UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 WARRENVILLE ROAD, SUITE 210
LISLE, IL 60532-4352

March 11, 2011

Mr. Mark Bezilla
Site Vice President
FirstEnergy Nuclear Operating Company
Perry Nuclear Power Plant
P. O. Box 97, 10 Center Road, A-PY-A290
Perry, OH 44081-0097

SUBJECT: NRC INSPECTION REPORT NUMBERS 072-00069/11-002(DNMS); 050-00440/11-010 – DRY FUEL STORAGE STACK-UP OPERATIONS AT THE PERRY NUCLEAR POWER PLANT

Dear Mr. Bezilla:

On March 4, 2011, the U.S. Nuclear Regulatory Commission (NRC) completed its inspection of the proposed inter-cask transfer operation, known as stack-up, at the Perry Nuclear Power Plant. The purpose of the inspection was to determine whether the freestanding stack-up configuration is permissible by the applicable licensing basis. An exit teleconference was held on March 4, 2011, where the inspectors discussed the preliminary inspection findings with Mr. V. Veglia and other members of your staff. The enclosed report documents the inspection results.

During this inspection, the NRC staff examined design documents performed under your license as they relate to public health and safety. Specifically, the inspectors reviewed stability calculations and evaluations for the proposed inter-cask transfer operation. Details of the documents reviewed are identified in the enclosed report. The inspection also consisted of dialogue between the NRC staff and your personnel.

The inspection was conducted per NRC Inspection Manual 2690, “Inspection Program for Dry Storage of Spent Reactor Fuel at Independent Spent Fuel Storage Installations and Guidance for Title 10 of the Code of Federal Regulations (CFR) Part 71 Transportation Packages,” and used portions of Inspection Procedure (IP) 60854.1, “Preoperational Testing of an ISFSI at Operating Plants.” This report details the results of the inspection related to stack-up only. The remaining inspection performed under IP 60854.1 is ongoing and will be documented in a future inspection report.

Based on the results of this inspection, the NRC has determined that the proposed freestanding stack-up configuration is not in accordance with the licensing basis and one Severity Level IV violation of NRC requirements was identified. This violation is being treated as a Non-Cited Violation (NCV), consistent with Section 2.3.2 of the enforcement policy, and is discussed in the enclosed inspection report.

If you contest the subject or severity of this NCV, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Regional Administrator, U.S. Nuclear Regulatory Commission - Region III, 2443 Warrenville Road, Suite 210, Lisle, IL 60532-4352; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the Resident Inspector Office at the Perry Nuclear Power Plant.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response (if any), will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/readingrm/adams.html.

Sincerely,

/RA/

Christine A. Lipa, Chief
Materials Control, ISFSI, and
Decommissioning Branch
Division of Nuclear Materials Safety

Docket Nos.: 72-069 and 50-440
License No.: NPF-58

Enclosure:
NRC Inspection Reports 072-00069/11-002(DNMS)
and 050-00440/11-010

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos.	72-069; 50-440
License No.	NPF-58
Report Nos.	072-00069/11-002(DNMS); 050-00440/11-010
Licensee:	FirstEnergy Nuclear Operating Company
Facility:	Perry Nuclear Power Plant, Unit 1
Location:	Perry, OH
Inspection Dates:	July 26, 2010 – March 4, 2011
Inspectors:	Rhex Edwards, Reactor Inspector Matt Learn, Reactor Engineer Jim Neurauter, Senior Reactor Inspector
Approved by:	Christine A. Lipa, Chief Materials Control, ISFSI, and Decommissioning Branch Division of Nuclear Materials Safety

EXECUTIVE SUMMARY

Perry Nuclear Power Plant, Unit 1
NRC Inspection Report Nos. 072-00069/11-002(DNMS); 050-00440/11-010

The purpose of the inspection was to evaluate the licensee's proposed activities associated with the inter-cask transfer conducted during dry fuel storage operations. During this inspection, region based inspectors were unable to draw conclusions from available guidance and sought the expertise of the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Material Safety and Safeguards (NMSS), through a Technical Assistance Request (TAR). This guidance is included as Attachment 2 to this inspection report. The breadth of this inspection report is limited and only details the results of the inspection related to inter-cask transfer operations. The remaining inspection performed under IP 60854.1 is ongoing and will be documented in a future inspection report.

Dry Fuel Storage Transfer Activities:

- The NRC staff determined that the proposed inter-cask transfer activities do not meet the current licensing basis and that the proposed evolution would require: a lateral restraint system; an exemption to not use lateral restraints; or a request from the certificate holder for a Certificate of Compliance (CoC) amendment.

- The inspectors identified one Severity Level IV Non-Cited Violation (NCV) of Title 10 of the Code of Federal Regulations (CFR) 72.146, "Design Control."

Report Details

1.0 Preoperational Testing of an Independent Spent Fuel Storage Facility (ISFSI) at Operating Plants (60854.1)

a. Inspection Scope

The scope of Inspection Procedure (IP) 60854.1 includes verifying that loading, unloading, and transfer activities meet the commitments and requirements specified in the Dry Cask Storage System Safety Analysis Report (SAR), Safety Evaluation Report (SER), Certificate of Compliance (CoC), and Title 10 of the Code of Federal Regulations (CFR) Part 72. Additionally, the inspection procedure has the inspectors verify that the equipment used during preoperational test activities has been tested and/or evaluated for its impact on plant structures, systems and components before performance of the preoperational tests. From this inspection guidance, the NRC inspectors conducted a review of Perry Nuclear Power Plant's proposed inter-cask transfer operation known as stack-up. The stack-up configuration refers to the condition when the Holtec HI-TRAC (transfer cask), with loaded Multi-Purpose Canister (MPC) inside, is resting atop the HI-STORM (storage overpack). The breadth of this inspection report is limited and only details the results of the inspection related to the stack-up configuration. The remaining inspection conducted in accordance with IP 60854.1 will be documented in a future inspection report.

