INSPECTOR NOTES
ST LUCIE ISFSI PRE-OPERATIONAL TESTING AND FIRST LOADING

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ST LUCIE ISFSI PRE-OPERATIONAL INSPECTION

(INSPECTOR NOTES)

Category: Crane Design ***Topic:*** Bridge and Trolley Brakes

Reference: NUREG 0554, Section 5.1

Requirement: Bridge and trolley control and holding brakes should be: a) rated at 100% of maximum drive torque that can be developed at the point of application; and b) automatically actuate on interruption of power and overspeed. The holding brakes should be designed so that they cannot be used as foot-operated slowdown brakes. Drag brakes should not be used.

Finding: The bridge and trolley control and holding brakes are capable of applying a counter torque that is 100% of the maximum drive torque that can be developed at the point of application. The maximum torque capacity of the driving motor and gear reducer for both motions does not exceed the capacity of the gear train and brakes to stop either of the motions from the maximum speed with the design rated load attached. The bridge and trolley motors are provided with spring set, electrically released holding brakes that are automatically applied when power is interrupted. The holding brakes are electrically actuated and therefore, cannot be used as a foot operated slow down brake. The crane does not employee drag brakes.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Bridge Bumpers

Reference: NUREG 0554, Sect 5.2; ASME B30.2, Section 2-1.8.2

Requirement: A bridge shall be provided with bumpers, or other automatic means of equivalent effect, capable of stopping the bridge when traveling with power off in either direction at a speed of at least 40% of rated load speed.

Finding: Compression bumpers, attached to the bridge, are provided to buffer contact with the end of travel. The bridge bumpers were designed to withstand a speed of 40% of rated load as specified in Calculation CAL-19939-ME-425.

Documents Reviewed: E-mail from Jeff Griesemer, American Crane to Ralph Russo, FPL dated Feb. 27, 2008 referencing Calculations CAL-19939-ME-325, Revision 2 and CAL-19939-ME-425, Revision 2

Category: Crane Design ***Topic:*** Crane Support Structure

Reference: NUREG 0554, Sections 2.3 & 2.5

Requirement: The crane support structure should be designed to maintain structural integrity under

normal operating conditions and seismic events.

Finding: As part of the installation of the new single failure proof cranes at Unit 1 and Unit 2, the licensee replaced the crane support structures. These structures are located outside the fuel handling building of each unit. The crane runway support structure includes the columns, vertical bracing, runway girders and walkway platform truss system. In each unit, two columns of the crane runway support structure are supported by the fuel handling building roof. The other columns are supported on reinforced concrete foundations at grade level. None of the structures affect the reactor safe shutdown systems. All of the crane support structures were included in the seismic analysis for the new cranes. The analysis used the seismic properties for the site based on the Part 50 Updated Final Safety Analysis Reports (UFSAR), Section 3.7. (Additional information related to seismic design aspects of the crane are included in this inspection report under the Category: Crane Design - Topic: Seismic Events During Cask Movement.) The design life of the cranes was based on 40 years of outside service. This design included provisions for the chemical (salt) environment at the site, torrential rains, high winds to 120 mph produced by a hurricane, high winds to 360 mph produced by a tornado and pressure differentials that would be caused by a tornado. During high wind situations, the crane will not be operated at wind speeds exceeding 50 mph.

Documents Reviewed: -Updated Final Safety Analysis Report (UFSAR) for Saint Lucie Nuclear Power Station (Unit 1), Revision 22
-Updated Final Safety Analysis Report (UFSAR) for Saint Lucie Nuclear Power Station (Unit 2), Revision 17
-American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Drum Safety Devices

Reference: NUREG 0554, Section 4.2

Requirement: The hoist drum should be provided with structural and mechanical safety devices to limit its drop during a shaft or bearing failure. The devices should prevent disengaging from the holding brake.

