UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 E. LAMAR BLVD
ARLINGTON TX 76011-4511

August 24, 2018

Mr. Thomas J. Palmisano
Vice President and Chief Nuclear Officer
Southern California Edison Company
San Onofre Nuclear Generating Station (SONGS)
P.O. Box 128
San Clemente, CA 92674-012

SUBJECT: SAN ONOFRE NUCLEAR GENERATING STATION – NRC INSPECTION REPORT 05000206/2017-003, 05000361/2017-003, 05000362/2017-003, AND 07200041/2017-001

Dear Mr. Palmisano:

This letter refers to routine U.S. Nuclear Regulatory Commission (NRC) team inspections conducted from June 2017 through June 2018. The purpose of the inspection was to observe your dry fuel storage preoperational testing activities, to independently assess your readiness to load spent fuel into the newly constructed UMAX Independent Spent Fuel Storage Installation (ISFSI), and to inspect initial fuel loading operations. The initial loading of the spent fuel into the first dry fuel storage cask of your UMAX ISFSI occurred between January 22-31, 2018. After continued in-office review of information following the loading of the first canister into the UMAX ISFSI, a final telephonic exit meeting was conducted on August 8, 2018, with Mr. Lou Bosch, Plant Manager, and other members of your staff.

The NRC inspection team examined activities conducted under your license as they relate to public health and safety, and to confirm compliance with the Commission's rules and regulations, and with the conditions of your license. The inspection reviewed compliance with the requirements specified in the Holtec HI-STORM UMAX storage system's Certificate of Compliance 72-1040, the associated Technical Specifications, the FW and UMAX Final Safety Analysis Reports, and the regulations in Title 10 of the *Code of Federal Regulations* (CFR) Parts 20, 50, and 72. Within these areas, the inspection consisted of selected examination of procedures and representative records, observations of activities, and interviews with personnel. The inspection determined that you had completed all required activities identified in the Holtec Certificate of Compliance 72-1040 for use of the Holtec HI-STORM UMAX storage system at your site.

Based on the results of these inspections, the NRC has determined that one Severity Level IV violation of NRC requirements occurred. The violation was related to the design control of field changes made to important to safety equipment associated with your loading activities. Because the violation was of low safety significance and the licensee initiated a condition report with appropriate resolutions to address and correct the issue, this violation is being treated as a Noncited Violation (NCV), consistent with Section 2.3.2 of the NRC Enforcement Policy. The NCV is described in the subject inspection report.

Additionally, the NRC opened an Unresolved Item (URI) related to the methodology utilized in the licensee's 10 CFR 72.48 evaluation regarding a hypothetical transfer cask drop within the spent fuel pool during a seismic event. Additional information is needed to determine if the change could be performed through the 10 CFR 72.48 process. The URI is described in the subject inspection report.

If you contest the violation or significance of the NCV, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington DC 20555-0001, with copies to: (1) the Regional Administrator, Region IV and (2) the Director, Office of Enforcement, United States Nuclear Regulatory Commission, Washington, DC 20555-0001.

In accordance with 10 CFR 2.390 of the NRC's "Agency Rules of Practice and Procedure," a copy of this letter, its enclosure, and your response, if you choose to provide one, 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, accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html. To the extent possible, your response should not include any personal, privacy, or proprietary information so that it can be made available to the public without redaction.

Should you have any questions concerning this inspection, please contact the undersigned at (817) 200-1151 or Mr. Lee Brookhart at (817) 200-1549.

Sincerely,

/RA/

Janine F. Katanic, PhD, CHP, Chief
Fuel Cycle and Decommissioning Branch
Division of Nuclear Materials Safety

Dockets: 50-206; 50-361; 50-362; 72-041
Licenses: DPR-12; NPF-10; NPF-15

Enclosure:
Inspection Report 05000206/2017003, 05000361/2017003, 05000362/2017003, and 07200041/2017001

w/attachments:
Supplemental Information

U.S. NUCLEAR REGULATORY COMMISSION
REGION IV

Dockets:	05000206; 05000361; 05000362; 07200041
Licenses:	DPR-13; NPF-10; NPF-15
Report Nos.:	05000206/2017-003; 05000361/2017-003; 05000362/2017-003; 07200041/2017-001
Licensee:	Southern California Edison Company (SCE)
Facility:	San Onofre Nuclear Generating Station, Units 1, 2, 3 and Independent Spent Fuel Storage Installation
Location:	5000 South Pacific Coast Highway, San Clemente, California
Inspection Dates:	June 26-30, 2017, Welding Dry Run Demonstration August 1-3, 2017, Fluid Operations Dry Run Demonstration September 25-28, 2017, Transporter Heavy Loads Demonstration October 9-13, 2017, Programs Review December 4-7, 2017, Fuel Building Heavy Loads Demonstration January 22-31, 2018, First Canister Loading Operation
Inspectors:	Lee Brookhart, Senior Inspector Fuel Cycle and Decommissioning Branch Eric Simpson, Inspector Fuel Cycle and Decommissioning Branch Marlone Davis, Senior Transportation and Safety Inspector Inspections and Operations Branch NMSS, Division of Spent Fuel Management Earl Love, Senior Transportation and Safety Inspector Inspections and Operations Branch NMSS, Division of Spent Fuel Management
Approved By:	Janine F. Katanic, PhD, CHP, Chief Fuel Cycle and Decommissioning Branch Division of Nuclear Materials Safety

Enclosure

EXECUTIVE SUMMARY

San Onofre Nuclear Generating Station, Units 1, 2, 3, and ISFSI
NRC Inspection Report 05000206/2017003; 05000361/2017003; 05000362/2017003; 07200041/2017001

Between June 2017 and January 2018, the NRC conducted six separate on-site inspections related to the San Onofre Nuclear Generating Station's (SONGS) program for the safe handling and storage of spent fuel at their UMAX Independent Spent Fuel Storage Installation (ISFSI). The inspection teams observed five dry run pre-operational training demonstrations and the loading of the first spent fuel canister for the Holtec UMAX cask system. The licensee selected the Holtec Certificate of Compliance No. 72-1040, HI-STORM UMAX cask storage system to house the remaining fuel from Units 2 and 3 after the decision was made to cease power operations. The ISFSI was licensed by the NRC under the general license provisions of Title 10 *Code of Federal Regulations* (CFR) Part 72, Subpart K.

Topical areas reviewed during the inspections included overhead crane requirements, loading operations, fuel verification, radiation protection, quality assurance, nondestructive testing, training, welding, and fire protection. Between the site dry run inspections and continuing after the first loading inspection, an in-office review was performed by the NRC inspectors relating to additional documentation provided by the SONGS staff. This effort involved the review of licensee reports, procedures, calculations, training documentation, test results, personnel qualification records, safety evaluations, and condition reports. During the dry run inspections, the licensee completed the pre-operational demonstrations of equipment and the implementation of the procedures to verify all operations required by the conditions of the license and the technical specifications could be performed safely. The first cask was placed within the SONGS UMAX ISFSI on January 31, 2018.

Preoperational Testing of an ISFSI (60854)

- Forced helium dehydration dryness limits, helium purity, and helium backfill requirements had been incorporated into the licensee's procedures. Operation of the forced helium dehydration system and backfill to the required dryness limits was demonstrated during the pre-operational dry run exercises and first loading activities. (Section 1.2.a)

- The cask loading cranes used in the spent fuel handling buildings to lift the spent fuel canisters had been previously accepted by the NRC as single failure proof cranes. The cranes were designed to retain control of and hold loads during design basis seismic events at the SONGS site. Calculations were reviewed by NRC's Division of Spent Fuel Management that demonstrated that the forces from a seismic event in the upward and horizontal directions would not exceed the strength of the crane's seismic restraints. Additional seismic evaluations were reviewed to ensure seismic stability during transfer operations. This review included the transfer cask (loaded with a canister) in the spent fuel building during decontamination and closure operations, on the low profile transporter, on the vertical cask transporter, and during transfer of the canister into the UMAX ISFSI. Based on the review of the design documents and calculations, the Division of Spent Fuel Management's staff concluded that there was reasonable assurance that the cranes and other handling/restraining equipment were structurally adequate to withstand design basis earthquake loads during fuel loading operations. (Section 1.2.b)

- The 125-ton spent fuel building cranes were subjected to daily prior-to-use inspections that satisfied the requirements of American Society of Mechanical Engineers (ASME) B30.2, "Overhead and Gantry Cranes". On an annual basis the cranes were subjected to a more rigorous inspection that met the requirements of ASME B30.2 and the Ederer Generic Licensing Topical Report EDR-I(P) "Ederer's Nuclear Safety Related Extra Safety and Monitoring Cranes," Revision 3. (Section 1.2.c)

- The 125-ton spent fuel building cranes were properly load tested, as required by ASME B30.2, in the fall of 2017. The tests included a full performance test with 100 percent of the maximum critical load and a 125 percent static load test. The cranes' hooks were subjected to a 200 percent hook load test in 2003 by Ederer Inc. (Section 1.2.d)

- The NRC inspectors observed the licensee successfully complete all the required pre-operational tests specified in the Certificate of Compliance. This included fuel assembly selection, welding, nondestructive testing, drying, helium backfilling, and the unloading of a sealed canister. A weighted canister was used to demonstrate heavy load activities inside the fuel handling building, transport between the fuel handling building and the ISFSI, and movement back into the fuel handling building for unloading purposes. (Section 1.2.e)

- The licensee's fuel loading characterization plan met the Certificate of Compliance limits for length, width, weight, irradiation cooling time, average burn-up, cladding, decay heat, and fuel enrichment. The licensee had established provisions for independent verification of the correct loading of spent fuel assemblies into the canister. (Section 1.2.f)

- The licensee had incorporated the requirements related to heavy loads for lift height limits, travel paths, and temperature restrictions during movement of the transfer cask into its procedures. The site's vertical cask transporters were load tested and maintained in accordance with NUREG-0612 criteria. (Section 1.2.g)

- The requirements for nondestructive testing of a spent fuel canister were incorporated into the licensee's procedures. The helium leak testing equipment used during the dry run demonstration and first loading was verified to meet the requirements listed in the technical specifications. The visual and liquid dye penetrant examination procedures implemented all the applicable requirements from ASME Boiler and Pressure Vessel Code Section III, Section IV, and the Final Safety Analysis Report regarding nondestructive examination of welds. (Section 1.2.h)

- The requirements for canister hydrostatic testing had been incorporated into the licensee's procedures and were consistent with the requirements of ASME Boiler and Pressure Vessel Code Section III Subsection NB, Article NB-6000. The hydrostatic testing sequence and criteria described in the Final Safety Analysis Report had been incorporated into the licensee's procedures. (Section 1.2.i)

- The licensee's special lifting device program complied with American National Standard Institute (ANSI) N14.6, "Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds or More," (1993) criteria for stress design, annual inspections, and 300 percent proof loadings for the MPC lift cleats, HI-TRAC lift lugs, HI-TRAC lift links, lift yokes, and the lift yoke extensions. (Section 1.2.j)

- The licensee had established procedures and work orders to perform the required daily monitoring surveillances required by the technical specifications, monthly vent inspections for damage, and monthly/annual/five year inspections of the ISFSI and Vertical Ventilated Module per Final Safety Analysis Report requirements. (Section 1.2.k)

- All welding procedures contained the required variables specified in ASME Boiler and Pressure Vessel Code Section IX for gas tungsten arc welding. Requirements for hydrogen monitoring during welding of the inner cask lid had been incorporated into the procedures. The welders had met the qualification testing requirements for manual and machine welding of the canister lid. (Section 1.2.l)

Operations of an ISFSI (60855)

- The first loading inspection conducted in January 2018 included 24-hour observation of loading operations for the critical tasks associated with the licensee's first UMAX loading. Inspectors observed operations which included fuel loading, heavy lifts associated with the fuel building crane, welding and nondestructive testing of the canister lid-to-shell weld, hydrostatic pressure testing, forced helium dehydration, helium backfill, vent/drain port cover welding and nondestructive testing, helium leak testing, radiological surveying, and transport of the loaded transfer cask to the UMAX ISFSI pad. (Section 2.2.a)