The inspectors reviewed licensee design basis documentation associated with a free-standing (no lateral seismic restraint) stack-up configuration. Specifically, the inspectors reviewed the Perry Nuclear Power Plant, 10 CFR 50.59 Evaluation No. 10-03150, "Perry Nuclear Power Plant Spent Fuel Dry Storage-Freestanding Cask Configurations," design calculation G58-P-001, "Seismic Stability Analysis of HI-TRAC/HI-STORM Stack-up," and design calculation G58-H-HI-2084168, "Dynamic Analysis of HI-TRAC/HI-STORM Stack Under Postulated Seismic Events in the Fuel Handling Building @ 620'-6" EL."

b. Observations and Findings

On July 26, 2010, the inspectors received from the Perry Nuclear Power Plant, 10 CFR 50.59 Evaluation No. 10-03150, "Perry Nuclear Power Plant Spent Fuel Dry Storage-Freestanding Cask Configurations," and other supporting evaluations used to determine if the freestanding components used in a dry cask storage campaign would require a license amendment request (LAR). Licensee calculation G58-P-001, "Seismic Stability Analysis of HI-TRAC/HI-STORM Stack-up," was used to demonstrate dynamic stability of the free-standing stack-up during the vertical transfer operation of the MPC from a HI-TRAC into a HI-STORM while inside the Fuel Handling Building. The calculation used a methodology described in American Society of Civil Engineers (ASCE) Standard 43-05, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities," dated 2005.

The design requirements during MPC transfer operations are specified in the Holtec International HI-STORM 100 Cask System, Revision 7, Final Safety Analysis Report (FSAR) and NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," dated July 1980, provides guidance on defense-in-depth for the control of heavy loads. The inspectors were unable to conclude that the requirements of the Holtec FSAR were met

or that the process conformed to NUREG-0612 guidelines for control of heavy loads. Specifically Region III inspectors identified a concern with the lack of seismic restraint that would provide lateral stability to the stack-up configuration during transfer of the MPC from the HI-TRAC to the HI-STORM. During this operation, the HI-TRAC is not attached to the single-failure-proof crane. The inspectors noted an increased possibility for the stack-up configuration to tip-over during a seismic event. In addition, the inspectors noted that NUREG/CR-6926, "Evaluation of the Seismic Design Criteria in ASCE Standard 43-05 for Application to Nuclear Power Plants," dated March 2007, specified an NRC staff review is required for evaluations utilizing ASCE Standard 43-05 guidance related to dynamic stability of a free-standing rigid body. Since the inspectors could not identify prior NRC staff review of the ASCE Standard 43-05 methodology to evaluate dynamic stability of a rigid body, NRC Region III inspectors concluded that use of this dynamic stability methodology was a departure from a methodology used in the FSAR, and therefore would require an LAR.

Through a Technical Assistance Request (TAR), NRC Region III requested assistance from the Office of Nuclear Material Safety and Safeguards (NMSS) Division of Spent Fuel Storage and Transportation (DSFST) regarding unrestrained vertical transfer operations to: (1) determine whether the licensee was within their licensing basis; (2) perform a technical review and determine acceptability of calculation G58-P-001; (3) provide guidance for inspection of unrestrained vertical transfer operations, if permissible; and (4) evaluate the need for guidance to licensees on acceptable methods of evaluating vertical transfer operations. The TAR was sent to DSFST on October 29, 2010.

DSFST completed its review and provided a response to Region III on February 25, 2011. This response is included as Attachment 2 of this inspection report. Pertinent excerpts from the TAR response include:

> NUREG-0612 provides guidelines for the control of heavy loads at nuclear power plants. The guidelines were developed "for all facilities to reduce the potential for the uncontrolled movement of a load or load drop…" NUREG-0612, p. 1-4. NUREG-0612 further states that "the NRC staff has developed an overall philosophy that provides a defense-in-depth approach for controlling the handling of heavy loads." (Emphasis added). NUREG-0612, p. 5-1. The NUREG provides two paths to achieve defense-in-depth: (1) by providing redundancy (i.e., a single-failure-proof handling system) in the handling of the heavy load; or (2) by providing an analysis of the heavy load drop to show that the evaluation criteria of Section 5.1 of NUREG-0612 are satisfied. If the licensee chooses not to provide redundancy, then even though the licensee may have performed a calculation demonstrating that there is sufficient safety margin such that a load drop is unlikely to occur, the licensee should provide an analysis of the consequences of the heavy load drop to show that the evaluation criteria of Section 5.1 are satisfied.
>
> The "stack-up" of a HI-TRAC transfer cask on top of a HI-STORM storage cask was an unknown load handling procedure when NUREG-0612 was issued in July 1980. Never-the-less, NUREG-0612 indicates that it reflects

"an overall philosophy that provides a defense-in-depth approach for controlling the handling of heavy loads."

The Holtec FSAR recognizes a defense-in-depth approach. Holtec FSAR Section 3.1.2.1.1.1 "Tip-Over" states the following:

> The potential of the HI-STORM 100 Overpack tipping over during the lowering (or raising) of the loaded MPC into (or out of) it with the HI-TRAC cask mounted on it is ruled out <u>because of the safeguards and devices mandated by this FSAR for such operations</u> (Subsection 2.3.3.1 and Technical Specification 4.9). (Emphasis added). FSAR p. 3.1-9.

> Subsection 2.3.3.1 contains a comprehensive set of design criteria for the ancillary equipment and components required for the MPC transfer operations to ensure that the design objective of precluding a kinematic instability event during MPC transfer operations is met. FSAR p.3.1-9.

Holtec FSAR, Section 2.3.3.1 "Equipment" states, in part, the following:

> Users may effectuate the inter-cask transfer of the MPC between the HI-TRAC transfer cask and either the HI-STORM 100 or the HI-STAR 100 overpack in a location of their choice, depending on site-specific needs and capabilities. For those users choosing to perform the MPC inter-cask transfer using devices not integral to structures governed by the regulations of 10 CFR Part 50 (e.g., fuel handling or reactor building), a Cask Transfer Facility (CTF) is required. FSAR p. 2.3-4.

> The detailed design criteria which must be followed for the design and operation of the CTF are set down in Paragraphs A through R… FSAR p. 2.3-5.

Holtec FSAR Paragraph A "General Specifications" subparagraph (iii) "Definitions" states that:

> the CTF structure is the stationary, anchored portion of the CTF which provides the required structural function to support MPC transfer operations, <u>including lateral stabilization of the HI-TRAC transfer cask</u> and, if required, the overpack, to protect against seismic events. (Emphasis added). FSAR p. 2.3-7.

Holtec FSAR Paragraph C "Heavy Load Handling" subparagraph (iii) "Defense-in-Depth" states that:

> When the HI-TRAC transfer cask is stacked on the overpack, <u>HI-TRAC shall be either held by the lifting device or laterally restrained</u> by the CTF structure. (Emphasis added). FSAR p. 2.3-12.