Finding: The dual drums on the main hoist employ drum catching devices which prevent each of the two main hoist drums from disengaging from the emergency stop disk caliper braking system. The arrangement effectively locks the drum between a support frame and the brake and prevents disengagement of the braking system. The drum retaining devices are steel structures which ensure that a shaft or bearing failure will not allow the main hoist drums to disengage from the respective drum brakes.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Emergency Stop Feature

Reference: NUREG 0554, Sections 3.3, 6.1, and 6.6

Requirement: An emergency stop feature should be installed at the control station. For cranes remotely operated using radio control stations, a second emergency stop feature should be provided at ground level to remove power from the crane, independent of the controller. Cranes that use more than one control station should be provided with electrical interlocks that permit only one control station to be operated at a time.

Finding: An emergency stop button is located on the radio transmitter and in the cab of the crane. An electrical interlock is provided between the cab control and the radio control. A manual disconnect switch, located on the bridge, is provided to independently disconnect the power from the crane and runway. Power can also be disconnected from the crane using the breaker at the load center, though this breaker is not at ground level. Units 1 and 2 have similar design.

Documents Reviewed:
-American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-NUREG-0554 "Single Failure Proof Cranes for Nuclear Power Plants," dated May 1979

Category: Crane Design ***Topic:*** Hoist Control Brake Operation

Reference: NUREG 0554, Sect 4.9; ASME B30.2, Section 2-1.9.3

Requirement: The minimum hoist braking system should included one power control brake (not mechanical or drag brake type) and two holding brakes. The power control brake may be regenerative, dynamic, counter-torque or eddy-current and shall be capable of maintaining controlled lowering speeds. The control brake shall have the thermal capacity required for the frequency of operation.

Finding: The crane includes a main hoist control system utilizing dynamic braking as the power control braking system and two shoe type high speed holding brakes on the high speed shafting for the main hoist. Each of the two independent holding brake systems are designed with sufficient capacity to stop the full load of the hoist. The holding brakes are designed with large brake discs on each of the brakes to provide for heat dissipation to ensure damage will not occur during lowering of the load at minimum speed.

Documents Reviewed:
-American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

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Category: Crane Design ***Topic:*** Hoist Holding Brake Location

Reference: NUREG 0554, Section 4.9; NUREG 0612, Pg C-3 (6)

Requirement: When the hoisting system uses dual gear trains, a holding brake should be applied to each gear train. When the hoisting system uses a single gear train, one holding brake should be applied to the gear train and the second brake should be applied directly to the drum.

Finding: The holding brake system is single failure proof. Each hoisting brake has dual brakes. One holding brake is on the gear train located on the motor. The second holding brake is mounted on the hoisting drum. Each holding brake is designated to stop the full load of the hoist.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Hoist Holding Brake Operation

Reference: NUREG 0554, Section 4.9

Requirement: The minimum hoist braking system should included one power control braking system (not mechanical or drag brake type) and two holding brakes. Holding brakes should have a minimum brake capacity of 125% of the torque developed during the hoisting operation at the point of brake application, and should be automatically applied to the full holding position when power is off, and under overspeed condition and overload conditions.

Finding: The crane includes a main hoist control system utilizing dynamic braking as the power control braking system and two shoe type high speed holding brakes on the high speed shafting for the main hoist. Each holding brake of the main hoist has been designed with a minimum capacity of 125% of the torque developed during the hoisting operation at the point of brake application. The holding brakes are fail safe, i.e. power released and spring actuated. Each holding brake is designed to actuate should any hoisting fault be detected, including overspeed, overload or out of balance.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Lamellar Tearing

Reference: NUREG 0554, Section 2.6

Requirement: Problems have been experienced with weld joints between rolled structural members.

Specifically, subsurface lamellar tearing has occurred at the weld joints during fabrication, and the through thickness strength of the material has been reduced. When weld joints are carefully designed and fabricated, lamellar tearing is not expected to occur. For certain weld joints, it may be necessary to examine the joint by radiography or ultrasonic inspection, as appropriate, to ensure the absence of lamellar tearing in the base metal and the soundness of the weld material.