- During the first loading operations, the NRC inspectors identified one violation of 10 CFR 72.146 (c), "Design Control," requirements. The licensee had made modifications to Important to Safety components associated with the transfer cask seismic restraint system through the vendor's (Holtec) corrective action program and did not follow the SONGS Engineering Design Change Process. The licensee failed to ensure that design changes or field changes to Important to Safety components were subjected to design control measures commensurate with those applied to the original design. The original documentation for the changes did not contain a rigorous engineering analysis that demonstrated the changes were acceptable and those changes were not properly accepted for implementation through the Licensee's 10 CFR 50.59/72.48 program. This violation was determined to have a low safety significance since all the deviations or modifications from the original design were subsequently found to be acceptable and the changes did not affect the specific components' safety design function or bases. Because the licensee entered the issue into their corrective action program, the safety significance of the issue was low, the licensee restored compliance, and the issue was not found to be repetitive or willful, this Severity Level IV violation was treated as a Noncited Violation, consistent with the NRC Enforcement Policy. (Section 2.2.b)

Review of 10 CFR 72.212(b) Evaluations (60856)

- Emergency planning provisions for the UMAX ISFSI had been incorporated into the site's emergency plan. This included adding a specific emergency action level for an event involving damage to a loaded UMAX casks. (Section 3.2.a)

- A fire and explosion hazards analysis had been performed specific to the SONGS UMAX ISFSI. Administrative controls were established to limit the quantity of combustible and flammable liquids around the ISFSI and near the transport path during movement of the canister. The licensee provided calculations demonstrating that the worst case postulated fire event during transportation would not result in a significant increase in the temperature of the spent fuel inside a loaded canister. (Section 3.2.b)

- The licensee evaluated the bounding environmental conditions specified in the Holtec Final Safety Analysis Report and Certificate of Compliance 72-1040 Technical Specifications against actual site conditions. These included: tornados/high winds, flood, seismic events, tsunamis, hurricanes, lightning, burial of the ISFSI under debris, normal and abnormal temperatures, collapse of nearby facilities, and fires/explosions. The site environmental conditions at SONGS were bounded by the Holtec storage system's design parameters. (Section 3.2.c)

- The licensee had implemented its approved reactor facility 10 CFR Part 50 quality assurance program and corrective action program for the activities associated with the UMAX ISFSI. Selected quality assurance activities were reviewed related to calibrations, audits, surveillances, and receipt inspections. (Section 3.2.d)

- The licensee had incorporated keeping radiation exposures As Low as Reasonably Achievable into planning for the cask loading program. Requirements for radiation surveys described in the Final Safety Analysis Report and technical specifications had been incorporated into the licensee's procedures for cask loading operations. Projected radiation levels at the ISFSI were calculated for an assumed individual located at the owner controlled area boundary. The analysis demonstrated the dose to this individual would meet the requirements of 10 CFR 72.104. (Section 3.2.e)

- The licensee was maintaining 10 CFR Part 72 records in their quality related records system. (Section 3.2.f)

Review of 10 CFR 72.48 Evaluations (60857)

- Safety screenings had been performed in accordance with the licensee's procedures and 10 CFR 72.48 requirements. All screenings reviewed were determined to be adequately evaluated. One 10 CFR 72.48 evaluation identified three areas (fire hazards, tornado missiles, and transfer cask drop scenario) where implementation of the UMAX storage system at the SONGS site was identified to be different than the descriptions provided in the HI-STORM FW and UMAX Final Safety Analysis Reports. All three changes were evaluated by the licensee through the site's 10 CFR 72.48 process to demonstrate the evaluations continued to meet the system's original design basis acceptance criteria listed in the HI-STORM FW and UMAX Final Safety Analysis Reports. An Unresolved Item was opened to track the NRC's review of the methodology utilized in the evaluation for the transfer cask drop within the spent fuel pool and determine if the change could be performed through the 10 CFR 72.48 process. (Section 4.2.a)

Report Details

Summary of Facility Status

The SONGS ISFSI consists of two ISFSI designs located adjacent to each other. The Transnuclear, (TN) Inc. Nuclear Horizontal Modular Storage (NUHOMS) ISFSI contained 51 loaded concrete advanced horizontal storage modules (AHSMs) which housed stainless steel dry shielded canisters (DSCs). Spent fuel from all three reactors were stored at the NUHOMS ISFSI in 50 of the canisters. Greater-than-Class-C (GTCC) waste from the Unit 1 reactor decommissioning project was stored in one canister. There were a total of 63 AHSMs on the NUHOMS ISFSI pad. The twelve empty AHSMs will be available for storage of additional GTCC waste. The NUHOMS ISFSI pad consisted of two adjacent pad areas designed to hold the AHSMs. The pads were both 293 feet in length. The first pad area was 43 feet 6 inches wide and held 31 canisters. The second pad area was 60 feet 6 inches wide and was designed to hold 62 AHSM in a double row, positioned back to back. The 63 AHSMs currently on the TN ISFSI pads were designed for the 24PT1-DSC (Unit 1 fuel) and 24PT4-DSC (Unit 2/3 fuel) canisters, which hold a maximum of 24 spent fuel assemblies. The 24PT1-DSCs were loaded and maintained under Amendment 0 of Certificate of Compliance (CoC) 72-1029 and the 24PT4-DSCs were loaded and maintained under Amendment 1 of the CoC 72-1029. Both systems were being maintained under Final Safety Analysis Report (FSAR) Revision 5.

The Holtec UMAX ISFSI portion was designed to hold 75 multi-purpose canisters (MPCs). The UMAX ISFSI is 231 feet long and 102 feet wide. However, its dimensions are not rectangular. The ISFSI is wider on its northern end than on its southern end. The support foundation pad was constructed below grade at the 8.5’ Mean Lower Low Water (MLLW) elevation. The top of the ISFSI top pad was located at the 31.5’ MLLW elevation. Approximately half of the UMAX ISFSI was located below grade while the other half had excavated common fill that sloped up to the top of the ISFSI top pad. The licensee has begun loading MPC-37s containing 37 pressurized water reactor fuel assemblies in accordance with UMAX CoC No. 72-1040 and Technical Specifications, Amendment 2, the HI-STORM UMAX FSAR, Revision 4, and the HI-STORM FW FSAR, Revision 5. The licensee plans to remove all the remaining fuel from the Units 2 and 3 spent fuel pools to the UMAX ISFSI.

1 Preoperational Testing of an ISFSI at Operating Plants (60854)

1.1 Inspection Scope

The NRC inspectors reviewed by direct observation and independent evaluation that the licensee has developed, implemented, demonstrated, and evaluated preoperational testing activities to safely load spent fuel into a dry cask storage system and transfer the loaded canister to the ISFSI. The inspections verified the licensee fulfilled all appropriate testing acceptance criteria and implemented all required changes to the appropriate plant programs and procedures to support ISFSI operations.

1.2 Observations and Findings

a. Canister Drying

The licensee utilized forced helium dehydration (FHD) to achieve the dryness levels required by Technical Specification Appendix A, Table 3-1. The operation of the system was described in procedure HPP-2464-300 "MPC Sealing at SONGS," Revision 0. The NRC inspectors verified that the licensee met the technical specifications required limits for dryness during the loading of the first canister in the January 2018 inspection. Helium meeting the Technical Specification, Appendix A, Table 3-1 requirement for a purity of 99.995 percent or greater was verified to be utilized during dry run demonstrations and first loading operations associated with MPC blowdown, drying, and backfill operations. Helium backfill pressure requirements were incorporated into licensee procedure HPP-2464-300. The NRC inspectors observed that the required backfill pressure was met during the loading of the first canister.

b. Crane Design and Loading Operations Seismic Analysis

The licensee utilized 125-ton Ederer's Extra Safety and Monitoring (X-SAM) single-failure-proof cranes in each of their Unit 2 and Unit 3 spent fuel buildings to transfer the MPC and transfer cask (HI-TRAC VW) out of the spent fuel pool to the cask washdown area and then onto the low-profile transporter (HI-PORT). The NRC had reviewed the safety features of the X-SAM crane and issued a Safety Evaluation Report on January 2, 1980, related to Ederer's Generic Licensing Topical Report EDR-I(P), "Ederer's Nuclear Safety Related Extra Safety and Monitoring (X-SAM) Cranes," Revision 1 and on August 26, 1983, related to Revision 3. In the 1980 letter, the NRC stated that the design features presented in the topical report for the Ederer X-SAM crane were acceptable for assuring that a single failure would not result in the loss of capability to safely retain a critical load. In the 1983 letter, the NRC Safety Evaluation Report discussed the features of the wire rope used for the X-SAM crane and noted the safety criteria for the wire rope was met and was found acceptable to the NRC.

The fuel building overhead crane used a dual rope reeving system with individual attaching points and a load balancing system to hold and transfer the critical load without excessive shock in case of failure of one of the rope systems. The X-SAM crane is equipped with an energy absorbing torque limiter (EATL) which allows the hoist to safely withstand two blocking, overloading, or load hang-up, and still retain the load even if the drive motor is de-energized. Not only are the loads controlled following a two-blocking, load hang-up, etc., but the hoist's components are also protected, throughout their life, from being overstressed by these incidents. To provide this protection, the EATL directly converts the hoists high speed kinetic energy to heat during an overloading incident. The crane also utilized a system of upper travel limit switches that were designed to shut the crane down before a two-blocking event could occur.

The hoist drum was provided with the structural and mechanical safety devices to limit its drop during a shaft or bearing failure. The devices would also prevent disengaging from the holding brake. Ederer Topical Report EDR-I (P)-A, Section III.B.1.b, stated "The emergency drum brake system provides an independent means for reliably and safely stopping and holding the load following a failure in the hoist machinery." Hoist machinery failures included shaft or bearing failures. The crane was designed to retain control of and hold loads during seismic events. The bridge and trolley were designed to remain in place on their respective runways with their wheels prevented from leaving the tracks during a seismic event.

All of the Licensee's 10 CFR Part 72 seismic evaluations, for use of the UMAX system, were reviewed by NRC Division of Spent Fuel Management (DSFM) during the inspection period. This review included seismic loading analysis for cranes, as well as the seismic stability analysis of the transfer operations of the MPC to the ISFSI pad. The seismic stability during transfer operations included the HI-TRAC VW transfer cask (loaded with an MPC) in the spent fuel building during decontamination and closure operations, on the HI-PORT, on the vertical cask transporter (VCT), and during transfer of the MPC to the UMAX storage system ISFSI.

The rated load and seismic analysis was conducted using GT-STRUDL to analyze a three-dimensional model to create the mass and stiffness properties of the crane components using line elements and lumped masses. The response spectrum method from American Society of Mechanical Engineers (ASME) NOG-1, “Rules for Construction of Overhead and Gantry Cranes,” was used in the analysis of the seismic loads. The load combinations applied to the model were consistent with those of Crane Manufacturers Association of America, Inc. (CMAA)-70 “Specification for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes,” (2000) which included Operational Basis Earthquake (OBE) and Design Basis Earthquake (DBE) loads as well as the 125-ton live load, which is the rated capacity of the crane. The three orthogonal components of the earthquake motion were combined using the square root sum of squares of the structural response and combined with the static load cases. A two percent critical damping was used for OBE case and a four percent critical damping was used for the DBE case. Hand calculations and the finite element software ANSYS were used to analyze the forces on the individual components to determine their acceptability. The codes, standards and regulations used for the analysis and acceptance criteria included ASME B30.2 (1996); CMAA-70; ASME NOG-1 (2000); American Society of Civil Engineers 4-86, “Seismic Analysis of Safety-Related Nuclear Structures” (1986); NUGREG-0554, “Single Failure Proof Cranes for Nuclear Power Plants,” (1976); American Institute of Steel Construction (AISC) Manual of Steel Construction, 9th edition; American Welding Society (AWS) D1.1, “Structural Welding – Steel;” AWS D14.1, “Specification for Welding of Industrial and Mill Cranes and other Material Handling Equipment;” and American National Standards Institute (ANSI) N14.6, “Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds or More,” (1993).