Holtec FSAR Section 3.1.2.1.1.1 makes it clear that tip-over of the stack-up configuration is ruled out because of the safeguards and devices mandated by the Holtec FSAR in Section 2.3.3.1, which contains design criteria for the devices required to ensure that kinematic instability (tip-over) will not occur. In structures governed by the regulations of 10 CFR 50, such as the Perry Fuel Handling Building (FHB), where the functional requirements of the CTF can be met by integrally attaching these devices to the building's walls, columns and floor to provide lateral restraint, a separate CTF is not required. The only facility for which the NRC staff has reviewed and approved a stack-up configuration is the Private Fuel Storage Facility where lateral seismic restraints were provided.

Holtec FSAR Section 2.3.3.1 establishes the design basis for the safety analysis of the stack-up configuration, which is that "the HI-TRAC shall be either held by the lifting device or laterally restrained." FSAR p. 2.3-12. Because of these requirements specified by the FSAR a tip-over of the stacked-up components is ruled out, and therefore an accident analysis for tip-over of the stack-up configuration is not required.

Title 10 CFR 72.212(b)(3) states in part that "The general license shall: Review the Safety Analysis Report (SAR) referenced in the Certificate of Compliance…, prior to use of the general license, to determine whether or not the reactor site parameters,…, are enveloped by the cask design basis considered in these reports."

Title 10 CFR 50.59(c)(2) states in part the following: "A licensee shall obtain a license amendment pursuant to §50.90 prior to implementing a proposed change, test, or experiment, if the change, test, or experiment would:. . . (v) Create a possibility for an accident of a different type than any previously evaluated in the final safety analysis report; . . . or (viii) Result in a departure from a method of evaluation described in the FSAR used in establishing the design basis or in the safety analyses."

Title 10 CFR 72.48(c)(2) states in part the following "…a general licensee shall request that the certificate holder obtain a CoC amendment pursuant to §72.244, prior to implementing a proposed change,... if the change… would:… (c)(2)(v) Create a possibility for an accident of a different type than any previously evaluated in the FSAR;… or (viii) Result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design basis or in the safety analyses."

The licensee's 10 CFR 50.59 evaluation of the stack-up configuration does not address the design basis for the safety analysis of the stack-up configuration found in subsection 2.3.3.1 of the Holtec FSAR, which 10 CFR 72.212 requires the licensee to review. Instead of laterally restraining the HI-TRAC when it is not held by the lifting device, as mandated by the Holtec FSAR, the licensee performed a calculation to demonstrate that the stack-up configuration is dynamically stable. This is a departure from the seismic design basis for the safety analysis of the stack-up configuration, and creates the possibility for an

accident not previously evaluated in Holtec FSAR. The licensee did not perform a 10 CFR 72.48 evaluation.

Because the HI-TRAC is required by the FSAR to be laterally restrained when not held by the lifting device, no accident analysis for the tip-over of the stack-up configuration was performed in the Holtec FSAR. Therefore, not providing lateral restraints is not only a departure from a method of evaluation described in the Holtec FSAR, it also creates a possibility for an accident not previously evaluated in the Holtec FSAR. A 10 CFR 72.48 evaluation, had it been performed, would require the general licensee to request the CoC holder to obtain a CoC amendment pursuant to §72.244 or would require the general licensee to request an exemption.

The Holtec FSAR adheres to the defense-in-depth philosophy of NUREG-0612 for the control and handling of the stack-up configuration. As stated in the Holtec FSAR "tipping over during the lowering of the loaded MPC… is ruled out because of the safeguards and devices mandated by this FSAR for such operations." The safeguards mandated by the FSAR are that "the HI-TRAC shall be either held by the lifting device or laterally restrained…" Because the tip-over of the laterally supported stack-up configuration is ruled out, no accident analysis for this event is performed in the Holtec FSAR. Furthermore, the bases for the acceptability of the HI-STORM 100 dry cask storage system for such operations are the safeguards and devices "mandated" within the Holtec FSAR. Rather than providing lateral restraint to the stack-up configuration, the licensee chose to perform a calculation to show that the stack-up is dynamically stable during a seismic event. The NRC staff finds this change to be a substantial departure from the method of evaluation described in the Holtec FSAR that establishes the seismic design basis for the safety analysis of the stack-up configuration. The NRC staff also finds that this change creates the possibility for a tip-over of the stack-up configuration, which is an accident of a different type than previously evaluated in either the Perry FSAR or the Holtec FSAR.

The DSFST staff concluded that Perry should have: (1) provided a lateral restraint system in accordance with the FSAR; (2) requested the certificate holder seek a CoC amendment from the NRC for the HI-STORM 100 Cask System; or (3) requested an exemption from the NRC to allow operations without lateral restraint.

.1 <u>Control of Heavy Loads Design Basis Not Incorporated into Stack-up Configuration during MPC Transfer Operations</u>

A finding of very low safety-significance and associated Non-Cited Violation (NCV) of 10 CFR Part 72.146, "Design Control," was identified by the inspectors for the failure of the licensee to incorporate applicable regulatory requirements and the design basis into the seismic evaluation of the stack-up configuration during MPC transfer operations. Specifically, a dynamic stability determination of the stack-up during a postulated seismic event, in lieu of providing lateral restraints, does not meet design basis requirements as described in the Holtec HI-STORM 100 FSAR.

The inspectors determined that the failure to correctly translate the applicable design basis into specifications, drawings, procedures, and instructions for the control of the

stack-up configuration, was contrary to 10 CFR 72.146, “Design Control,” and warranted a significance evaluation.

Consistent with the guidance in Section 2.2 of the NRC Enforcement Policy, ISFSIs are not subject to the Significance Determination Process and, thus, traditional enforcement was used for this issue. The inspectors determined that the issue was of more than minor significance using Example 3i of Appendix E, “Examples of Minor Issues” of Inspection Manual Chapter 0612, “Power Reactor Inspection Reports.” Specifically, the licensee’s determination to not install lateral seismic restraint to the stack-up configuration created the possibility for an accident of a different type than any previously evaluated in the FSAR and that this configuration required additional accident analyses to be performed. The inspectors determined that the issue could be evaluated using example 6.1.d.2 of the NRC Enforcement Policy as a Severity Level IV violation because the licensee had not performed an MPC transfer operation and NRC intervention resulted in the licensee postponing their ISFSI campaign.

Title 10 CFR 72.146, “Design Control,” requires, in part, that the licensee, applicant for a license, certificate holder, and applicant for a CoC shall establish measures to ensure that applicable regulatory requirements and the design basis, as specified in the license or CoC application for those structures, systems, and components to which this section applies, are correctly translated into specifications, drawings, procedures and instructions. Further, it requires that the design control measures must provide for verifying or checking the adequacy of design methods such as design reviews, alternate or simplified calculation methods, or by a suitable testing program.