Finding: The trolley and bridge structures were fabricated primarily from plates and structural shapes rolled from carbon steel. The bridge structures (girders, end trucks and end ties) utilized plate thicknesses of 1-1/4" or less in highly restrained weld configurations to reduce the potential for lamellar tearing. The trolley structure (end trucks, load girts and upper block) utilized plate thicknesses of 1" or less in highly restrained welded configurations. For any load girts joint penetration welds in the base materials exceeding 1" plate thickness, ultrasonic testing was performed. Most single failure point welds within the frame were eliminated by designing connections which transfer the forces. If the design could not eliminate a single failure point weld, the weld was welded with certified welders using certified filler material, visually inspected and magnetic particle or dye penetrant tested to ensure weld integrity. All welds were visually inspected.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Overload Protection

Reference: NUREG 0554, Section 4.5

Requirement: The complete hoisting system should have the required strength to resist failure during load hang-up. As an alternative the system design may include a load cell system in the drive train, a motor current-sensing device, or a mechanical load-limiting device that will de-energize the hoist drive motor and the main power supply under a load hang-up condition. The auxiliary hoist, if used for critical lifts, should also be equipped with overload protection.

Finding: The main hoist is designed to safely handle a two-block situation without permanent deformation or damage. In addition, two upper, redundant limit switches of different design and actuation are provided to prevent two-blocking. A mechanical slip clutch is located between the gearbox and motor to disengage the rotating high speed kinetic energy from the system during two-blocking. A load sensing system is included in the reeving system that will de-energize the hoist and stop motion when a load greater than 115% of the rated load is detected. The auxiliary hoist is not single failure proof and will not be used for critical lifts.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes

at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Provisions For Manual Operation

Reference: NUREG 0554, Sections 3.4; 4.9

Requirement: A crane that has been immobilized because of failure of controls or components while holding a critical load should be able to hold the load or set the load down while repairs or adjustments are made. This can be accomplished by inclusion of features that will permit manual operation of the hoisting system and the bridge and trolley transfer mechanisms by means of appropriate emergency devices.

Finding: The main hoist has redundant brakes to allow portions of the hoist drive train to be repaired while retaining the load. In addition, the main hoist, trolley and bridge can each be moved independently under a loss of power event so that a load could be moved to a safe lay down location and then lowered. The hydraulic drum brakes on the hoist can be manually modulated to lower the load in the event of hoisting equipment failure using a hand pump to cycle the brakes. The bridge and trolley have attachment points for manual operation by rigging to the crane structure and using the manual release on the brake system.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Seismic Events During Cask Movement

Reference: NUREG 0554, Section 2.5

Requirement: The crane should be designed to retain control of and hold the load, and the bridge and trolley should be designed to remain in place on their respective runways with their wheels prevented from leaving the tracks during a seismic event.

Finding: The St. Lucie crane is designed to retain control of a 150-ton load for abnormal conditions including a broken rope, two-blocking, and load hang-up during a safe shutdown earthquake (SSE) and operating basis earthquake (OBE). The trolley and bridge structures are robust in nature and have low centers of gravity. The design gives the structure very little upward thrust and lateral displacement during a seismic event. The bridge and trolley are provided with seismic hold down lugs so that the bridge and trolley remain in place on their respective runways with their wheels prevented from leaving the rails with the brakes applied. All crane brakes are set when the crane is not being operated or power is removed. A three dimensional model of the crane support structure - fuel handling building (FHB) was developed to perform the seismic analysis. The model included the crane runway girders, crane bridge girders, end trucks, the trolley, and the crane runway steel support structure connected to the FHB analytical model. Both Unit 1 and Unit 2 were modeled. The geometric, stiffness and weight properties of the FHB were in accordance with Figure 3.7-9 and Table 3.7-5 of the Unit 1

Updated Final Safety Analysis Report (UFSAR) and Figure 3.7-34 and Table 3.7-8 of the Unit 2 UFSAR, respectively. The crane runway support steel structure included the columns, vertical bracing, runway girders and walkway platform truss system. In each unit, two columns of the crane runway support structure are supported on the FHB roof. Other columns are supported on reinforced concrete foundations at grade level. The soil spring constants for the column foundations for the seismic analysis were calculated using the formulae in Section 3.7.1.5 of the Unit 1 UFSAR and Section 3.7.2.4 of the Unit 2 UFSAR, respectively. In the model, three trolley positions on the bridge girder were considered, i.e., end of the bridge, 1/4 span of the bridge and midspan of the bridge. These trolley positions were in accordance with Table NOG-4153.7-1. The analysis determined that the bridge will remain on the runway and the trolley will remain on the bridge with brakes applied while holding the 150-ton load during a seismic event.