As part of the analyses, members classified as non-compact according to the AISC, were checked for local buckling. Several upgrades were completed to satisfy the seismic qualification of the 125-ton crane, including a 12-wheel trolley option in lieu of the 4-wheel trolley. Other specific upgrades included: replacing bolts in connection between the girder and the truck, adding fillet welds between the lower connection plate and the bottom of the bridge truck, adding a shim plate to the inside face of the box girder top flange (the shim provided a contact surface for the X-SAM trolley uplift seismic restraints), adding longitudinal stiffeners below the top flange, and adding vertical/transverse stiffeners to limit the web panel size to 48-inches to satisfy CMAA-70 and ASME NOG-1 web buckling requirements.

Based on the review of the design documents and calculations, the DSFM staff concluded that there was reasonable assurance that the cranes were structurally adequate to withstand the earthquake loads during fuel loading operations.

The HI-TRAC VW loaded with the MPC containing spent nuclear fuel was analyzed using a 1.20g zero period acceleration at the floor level of the cask wash down area. The HI-TRAC VW was prevented from tipping over by restraints at two levels that connect to the wall of the cask wash down area. The restraints consist of two slings that connect to the wall mounted attachments and wrapped around the cask in a crisscross fashion to prevent the cask from tipping over. The analysis included a concrete wall evaluation, a base plate and anchor bolt evaluation, and a transfer cask stop evaluation.

The concrete wall evaluation demonstrated that the wall had sufficient strength to withstand the added bending and shear forces caused by the seismic loads on the cask, to include impact with the wall. In addition, should the concrete cask impact the wall, the wall had sufficient thickness to prevent penetration or perforation, and sufficient strength to resist the punching shear that results from compression on the steel tubes that make up the cask stop.

The analysis of the seismic restraint anchor assembly demonstrated that the base plate, stiffener plates and associated welds, and anchor bolts had sufficient strength to withstand the seismic loads due to restraining the cask.

The transfer cask stop consisted of a steel tubes connected together with welded gusset plates. The analysis of the stop assembly determined that the steel tubes, gusset plates and associated welds were structurally adequate to resist the compressive, bending, and shear forces due to the seismic load. Additionally, the force generated from the seismic load was within the load capacity of the seismic restraints and shackle.

Based on a review of the design documents and calculations, the DSFM staff concluded that there was reasonable assurance that the seismic restraint system as well as the concrete wall to which it was attached, had adequate strength to maintain the HI-TRAC VW transfer cask, loaded with an MPC and spent nuclear fuel, stable in the cask washdown area under the DBE.

The HI-PORT, loaded with the HI-TRAC VW and MPC, during transit on the haul path at SONGS was analyzed for stability (tip-over and sliding) during a design basis seismic event. The HI-PORT was comprised of two trailers with a drop deck between them. The HI-TRAC VW bottom flange was bolted to a seismic restraining ring which was bolted to the drop deck of the HI-PORT.

Five time history sets were used to perform the stability analysis which was simulated with the computer code LS-DYNA. The mean values of peak axial and shear loads on the individual bolts were obtained from the dynamic analysis, as were the mean bending and shear loads in the trailers and drop-deck, and the mean loads at the connections between the trailers and the drop-deck. These loads were compared against the structural capacities of the respective components. All load bearing components were shown to have safety factors greater than 1.0 (structural capacity was greater than structural demand). The maximum rocking angle in the lateral direction was 0.035 degrees and the maximum sliding distance of the HI-PORT was 10.38 inches. Using a factor of safety of three, a minimum clearance of 32 inches to the outer edge of safety related structures was established and implemented in the licensee's transportation procedures. In addition, the HI-PORT was restricted to 3.1 miles per hour.

Based on a review of the design documents and calculations, the DSFM staff concluded that there was reasonable assurance that the HI-PORT, loaded with the HI-TRAC VW transportation cask, would not tip over, and that the HI-TRAC VW would remain attached to the HI-PORT during a DBE. Additionally, with the imposed transport limitations (distance and speed), the HI-PORT would not impact safety related structures while in transit during a potential DBE.

The seismic response of the VCT carrying the HI-TRAC VW was analyzed on the haul path, the transfer slab, the ISFSI ramp, the approach slab, and the ISFSI pad during the bounding DBE. The design basis response spectra and corresponding time histories at grade level were used in the stability evaluation to ensure the VCT did not tip over and remained on the respective path, transfer/approach slab, and ISFSI pad.

The ISFSI ramp was assumed to have a grade of seven percent. Based on Licensee UMAX design drawings, the maximum grade of six percent existed on the ISFSI ramp. Additionally, the VCT was assumed to tip in the lateral direction (shortest footprint dimension), which would require the VCT, loaded with a HI-TRAC VW, to travel across the path instead of up or down the path. The site specific zero period acceleration for SONGS was 0.67g horizontal and 0.45g vertical. The amplification from the HI-STORM UMAX soil structure interaction (SSI) analysis was 1.1, 1.0, and 1.08 in the E-W, N-S, and vertical directions for the top of the ISFSI pad. The zero period acceleration was amplified by 15 percent for the analysis on the ISFSI pad, approach slab, and ramp.

The center of gravity of the VCT loaded with the HI-TRAC VW was based on a maximum lift height of 11 inches on the haul path and 51 inches on the ISFSI pad. These lift height distances were controlled by the licensee’s transfer operation procedures.

Upon review of the sliding analysis, it was determined that the VCT will slide under the bounding DBE. A minimum distance of 47 inches from the edge of the ISFSI ramp, approach slab, and ISFSI pad was recommended to ensure the VCT would not slide off of the structures. This limit was based on a safety factor of greater than 1.0. The licensee’s transportation procedure contained the required standoff distance and a white line was painted around the edge of the ISFSI ramp, approach slab, and ISFSI pad to ensure workers would abide by the limitations from the evaluation.

Based on a review of the design documents and calculations, the DSFM staff concluded that there was reasonable assurance that the VCT, loaded with the HI-TRAC VW transfer cask, would not tip over on the transfer slab, ISFSI ramp, approach slab, or the ISFSI pad as a result of the DBE. Additionally, with the imposed transport limitations, the staff had reasonable assurance that the VCT, loaded with the HI-TRAC VW, would not slide off of the ISFSI ramp, approach slab, or the ISFSI pad as a result of the DBE.

The stack-up evolutions at the UMAX ISFSI pad consisted of the HI-TRAC VW transfer cask bolted to the Mating Device (MD), the MD bolted to the Mating Device Adapter (MDA), and the MDA bolted to the HI-STORM UMAX Cavity Enclosure Container (CEC). An evaluation was performed to determine the structural adequacy of the HI-TRAC VW-to-MD, MD-to-MDA, and MDA-to-CEC connections as well as the ISFSI pad bearing capacity under the DBE.

A finite element model of the HI-TRAC VW, MD, and MDA on top of the ISFSI pad was built in LS-DYNA to determine the loading on the bolts, welds, and components, as well as the ISFSI pad. Hand calculations were then used to determine the structural adequacy of the connections and components in accordance with ASME Boiler and Pressure Vessel Code (BPVC), Section III, Division I, Subsection NF, and the structural adequacy of the ISFSI pad in accordance with American Concrete Institution (ACI) 318-05. A scale factor of 20 percent was applied to the at-grade DBE basis earthquake time history set in all directions to account for amplification at the top of the pad.

The peak axial and shear loads on the bolts that connected the HI-TRAC VW, MD, MDA and CEC were all less than the maximum allowable load for the bolts. The bolt interaction ratio (used to evaluate the combination of axial and shear forces on the bolts) were less than one, indicating the bolts were adequate under the combined axial and shear forces. Additionally, an analysis of the shear strength of the threads determined that the engagement lengths of the bolts were adequate for the connections.

The plate stresses in the MD were taken directly from the LS-DYNA analysis and compared with the allowable stress for that material. Components and welds that were not explicitly modeled were evaluated using bounding loads obtained from the analysis. All load bearing components and welds were determined to have safety factors greater than 1.0, meaning the calculated stress was less than the allowable stress for that material.

The tensile loads at the MD-to-MDA and MDA-to-CEC bolted connections were used to evaluate the supporting components and welds within the MDA. All bearing components and welds were determined to have safety factors greater than 1.0.

Finally, the ISFSI pad concrete bearing capacity was evaluated using the total load along each side of the MDA that was extracted from the LS-DYNA analysis. The safety factors against bearing on the ISFSI pad concrete due to the loads between the MDA and the CEC cover plate during stack-up were determined to be greater than 1.0.

Based on a review of the design documents and calculations, the DSFM staff concluded that there was reasonable assurance that the stack-up of the HI-TRAC VW, MD, and MDA on the CEC had adequate strength to sustain the DBE on the ISFSI pad. Additionally, the staff concluded that the ISFSI pad concrete strength was sufficient to withstand the DBE during stack-up operations.

c. Crane Inspection and Operation

During the licensee's programs review, NRC inspectors reviewed SONGS crane maintenance program for the 125-ton single-failure-proof X-SAM cranes located in the Unit 2 and 3 spent fuel buildings. Frequent crane inspections were performed daily during use, on the X-SAM cranes as required by the ASME B30.2 code. The inspection criteria from the ASME B30.2 code was captured in the licensee's Procedure HPP-2464-010, "SONGS Cask Handling Crane Checkout and Operation," Revision 2. The NRC inspectors observed the licensee perform the daily inspection during dry run demonstrations and first canister loading operations.

The required annual testing of the overhead X-SAM cranes followed HPP-2464-009, “Maintenance and Inspection of Cranes,” Revision 1. The latest annual inspection was completed during the recent load testing of the cranes on November 11, 2017, for Unit 2 and October 2, 2017, for Unit 3. The licensee’s procedure contained all the required inspection criteria outlined in ASME B30.2 and ASME B30.10, “Hooks.” Additionally, all the crane’s safety devices were tested in accordance with the Ederer Topical Report, Revision 3. The safety devices tested included: overload sensing system, hydraulic load equalization system fluid level, EATL, emergency drum brake system, drive train continuity detector, and wire rope spooling monitor.

Crane operation requirements and crane operator qualification requirements from ASME B30.2 were reviewed during dry run demonstrations and the first loading operations by NRC inspectors. The NRC inspectors verified that the crane operators training and qualification program met the requirements of the ASME code. Documentation was provided that demonstrated the crane operators for the first loading operations were trained and qualified in accordance with the licensee’s program. The NRC inspectors observed the operators perform the required ASME code brake test prior lifting a load that approached the rate load. This was accomplished by raising the load a short distance and applying the brakes to ensure the load would not lower unexpectedly. In accordance with the site’s heavy load program and NUREG-0612, “Control of Heavy Loads and Critical Lifts,” lift heights, load paths, special provisions, temperature restrictions, and rigging diagrams were placed in the appropriate procedures for the transfer operations that were occurring.

d. Crane Load Testing

The maximum calculated weight of the HI-TRAC VW with a MPC loaded with spent fuel and water raised out of the spent fuel pool was described in Holtec Report No. HI-2156458, “Cask Handling Weights at SONGS,” Revision 3 as 246,537 pounds (123.3 tons). Both Units’ 125-ton X-SAM cranes had recently completed a static load tested to 125 percent the rated capacity followed by a dynamic performance load test at 100 percent of the rated capacity. The Unit 2 crane’s load testing was completed on November 20, 2017, and the Unit 3 crane’s load testing was completed on October 2, 2017. The dynamic testing included movement in all directions and verifying all limiting and safety control devices. Additionally, the licensee provided documentation that demonstrated that each of the 125-ton hooks had been statically load tested to 200 percent the rated capacity in accordance with ASME B30.10 in 2003 by Ederer Inc.

e. Dry Run Demonstrations

The Holtec CoC 72-1040 Condition #8 required that dry run training exercises of the loading, closure, handling, unloading, and transfer of the HI-STORM UMAX Canister Storage System shall be conducted by the licensee prior to the first use of the system to load spent fuel assemblies. The dry runs shall include, but are not limited to the following: (a) Moving the MPC and the transfer cask into the spent fuel pool or cask loading pool; (b) Preparation of the HI-STORM UMAX Canister Storage System for fuel loading; (c) Selection and verification of specific fuel assemblies to ensure type conformance; (d) Loading specific assemblies and placing assemblies into the MPC (using a dummy fuel assembly), including appropriate independent verification; (e) Remote installation of the MPC lid and removal of the MPC and transfer cask from the spent fuel pool or cask loading pool; (f) MPC welding, nondestructive examination (NDE) inspections, pressure testing, draining, moisture removal (by vacuum drying or forced helium dehydration, as applicable), and helium backfilling (A mockup may be used for this dry-run exercise); (g) Transfer of the MPC from the transfer cask to the HI-STORM UMAX Vertical Ventilated Module (VVM); and (h) HI-STORM UMAX Canister Storage System unloading, including flooding MPC cavity and removing MPC lid welds (A mockup may be used for these dry-run exercises).