Contrary to the above, as of July 26, 2010, the licensee failed to establish measures to ensure that applicable regulatory requirements and the design basis, as specified in the license or CoC application for those structures, systems, and components to which this section applies, were correctly translated into specifications, drawings, procedures, and instructions. Specifically, calculation number G-58-P-001 failed to incorporate seismic restraint of the stack-up configuration during MPC transfer operations. A tip-over of the restrained configuration during a postulated seismic event is ruled out in the Holtec HI-STORM FSAR because of these mandated safeguards and devices. Because this issue is of very low safety-significance (Severity Level IV), and has been entered into the licensee’s corrective action program in condition report (CR) 10-84670, this violation is being treated as an NCV consistent with Section 2.3.2 of the NRC Enforcement Policy. (NCV 072-00069/11-002-01)

.2 Dynamic Stability Analysis Observations

As part of the Region III TAR, a sample of licensee dynamic stability calculations was submitted for staff technical review and staff guidance related to inspection of unrestrained vertical transfer operations. These comments are included in Attachment 2.

Although NRC staff identified potential technical issues during the review of calculations G58-P-001 and G58-H-HI-2084168, the issue of the licensee’s failure to provide lateral restraint to the stack-up configuration was evaluated above in Section 1.b.1. The licensee has entered the concern into their corrective action program as CR10-84670.

Final licensee corrective actions related to the stack-up will be subject to future NRC inspection.

.3 50.59/72.48 Safety Evaluation Observations

In NRC Regulatory Guide 1.187, "Guidance for Implementation of 10CFR 50.59 Changes, Tests and Experiments," dated November 2000, NRC staff endorsed Revision 1 of Nuclear Energy Institute (NEI) 96-07, "Guidelines for 10 CFR 50.59 Evaluations," for complying with the provisions of 10 CFR 50.59. Regulatory Guide 1.187 also states, in-part, that NEI 96-07 is also generally applicable to evaluations performed by licensees of ISFSIs or spent fuel storage cask design certificate holders for implementation of the revised 10 CFR 72.48.

Section 4.3.8 of NEI 96-07, "Does the Activity Result in a Departure from a Method of Evaluation Described in the USFAR Used in Establishing the Design Bases or in the Safety Analyses?'" guidance indicates, in-part, that another methodology previously accepted by the NRC through issuance of a safety evaluation report (SER) is not considered a departure from an evaluation described in the UFSAR. As noted in Section 1.b above, the only facility for which the NRC staff has reviewed and approved a stack-up configuration is the Private Fuel Storage Facility where lateral seismic restraints were provided.

NRC staff guidance to inspectors related to the unrestrained stack-up configuration, provided in Attachment 2, included in-part:

> For the inspection of a freestanding (unrestrained) stack-up configuration, the inspectors shall request the general licensee to provide the documentation approving the unrestrained stack-up configuration used to perform vertical transfer operations and the associated NRC staff SER. In the absence of such documentation vertical transfer operations shall be postponed until either documentation approving such operations can be provided or a system of lateral restraints has been installed.

Although NRC staff identified potential issues during the review of the licensee's 10 CFR 50.59 evaluation including the lack of a 10 CFR 72.48 evaluation, the issue of the licensee's failure to provide lateral restraint to the stack-up configuration was evaluated above in Section 1.b.1. The licensee has entered the concern into their corrective action program as CR10-84670. Final licensee corrective actions related to the stack-up will be subject to future NRC inspection.

c. Conclusion

The inspectors determined that the failure to correctly translate the applicable design basis into specifications, drawings, procedures, and instructions for the control of stack-up configuration, was contrary to 10 CFR 72.146, "Design Control." The NRC staff finds that not restraining the stack-up evolution is a substantial departure from the method of evaluation described in the Holtec FSAR that establishes the seismic design basis for the safety analysis of the stack-up configuration. NRC staff also finds that this change creates the possibility for a tip-over of the stack-up configuration, which is an accident of a different type than previously evaluated in either the Perry FSAR or the Holtec FSAR.

Based on these findings the licensee should have laterally restrained the stack-up, requested an exemption, or requested the certificate holder to seek an amendment. Because this matter was of very low safety-significance (Severity Level IV), and has been entered into the licensee's corrective action program CR10-84670, this violation is being treated as an NCV consistent with the NRC Enforcement Policy.

2.0 Exit Meeting Summary

On March 4, 2011, the inspectors presented the inspection results to Mr. V. Veglia and other members of the licensee staff via teleconference. The licensee acknowledged the issues presented. The inspectors confirmed that none of the potential report input discussed was considered proprietary.

ATTACHMENTS:
1. Supplemental Information
2. Response to Region III Technical Assistance Request, Evaluation of Freestanding Stack-up Configuration

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee

V. Veglia – Director, Fleet Project Management
R. Coad – Manager, Perry Regulatory Compliance
J. Fox – Manager, Fleet Project Management (Acting Dry Cask Storage Project Manager)
T. Hilston – Manager, Perry Design Engineering
T. Lentz – Manager, Fleet Licensing
N. Bonner – Dry Cask Storage Project
B. Spiesman – Fleet Licensing
S. Thomas – Perry Site Projects
L. Zerr – Perry Regulatory Compliance

INSPECTION PROCEDURES USED

IP 60854.1 Preoperational Testing of an Independent Spent Fuel Storage Facility (ISFSI) at Operating Plants

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

072-00069/11-002-01	NCV	Control of Heavy Loads Design Basis Not Incorporated into Stack-up Configuration during MPC Transfer Operations (Section 1.b.1)

Closed

072-00069/11-002-01	NCV	Control of Heavy Loads Design Basis Not Incorporated into Stack-up Configuration during MPC Transfer Operations (Section 1.b.1)

Discussed
None.

LIST OF DOCUMENTS REVIEWED

The following is a list of documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspectors reviewed the documents in their entirety, but rather, that selected sections of portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the inspection report.