Documents Reviewed:

-American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Society of Mechanical Engineers (ASME) NOG-1 "Rules for Construction of Overhead and Gantry Cranes," 1998
-Updated Final Safety Analysis Report (UFSAR) for Saint Lucie Nuclear Power Station (Unit 1), Revision 22
-Updated Final Safety Analysis Report (UFSAR) for Saint Lucie Nuclear Power Station (Unit 2), Revision 17

Category: Crane Design ***Topic:*** Seismically Induced Load Swing

Reference: NUREG 0554, Section 2.5; Reg Guide 1.29

Requirement: The maximum critical load plus operational and seismically induced pendulum and swing load effects on the crane should be considered in the design of the trolley and should be added to the trolley weight for the design of the bridge.

Finding: The pendulum and swinging load effect of the 150-ton load was simulated in the seismic analysis model by a beam element, one end connected to the trolley beam with the suspended weights on the other end. The equivalent stiffness of the beam with the suspended weight at its end was calculated such that its frequency was equal to the pendulum frequency of the suspended weight. Two suspended weight positions were considered, uppermost position and lowermost position. These seismically induced pendulum and swing load effects were included in the structural analysis for the crane support structure for both the operating basis earthquake (OBE) and the design basis earthquake (DBE).

Documents Reviewed:

-American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Trolley Bumpers

Reference: NUREG 0554, Sect 5.2; ASME B30.2, Section 2-1.8.3

Requirement: A trolley shall be provided with bumpers, or other automatic means of equivalent effect, capable of stopping the trolley when traveling with power off in either direction at a speed of at least 50% of rated load speed.

Finding: Compression bumpers, attached to the trolley, are included for buffering contact with the end of the travel stops. Positive mechanical end stops are installed on the runway for limiting the bridge travel and on the bridge girders for limiting the trolley travel. The crane has both slow down and stop limit switches on both the trolley and bridge. The slow down switches are programmed at 10% so that the trolley and bridge will slow down to 10% of rated speed before impacting the end of travel limit switch. This set-up should stop the trolley or bridge prior to contacting the bumpers.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Two-Block Protection

Reference: NUREG 0554, Section 4.5

Requirement: The complete hoisting system should have the required strength to resist failure during two-blocking. As an alternative, a system of upper travel limit switches may be used to prevent two-blocking. The system should include two independent travel limit devices of different designs and activated by separate mechanical means. These devices should de-energize the hoist drive motor and the main power supply. The auxiliary hoist, if used for critical lifts, should also be equipped with two independent travel limit switches to prevent two-blocking.

Finding: The mechanical and structural components of the main hoist system have been designed to withstand a two-block event without permanent deformation or damage. In addition, two upper, redundant limit switches of different design and actuation are used to prevent two-blocking. The first limit switch interrupts power to the raising circuit which will stop the motion and set the holding brake. The second upper limit switch activates if the first switch fails. The second switch de-energizes the hoist motor power supply when the lower block lifts a weighted arm suspended from the frame. This limit switch also stops all hoisting motion and sets the holding brake. Should both limit switches fail, a mechanical slip clutch is located between the gear box and motor. The auxiliary hoist is not designed as single failure proof and is not used for critical lifts.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety

Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

Category: Crane Design ***Topic:*** Wire Rope Breaking Strength

Reference: NUREG 0554, Section 4.1

Requirement: The maximum load (including static and inertia forces) on each individual wire rope in the dual reeving system with the maximum critical load attached should not exceed 10% of the manufacturer's published breaking strength.