On June 26-30, 2017, NRC inspectors observed SONGS perform dry run demonstrations listed in Condition #8 (f) and (h): MPC welding, NDE inspections, and removing MPC lid welds. The licensee utilized Holtec's welding vendor PCI Energy Services (PCI) to perform the welding on a mock-up canister. The welding demonstration included MPC lid to shell welding, welding of the vent and drain cover plates, welding of the plug on the cover plates, welding of the canister closure ring, and demonstration of the in-line hydrogen monitoring system. The visual NDE examinations and the liquid dye penetrant examinations were performed on all the welds. Additionally, helium leak testing of the vent and drain port covers was performed during the dry run by Leak Test Services (LTS). The licensee successfully demonstrated all required welding and the NDE examinations.

The removal of the canister lid welds was demonstrated by providing the NRC with a videotape of a welded MPC-37 lid being removed. The DSFM has accepted that if the cutting evolution had been successfully completed on the same model of MPC canister at one site, another general licensee can take credit for the demonstration, as long as the same equipment and procedures would be utilized. The demonstration to remove the welds from a MPC-37 canister was performed July 16-18, 2015, at the Holtec Manufacturing Division located in Turtle Creek, PA. Inspectors from NRC's DSFM observed the cutting dry run at the Holtec facility. The cutting activities included boring through the cover plate and the MPC vent/drain port covers. The lid cutting machine was then utilized to cut through the cover plate and the MPC lid-to-shell weld. During the cutting evolution, Holtec personnel purged the area under the lid with argon while monitoring for hydrogen as required by the FSAR. All cutting demonstrations were successful, and the MPC lid was removed from the shell. This inspection was documented in an NRC Inspection Report (ADAMS Accession No. ML15303A348). The procedures and arrangements to use the same cutting system had been adopted into the SONGS ISFSI program.

On August 1-3, 2017, NRC inspectors observed SONGS complete dry run demonstrations of Condition #8 (f) and (h). The specific operations included: pressure testing, draining, moisture removal (by forced helium dehydration), helium backfilling and the unloading portion of flooding the MPC cavity. The fluid operations demonstration included observing the licensee's implementation of their radiation protection and foreign material exclusion programs. All demonstrations were successfully performed on a mock-up canister.

On September 25-28, 2017, NRC inspectors observed SONGS complete dry run demonstrations of Condition #8 (b), (g), and (h). The specific operations included:

preparation of the UMAX for canister loading, transfer of the MPC/transfer cask from the spent fuel pool building to the UMAX ISFSI, downloading the MPC into the VVM, and unloading portions that included removing the MPC from the VVM and returning the MPC/transfer cask to the spent fuel building. The heavy loads demonstration included preparing the UMAX for the canister by installing the mating device, use of the HI-PORT and the VCT to move the canister from the spent fuel pool building to the UMAX ISFSI and back. All demonstrations were completed with a mock-up canister that was filled with concrete to simulate the weight of the MPC loaded with spent fuel. The licensee successfully completed all required movements associated with the required demonstration.

On October 9-13, 2017, during the programs review, the inspectors reviewed the licensee's fuel selection and verification procedure completing dry run demonstration Condition #8 (c). Additional information related to the fuel selection is contained in Section 1.2.f of this report. Additionally, a physical walk-through of the selection and verification process associated with the licensee's program was demonstrated during the final dry run when the licensee performed fuel loading operations of a dummy fuel assembly into several positions in the canister basket on December 4-7, 2017. The licensee successfully implemented an adequate process to select fuel and to verify the assemblies loaded.

On December 4-7, 2017, the NRC inspectors observed SONGS complete dry run demonstrations of Condition #8 (a), (c), (d), and (e). The specific operations included: moving the MPC and the transfer cask into the spent fuel pool, a walk-through of the independent verification process for fuel loading, loading a dummy fuel assembly into a number of positions in the MPC, remote installation of the MPC lid, and removal of the MPC and transfer cask from the spent fuel pool. These operations were completed in the Unit 3 spent fuel building using the licensee's 125-ton overhead cask handling crane and the Unit 3 bridge crane that moves fuel assemblies within the pool. This demonstration completed all the required dry run demonstrations from the CoC. The licensee successfully completed the above listed operations and demonstrated that the procedures, programs, and training related to the dry cask storage operations for the Holtec HI-STORM UMAX system had been successfully integrated into their site operations.

f. <u>Fuel Selection/Verification</u>

Dry cask storage planning for the SONGS UMAX ISFSI included removing all fuel contents from the Unit 2 and 3 spent fuel pools (SFPs) to support decommissioning activities at the formerly operational nuclear plant. The items to be placed into the UMAX ISFSI included 2,668 spent fuel assemblies and associated hardware, Rod Storage Baskets, and other fuel associated debris from the two SFPs. The NRC inspectors reviewed Holtec Report HI-2167416, "Loading Plans for SONGS ISFSI Expansion," Revision 6. All of the SFP contents to be stored in the SONGS ISFSI met the HI-STORM UMAX CoC 72-1040, Appendix B requirements for storage of spent fuel assemblies, damaged fuel assemblies, and other associated fuel related items. The spent fuel planned for storage in the SONGS UMAX ISFSI also met the loading requirements of the proposed Holtec HI-STAR 190 transportable cask.

The licensee performed a full characterization of the spent fuel contents of their Unit 2 and 3 SFPs. The fuel assemblies selected for storage met all of the Holtec CoC 72-1040 requirements, including length, width, weight, cooling time, fuel utilization (burn-up), cladding types, decay heat, and fuel initial enrichment. The majority of the contents to be loaded into the Holtec UMAX ISFSI were intact spent fuel assemblies. There were, however, a number of a fuel assemblies that met the Holtec UMAX CoC Appendix B definition of damaged fuel assemblies. The items identified as damaged fuel or fuel debris can be stored in the UMAX ISFSI but can only be loaded into twelve peripheral locations of the MPC-37 canister in damaged fuel containers. Approximately 28 MPC-37s with damaged fuel containers will be loaded into the SONGS UMAX ISFSI.

In the event of an MPC misloading (violation of CoC 72-1040, Appendix B, Section 2.1), SONGS Procedure SO123-0-A7, “Notification and Reporting of Significant Events,” Revision 44, required that SONGS notify the NRC Operations Center within 24 hours after the licensee or other entity discovers the violation.

Procedure HPP-2464-200, “MPC Loading at SONGS,” Revision 0 included steps that address the requirements of Holtec CoC 72-1040, Appendix A, including meeting the proper boron concentrations for loading the intact and damaged spent fuel assemblies at SONGS. The procedure included steps for independent post loading verification of fuel assemblies by SONGS Reactor Engineering personnel by video. The post loading verification is required by the HI-STORM FW FSAR, Section 9.2.3.3. Site procedures provided provisions for controlling and tracking the stored spent fuel records in accordance with 10 CFR 72.72 and 10 CFR 72.174. In accordance with the requirements of 10 CFR Part 74, SONGS Procedure SO123-X-1.7, “Special Nuclear Material Accountability,” Revision 22 controlled tracking spent fuel and special nuclear material.

g. Heavy Loads

The licensee utilized two VCTs to lift the loaded HI-TRAC VW with MPC from the HI-PORT to the UMAX ISFSI pad for long term storage. The VCT was classified as an Important to Safety (ITS) component since the device provided the function of a crane to download the MPC from the HI-TRAC VW into the CEC. Each VCT was factory tested, statically to 125 percent and dynamically to 100 percent of the rated load. The VCTs were rated to 207.5 tons, in order to accommodate users that utilize the same VCT to carry a loaded HI-STORM FW overpack that weighs considerably more than a loaded HI-TRAC VW (118.5 tons). One VCT was tested on April 9, 2015, the other on April 7, 2016. All the weights utilized were verified to be slightly over the 125 percent and 100 percent weight requirements. During the dynamic load test, each VCT was traveled in all directions while testing the systems’ safety devices.

The VCT’s MPC downloader system was statically tested to 150 percent and dynamically to 100 percent of the rated load on the same dates as the VCT load testing described above. The MPC downloader system was rated to 128 tons. The weight of an MPC loaded with spent fuel and backfilled with helium weighed approximately 49 tons. After the testing of each downloader system, all accessible load bearing welds for the VCT that were designated as ITS, were subjected to visual and magnetic particle testing.

Technical Specification 5.2.c.2 required the VCTs to be inspected and maintained in accordance with NUREG-0612. Based on Holtec guidance, the licensee inspected the transporter in accordance with applicable sections of ASME B30.2 to meet the requirement. The daily inspection guidance was provided in HPP-2464-400, "MPC Transfer at SONGS," Attachment 8.8, "VCT Frequent Use Inspection Checklist." The annual inspection guidance was provided in HPP-2464-720, "Inspection and Maintenance for Vertical Cask Transporter," Revision 2 and was last completed on December 15, 2017 for each VCT. The inspection procedure met the applicable requirements of the ASME code.

The NRC inspectors verified that the transportation procedures associated with the VCT movements contained lift heights, load paths, special provisions, temperature restrictions, and rigging diagrams for all heavy lifts in accordance with the site's heavy load program and NUREG-0612 requirements.

h. Nondestructive Examination (NDE)

The NDE program adopted by SONGS to perform NDE inspections on the MPC welds was reviewed by the NRC inspectors to ensure the program and implementing procedures met the applicable ASME codes required by the UMAX FSAR. The NDE inspections of welds were performed by PCI's personnel. The helium leak testing was performed by LTS. During the welding dry run inspection on June 26-30, 2017, NRC inspectors reviewed the qualification requirements for the Level II or Level III inspectors for each program, the procedures utilized for each type of inspection, the work process, and the qualification of materials utilized in the inspections to verify the ASME/ANSI code requirements and technical specifications of license were properly incorporated in to licensee's program.

The helium leak testing was performed in accordance with ANSI N14.5, "Leak Tests on Packages for Shipment for Radioactive Materials," Revision 1997, to the established leak tight criteria of a leakage less than $2x10^{-7}$ atmosphere cubic centimeters per second (atm*cc/sec) as required by CoC 72-1040 Technical Specification, Appendix A Surveillance Requirement 3.1.1.3. The leak testing was performed in accordance with Procedure MSLT-MPC-Holtec, "Helium Mass Spectrometer Leak Test Procedure for MPC," Revision 3665-00. The process utilized a helium leak rate detector with a sensitivity level well below the technical specification leak rate criteria. Additionally, a calibration standard traceable to the National Institute of Standards and Technology was utilized to calibrate the helium leak rate detector prior to use. Four LTS Level III inspectors' certificates of qualification were reviewed to verify their certifications met American Society for Nondestructive Testing Inc. (SNT-TC-1A), "Recommended Practices for Qualification and Certification of NDE testing Personnel," Revision 1992 criteria and were current for the dates of the dry run and first loading inspection. During the first loading inspection, the licensee successfully performed the leak testing of the first MPC and results were below the required helium leak rate limit.