10 CFR 50.59 Screen No. 10-3150; Perry Nuclear Power Plant Spent Fuel Dry Storage – Free Standing Stack Configurations; Revision 0 dated July 21, 2010

10 CFR 50.59 Evaluation No. 10-3150; Perry Nuclear Power Plant Spent Fuel Dry Storage – Free Standing Stack Configurations; Revision 0 dated July 23, 2010

Calculation G58-P-001; Seismic Stability Analysis of HI-TRAC/HI-STORM Stack-up; Revision 0 dated July 26, 2010

Calculation G58-H-HI-2084168; Dynamic Analysis of HI-TRAC/HI-STORM Stack Under Postulated Seismic Events in the Fuel Handling Building @ 620'-6" El.; Revision 0 dated July 22, 2010

Condition Report CR10-84670; NRC Issues Identified with 50.59 Evaluation of Dry Fuel Component Stackup in FHB; dated October 22, 2010

LIST OF ACRONYMS USED

ADAMS	Agencywide Document Access Management System
ASCE	American Society of Civil Engineers
CoC	Certificate of Compliance
CR	Condition Report
CFR	Code of Federal Regulations
CTF	Cask Transfer Facility
DNMS	Division of Nuclear Material Safety
DSFST	Division of Spent Fuel Storage and Transportation
FHB	Fuel handling Building
FSAR	Final Safety Analysis Report
IP	Inspection Procedure
ISFSI	Independent Spent Fuel Storage Installation
LAR	License Amendment Request
PARS	Publicly Available Records System
MPC	Multi-Purpose Canister
NCV	Non-Cited Violation
NMSS	NRC Office of Nuclear Material Safety and Safeguards
NRC	U.S. Nuclear Regulatory Commission
SAR	Safety Analysis Report
SER	Safety Evaluation Report
TAR	Technical Assistance Request

If you contest the subject or severity of this NCV, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Regional Administrator, U.S. Nuclear Regulatory Commission - Region III, 2443 Warrenville Road, Suite 210, Lisle, IL 60532-4352; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the Resident Inspector Office at the Perry Nuclear Power Plant.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter, its enclosures, and your response (if any), will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/readingrm/adams.html.

Sincerely,

/RA/

Christine A. Lipa, Chief
Materials Control, ISFSI, and
Decommissioning Branch
Division of Nuclear Materials Safety

Docket Nos.: 72-069 and 50-440
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Enclosure:
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Letter to Mr. Mark Bezilla from Christine A. Lipa, dated March 11, 2011.

SUBJECT: NRC INSPECTION REPORT NUMBERS 072-00069/11-02(DNMS); 050-00440/11-10 – DRY FUEL STORAGE STACK-UP OPERATIONS AT THE PERRY NUCLEAR POWER PLANT

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Response to Region III Technical Assistance Request
For FirstEnergy Operating Company
Perry Nuclear Power Plant, Unit 1
Evaluation of Freestanding Stack-up Configuration
DSFST Ticket Number: 201100002

Problem Statement:

The Certificate of Compliance (CoC) for Spent Fuel Storage Casks No. 1014, Amendment 5, Condition 5, for Heavy Loads Requirements, requires a plant-specific regulatory review be conducted to show operational compliance with the licensed facility at which a lift of a multi-purpose canister (MPC), transfer cask (HI-TRAC), or storage cask (HI-STORM) is conducted. Additional requirements for these lifting operations are located in the Holtec International HI-STORM 100 Cask System, Revision 7, Final Safety Analysis Report (Holtec FSAR, Reference 12) and Nuclear Regulatory Commission (NRC) NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants," dated July 1980.

FirstEnergy Nuclear Operating Company (the licensee), owner of the Perry Nuclear Power Plant, Unit 1 (Perry) (a general licensee), performed a Title 10 of the *Code of Federal Regulations* (CFR) Part 50.59 evaluation No. 10-03150, "Perry Nuclear Power Plant Spent Fuel Dry Storage-Freestanding Cask Configurations," to determine if the freestanding components used in a dry cask storage campaign would require a license amendment request (LAR). Licensee calculation number G58-P-001, "Seismic Stability Analysis of HI-TRAC/HI-STORM Stack-up," revision 0, (Reference 3) was used to demonstrate dynamic stability of free-standing components during vertical transfer operation of the MPC from a HI-TRAC to a HI-STORM while inside the fuel handling building. The calculation uses the methodology described in American Society of Civil Engineers (ASCE) Standard 43-05 (Reference 6), which was reviewed and evaluated in NRC NUREG/CR-6926 (Reference 8). The NRC regional inspectors (inspectors) believe that this methodology requires a LAR and that NUREG/CR-6926 requires an NRC staff review for use of ASCE Standard 43-05. Additionally, the inspectors cannot determine if the requirements of the Holtec FSAR and NUREG-0612 are satisfied.

This Technical Assistance Request (Reference 1) requests: (1) the DSFST staff to review the 10 CFR 50.59 screen and evaluation to determine whether the licensee is within their licensing basis; (2) a technical review and acceptability of Calculation No. G58-P-001; (3) guidance for inspection of unrestrained vertical transfer operations; and (4) an evaluation of the need for guidance to the licensees on acceptable methods of evaluating vertical transfer operations.

Action Requested and Summary of Response

For assistance in resolution of the concerns identified above, Region III is requesting a review of the licensee's 10 CFR 50.59 screen and evaluation to determine whether the licensee is within their licensing basis, as well as a technical review and acceptability of Calculation No. G58-P-001. The specific questions/concerns are as follows:

1) Is the licensee's analysis within their licensing and design basis for 10 CFR Part 50 requirements, or is a LAR needed?

No. The CoC holder must request an amendment, or the general licensee must request an exemption.

2) Is the licensee's analysis within their licensing and design basis for 10 CFR Part 72 requirements, or is a LAR needed?

   No. The CoC holder must request an amendment, or the general licensee must request an exemption.

3) Does the licensee's methodology comply with the Holtec FSAR subsection 3.1.2.1.1.1 and the intent of NUREG-0612 or is an LAR needed?

   No. The CoC holder must request an amendment, or the general licensee must request an exemption.

4) If a LAR is not required, then:

   a) Is the methodology and assumptions used in the analysis of the free standing transfer operations adequate based on ASCE 43-05 and NUREG/CR-6926?

   b) Please provide guidance and the acceptance criteria for inspection of unrestrained vertical transfer operations, as well as movement operations of the HI-STORM and HI-TRAC in and out of the building on a Zero Profile Transporter.

5) Regarding the HI-STORM 100 Cask System, please evaluate the need for generic guidance to licensees on acceptable methods and acceptance criteria for evaluating vertical transfer operations.

   In future amendment or exemption requests submitted by CoC holders or licensees to justify alternative approaches to laterally restraining the HI-TRAC during MPC transfer operations in a stack-up configuration, the NRC staff expects the licensee will provide calculations demonstrating that the stack-up configuration is dynamically stable during a seismic event. While the NRC staff cannot speculate on what the content and rigor of these calculations may be, the staff has offered some guidance to licensees on acceptable methods and acceptance criterion by providing general comments on the two calculations that were submitted by the licensee.