Finding: The St. Lucie crane has dual (two) wire ropes. The wire ropes for the crane are 1-1/4" diameter, 9 x 25 class, EEIPS ropes supplied by Python National. The minimum break strength requirement specified by the crane manufacturer was 122.5 tons. The commercial grade dedication plan developed by American Crane and Equipment Company and included in the QA Document Package FPL P.O. 00052828 specified the minimum 122.5-ton breaking strength and stated that the ropes did not have to be tested to failure. The QA Document Package also included the Hessville Cable and Sling Co. Certificate of Testing for the two wire ropes used on the crane. The wire ropes were pull tested to 245,710 lbs (122.8 tons) by Hessville Cable and Sling Company on December 27, 2002 and did not break.

The crane has two ropes, with each rope carrying 75 tons under normal operations. The ropes are configured using a 16-part reeve to carry the full load (i.e. 8 reeves per rope). Therefore, each reeve would carry 75/8 = 9.375 tons. Using the manufacturer's minimum break strength value of 122.5 tons, 10% would equate to 12.25 tons, which is greater than the 9.375-ton weight being carried by each reeve at full load.

Documents Reviewed: -Quality Assurance Document Package FPL P.O. 00052828, ACECO W.O. # 19940 "Section 8: Main Hoist Wire Rope"

Category: Crane Design ***Topic:*** Wire Rope Configuration

Reference: NUREG 0554, Section 4.1

Requirement: A dual rope reeving system with individual attaching points and a load balancing system will permit either rope system to hold and transfer the critical load without excessive shock in case of failure of the other rope system. The dual reeving system may be a single rope from each end of the drum terminating at one of the blocks or equalizer with provisions for equalizing beam-type load and rope stretch, with each rope designated for the total load. Alternatively, a two-rope system may be used from each drum or separate drums using a sheave equalizer or beam equalizer or other combination that provides two separate and complete reeving systems.

Finding: The main hoist design used two drums each with one rope, with a balanced dual reeving system with each rope terminating on the drum it originated on. The main hoist reeving system provided independent load balance of the head and load blocks through a configuration of ropes and rope equalizers. The main hoist employed an equalizer rocker beam and hydraulic shock absorbers to balance and distribute the forces associated with the load transfer. Each rope was capable of handling the entire 150-ton load such that if

one rope breaks, the remaining intact reeving system would not be loaded to more than 40% of the braking strength of the wire rope, including the dynamic effects of the load transfer. Each rope had an eight-part reeve such that each reeve would carry 150/8 = 18.75 tons should only one rope be available to carry the full 150-ton load. The rope strength was specified by the manufacturer as a minimum of 122.5 tons. Forty percent of this value would be 122.5 x 0.4 = 49 tons, well above the required 18.75-ton strength needed to carry the full load.

The design of the crane used one right- and one left-hand lay rope. The Quality Assurance Package FPL PO 00052828 was reviewed concerning the specifications of the wire ropes for the crane. Specifications for both a right regular lay rope and a left regular lay rope were included along with a picture showing the proper installation of the rope on the drums as to which drum would be wound with right lay and which would be wound with left lay. The specifications called for a 9 x 25 wire rope with diameter 1.250 to 1.313 inches and a minimum length of 980 feet. The wire rope breaking strength was specified as a minimum of 122.5 tons. The ropes were purchased from Python National and manufactured in Germany. The certificate from the German company specified the dimensions of the wire rope as 1 1/4" with strand construction of 9 x 25. Documentation was provided in FPL PO 00052828 confirming the rope diameter was within specifications through actual measurements of the ropes.

Documents Reviewed:

-American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-Quality Assurance Document Package FPL P.O. 00052828, ACECO W.O. # 19940 "Section 8: Main Hoist Wire Rope"

Category: Crane Inspection/Maintenance ***Topic:*** Crane Inspection - Frequent

Reference: ASME B30.2; Section 2-2.1.2

Requirement: Cranes in regular use shall be subjected to a frequent crane inspection monthly during normal service, weekly to monthly during heavy service, and daily to weekly during severe service. The frequent inspection points should include: a) operating mechanisms for proper operation; b) leakage in lines, tanks, valves, pumps, and other parts of the air or hydraulic systems; c) hooks for cracks, more than 15% of normal throat opening, or more than 10 degrees of twist; d) hook latches for proper operation; e) hoist ropes including end clamps; and e) the rope reeving system. All limit switches should be checked at the beginning of each work shift by inching, or running at slow speeds, each motion into its limit switch.