The NDE visual testing of the MPC canister welds was performed in accordance with Procedure GQP-9.6, "Visual Examination of Welds," Revision 16. The NRC inspectors verified the procedure contained the required acceptance criteria listed in ASME BPVC, Section III, "Rules for Constructions of Nuclear Facility Components," Article NF-5360, Revision 1995. The procedure's qualification record demonstrated that the examination process was adequate to identify the required standard reference indications.

The NDE liquid penetrant testing of the MPC canister welds was performed in accordance with Procedure GQP-9.2, "High Temperature Liquid Penetrant Examination and Acceptance Standards for Welds, Base Materials, and Cladding," Revision 9. The NRC inspectors verified the procedure contained the minimum elements from ASME BPVC Section V, "Nondestructive Examination," Article 6, T-621, and the acceptance criteria listed in ASME Section III, NB-5352. The procedure's qualification record was reviewed to verify the process was capable of detecting the required indications. Certified mill test reports with chemical analysis for the materials used in the high temperature liquid penetrant examinations (cleaner solvent, developer, and dye penetrant) met ASME Section V, Article 6, T-641 requirements. All cleaning, developing, and final interpretation time limits, based on the temperature of the component, were specified in the procedure and adhered to by the NDE personnel. The liquid penetrant examination was required by the procedure to be performed on the root pass weld, prior to any intermediate weld exceeding 3/8", and the final weld in accordance with CoC 72-1040 Appendix B Table 3-1 criteria. The NDE personnel complied with ASME code requirements regarding surface preparation and avoiding excess penetrant removal. Two PCI Level II inspectors certifications of qualification were reviewed to verify their training was current and in accordance with the SNT-TC-1A qualification requirements for visual and liquid dye penetrant examinations. During the first loading inspection, the licensee successfully performed the NDE examinations on first MPC with no indications identified.

i. <u>Pressure Testing</u>

The Holtec HI-STORM UMAX FSAR states that the Holtec MPCs placed into the UMAX VVM for storage are pressure tested in accordance with Section III, Subsection NB-6000 of the ASME BPVC to meet structural requirements and to verify the confinement function of the UMAX dry fuel storage system. The UMAX FSAR established the MPC pressure testing requirements by making direct reference to the pressure testing requirements listed in the HI-STORM FW FSAR. Both HI-STORM FW and HI-STORM UMAX dry fuel storage systems utilize the MPC-37. In addition, the Holtec HI-TRAC VW water jacket was required to be hydrostatically pressure tested per the applicable ASME code after being manufactured and the test results documented.

Holtec HI-STORM FW FSAR, Section 10.1.2.2.2, "MPC Confinement Boundary," required that either a hydrostatic test to 125 percent of the design pressure or a pneumatic pressure test to 120 percent of the design pressure take place in accordance with the requirements of the 2007 ASME Code when field welding of the MPC lid-to-shell weld was completed. The design pressure of the MPC-37 canister is 100 psig.

The NRC inspectors reviewed Procedure HPP-2464-300, "MPC Sealing at SONGS," Revision 0, and found that the procedure described the hydrostatic testing of the MPC lid-to-shell weld, including holding the pressure between 125.5 to 129.5 psig for 10 minutes, and specified that the pressure be maintained. During the pressure test, the weld area was to be inspected for water leakage. After the test was completed, the canister was allowed to depressurize and a liquid dye penetrant test of the weld area was required. The steps of the procedure were aligned with the requirements of ASME code.

The NRC inspectors observed SONGS successfully perform the hydrostatic testing requirements of a mock-up MPC-37 canisters during the fluid operations dry run demonstration on August 1-3, 2017, and during the NRC inspection of loading activities for the first MPC-37 processed during the loading campaign on January 25, 2018. The hydrostatic test and the post visual and liquid penetrant examinations were performed satisfactorily on both occasions in accordance with ASME code requirements.

Procedure HPP-2464-300 controlled pressure gauge calibrations in accordance with ASME Code, Section III, Article NB-6413 to not exceed two weeks. The NRC inspectors verified that the pressure gauges used for the hydrostatic testing of the MPC had been calibrated within an acceptable date range during the first loading inspection.

j. Special Lifting Devices and Slings

The special lifting devices utilized for the UMAX loading operations were reviewed by the NRC inspectors to verify compliance with ANSI N14.6 requirements. The list of special lifting devices included: MPC lift cleats, HI-TRAC lift lugs, HI-TRAC lift links, lift yoke, and lift yoke extension. Component purchase specifications or structural evaluations of selected devices were reviewed to verify the material used for fabrication met the six times yield strength and ten times ultimate strength in accordance with ANSI requirements. Dual path components were required to be capable of lifting three times the combined weight of the shipping container plus the weight of the intervening components of the special lifting device, without generating a combined shear stress or maximum tensile stress at any point in the device in excess of the corresponding minimum tensile yield strength of the material of construction. The devices were also required to be capable of lifting five times the weight without exceeding the ultimate tensile strength of the materials.

The required load testing documentation was provided for each special lifting device to verify the devices underwent 300 percent load testing at the manufacturer's facility. The test loads were held for ten minutes and then a visual, dimensional, and NDE inspection were conducted on the components. No NDE indications or issues were identified during the post load testing of the devices reviewed.

Annual inspection of the special lifting devices was established in the licensee's programs. Procedure HSP-355 "Annual Recertification of Special Lifting Devices," Revision 3, covered the annual inspection requirements for the MPC lift cleats, HI-TRAC lift lugs, HI-TRAC lift links, lift yoke, and the Holtec lift yoke extension. Procedure HPP-2464-030 "Testing and Inspection of Trans Nuclear Dry Fuel Storage Special Lifting Devices at SONGS," Revision 1, provided the instructions to perform the annual testing of the TN equipment. In accordance with ANSI requirements, the procedures required either a load test with a visual and dimensional test or a nondestructive test of the critical areas with a visual and dimensional test if the load test was omitted.

k. Storage Operations

The licensee had established procedures and work orders to perform the required daily vent or air temperature monitoring surveillances required by the technical specifications, monthly vent inspections for damage, and monthly/annual/five year inspections of the ISFSI and VVMs per FSAR requirements. The daily vent or temperature monitoring inspections was implemented in licensee Procedure S023-3-2.37 “Advanced Horizontal Storage Modules/Vertical Ventilated Modules System,” Revision 9 in accordance with CoC 72-1040, Appendix A, Technical Specification 3.1.2. The monthly vent inspection for damage was implemented in licensee Work Order Task Sheet 0917-77051-3 “HI-STORM UMAX ISFSI VVM Vent Screens,” in accordance with UMAX FSAR Table 10.4.1 requirements. The monthly, annual, and five year inspections of UMAX ISFSI and VVMs was implemented in a number of work orders which met the requirements listed in UMAX FSAR Tables 10.4.1 and 10.4.2.

l. Welding

The NRC inspectors reviewed the licensee’s MPC closure procedure to ensure that the lid-to-shell weld, closure ring weld, and vent and drain cover welds met the requirements of CoC 72-1040, Appendix B, such that all applicable welds were subjected to liquid dye penetrant examination and helium leak testing, when applicable, and combustible gas monitoring was in place during the lid-to-shell welding. As required by CoC 72-1040 Condition 8.f (see Section 1.2.e, above), the licensee successfully demonstrated that their welding processes during the welding dry run demonstration on June 26-30, 2017. The NRC inspectors also verified that the CoC 72-1040, Appendix B requirements were satisfied during the processing of the first MPC-37 for SONGS’ UMAX loading campaign.

During the welding dry run, the NRC inspectors verified that all of the applicable requirements of ASME BPVC Sections -II, -III, and -IX were being followed for welding materials, procedure qualification, and welding performance in the field. In specific, the NRC inspectors verified through procedure and document review that the appropriate weld qualification records were in place and that certain welding processes, such as tack welding, gas tungsten arc welding, and weld repairs, followed the appropriate guidance.

The NRC inspectors verified by records review that weld filler materials and electrodes met the minimum applicable requirements of ASME BPVC, Sections -II and -III, including delta ferrite content. The NRC inspectors also verified by procedure review and field verification that the licensee had procedures in place to direct the specification, control, and storage of purchased weld materials in accordance with 10 CFR 72.154.

The licensee had procedures in place to direct all welding activities, including weld repairs. The training and qualification records for the welders were provided for inspection. The welders performing the MPC closure operations during the dry runs and for the loading of the first MPC-37 met all of the required training and were qualified to perform all of the welds applicable to MPC-37 closure operations.

1.3 Conclusions

The FHD dryness limits, helium purity, and helium backfill requirements established in Technical Specification Appendix A Table 3-1 had been incorporated into the licensee’s procedures. The licensee planned to use the FHD system for drying all canisters loaded at the site. Operation of the FHD system and backfill to the required limits was demonstrated during the pre-operational dry run exercises and first loading activities.

The cask loading cranes used in the spent fuel handling buildings to lift the spent fuel canisters had been accepted by the NRC in 1980 as single failure proof cranes. The cranes were designed to retain control of and hold loads during a DBE at the SONGS site. Calculations were reviewed by NRC's DSFM that demonstrated that the forces from a seismic event in the upward and horizontal directions would not exceed the strength of the crane's seismic restraints. Additional seismic evaluations were reviewed to ensure seismic stability during transfer operations. This review included the transfer cask (loaded with a canister) in the spent fuel building during decontamination and closure operations, on the low profile transporter, on the vertical cask transporter, and during transfer of the MPC into the UMAX ISFSI. Based on the review of the design documents and calculations, the Division of Spent Fuel Management's staff concluded that there was reasonable assurance that the cranes and other handling/restraining equipment were structurally adequate to withstand DBE loads during fuel loading operations.

The 125-ton spent fuel building cranes were subjected to daily prior-to-use inspections that satisfied the requirements of ASME B30.2. On an annual basis the cranes were subjected to a more rigorous inspection that met the requirements of ASME B30.2 and the Ederer Generic Licensing Topical Report

The 125-ton spent fuel building cranes were properly load tested, as required by ASME B30.2, in the fall of 2017. The tests included a full performance test with 100 percent of the maximum critical load and a 125 percent static load test. The cranes' hooks were subjected to a 200 percent hook load test in 2003 by Ederer Inc.

The NRC inspectors observed the licensee successfully complete all the required pre-operational tests specified by License Condition #8 of the CoC. This included fuel assembly selection, welding, nondestructive testing, drying, helium backfilling, and the unloading of a sealed canister. A weighted canister was used to demonstrate heavy load activities inside the fuel handling building, transport between the fuel handling building and the ISFSI, and movement back into the fuel handling building for unloading purposes.

The licensee's fuel loading characterization plan met the HI-STORM UMAX CoC 72-1040, Appendix B limits for length, width, weight, irradiation cooling time, average burn-up, cladding, decay heat, and fuel enrichment. The licensee had established provisions for independent verification of the correct loading of spent fuel assemblies into the canister by use of video.

The licensee had incorporated the requirements related to the ISFSI project into the site heavy loads programs and procedures. Lift height limits, travel paths, and temperature restrictions during movement of the transfer cask had been incorporated into the licensee's procedures consistent with the requirements in the FSAR. The site's VCT were load tested and maintained in accordance with NUREG-0612 criteria.

The requirements for nondestructive testing of a spent fuel canister were incorporated into the licensee's procedures. The helium leak testing equipment used during the dry run demonstration and first loading was verified to meet the requirements listed in the technical specifications. The visual and liquid dye penetrant examination procedures implemented all the applicable requirements from ASME BPVC Section III, Section IV, and the FSAR regarding nondestructive examination of welds. A review of the nondestructive testing personnel's qualifications revealed they were properly qualified as a Level III or Level II examiners.

The requirements for canister hydrostatic testing had been incorporated into the licensee's procedures and were consistent with the requirements of ASME BPVC Section III Subsection NB, Article NB-6000. The hydrostatic testing sequence and criteria described in the FSAR had been incorporated into the licensee's procedures.

The licensee's special lifting device program complied with ANSI N14.6 criteria for stress design, annual inspections, and 300 percent proof loadings for the MPC lift cleats, HI-TRAC lift lugs, HI-TRAC lift links, lift yokes, and the lift yoke extensions.