NRC Staff Evaluation of the Licensee's 10 CFR 50.59 Screen and Evaluation for the Stack-up Configuration

NUREG-0612 provides guidelines for the control of heavy loads at nuclear power plants. The guidelines were developed "for all facilities to reduce the potential for the uncontrolled movement of a load or load drop…" NUREG-0612, p. 1-4. NUREG-0612 further states that "the NRC staff has developed an overall philosophy that provides a defense-in-depth approach for controlling the handling of heavy loads." (Emphasis added). NUREG-0612, p. 5-1. The NUREG provides two paths to achieve defense-in-depth: (1) by providing redundancy (i.e., a single-failure-proof handling system) in the handling of the heavy load or (2) by providing an analysis of the heavy load drop to show that the evaluation criteria of Section 5.1 of NUREG-0612 are satisfied. If the licensee chooses not to provide redundancy, then even though the licensee may have performed a calculation demonstrating that there is sufficient safety margin such that a load drop is unlikely to occur, the licensee should provide an analysis of the consequences of the heavy load drop to show that the evaluation criteria of Section 5.1 are satisfied.

The "stack-up" of a HI-TRAC transfer cask on top of a HI-STORM storage cask was an unknown load handling procedure when NUREG-0612 was issued in July 1980. Never-the-less, NUREG-0612 indicates that it reflects "an overall philosophy that provides a defense-in-depth approach for controlling the handling of heavy loads."

The Holtec FSAR (Reference 12) recognizes a defense-in-depth approach. Holtec FSAR Section 3.1.2.1.1.1 "Tip-Over" states the following:

> " The potential of the HI-STORM 100 Overpack tipping over during the lowering (or raising) of the loaded MPC into (or out of) it with the HI-TRAC cask mounted on it is ruled out <u>because of the safeguards and devices mandated by this FSAR for such operations</u> (Subsection 2.3.3.1 and Technical Specification 4.9)." (Emphasis added). FSAR p. 3.1-9.
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> "Subsection 2.3.3.1 contains a comprehensive set of design criteria for the ancillary equipment and components required for the MPC transfer operations to ensure that the design objective of precluding a kinematic instability event during MPC transfer operations is met." FSAR p.3.1-9.

Holtec FSAR, Section 2.3.3.1 "Equipment" states in part the following:

> "Users may effectuate the inter-cask transfer of the MPC between the HI-TRAC transfer cask and either the HI-STORM 100 or the HI-STAR 100 overpack in a location of their choice, depending on site-specific needs and capabilities. For those users choosing to perform the MPC inter-cask transfer using devices not integral to structures governed by the regulations of 10 CFR Part 50 (e.g., fuel handling or reactor building), a Cask Transfer Facility (CTF) is required." FSAR p. 2.3-4.
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> "The detailed design criteria which must be followed for the design and operation of the CTF are set down in Paragraphs A through R . . . " FSAR p. 2.3-5.

Holtec FSAR Paragraph A "General Specifications" subparagraph (iii) "Definitions" states that:

> ". . . The CTF structure is the stationary, anchored portion of the CTF which provides the required structural function to support MPC transfer operations, <u>including lateral stabilization of the HI-TRAC transfer cask</u> and, if required, the overpack, to protect against seismic events." (Emphasis added). FSAR p. 2.3-7.

Holtec FSAR Paragraph C "Heavy Load Handling" subparagraph (iii) "Defense-in-Depth" states that:

> "When the HI-TRAC transfer cask is stacked on the overpack, <u>HI-TRAC shall be either held by the lifting device or laterally restrained</u> by the CTF structure." (Emphasis added). FSAR p. 2.3-12.

Holtec FSAR Section 3.1.2.1.1.1 makes it clear that tip-over of the stack-up configuration is ruled out because of the safeguards and devices mandated by the Holtec FSAR in Section 2.3.3.1, which contains design criteria for the devices required to ensure that kinematic instability (tip-over) will not occur. In structures governed by the regulations of 10 CFR 50, such as the Perry Fuel Handling Building (FHB), where the functional requirements of the CTF can be

met by integrally attaching these devices to the building's walls, columns and floor to provide lateral restraint, a separate CTF is not required. The only facility for which the NRC staff has reviewed and approved a stack-up configuration is the Private Fuel Storage Facility where lateral seismic restraints were provided (Reference 10).

Holtec FSAR Section 2.3.3.1 establishes the design basis for the safety analysis of the stack-up configuration, which is that "the HI-TRAC shall be either held by the lifting device or laterally restrained." FSAR p. 2.3-12. Because of these requirements specified by the FSAR a tip-over of the stacked-up components is ruled out, and therefore an accident analysis for tip-over of the stack-up configuration is not required.

Regulatory Requirements

10 CFR 72.212(b)(3) states in part that "The general licensee shall: Review the Safety Analysis Report (SAR) referenced in the Certificate of Compliance ..., prior to use of the general license, to determine whether or not the reactor site parameters, ..., are enveloped by the cask design bases considered in these reports."

10 CFR 50.59(c)(2) states in part the following: "A licensee shall obtain a license amendment pursuant to §50.90 prior to implementing a proposed change, test, or experiment, if the change, test, or experiment would: ... (v) Create a possibility for an accident of a different type than any previously evaluated in the final safety analysis report; ... or (viii) Result in a departure from a method of evaluation described in the FSAR used in establishing the design basis or in the safety analyses."

10 CFR 72.48(c)(2) states in part the following "… a general licensee shall request that the certificate holder obtain a CoC amendment pursuant to §72.244, prior to implementing a proposed change, ... if the change … would: … (c)(2)(v) create a possibility for an accident of a different type than any previously evaluated in the FSAR; … or (viii) Result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design basis or in the safety analyses."

The licensee's 10 CFR 50.59 evaluation of the stack-up configuration does not address the design basis for the safety analysis of the stack-up configuration found in Subsection 2.3.3.1 of the Holtec FSAR, which 10 CFR 72.212 requires the licensee to review. Instead of laterally restraining the HI-TRAC when it is not held by the lifting device, as mandated by the Holtec FSAR, the licensee performed a calculation (Reference 3) to demonstrate that the stack-up configuration is dynamically stable. This is a departure from the seismic design basis for the safety analysis of the stack-up configuration, and creates the possibility for an accident not previously evaluated in the Perry FSAR. The licensee did not perform a 10 CFR 72.48 evaluation.