Finding: The crane was classified by FPL as a Class A crane (Standby or Infrequent Service). The licensee and the crane manufacturer (ACECO) inspect the crane and its components following Procedures MMP-74.02 and EMP-74.04.

Documents Reviewed:

-Procedure MMP-74.02 "Spent Fuel Cask Handling Crane Inspection," Revision 1A
-Procedure EMP-74.04 "Cask Crane Annual Inspection," Revision 0

-Weekly and Daily Operational Checks or Inspections performed on February 11, 2008, February 18, 2008, and February 25, 2008.

Category: Crane Inspection/Maintenance ***Topic:*** Crane Inspection - Periodic

Reference: ASME B30.2; Section 2-2.1.3

Requirement: Cranes in regular use shall be subjected to a periodic crane inspection annually during normal and heavy service, and quarterly during severe service. The periodic inspection includes checking for: a) deformed, cracked or corroded members; b) loose bolts or rivets; c) cracked or worn sheaves and drums; d) worn, cracked or distorted pins, bearings, shafts, gears, and rollers; e) excessive brake system wear; f) load, wind, and other indicators over their full range for any significant inaccuracies; g) gasoline, diesel, electric, or other power plants for improper performance; h) excessive drive chain sprocket wear and chain stretch; i) deterioration of controllers, master switches, contacts, limit switches and pushbutton stations.

Finding: The licensee and the crane manufacturer (ACECO) inspect the crane and its components (e.g., hook) following Procedures MMP-74.02 and EMP-74.04. Among the items included in the annual inspection of the crane were: a) deformed, cracked or corroded members; b) loose bolts and rivets; c) cracked or worn sheaves and drums; d) worn, cracked or distorted pins, shafts, and rollers; e) excessive brake system wear; and f) weigh scale and wind speed display damage or loose connections. Procedure EMP-74.04 was used to test the operation of various electrical components of the crane including push buttons and limit switches.

Documents Reviewed: -Procedure MMP-74.02 "Spent Fuel Cask Handling Crane Inspection," Revision 1A
-Procedure EMP-74.04 "Cask Crane Annual Inspection, " Revision 0

Category: Crane Inspection/Maintenance ***Topic:*** Crane Operational Testing

Reference: ASME B30.2; Sect 2-2.2.1

Requirement: Prior to initial use, all new, reinstalled, altered, extensively repaired or modified cranes shall be tested to ensure compliance with ASME B30.2 including the following: (a) hoisting and lowering, (b) trolley travel, (c) bridge travel, (d) limit switches, and (e) locking and safety devices. The trip setting of the hoist devices shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the limit device shall be located so that it will trip the device under all conditions in sufficient time to prevent contact of the hook or load block with any part of the trolley or crane.

Finding: The crane manufacturer performed an initial functional and load test (both 110% and 125%) on the trolley at its facility prior to shipping to the site. Crane operational tests, including 100% and 125% load tests, were performed at St. Lucie after the Unit 1 and Unit 2 cranes were installed. This testing program was documented in Work Order Task 32016943-05, REP-19939-019 and REP 19939-020 for Unit 1 and Work Order Task 32016815-04, REP-19939-035, and REP-19939-036 for Unit 2. The tests conducted on the new cranes were performed in 2003 and were significantly more extensive than required by ASME B30.2. The acceptance tests included the trolley, bridge, main hoist

and auxiliary hoist and involved verification of the operability of the various safety features, indicating devices, crane controls, limit switches, brakes and holding devices. This included verification that the limit switches would operate properly to prevent the hook or load block from contacting the trolley or crane. A 100% load test and 125% load test were conducted on both the main hook and auxiliary hook and included moving the trolley and bridge through their entire ranges of motion while loaded. Post load test hook inspections were performed including magnetic particle nondestructive testing of the hooks after the 125% load tests.

