, 1st sentence – changed “the 20.5g results in a peak acceleration of 20.9g” to “the 21.9g results in a peak acceleration of 22.3g”

Appendix 12.B

- Page 12.B-35, Section B 3.4, Site Specific Parameters and Analyses (continued), Item 6, last column of table – changed specified concrete compressive strength from “ $\leq 4,000$ psi at 28 days” to “ $\leq 6,000$ psi at 28 days”

Proposed Technical Specifications – Appendix B

- Page B3-9, Section B 3.4, Site Specific Parameters and Analyses (continued), Item 6, last column of table – changed specified concrete compressive strength from “ $\leq 4,000$ psi at 28 days” to “ $\leq 6,000$ psi at 28 days”

April 2009

Revision 09B

NAC-MPC

NAC Multi-Purpose Canister

FINAL SAFETY ANALYSIS REPORT

MPC-LACBWR
Amendment

Volume 1 of 2

Docket No. 72-1025



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Revision 09B

NAC-MPC

NAC Multi-Purpose Canister

FINAL SAFETY ANALYSIS REPORT

**MPC-LACBWR
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12.B-36	MPC-LACBWR Revision 09B	12.C.3-26	MPC-LACBWR Revision 08A
12.B-37	MPC-LACBWR Revision 08A	12.C.3-27	MPC-LACBWR Revision 08A
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12.C-1	Revision 2	12.C.3-29	MPC-LACBWR Revision 08A
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12.C.1-1	MPC-LACBWR Revision 08A	12.C.3-31	Revision 7
12.C.2-1	MPC-LACBWR Revision 08A	12.C.3-32	MPC-LACBWR Revision 08A
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12.C.3-2	Revision 2	12.C.3-36	MPC-LACBWR Revision 08A
12.C.3-3	Revision 2	12.C.3-37	Revision 5
12.C.3-4	MPC-LACBWR Revision 08A	12.C.3-38	MPC-LACBWR Revision 08A
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12.C.3-43.....MPC-LACBWR Revision 08A

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13.1-1MPC-LACBWR Revision 08A
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13.2-1MPC-LACBWR Revision 08A
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Chapter 11
Appendix 11.A

Table 11.A.2.11-5 MPC-LACBWR Basket Maximum Stress Summary,
Concrete Cask 6-inch Drop

Canister Component	Calculated Stress		Allowable Stress		Margin of Safety
	Stress Type	Maximum Value (ksi)	Criteria	Allowable Value (ksi)	
Support Disk	P_m	3.4	$2.4S_m$	90.0	25.5
	P_m+P_b	36.3	$3.6S_m$	128.5	2.53
Top Weldment	P_m	3.0	$2.4S_m$	44.9	14.0
	P_m+P_b	26.2	$1.0S_u$	64.4	1.46
Bottom Weldment	P_m	0.4	$2.4S_m$	43.4	107.5
	P_m+P_b	39.2	$1.0S_u$	64.0	0.63

11.A.2.12 Tip-Over of the Concrete Cask

This section discusses the evaluation of the MPC-LACBWR concrete cask for a non-mechanistic tip-over onto the ISFSI concrete pad. For a concrete cask tip over event to occur, the center of gravity of the loaded cask must be rotated beyond the cask bottom edge, i.e., the point of rotation. When the center of gravity passes beyond the point of rotation, the potential energy of the loaded concrete cask will be converted to kinetic energy as it rotates toward a horizontal orientation on the ISFSI pad. The subsequent motion of the concrete cask is governed by the structural characteristics of the concrete cask, ISFSI pad, and underlying soil.

11.A.2.12.1 Cause of Concrete Cask Tip-Over Event

The structural analysis of the concrete cask demonstrates that no design-basis accident events will cause the concrete cask to tip-over. An earthquake magnitude that greatly exceeds the design-basis earthquake described in Section 11.A.2.2 would be required to tip-over the concrete cask.