Because the HI-TRAC is required by the FSAR to be laterally restrained when not held by the lifting device, no accident analysis for the tip-over of the stack-up configuration was performed in the Holtec FSAR. Therefore, not providing lateral restraints is not only a departure from a method of evaluation described in the Holtec FSAR, it also creates a possibility for an accident not previously evaluated in the Holtec FSAR. A 10 CFR 72.48 evaluation, had it been performed, would require the general licensee to request the CoC holder to obtain a CoC amendment (i.e., LAR) or would require the general licensee to request an exemption..

For the inspection of a freestanding (unrestrained) stack-up configuration, the inspectors shall request the general licensee to provide the documentation approving the unrestrained stack-up configuration used to perform vertical transfer operations and the associated NRC staff SER. In the absence of such documentation vertical transfer operations shall be postponed until either documentation approving such operations can be provided or a system of lateral restraints has been installed. When a lateral restraint system has been provided, the inspectors should review the seismic analysis calculations to ensure the structural adequacy of the lateral restraint design.

Finding 1:

The Holtec FSAR adheres to the defense-in-depth philosophy of NUREG-0612 for the control and handling of the stack-up configuration. As stated in the Holtec FSAR "tipping over during the lowering of the loaded MPC … is ruled out because of the safeguards and devices mandated by this FSAR for such operations." The safeguards mandated by the FSAR are that "the HI-TRAC shall be either held by the lifting device or laterally restrained …" Because the tip-over of the laterally supported stack-up configuration is ruled out, no accident analysis for this event is performed in the Holtec FSAR. Furthermore, the bases for the acceptability of the HI-STORM 100 dry cask storage system for such operations are the safeguards and devices "mandated" within the Holtec FSAR.

Contrary to the above, instead of choosing to provide lateral restraint to the stack-up configuration, the licensee chose to perform a calculation to show that the stack-up is dynamically stable during a seismic event. The NRC staff finds this change to be a substantial departure from the method of evaluation described in the Holtec FSAR that establishes the seismic design basis for the safety analysis of the stack-up configuration. The NRC staff also finds that this change creates the possibility for a tip-over of the stack-up configuration, which is an accident of a different type than previously evaluated in either the Perry FSAR or the Holtec FSAR. Therefore, the NRC staff concludes that this change requires a LAR in the form of a CoC amendment or a request for an exemption.

NRC Staff Evaluation of the Licensee's Calculations for the Stack-up Configuration

In future LARs submitted by licensees to justify alternative approaches to laterally restraining the HI-TRAC during MPC transfer operations in a stack-up configuration, the NRC staff expects the licensee will provide calculations demonstrating that the stack-up configuration is dynamically stable during a seismic event. While the NRC staff cannot speculate on what the content and rigor of these calculations may be, the staff can offer some general comments on the two calculations that were submitted by the licensee. These comments are intended to provide guidance to licensees on acceptable methods for evaluating vertical transfer operations. The "stack-up configuration" only refers to the operational condition where the HI-TRAC cask, loaded with the MPC, rests atop the HI-STORM overpack.

Comments on calculation, G58-P-001

Calculation G58-P-001 (Reference 3) uses a simplified analysis method from ASCE Standard 43-05, Appendix A to determine best estimate margins of safety against overturning of the stack-up configuration. The ASCE Standard 43-05 was reviewed in NUREG/CR-6926. The acceptability of the simplified rocking and sliding methodology provided in ASCE Standard 43-

05, Appendix A of the as described in NUREG/CR-6926, is summarized in the following paragraph.

Section 7.1 of ASCE Standard 43-05 indicates that it is generally preferable to anchor components so as to prevent rocking and sliding. However, ASCE Standard 43-05 does permit rocking and sliding of unanchored rigid bodies, and provides procedures for such analyses in Section 7.1 and Appendix A. It notes that with rare exceptions, the NRC regulatory guidance documents do not permit unanchored safety-related components at nuclear power plants. NRC NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," does not discuss simplified analytical methods for calculating rocking and sliding comparable to those in the ASCE Standard 43-05. Therefore, this is an area that warrants further detailed review if the methods in Section 7.1 and Appendix A of ASCE Standard 43-05 are to be used, and the application of such methods should be reviewed on a case-by-case basis.

The NRC staff agrees with this assessment, and has the following additional comments as related to the analysis of the stack-up configuration using the ASCE Standard 43-05 methodology. These comments do not constitute a safety evaluation.

Comment 1: The mating device or other structural components that secure the HI-TRAC cask atop the HI-STORM overpack shall be demonstrated to produce a rigid connection between the HI-TRAC and HI-STORM to ensure that the stack-up configuration behaves as a single rigid body in response to input ground motion. Such a demonstration is expected to require a detailed finite element analysis of the components joining the cask and overpack.

Comment 2: The inertial impact effects of the MPC sliding or tipping inside the HI-TRAC shall be evaluated and incorporated into the analysis.

Comment 3: The effects on seismic response of the flexibility of the surface upon which the HI-STORM rests, and how these effects relate to the assumptions of a rigid body sliding or rocking on a nearly rigid surface, shall be thoroughly described and investigated. When these effects are found to be significant, the approximate methods in Appendix A of ASCE Standard 43-05, shall not be used.

Comment 4: The approximate methodology for determining the rocking stability of a rigid body subjected to input ground motion is a median centered analysis technique, and provides a "best estimate" result. This implies a 50^{th} percentile confidence limit for the calculated rocking angle. To this best estimate rocking angle the ASCE Standard applies a safety factor of 2.0, and the final result is required to be less than the instability angle. Because no uncertainty is considered in the analysis, the NRC staff finds that a safety factor of 2.0 may not be sufficiently large enough to achieve high confidence in the results.

Comments on calculation, G58-H-HI-2084168

Calculation G58-H-HI-2084168, 'Dynamic Analysis of Hi-TRAC/Hi-STORM Stack Under Postulated Seismic Events in the Fuel Handling Building @620'-6 EL" (Reference 4) provides a seismic analysis for the stack-up configuration in which the interface between the mating device and the HI-TRAC are bolted and the interface between the mating device and the HI-STORM is

not bolted (i.e., free to slide and lift off). This calculation is an example of a non-linear time-history analysis method for the evaluation of the stack-up configuration.