The brakes drums were replaced in June 2006 and the crane vendor (American Crane Equipment Corporation) performed a functional test per REP-19939-045. Licensee's staff stated that the wind speed instrument had been replaced and that Belfort Instrument Company, Cat. No. 120 and 122, Instruction Book No. 509754 was used to perform the operational/functional test.

Documents Reviewed:

-Procedure QI-3-PSL-1 "Design Control St. Lucie Plant," Appendix F "Implementer Turnover Package (ITOP)," Revision 13
-Work Order Task No. 32016815-04 "Unit 2 Crane Load Test," dated May 11, 2004
-Work Order Task No. 32016943-05 "Unit 1 Crane Load Test," dated June 15, 2004
-REP-19939-019 "Site Acceptance Test Plan for Unit 1 Fuel Cask Crane," Revision 2
-REP-19939-020 "Site Load Test Plan for Unit 1 Fuel Cask Crane," Revision 1
-REP 19939-035 "Site Acceptance Test Plan for Unit 2 Fuel Cask Crane," Revision 2
-REP-19939-036 "Site Load Test Plan for Unit 2 Fuel Cask Crane," Revision 1
-REP-19939-045 "Test Plan for Torque Testing Main Hoist Electric Shoe Brakes," Revision 0
-Work Order Task No. 34016024 05 "Defect Request: U1: CRN 135/R/R Brakes Drums"
-Work Order Task No. 34016024 08 "Defect Request: Wind Speed"
-Belfort Instrument Company, Catalog No. 120 and 122, Instruction Book No. 509754
-ASME B30.2 "Overhead and Gantry Cranes," dated 1976

Category: Crane Inspection/Maintenance ***Topic:*** Hoist Overload Testing

Reference: NUREG 0554, Section 8.3; NUREG 0612, C-4, (9)

Requirement: If the hoisting system is designed with adequate strength to resist failure during load hang-up, the hoisting system should be tested by securing the load-block-attaching points to a fixed anchor and applying the maximum critical load. Alternately, if a load cell system, a motor current-sensing device, or a mechanical load-limiting device is provided to prevent load hang-up, the device(s) should be tested to verify operability.

Finding: The crane design employs an energy controlling device between the load and head blocks. This device was tested as described in Section 8.3 of NUREG 0554. The crane's design also used the NUREG 0554 alternative redundant upper limit switch design for defense in depth to prevent two-blocking. The limit switches were field tested under load and calibrated to trip at 110% of the 150-ton load. During the 125% load test for the Unit 1 & 2 cranes, a jumper wire was installed within the main control circuit to allow the main hoist to lift the 125% load. After the load was lifted, the brakes tested, and the load lowered, the jumper wire was removed and an attempt made to lift the load. Verification was made that the hoisting motion in the up direction was disabled and the

hoist would only operate in the down direction. For the Unit 2 crane, this test was conducted November 4, 2003. For the Unit 1 crane, the test was conducted November 7, 2003.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-NUREG-0554 "Single Failure Proof Cranes for Nuclear Power Plants," dated May 1979
-Work Order Task No. 32016943-05 "Unit 1 Crane Load Test," dated June 15, 2004
-REP-19939-019 "Site Acceptance Test Plan for Unit 1 Fuel Cask Crane," Revision 2
-REP-19939-020 "Site Load Test Plan for Unit 1 Fuel Cask Crane," Revision 1
-Work Order Task No. 32016815-04 "Unit 2 Crane Load Test," dated May 11, 2004
-REP 19939-035 "Site Acceptance Test Plan for Unit 2 Fuel Cask Crane," Revision 2
-REP-19939-036 "Site Load Test Plan for Unit 2 Fuel Cask Crane," Revision 1

Category: Crane Inspection/Maintenance ***Topic:*** Hoist Two-Block Testing - Limit Device Method

Reference: NUREG 0612, C-4, (8)

Requirement: If the hoisting system is provided with a system of upper travel limit switches to prevent two-blocking, the travel limit switches should be tested to verify operability. If the crane is equipped with a load limiter (strain gage, etc.) the load limiter should be tested to verify operability.