A tip-over of the concrete cask would be observed during a survey of the site following the earthquake or other catastrophic event. The tipped-over orientation of the concrete cask would be obvious by inspection.

11.A.2.12.2 Analysis of the MPC-LACBWR Concrete Cask Tip-Over Event

11.A.2.12.2.1 Analysis of the MPC-LACBWR Concrete Cask

The concrete cask tip-over evaluation is performed to determine the response of the concrete cask to the tip-over event and the maximum accelerations experienced by canister and basket structural. The methodology used to determine the concrete cask response is based on NUREG/CR-6608. The dynamic response of the concrete cask for the tip-over event is evaluated using the LS-DYNA program. The MPC-LACBWR concrete cask tip-over analysis is performed using the Yankee-MPC concrete cask tip-over finite element model described in MPC FSAR Section 11.2.12. The soil depth for the MPC model in MPC FSAR Section 11.2.12 is 6 feet. At the MPC-LACBWR site, the soil depth is 40 feet, thereby confirming that the 6-foot soil thickness used in the model is conservative. Modifications to the concrete strength, density and elastic modulus of the soil underneath the concrete pad are as follows.

Property	Concrete Cask Tip-Over Model	
	Yankee - MPC	LACBWR - MPC
Soil Density	100 pcf	120 pcf
Soil Elastic Modulus	70,000 psi	10,000 psi
Concrete Pad Compressive Strength	4,000 psi	6,000 psi

The results of the MPC-LACBWR concrete cask tip-over analysis show that the peak accelerations at key locations of the concrete cask liner, which are used in the evaluation of the loaded canister/basket model (Section 11.A.2.12.2 and Section 11.A.2.12.3) are:

Axial Position (Distance from Cask Bottom End)	Canister/Basket Component at Location	Peak Acceleration
122.8 in.	Top Support Disk	21.9g
139.4 in.	Canister Top End	24.6g

11.A.2.12.2.2 Analysis of the MPC-LACBWR Canister and Basket

Canister Stress Analysis

The MPC-LACBWR canister is evaluated for the concrete cask tip-over condition using a plastic analysis in accordance with Appendix F of the ASME Code. The analysis is performed using the half-symmetry finite element model shown in Figure 11.A.2.12-1. This model is similar to the model used for the MPC-LACBWR canister normal condition stress analysis, as described in Section 3.A.4.4.1.1, but has a refined mesh, gap elements that are sized based on the concrete cask annulus, and plastic material properties.

A bi-linear kinematic hardening material model, defined by a yield strength and a tangent modulus, is used to perform a plastic analysis. The material model is based on the properties of the canister Type 304 stainless steel material at a temperature of 300°F, corresponding to the temperature of the lid weld region where the highest stresses are expected to occur. The yield strength is modeled as 21.4 ksi. The tangent modulus is taken as $(S_u - S_y)/\epsilon_p = 10.95 \times 10^4$ psi, where S_u is the ultimate tensile strength (66.2 ksi) and ϵ_p is the ultimate strain (40%).

The canister tip-over stress analysis is conservatively performed using a transverse acceleration of 25g over the full length of the canister. Note that this corresponds to a DLF of 1.02 (25/24.6)

at the top of the canister, which is conservative since the canister lid (7 inches thick) region is stiff due to its monolithic structure. The inertial load of the basket assembly is modeled as a pressure load on the inside surface of the canister shell. The basket pressure load distribution is assumed to be uniform over the length of the canister shell that is in contact with the support disks and is assumed to vary linearly in the circumferential direction, from a maximum value at the symmetry plane to zero at an angle of 22° from the symmetry plane. In addition, a uniform internal pressure load of 12 psig is applied to the model.