The licensee had established procedures and work orders to perform the required daily monitoring surveillances required by the technical specifications, monthly vent inspections for damage, and monthly/annual/five year inspections of the ISFSI and VVM per FSAR requirements.

All welding procedures contained the required variables specified in ASME BPVC Section IX for gas tungsten arc welding. Requirements for hydrogen monitoring during welding of the inner cask lid had been incorporated into the procedures. The welder's performance qualification test records were reviewed and documented that the welders had met the qualification testing requirements for manual and machine welding of the canister lid. Weld qualification test coupons satisfactorily passed the required tests.

2 Operations of an ISFSI (60855)

2.1 Inspection Scope

The inspection included 24-hour coverage of the loading operations for the critical tasks associated with the licensee's first UMAX loading. Inspectors from NRC Region IV observed operations which included fuel loading, heavy lifts associated with the fuel building crane, welding and nondestructive testing of the canister lid-to-shell weld, hydrostatic pressure testing, forced helium dehydration, helium backfill, vent/drain port welding and nondestructive testing, helium leak testing, radiological surveys, and transport of the loaded HI-TRAC VW to the UMAX ISFSI pad. The inspectors reviewed selected procedures and records to verify ISFSI operations were in compliance with the Holtec CoC 72-1040 license technical specifications and Holtec FSARs.

2.2 Observations and Findings

a. Loading Operations

On January 22-31, 2018, NRC inspectors were onsite to observe the first canister loading operations. Inspectors observed all fuel assemblies loaded into the canister.

The fuel assemblies were inspected for damage prior to placement in the canister by use of an underwater camera. No damage was observed on any of the fuel assemblies loaded and the assemblies were free of foreign material. The canister's contents were reviewed to verify that the licensee was loading fuel in accordance with the technical specifications for approved contents. Documents reviewed included MPC loading maps and fuel assembly specific information such as identification, decay heat, cooling time, average U-235 enrichment, burn-up values, and other information. All fuel documents reviewed documented that SONGS had met the requirements listed in Appendix B of the CoC.

Observations of heavy lifts included placement of the MPC lid, removal of the HI TRAC VW with a loaded MPC from the spent fuel pool, placement of the HI-TRAC/MPC onto the HI-PORT, and lifting of the HI-TRAC/MPC from the HI-PORT to the VCT. The smooth operation of the 125-ton single failure proof crane and VCT was due, in part, to the licensee's extensive preventative maintenance effort on the lifting equipment. Numerous crane components had been replaced or upgraded to ensure successful completion of the upcoming continuous loading campaign. All lifting operations observed were performed in accordance with the site's heavy loads program.

Welding of the canister lid-to-shell weld began on January 24, 2018. The licensee utilized a calibrated in-line hydrogen monitor throughout the welding operations to ensure hydrogen levels were well below the lower explosive limit. Following the lid-to-shell welding, the required NDE (visual and dye penetrant testing) was performed to meet license requirements. No indications were identified during the NDE tests. Welding on the vent and drain port cover plates was completed after hydrostatic pressure testing, blowdown, FHD drying, and helium backfilling. The welds on the vent and drain port cover plates successfully passed all NDE examinations. After the vent/drain ports were helium leak tested, the closure ring was placed on the canister and properly welded.

The NRC inspectors observed the licensee successfully perform the hydrostatic pressure testing, blowdown, FHD drying, and helium backfill operations. The MPC was hydrostatically tested to the required pressure range, held for the required timeframe, and subsequently passed a second NDE exam. All water was then removed from the canister using the FHD and then successfully dried. The licensee met the time-to-boil time limit and had removed the water from the canister without having to initiate alternate cooling operations. The helium gas temperature exiting the freezer section of the dryer was below the required temperature and held for over 30 minutes in accordance with Technical Specification Appendix A Table 3-1, verifying the canister was adequately dried. The canister was then backfilled with helium of a purity greater than 99.995 percent, to the pressure range required in Technical Specification Appendix A Table 3-2.

Radiological coverage was provided throughout the loading campaign in accordance with the licensee's procedures. The radiation protection (RP) staff implemented adequate ALARA controls to minimize the overall collective dose during cask loading. The RP staff provided a sufficient amount of RP technician coverage during work activities, conducted detailed and comprehensive pre-job briefings on radiological conditions, effectively used portable radiation shielding, and effectively directed personnel to remain in low dosage areas when not actively working on the canister. The NRC inspectors observed the RP perform the required Technical Specification

Appendix A Section 5.3 surveys and verified the results were below the radiation and contamination limits specified.

During transportation operations to the ISFSI pad, NRC inspectors observed the licensee perform the required fire hazard walk-down of the haul path to ensure procedural requirements were met prior to transportation operations. The HI-PORT and VCT successfully transported the canister to the UMAX ISFSI without any malfunctions.

b. Design Control

During the first canister loading inspection on Monday January 22, 2018, the NRC inspector observed that the HI-TRAC VW transfer cask's seismic restraint system had been modified from its original design in order to be installed the Unit 2 spent fuel building. A 16 inch by 2 inch section of the back support plate for the seismic restraint system had been removed to allow the base plate to be installed around the existing sling restraints associated with the overall seismic restraint system. Additionally, the lift yoke extension had been non-structurally modified to be stored in the Unit 2 Spent Fuel Building. These design changes had been performed after the last NRC dry run inspection. The NRC inspector requested from SONGS the design change packages and applicable 10 CFR 50.59/72.48 reviews that were performed to ensure the newly modified ITS equipment would still be able to perform their safety function in accordance with the system's original design basis.

The licensee determined that the modification to both ITS components were processed through Holtec's field condition report (FCR) process under FCR-2464-LOA-065 for the seismic restraint base plate modification and under FCR-2464-LOA-041 for the lift yoke extension. The FCR-2464-LOA-065 for the seismic restraint base plate stated the system would continue to perform as designed, but the document did not contain sufficient technical analysis to justify the modification. The lift yoke extension FCR-2464-LOA-041 did contain the sufficient technical analysis to support that ITS equipment would continue to adequately meet its designed safety function which was documented in Holtec response to request for technical information (RRTI) #2464-034. However, the licensee discovered that neither change had been fully processed in accordance with SONGS engineering design control process or fully accepted under the Licensee's 10 CFR 50.59/72.48 review process.

These NRC identified issues led to SONGS placing the conditions into their corrective action program (CAP) as action request (AR) 0118-14935. An apparent cause evaluation (ACE) was conducted which reviewed the extent of condition related to vendor changes made to ITS components. The ACE was completed on April 26, 2018. The ACE review documented SONGS's engineering review of 391 Holtec documents, which included 255 construction FCRs, 36 RRTIs, 10 supplier manufacturing deviation reports (SMDRs), and 90 loading FCRs. From that review, the NRC discovered four additional examples where ITS components were modified under Holtec's FCR process without fully following SONGS engineering design change process or SONGS's 10 CFR 50.59/72.48 review process. These items included accept-as-is deviations to one ITS divider shell, two deviations related to the ITS self-hardening subgrade of the ISFSI pad, and one deviation related to the ITS ISFSI top pad surface.

As necessary, the licensee's vendor completed additional calculations for all the components which did not contain rigorous analysis in the original FCR. All the revised calculations and justifications were reviewed by the NRC inspector and were found to contain sufficient engineering analysis to demonstrate the modified ITS components would still be capable of performing their design basis safety functions. Additionally, the design changes were subsequently accepted for implementation by SONGS in accordance with their 10 CFR 50.59/72.48 program.

Section 10 CFR 72.146 (c), "Design Control," states, in part, that the licensee shall subject design changes including field changes, to design control measures commensurate with those applied to the original design.

The licensee's Procedure SO123-XXIV-10.1 titled "Engineering Design Control Process – NECP" Attachment 8, Step 5.5.2, stated, "Design changes to the Dry Cask Storage system are required to be supported by calculations prepared in accordance with this procedure and the 72.48 program."

Contrary to the above, SONGS failed to ensure that design changes or field changes to ITS components were subjected to design control measures commensurate with those applied to the original design. Specifically, a number of field changes to ITS components were not processed in accordance with SONGS engineering design change process with rigorous engineering analysis that demonstrated the changes were acceptable and those changes were not properly accepted for implementation through the Licensee's 10 CFR 50.59/72.48 program.

Consistent with guidance in Section 2.2 of the NRC Enforcement Policy, this violation was dispositioned through the traditional enforcement process. The inspectors used the NRC Enforcement Policy to evaluate the significance of the violation. This violation was determined to have a low safety significance since all the deviations or modification from the original design were found to be acceptable and did not affect the specific components' safety design function or bases. This violation was found to be more than minor since if left uncorrected, it could have the potential to lead to a more significant safety concern. Specifically, failure to adequately control changes and modifications to ITS components could lead to a condition where the appropriate calculation and review was not performed to ensure the component would continue to meet its safety function in accordance with their design basis.

Because the licensee entered the issue into its CAP (AR 0118-14935), the safety significance of the issue was low, the licensee restored compliance, and the issue was not found to be repetitive or willful, this Severity Level IV violation was treated as a Noncited Violation (NCV), consistent with Section 2.3.2.a of the NRC Enforcement Policy (07200041/2017001-001).

2.3 Conclusions

The first loading inspection conducted in January 2018 included 24 hour coverage of the loading operations for the critical tasks associated with the licensee's UMAX loading. Inspectors from NRC Region IV observed operations which included fuel loading, heavy lifts associated with the fuel building crane, welding and nondestructive testing of the canister lid-to-shell weld, hydrostatic pressure testing, FHD drying, helium backfill, vent/drain port cover welding and nondestructive testing, helium leak testing, radiological surveying, and transport of the loaded transfer cask to the UMAX ISFSI pad.

During the first loading operations, the NRC inspectors identified one violation of 10 CFR 72.146 (c), “Design Control” requirements. The licensee had made modifications to ITS components through the vendor’s (Holtec) corrective action program and did not follow SONGS engineering design change process. The licensee failed to ensure that design changes or field changes to ITS components were subjected to design control measures commensurate with those applied to the original design. The original documentation for the changes was identified to not contain a rigorous engineering analysis that demonstrated the changes were subsequently found to be acceptable and those changes were not properly accepted for implementation through the Licensee’s 10 CFR 50.59/72.48 program. This violation was determined to have a low safety significance since all the deviations or modifications from the original design were found to be acceptable and the changes did not affect the specific components’ safety design function or bases. Because the licensee entered the issue into their corrective action program, the safety significance of the issue was low, the licensee restored compliance, and the issue was not found to be repetitive or willful, this Severity Level IV violation was treated as a NCV, consistent with the NRC Enforcement Policy.

3 Review of 10 CFR 72.212(b) Evaluations (60856)

3.1 Inspection Scope

The programs review inspection conducted on October 9-13, 2017, performed an in depth review of the programs, evaluations, and procedures established to demonstrate that the licensee had met the requirements listed in 10 CFR 72.212 before operation of the UMAX ISFSI.

3.2 Observations and Findings

a. Emergency Planning

The NRC inspectors reviewed the licensee’s Permanently Defueled Emergency Plan (PDEP) to verify and assess the following: (1) the licensee’s emergency action levels (EAL) for accidents that affect the ISFSI; (2) the licensee’s offsite emergency support; and (3) the licensee’s training of employees and conducting periodic drills.