Comment 1: The three directional time-histories used in the non-linear analysis of the stack-up configuration were developed to envelop the floor response spectra at elevation 620'-6" of the FHB. The non-linear analysis was performed using a single set of time-histories. The use of a single set of time-histories to perform a non-linear seismic analysis does not comply with guidance issued by the NRC and National Standards Organizations. For example:

NRC NUREG-0800 states the following in Section 3.7.1:

> "For nonlinear structural analysis problems, multiple sets of ground motion time histories should be used to represent the design ground motion. Each set of ground motion time-histories shall be selected from real recorded ground motions appropriate for the characteristic low and high frequency events. The amplitude of these ground motions may be scaled but the phasing of Fourier components must be maintained. The adequacy of this set of ground motions, including duration estimates, is reviewed on a case-by-case basis."

ASCE Standard 4-98 (Reference 9) states the following in Section 3.2.2.3(d) Nonlinear Methods:

> "In general, more than one set of acceleration time-histories, meeting the requirements of Section 2.3, should be used …" p.23.

ASCE Standard 43-05 states the following in Section 7.1, Rocking and Sliding of Unanchored Rigid Bodies:

> 'When time-history analysis is used, a minimum of five different time-histories that satisfy the requirements of Section 2.4 shall be used." p. 23.

In NUREG/CR-6865 a parametric evaluation of the seismic behavior of freestanding dry storage casks was performed by Sandia National Laboratories. The authors conclude:

> "It is increasingly obvious that a suite of earthquake inputs should be examined in order to obtain statistically stable mean and standard variation in the response to form the basis for design decision. This would require multiple runs using several earthquake records." p. 31. "Once the cask begins to move relative to the pad, the response becomes highly nonlinear and highly dependent on the phasing of the ground motion with respect to the phasing of the cask response." p. 60.

The NRC staff finds the use of a single set of time-histories to perform a nonlinear seismic analysis to be unacceptable.

Comment 2: ASCE Standard 43-05 states the following in Section C7.1, Rocking and Sliding of Unanchored Bodies:

> "Considerable uncertainty exists in the coefficient of sliding friction between an unanchored body and its sliding surface ... In order to account for this uncertainty, coefficient of friction values at the estimated 95% and 5% exceedance fractiles should

be estimated and used in sliding and rocking evaluations, respectively. A range of coefficients for sliding friction from 0.3 to 0.7 is considered to be reasonable for sliding of a concrete or steel rigid body on a dry, broom finished concrete surface." p.71.

In evaluating the sliding and rocking response of dry casks on an Independent Spent Fuel Storage Installation pad, NUREG/CR-6865 uses a range of coefficients from 0.2 to 0.8.

In calculation G58-H-HI-2084168, the coefficient of friction between the HI-TRAC and HI-STORM uses only a single value of 0.5, and no variability is considered. The coefficient of friction between the HI-STORM and the floor ranges from 0.2 to 0.53.

The ranges of the coefficients of friction considered in the calculation are unacceptable.

Comment 3: Licensees should provide a high level of transparency in the analysis calculations so that the staff can efficiently review in detail the input and output files of the stack-up model to investigate assumptions, material properties, contact, damping, geometry, boundary conditions, response animation, etc., to be assured of the reasonableness of the results. Such transparency is provided by finite element programs such as ANSYS and LS-DYNA. Analyses submitted using programs, such as Visual Nastran, which are far less transparent, will require the staff to perform independent finite element analyses to verify the acceptability of the results that may lead to an extended period of review.

Comment 4: For stack-up rocking analyses, the rigid body coefficient of restitution (COR) shall be based on Reference B-9 in ASCE Standard 43-05. Higher values of COR can be used, if justified, and supported by sensitivity studies to evaluate the uncertainty in COR on stack-up response.

Comment 5: The effects on seismic response of the flexibility of the surface upon which the HI-STORM rests shall be thoroughly described, investigated, and if need be, incorporated into the analysis.

The two analysis methods presented in calculations G58-P-001 and G58-H-HI-2084168, for which the NRC staff has provided comments, when properly implemented provide results that demonstrate that a tip-over of the stack-up configuration is unlikely to occur during a seismic event. By themselves, however, they do not provide the defense-in-depth necessary to safely implement a program for the control and handling of heavy loads in a stack-up configuration. To establish defense-in-depth the licensee must provide an accident analysis of the consequences of a stack-up tip-over to show that the evaluation criteria of Section 5.1, Recommended Guidelines, of NUREG-0612 are satisfied.

Finding 2:

When lateral restraint is not provided to the HI-TRAC cask when it is not held by the lifting device in a stack-up configuration, an analysis acceptable to the staff shall be provided demonstrating that the stack-up configuration is dynamically stable during a seismic event. In addition, the licensee must provide for defense-in-depth consistent with the requirements for the control of heavy loads. Defense-in-depth shall be demonstrated by performing an accident

analysis of the consequences of a stack-up tip-over to show that the evaluation criteria of Section 5.1, Recommended Guidelines, of NUREG-0612 are satisfied.

References

1. Region III Technical Assistance Request, dated October 29, 2010, Package Accession No. ML103010389.
2. 10 CFR 50.59 Screen and Evaluation No.:10-03150, “Perry Nuclear Power Plant Spent Fuel Dry Storage-Freestanding Cask Configurations,” (ML103010390)
3. PNPP Calculation No. G58-P-001, Rev. 0 (Holtec International Report No. 2084168, Rev. 1), "Seismic Stability Analysis of HI-TRAC/HI-STORM Stack-up," dated July 9, 2010. (ML103010416)
4. Calculation No. G58-H-HI-2084168, "Dynamic Analysis of HI-TRAC/HI-STORM Stack Under Postulated Seismic Events in the Fuel Handling Building @620’-6 EL," dated July 22, 2010. (ML103010405)
5. NUREG-0612, "Control of Heavy loads at Nuclear Power Plants, Resolution of Generic Technical Activity A-36" dated July 1980.
6. ASCE Standard 43-05, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities," American Society of Civil Engineers, 2005.
7. NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” 2007.
8. NUREG/CR-6926, "Evaluation of the Seismic Design Criteria in ASCE/SEI Standard 43-05 for Application to Nuclear Power Plants," March 2007.
9. ASCE Standard 4-98, "Seismic Analysis of Safety-related Nuclear Structures and Commentary," American Society of Civil Engineers, 1998.
10. "Consolidated Safety Analysis Report Concerning the Private Fuel Storage Facility," March 2002, Docket No. 72-22.
11. Certificate of Compliance for Spent Fuel Storage Casks No. 1014, Amendment 5, issued to Holtec International, Docket No. 72-1014, July 14, 2008.
12. Holtec International HI-STORM 100 Cask System, Final Safety Analysis Report (FSAR), Revision 7, Docket No. 72-1014. (ML082401614)

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