The maximum primary membrane (P_m) and primary membrane plus bending (P_m+P_b) stress components and stress intensities in the MPC-LACBWR canister due to the storage cask tip-over load are summarized in Tables 11.A.2.12-1 and 11.A.2.12-2, respectively. In accordance with Appendix F of the ASME Code, the membrane stress is limited to $0.7S_u$ and the membrane plus bending stress is limited to $0.9S_u$. An additional factor of 0.8 is applied to the allowable stresses for the lid closure weld (Section 12). The results of the analysis show that the lowest margins of safety in the canister shell for P_m and P_m+P_b stress intensities both occur in the lid closure weld (Section 12 in Figure 3.A.4.4.1-2) and result from the storage cask tip-over load with internal pressure loading. The lowest margins of safety for P_m and P_m+P_b stress intensity are 0.40 and 0.63, respectively.

Support Disk and Weldment Stress Analysis

The MPC-LACBWR canister fuel basket is evaluated for the concrete cask tip-over conditions using the finite element model shown in Figure 11.A.2.12-2. This finite element model is similar to the model used for the MPC-LACBWR canister normal condition stress analysis, as described in Section 3.A.4.4.1.1, but uses a coarse mesh for the canister and includes the basket support disks in order to properly model the interaction between the basket and shell under transverse loading conditions.

Each of the basket support disks and the top weldment are modeled using elastic shell elements (SHELL63) with thickness input as real constants. The 15 support disks that are located in the bottom-end region of the canister, where tip-over loads are lowest, are modeled using the coarse mesh shown in Figure 11.A.2.12-3. The 11 support disks located in the canister top-end region, where the tip-over loads are highest, are modeled using the fine mesh shown in Figure 11.A.2.12-4. The top weldment disk is also modeled using a fine mesh, similar to that shown in Figure 11.A.2.12-4 for the support disk. Rather than modeling the basket tie-rods, each support disk is restrained in the axial direction (i.e., $UY=0$) at the nodes located at the centerline of each tie-rod. The interface between the basket and canister is modeled by CONTAC52

elements. Contact between the canister shell and the concrete cask steel liner is modeled by CONTAC52 elements that are attached at one end to the canister shell and constrained in all degrees-of-freedom on the other end. The gap elements on the canister shell are positioned to model the shift in the position of the canister shell as it comes into contact with the concrete cask inner liner.

As presented in Section 11.A.2.12.2.1, the maximum acceleration of the steel liner at the location of the top support disk is determined to be 21.9g. Using the acceleration time history developed in Section 11.A.2.12.2.1 and the methodology described in Section 11.2.12.2.2 for the Yankee-MPC basket support disk DLF calculation, the maximum DLF and corresponding frequencies for the MPC-LACBWR support disks are:

Mode Number	Frequency (Hz)	DLF
1	87	1.02
2	256	1.02
3	347	1.02
4	421	1.01

Applying the maximum DLF of 1.02 to the 21.9g results in a peak acceleration of 22.3g. The applied inertial load to the finite element model described in this section corresponds to a bounding transverse load of 25g at the basket top support disk. The inertial load of the canister and basket support disks due to the 25g tip-over load is accounted for by applying a rotational acceleration load of 76.4 rad/s^2 about the global origin of the model, which corresponds to the location of the concrete cask bottom edge about which the concrete cask tips over. In addition, horizontal line loads are applied to the edges of the fuel tube holes in each support disk to account for the weight of the basket components that are not modeled (i.e., fuel, fuel tubes, damaged fuel cans, heat transfer disks, and tie-rods.) The magnitudes of horizontal line loads applied to the ligaments of the standard and damaged fuel tube openings are calculated based on the weight of the contents of each opening and the transverse acceleration corresponding to the tip-over rotational acceleration. The analysis is performed for five (5) basket impact orientations as shown in Figure 11.A.2.12-5.