The licensee conducted an evaluation in accordance with 10 CFR 50.54(q) to incorporate the operation of the SONGS UMAX ISFSI into the existing SONGS PDEP. The licensee added definitions and EAL E-HU1.2, “Damage to a loaded canister CONFINEMENT BOUNDARY,” to cover the Holtec spent fuel transport and storage system. The additional EAL threshold for the Holtec system is two times the HI-STORM UMAX technical specifications allowable radiation level on the surface of the VVM or the Holtec transfer cask. The revised PDEP and emergency plan implementing procedures described arrangements with offsite emergency organizations including provisions on how the licensee would conduct periodic drills and training of employees.

b. Fire Protection

The licensee provided an analysis that demonstrated that the site-specific potential for fire and explosions was bounded by the conditions analyzed by the Holtec in accordance with license requirement CoC 72-1040 Appendix B Section 3.4.5. The fire and explosion hazards were analyzed along the haul path and at the UMAX ISFSI in Holtec Report HI-2156567 “Evaluation of Plant Hazards at SONGS,” Revision 2. The explosion hazards analyzed systems and structures which included gasoline tanks, acetylene tanks, lube oil hazards, transformer oil hazards, buildings, and off-site explosions. The assumptions used for the explosion hazards in the report appeared reasonable. No credible explosion hazard was identified at SONGS that exceeded the allowable stress levels identified in the UMAX FSAR which included the overpressure needed to tip over the HI-TRAC VW during transport operations or the structural limits of the closure lids for the UMAX ISFSI. The overpressures for acetylene and gasoline hazards did not exceed the acceptable limits for the UMAX ISFSI or the HI-TRAC VW as long as the specified stand-off distances were met that were incorporated into licensee transportation Procedure HPP-2464-400 “MPC Transfer at SONGS,” Revision 1.

The fire hazards which might affect the cask were identified and reviewed by the licensee. If a fire potential was credible, an evaluation was performed for each postulated hazard to determine if the hazard could exceed the allowable heat input to the cask. Site specific fire hazards included the trailer-mounted fire pump, fixed diesel fire pump, cold and dark standby diesel generator, miscellaneous acetylene tanks, a fuel buggy, and miscellaneous diesel tanks. The assumptions used for the fire hazards in the report appeared reasonable. No credible fire hazard was found to exceed the acceptable heat input to either the HI-TRAC VW or UMAX ISFSI as long as administrative actions included in the licensee Procedure HPP-2464-400 were followed.

During the review of the 10 CFR 72.212 report, the NRC inspectors reviewed the licensee’s analyzed worst case fire during transportation operations to determine whether it was bounded by the analyzed fire in the UMAX FSAR of 50 gallons of diesel fuel from the cask transporter. This evaluation was documented in Holtec report HI-2167264 “Thermal Evaluation of HI-TRAC VW Fire,” Revision 3. The HI-PORT was used to transport the HI-TRAC VW from the fuel handling building to the base area of the UMAX ISFSI. The most limiting scenario was identified to be when the HI-PORT and VCT were next to each other to allow the VCT to engage the HI-TRAC VW to continue transportation to the top of the UMAX ISFSI. Two telescoping man-lifts were also utilized during this transfer event. The combined fire hazard included both fuel tanks of the HI-PORT and VCT, hydraulic fluid from all four pieces of equipment, and the tire rubber associated with the HI-PORT. This fire loading exceeded the 50 gallons of diesel fuel described in the UMAX FSAR. The evaluation determined that the fuel temperature, MPC components, and MPC cavity pressure remained well below the limits established in the UMAX FSAR and the credible fire event did not exceed any FSAR fire accident acceptance criteria. The implementation of this change and associated evaluation was document in a SONGS 10 CFR 72.48 evaluation. Since all the predicted temperatures from the thermal analysis were below the specified temperature limits of short-term events reported in Section 4.5 of the UMAX FSAR, the safety conclusions remained unchanged. The 10 CFR 72.48 evaluation concluded the change did not require NRC approval. The inspectors determined that the 10 CFR 72.48 evaluation was performed adequately.

During the programs review inspection, NRC inspectors reviewed the licensee's Pre-Transport Haul Route Walkdown Checklist (Attachment 8.9) in Procedure HPP-2253-400 to ensure adequate controls were in place to limit combustibles along the haul path and that all fire and explosion hazards had been adequately identified in the reports. No issues were identified by the inspectors relating to the controls implemented to ensure the requirements of the licensee's fire and explosion hazards analyses were met.

c. General License Requirements for 10 CFR 72.212

The SONGS 10 CFR 72.212 Report evaluated the terms, conditions, and specifications in Amendment 2 for the HI-STORM UMAX CoC 72-1040 and documented the conditions as set forth had been met at the SONGS site. Each section of the 10 CFR 72.212 report documented the licensee's compliance with a requirements specified in 10 CFR 72.212(a) through (e). The sections covered topics which included conditions of the license, technical specifications, pad design adequacy, direct radiation, reactor site parameters, written evaluations, physical security, document retention, records, procedures, and program effectiveness.

The NRC inspectors performed a comprehensive review of the Licensee's 10 CFR 72.212 report during the programs review inspection conducted on October 9-13, 2017, and continued the inspection throughout the inspection period with in-office review of the licensee's documentation.

Section 11.0 "Reactor Site Parameters," documented the required written evaluations to verify requirements specified in the Holtec UMAX and FW FSAR and the associated NRC safety evaluation reports were met. The NRC inspectors reviewed these evaluations which related to specific analyses for fires and explosions, tornados, floods, tsunamis and hurricanes, earthquakes, lightning, burial of the ISFSI under debris, environmental temperatures, snow, and collapse of nearby facilities.

The licensee performed a review of the reactor emergency plan, quality assurance program, training program, and radiation protection program and documented the review in Section 15.0, "Program Effectiveness," of the report. Since the TN storage system was already in use, the licensee performed the necessary changes to the programs to incorporate the use of the Holtec UMAX storage system. No issues were identified relating to the NRC's review of the topics discussed above.

d. Quality Assurance

SONGS had a preexisting Generally Licensed 10 CFR Part 72, Subpart G Quality Assurance (QA) program in place for its TN CoC 72-1029 ISFSI. To address transitioning the site from power operations to decommissioning, SONGS developed a decommissioning quality assurance program (DQAP) to support decommissioning activities and to ensure continued oversight of the SONGS ISFSI. The DQAP was SONGS' NRC approved QA program that will be the basis for satisfying the QA requirements of the newly established Holtec HI-STORM UMAX ISFSI and the current TN ISFSI. The NRC inspectors reviewed selected QA activities related to calibrations, receipt inspections, surveillances, and audits.

The Holtec HI-STORM UMAX and HI-STORM FW FSARs identified structures, systems, and components that were ITS and categorized each item into one of three levels (A, B, or C) based on safety significance. The NRC inspectors verified through a review of the SONGS Quality Component List, Rev. 11 that the licensee had incorporated the Holtec HI-STORM UMAX and HI-STORM FW safety designations into their classification scheme along with those of the TN Advanced NUHOMS® System.

The licensee also had a preexisting NRC approved CAP that included the TN Advanced NUHOMS® ISFSI. Holtec, their newest dry fuel storage vendor, also had an NRC-approved CAP. Holtec was handling all fuel loading and radiation protection duties for the pool-to-pad dry fuel storage project for the UMAX ISFSI. After the identification by the NRC of items discussed in Section 2.2.b, Design Control, the licensee made a number of additional changes to ensure that proper evaluation of Holtec condition reports would be performed by SONGS personnel.

e. Radiation Protection

In accordance with 10 CFR 72.104, the licensee provided technical evaluations that demonstrated that the radiation dose from the TN and the UMAX ISFSIs would not exceed 25 mrem per year to the whole body or critical organ or 75 mrem per year to the thyroid of any individual located beyond the owner controlled area. The analyses reviewed by the NRC inspectors also included evaluations that demonstrated no individual would receive a dose greater than the limits specified in 10 CFR 72.106 during any design basis accident at the SONGS site. The UMAX ISFSI was assumed to be fully loaded with fuel characteristics that conservatively exceeded the fuel currently stored in the licensee's spent fuel pools. During loading operations personnel from the SONGS security force established control of public access in areas near the site seawall. The NRC inspectors reviewed site controlled area boundary dose projections in Holtec Report Nos.: HI-2177793, "On-Site and Off-Site Dose Calculations for the SONGS ISFSI," Revision 1, and HI-2156895, "Dose Versus Distance Calculations for the SONGS ISFSI for Compliance with 10 CFR 72," Revision 1. The UMAX accident scenarios were discussed in the Holtec HI-STORM UMAX FSAR.

The UMAX FSAR requires that the radiation protection concept of As Low as Reasonably Achievable (ALARA) be applied to all operations related to dry fuel storage at the SONGS ISFSI. The NRC inspectors verified that SONGS had ALARA policies in place in its radiation protection program through a review of site radiation protection policies and dry fuel loading procedures, including the SONGS Units 2 and 3 Spent Fuel Pool to Pad Project ALARA Plan, Revision 1.

The UMAX FSAR Section 10.3 requires that the shielding effectiveness of the UMAX VVM be assessed after the first MPC canister is placed into the ISFSI. The NRC inspector observed SONGS RP technicians make confirmatory neutron and gamma radiation measurements on the lid of the loaded VVM. The radiation levels present on the VVM lid were consistent with the licensee's site specific Technical Specification 5.3.3 requirements.

The licensee's RP group addressed the external gamma and neutron monitoring of personnel onsite by using electronic dosimeters. The electronic dosimeters used conservative neutron correction factors. This ensured that the real-time monitoring would provide an over-estimate of actual neutron doses so that these exposures would be managed conservatively. Personnel dose of legal record was measured using thermo-luminescent dosimeters which contained elements sensitive to the presence of neutrons.

The CoC 72-1040 Appendix A Technical Specification 5.3, “Radiation Protection Programs,” included numerous radiation measurement requirements, including the survey locations, and radiation limits. The licensee had incorporated all of the requirements of Section 5.3 in its site procedures and forms. In addition to radiation limits, the technical specification included removable contamination limits on the transfer cask and accessible portions of the MPC. The NRC inspectors verified that SONGS had incorporated those requirements into Procedure HPP-2464-031, “Pool to Pad Certificate of Compliance Radiological Surveys at SONGS,” Revision 0.

f. Records

The inspectors reviewed the licensee procedure SO123-VI-29, “Records Management,” to verify that provisions were in place to maintain records for each cask.

The licensee maintained cask records in accordance with its quality “Procedure SO123-VI-29,” “Records Management,” such that the cask package contained the required information to meet 10 CFR Part 72 requirements for record retention. The inspectors also verified that the licensee incorporated the requirement to register with the NRC no later than 30 days after using the cask to store fuel in Section 7.8.14 of HPP-2464-400, “MPC Transfer.”

3.3 Conclusions

Emergency planning provisions for the UMAX ISFSI had been incorporated into the site’s emergency plan. This included adding a specific EAL for an event damaging loaded UMAX casks.

A fire and explosion hazards analysis had been performed specific to the SONGS UMAX ISFSI. Administrative controls were established to limit the quantity of combustible and flammable liquids around the ISFSI and near the transport path during movement of the canister. The licensee provided calculations demonstrating that the worst case postulated fire event during transportation would not result in a significant increase in the temperature of the spent fuel inside a loaded canister.

The licensee evaluated the bounding environmental conditions specified in the Holtec FSAR and CoC 72-1040 technical specifications against actual site conditions. These included: tornados/high winds, flood, seismic events, tsunamis, hurricanes, lightning, burial of the ISFSI under debris, normal and abnormal temperatures, collapse of nearby facilities, and fires/explosions. The site environmental conditions at SONGS were bounded by the Holtec storage system’s design parameters.

The licensee had implemented their approved reactor facility 10 CFR Part 50 DQAP and CAP for the activities associated with the UMAX ISFSI. Selected QA activities were reviewed related to calibrations, audits, surveillances, and receipt inspections.

The licensee had incorporated keeping radiation exposures ALARA into planning for the cask loading program. Requirements for radiation surveys described in the FSAR and technical specifications had been incorporated into the licensee's procedures for cask loading operations. Projected radiation levels at the ISFSI were calculated for an assumed individual located at the owner controlled area boundary. The analysis demonstrated the dose to this individual would meet the requirements of 10 CFR 72.104.

The licensee was maintaining the 10 CFR Part 72 records in their quality related records system. Records required for retention by 10 CFR 72.174, 10 CFR 72.212, 10 CFR 72.234, and the FSAR had been identified in the licensee's program and were required to be maintained for the life of the ISFSI.