The highest stresses occur in the top two support disks (disk no. 25 and 26). The maximum primary membrane (P_m) and primary membrane plus bending (P_m+P_b) stresses for the sections defined in Figure 11.A.2.12-6 for support disks 25 and 26 due to each of the concrete cask tip-over impact orientations evaluated are summarized in Table 11.A.2.12-3. The allowable P_m and P_m+P_b stress intensities for the support disks are based on 17-4 PH material properties at a

bounding temperature of 500°F. The results of the basket tip-over stress analysis show that the lowest design margins for P_m and $P_m + P_b$ are 0.20 and 0.55, respectively.

Basket Support Disk Buckling Analysis

Buckling of the MPC-LACBWR support disk is evaluated for the tip-over condition in accordance with the methods and acceptance criteria of NUREG/CR-6322. The support disks are fabricated from 17-4 PH ferritic steel. Therefore, the formulas for non-austenitic steel presented in MPC FSAR Section 11.2.12.2.2 are used for the support disk buckling analysis.

The support disk buckling analysis considers the highest ligament stresses in the two support disks located nearest the top end of the basket (i.e., 25th and 26th support disks) resulting from each of the impact orientations shown in Figure 11.A.2.12-5. The support disk buckling analysis is conservatively performed using the smallest ligament cross-section dimensions and the largest ligament length for all disk ligaments. Table 11.A.2.12-4 summarizes the calculated and allowable forces and moments at the stress sections in support disks 25 and 26 with the lowest margins of safety against buckling for each concrete cask tip-over impact orientation evaluated. The results show that the lowest margin of safety against buckling of 0.16 occurs at section 111 of support disk number 25 for the 15.2° impact orientation. Therefore, the MPC-LACBWR support disks satisfy the buckling design criteria of NUREG/CR-6322 for the tip-over condition.

Basket Fuel Tube Analysis

The MPC-LACBWR fuel tube stresses and deformation resulting from the concrete cask tip-over load are bounded by those calculated for the MPC-CY fuel tubes in MPC FSAR Section 11.4.5 for a 55g side impact load. This conclusion is based on a comparison of the MPC-LACBWR and MPC-CY fuel tube loads and boundary conditions considered in the concrete cask tip-over stress analysis.

The MPC-LACBWR fuel tubes are similar to the MPC-CY fuel tubes, having the same 0.048-inch tube thickness, but are shorter, have smaller openings, and contain much lighter payloads than the MPC-CY fuel tubes. The MPC-LACBWR fuel tubes are 98.25 inches long compared to 131.95 inches for the MPC-CY fuel tubes. The MPC-LACBWR standard and oversized fuel tubes have square 5.75-inch and 6.00-inch openings, whereas the MPC-CY fuel tube has a square 9.12-inch opening. The lateral pressure loading on the MPC-LACBWR standard and oversized fuel tubes due to the 25g tip-over are 17.7 psi [i.e., $25g \times 400 \text{ lb}/(98.25 \times 5.75)$] and 19.0 psi [i.e., $25g \times 449 \text{ lb}/(98.25 \times 6.00)$], respectively, whereas the MPC-CY fuel tubes are designed for lateral pressure load of 72.67 psi, as discussed in MPC

Chapter 12
Appendix 12.B

B 3.4 Site Specific Parameters and Analyses (continued)

6. In addition to the requirements of 10 CFR 72.212(b)(2)(ii), the ISFSI pads and foundation shall include the following characteristics as applicable to the end drop and tip-over analyses:

Parameter	YANKEE-MPC	CY-MPC	MPC-LACBWR
Concrete thickness	36 inches maximum	36 inches maximum	36 inches maximum
Pad subsoil thickness	72 inches minimum	60 inches minimum	60 inches minimum
Specified concrete compressive strength	$\leq 4,000$ psi at 28 days	$\leq 4,000$ psi at 28 days	$\leq 6,000$ psi at 28 days
Concrete dry density (ρ)	$125 \leq \rho \leq 150$ lbs/ft ³	$135 \leq \rho \leq 150$ lbs/ft ³	$125 \leq \rho \leq 150$ lbs/ft ³
Soil in place density (ρ)	$85 \leq \rho \leq 130$ lbs/ft ³	$85 \leq \rho \leq 130$ lbs/ft ³	$110 \leq \rho \leq 120$ lbs/ft ³
Soil Stiffness	$k \leq 300$ psi/in	--	--
Soil Modulus of Elasticity	--	$\leq 30,000$ psi	$\leq 10,000$ psi

The concrete pad maximum thickness excludes the ISFSI pad footer. The compressive strength of the concrete should be determined according to the test method given in Section 5.6 of ACI 318. Steel reinforcement is used in the pad footer. The basis for acceptance of concrete shall be as described in Section 5.6 of ACI 318. The soil modulus of elasticity should be determined according to the test method described in ASTM D4719 or in ASTM D1196. The soil stiffness should be determined according to the test method described in Chapter 9 of the Civil Engineering Reference Manual, 6th Edition.

7. In cases where engineered features (i.e., berms, shield walls) are used to ensure that requirements of 10 CFR 72.104(a) are met, such features are to be considered important to safety and must be evaluated to determine the applicable Quality Assurance Category on a site specific basis.
8. TRANSFER CASK OPERATIONS shall only be conducted with surrounding air temperatures $\geq 0^{\circ}\text{F}$ for the Yankee-MPC and CY-MPC systems. Air temperatures $\geq 32^{\circ}\text{F}$ are required for the MPC-LACBWR system.

B 3.5 CANISTER HANDLING FACILITY (CHF)

B 3.5.1 TRANSFER CASK and CANISTER Lifting Devices

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

B 3.5.2 CANISTER HANDLING FACILITY Structure Requirements

B 3.5.2.1 CANISTER Station and Stationary Lifting Devices

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

(continued)

**Proposed
MPC-LACBWR
Technical Specifications
Appendix B**

B 3.4 Site Specific Parameters and Analyses (continued)

6. In addition to the requirements of 10 CFR 72.212(b)(2)(ii), the ISFSI pads and foundation shall include the following characteristics as applicable to the end drop and tip-over analyses:

Parameter	YANKEE-MPC	CY-MPC	MPC-LACBWR
Concrete thickness	36 inches maximum	36 inches maximum	36 inches maximum
Pad subsoil thickness	72 inches minimum	60 inches minimum	60 inches minimum
Specified concrete compressive strength	$\leq 4,000$ psi at 28 days	$\leq 4,000$ psi at 28 days	$\leq 6,000$ psi at 28 days
Concrete dry density (ρ)	$125 \leq \rho \leq 150$ lbs/ft ³	$135 \leq \rho \leq 150$ lbs/ft ³	$125 \leq \rho \leq 150$ lbs/ft ³
Soil in place density (ρ)	$85 \leq \rho \leq 130$ lbs/ft ³	$85 \leq \rho \leq 130$ lbs/ft ³	$110 \leq \rho \leq 120$ lbs/ft ³
Soil Stiffness	$k \leq 300$ psi/in	--	--
Soil Modulus of Elasticity	--	$\leq 30,000$ psi	$\leq 10,000$ psi

The concrete pad maximum thickness excludes the ISFSI pad footer. The compressive strength of the concrete should be determined according to the test method given in Section 5.6 of ACI 318. Steel reinforcement is used in the pad footer. The basis for acceptance of concrete shall be as described in Section 5.6 of ACI 318. The soil modulus of elasticity should be determined according to the test method described in ASTM D4719 or in ASTM D1196. The soil stiffness should be determined according to the test method described in Chapter 9 of the Civil Engineering Reference Manual, 6th Edition.

7. In cases where engineered features (i.e., berms, shield walls) are used to ensure that requirements of 10 CFR 72.104(a) are met, such features are to be considered important to safety and must be evaluated to determine the applicable Quality Assurance Category on a site specific basis.
8. TRANSFER CASK OPERATIONS shall only be conducted with surrounding air temperatures $\geq 0^{\circ}\text{F}$.