4 Review of 10 CFR 72.48 Evaluations (60857)

4.1 <u>Inspection Scope</u>

The Licensee's 10 CFR 72.48 screenings and evaluations performed to incorporate the use of the UMAX ISFSI were reviewed to determine compliance with regulatory requirements.

4.2 <u>Observations and Findings</u>

a. <u>Safety Evaluations</u>

The licensee had combined the 72.48 screening and evaluation process with the 10 CFR 50.59 process used at the site. Changes to the ISFSI and part 50 facility were processed in accordance with Procedure SO123-XV-4410 "CFR 50.59, 50.82, and 72.48 Program," Revision 21. As part of the programs review inspection, the NRC inspectors reviewed a number of 10 CFR 50.59/72.48 applicability determinations, screens, and one 10 CFR 72.48 evaluation that related to SONGS implementation of the UMAX Storage System.

The licensee completed four larger, nuclear engineering change packages (NECP) to encompass the use of the new UMAX ISFSI. A review was performed by the licensee for each NECP in accordance with 10 CFR 50.59 and 10 CFR 72.48 requirements. Construction of the UMAX ISFSI pad, approach slab, approach ramp, transfer pad, sump area berm, and ISFSI thermal monitoring system was performed under NECP 801372566. The new ISFSI security building was implemented under NECP 801372567 and 801372567. The umbrella NECP that supported implementation of the UMAX system operations for loading spent fuel into a MPC, use of HI-TRAC VW, drying and sealing, transfer of a loaded MPC, and placement at the ISFSI pad was implemented by NECP 801372564. Additionally, the NECP packages were reviewed for potential impacts against the existing TN ISFSI in accordance with 10 CFR 72.48. None of the 10 CFR 50.59/72.48 reviews identified a need for a Part 50 license amendment for the facility.

Section F of the 10 CFR 72.212 report contained a list of changes to the canister storage system licensing basis beyond UMAX FSAR Revision 4. The Holtec engineering change orders (ECO) and SMDRs were identified by the licensee as applicable to the storage system at SONGS. Additional changes to the storage system made by the vendor would be captured in this list and processed in accordance with SONGS 10 CFR 50.59/72.48 program. Some of these changes were incorporated through the 10 CFR 50.59/72.48 under the previously reviewed NECPs conducted by the licensee. Other changes that occurred after the issuance of the NECPs were accepted by the licensee through standalone or combined screenings with exception of the FCRs previously discussed, for which corrective actions were taken.

The licensee performed one 10 CFR 72.48 evaluation for the implementation of the Licensee's 10 CFR 72.212 report. The 10 CFR 72.48 evaluation identified three areas where implementation of the UMAX storage system at the SONGS site was identified to be different than the descriptions provided in the HI-STORM FW and UMAX FSARs. The three areas related to the combined fire hazard loading (see discussion in Section 3.2.a. of this report), the site's tornado-borne missile differences, and the seismic lateral forces experienced during a DBE when a loaded HI-TRAC VW transfer cask contains a loaded canister in the spent fuel pool.

The SONGS design and licensing basis postulated tornado-borne missiles differed from the missiles addressed in the Holtec FSARs. The licensee's design basis values for rotational wind speed, translational speed, maximum wind speeds, and pressure drop were all less than the values listed in the FSARs. However, the SONGS missiles imparted slightly higher kinetic energy to the various targets for moderate and small missile scope than demonstrated in the FSARs. Since the generic tornado-borne missiles as defined by Holtec do not necessarily bound the site-specific missile parameters for several sites (including SONGS), Holtec prepared a generic report which evaluated the effect of a broader range of postulated site-specific tornado missiles based on the parameters from multiple sites. The generic Holtec Report HI-2135869, "Site-Specific Tornado Missile Analysis for the HI-STORM FW System", Revision 6, re-evaluated the structural impact of the tornado driven missiles on the HI-TRAC and the potential for tip-over and penetration. The applicable tornado-borne missiles evaluated in the generic report bounded all of the SONGS design basis tornado-borne missiles and were summarized in Appendix D of HI-2156567, "Evaluation of Plant Hazards at San Onofre Nuclear Generating Station," Revision 3. The additional evaluations demonstrated that the hypothetical deformations of the UMAX closure lid and impacts to the HI-TRAC VW transfer cask did not compromise the containment boundary of the MPC, locally deform the lid or transfer cask such that the irretrievability of the MPC was threatened, or deform the equipment plastically such that the shielding effectiveness was affected. The evaluation concluded the impacted components had sufficient capacity to withstand the slightly higher loads imparted by the SONGS missiles.

During the site's 10 CFR 72.212 review, the licensee identified that when rigging equipment is being exchanged, for a short period of time, the HI-TRAC VW and loaded MPC is in an unconstrained condition on an intermediate shelf in the spent fuel pool. If a seismic event was to occur during that time frame, the HI-TRAC VW with a loaded MPC could hypothetically fall to the lower level of the spent fuel pool and experience a higher lateral force than previously analyzed by the HI-STORM FW and UMAX FSARs.

The Licensee's 10 CFR Part 50 license and Updated Final Safety Analysis Report had analyzed a potential cask drop from the intermediate shelf to the bottom of the pool as a credible accident. In the past, the licensee had utilized the TN NUHOMS storage system, which contained a lateral side drop evaluation of the TN transfer cask in the TN

FSAR that bounded the site's configuration. The Holtec HI-STORM FW and UMAX FSARs does not contain a side drop analysis for the HI-TRAC VW transfer cask. However, the HI-STORM FW FSAR does contain a tip-over analysis for an MPC inside the HI-STORM overpack storage container.

To evaluate the scenario for this hypothetical accident of the loaded HI-TRAC VW contacting the sides and bottom of the spent fuel pool, the licensee's vendor (Holtec) prepared report HI-2177713 "HI-TRAC Drop in Cask Storage Pool at SONGS", Revision 1. In the report, the licensee demonstrated acceptability of the peak impact deceleration for the HI-TRAC VW scenario at SONGS by comparing those lateral forces to the peak impact deceleration values used to support the 10 CFR Part 71 HI-STAR 190 transport package safety analyses which utilizes the same MPC canister. The licensee's evaluation concluded that the maximum peak lateral deceleration value of the HI-TRAC VW in the pool at SONGS to be 74g's, which was below the HI-STAR 190 side drop evaluation of 85.9g's. Additionally, the MPC and fuel basket evaluated stresses were identified by the licensee to be less than the design basis criteria described in the limiting values from HI-STORM FW FSAR Section 2.2.8. The licensee stated that the same computer software (LS-DYNA) was utilized in all three evaluations (SONGS site specific drop evaluation, HI-STORM FW/UMAX FSAR tip-over evaluation, and HI-STAR FSAR transportation cask drop evaluation).

To utilize this evaluation conducted for the Part 71 HI-STAR 190 transportation license to bound conditions for the storage operations under the 10 CFR Part 72 UMAX license, additional information will need to be submitted by the licensee and evaluated by the NRC to determine if the methodology and implementation of the evaluation through the 10 CFR 72.48 process was appropriate. This item will be tracked as an Unresolved Item (URI) (07200041/2018001-02) until the NRC completes its review of the additional information to determine if the issue of concern potentially constitutes a violation of 10 CFR 72.48 requirements.

4.3 Conclusions

Safety screenings had been performed in accordance with the licensee's procedures and 10 CFR 72.48 requirements. All screenings reviewed were determined to be adequately evaluated. One 10 CFR 72.48 evaluation identified three areas (fire hazards, tornado missiles, and transfer cask drop scenario) where implementation of the UMAX storage system at the SONGS site was identified to be different than the descriptions provided in the HI-STORM FW and UMAX FSARs. All three changes were evaluated by the licensee through the site's 10 CFR 72.48 process to demonstrate the evaluations continued to meet the system's original design basis acceptance criteria listed in the HI-STORM FW and UMAX FSARs. An URI was opened to track the NRC's review of the methodology utilized in the evaluation for a transfer cask drop within the spent fuel pool and determine if the change was acceptable to be performed through the Licensee's 10 CFR 72.48 process.

5 Exit Meeting

The inspectors reviewed the scope and findings of the inspection during a telephonic exit meeting conducted with Mr. Lou Bosch, Plant Manager, and other members of your staff on August 8, 2018.

SUPPLEMENTAL INSPECTION INFORMATION
PARTIAL LIST OF PERSONS CONTACTED

Personnel

A. Bates, Regulatory and Oversight Manager
L. Bosch, Plant Manager
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INSPECTION PROCEDURES USED

IP 60854	Preoperational Testing of an ISFSI
IP 60855	Operations of an ISFSI
IP 60856	Review of 10 CFR 72.212(b) Evaluations
IP 60857	Review of 10 CFR 72.48 Evaluations

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

07200041/2017001-01	NCV	Failure to Control Field Design Changes to ITS Components
07200041/2017001-02	URI	10 CFR 72.48 Methodology

Discussed

None

Closed

07200041/2017001-01	NCV	Failure to Control Field Design Changes to ITS Components

LIST OF ACRONYMS

ACE	Apparent Cause Evaluation
ADAMS	Agencywide Documents Access and Management System
AHSM	Advanced Horizontal Storage Module
AISC	American Institute of Steel Construction
ALARA	As Low as Reasonably Achievable
ANSI	American National Standards Institute
AR	Action Request
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
BPVC	Boiler and Pressure Vessel Code
CAP	Corrective Action Program
AR	Action Request
CEC	Cavity Enclosure Container
CFR	Code of Federal Regulations
CMAA	Crane Manufacturers Association of America, Inc.
CoC	Certificate of Compliance
DBE	Design Basis Earthquake
DNMS	Division of Nuclear Material Safety
DSC	Dry Shielded Canister
DSFM	Division of Spent Fuel Management
DQAP	Decommissioning Quality Assurance Program
EAL	Emergency Action Level
EATL	Energy Absorbing Torque Limiter
ECO	Engineering Change Order
FCDB	Fuel Cycle and Decommissioning Branch
FCR	Field Condition Report
FHD	Forced Helium Dehydration
FSAR	Final Safety Analysis Report
FW	Flood and Wind
GTCC	Greater than Class C
HI-PORT	low profile transporter
HI-STORM	Holtec International Storage Module
HI-TRAC VW	transfer cask
IP	Inspection Procedure
ISFSI	Independent Spent Fuel Storage Installation
ITS	Important to Safety
LTS	Leak Test Services
MD	Mating Device
MDA	Mating Device Adapter
MLLW	Mean Lower Low Water
MPC	multi-purpose canister
mrem	milliRoentgen equivalent man
NCV	Noncited Violation
NECP	Nuclear Engineering Change Package
NDE	Nondestructive Examination
NRC	U.S. Nuclear Regulatory Commission
NUHOMS	Nuclear Horizontal Modular Storage
OBE	Operational Basis Earthquake
PCI	PCI Energy Services

PDEP	Permanently Defueled Emergency Plan
QA	Quality Assurance
RP	Radiation Protection
RRTI	Holtec Response to Request for Technical Information
SCE	Southern California Edison
SFP	spent fuel pool
SMDR	Supplier Manufacturing Deviation Report
SONGS	San Onofre Nuclear Generating Station
SSI	Soil Structure Interaction
TN	Transnuclear, Inc.
TS	Technical Specification
UMAX	Underground Maximum Capacity
URI	Unresolved Item
VCT	Vertical Cask Transporter
VVM	Vertical Ventilated Module
X-SAM	Extra Safety and Monitoring

IR 05000206/2017-003, 05000361/2017-003, 05000362/2017-003, AND 07200041/2017-001; SONGS ISFSI – DATED AUGUST 24, 2018

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☒ SUNSI Review By: LEB		ADAMS ☒ Yes ☐ No		☒ Publicly Available ☐ Non-Publicly Available	☒ Non-Sensitive ☐ Sensitive
OFFICE	RIV/DNMS/FCDB	RIV/DNMS/FCDB	NMSS/DFSM/IOB	NMSS/DFSM/IOB	RIV/DNMS/FCDB/BC
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DATE	8/23/18	8/23/18	7/25/18	7/25/18	8/24/18

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