Finding: The main hoist limit switch was tested as part of the crane operational testing after the new cranes were installed in 2003 and is documented in Section III.F.4 of the two respective Acceptance Test Plans. The main hoist was run in the up direction until the limit switch tripped the hoist. Verification was made that two-blocking did not occur and that hoist motion was disabled. The crane fault pilot lit and the main hoist paddle limit pilot light properly lit.

Documents Reviewed: -REP-19939-019 "Site Acceptance Test Plan for Unit 1 Fuel Cask Crane," Revision 2
-REP 19939-035 "Site Acceptance Test Plan for Unit 2 Fuel Cask Crane," Revision 2

Category: Crane Inspection/Maintenance ***Topic:*** Hoist Two-Block Testing - Strength Method

Reference: NUREG 0554, Section 8.3; NUREG 0612, C-3 (8)

Requirement: If the hoisting system is equipped with an energy-controlling device between the load and head blocks, the complete hoisting machinery should be allowed to two-block during the hoisting test (load block limit and safety device are bypassed). This test, conducted at low speed without load, should provide assurance of the integrity of the design, the equipment, the controls and the overload protection devices. The test should demonstrate that the maximum torque that can be developed by the driving system, including the inertia of the rotating parts at the over torque condition, will be absorbed or controlled during two-blocking or load hang-up.

Finding: The crane design employs an energy controlling device between the load and head

blocks. A two-block test of the main hoist was successfully performed during factory functional testing in accordance with Section 8.3 of NUREG 0554.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-NUREG-0554 "Single Failure Proof Cranes for Nuclear Power Plants," dated May 1979

Category: Crane Inspection/Maintenance ***Topic:*** Hook Inspections - Frequent

Reference: ASME B30.10, Sections 10-1.4.2 and 10-1.4.6

Requirement: Hooks shall be inspected monthly during normal service, weekly to monthly during heavy service and daily to weekly during severe service. Hooks shall be inspected for: a) distortion such as bending, twisting or increased throat opening; b) cracks, severe nicks, or gouges; c) damaged or malfunctioning latch (if provided); and d) hook attachment and securing means. Hooks having any of the following deficiencies shall be removed from service unless a qualified person approves their continue use and initiates corrective action: a) cracks; b) wear exceeding 10% of the original sectional dimension; c) bend or twist exceeding 10 degrees from the plane of an unbent hook; and d) an increase in throat opening of 15% (for hooks without latches).

Finding: The licensee and the crane manufacturer (ACECO) inspected the crane and its components in accordance with Procedure MMP-74.02. This procedure included steps in which the operators share inspection results with the maintenance supervisor to determine if inspection results are acceptable. In accordance with Work Order Task No. 37006249 01, the licensee also follows OSHA regulations 29 CFR 1910.179, "Overhead and Gantry Cranes," when scheduling cranes and hook inspections. Requirements in 29 CFR 1910.179 are in general agreement with ASME B30.10, Section 10-1.4.2 and 10-1.4.6.

Documents Reviewed: -Procedure MMP-74.02, "Spent Fuel Cask Handling Crane Inspection," Revision 1A
-Work Order Task No. 37006249 01, "Fuel Handling Building Spent Fuel Cask Handling Crane: Inspection," (12 months)

Category: Crane Inspection/Maintenance ***Topic:*** Preventive Maintenance Program

Reference: ASME B30.2; Section 2-2.3.1

Requirement: A preventive maintenance program should be established based on the crane manufacturer's or a qualified person’s recommendations.

Finding: In general, the licensee has incorporated the manufacturer’s recommendations in its preventive maintenance program for the fuel building cranes and has addressed discrepancies between the manufacturer’s recommendations and the St. Lucie’s preventive maintenance program through several condition reports. The licensee incorporated the preventive maintenance bases (PMB) in Passport’s software. The preventive maintenance bases contained the preventive maintenance scope and its

required/suggested frequency. Licensee staff stated that preventive maintenance on the cranes would be performed weekly during fuel movement campaigns and monthly when fuel loading is not underway. Procedure MMP-74.02 is used to perform operational checks prior to using the crane.

Documents Reviewed:

-Procedure 0010431 "Preventive Maintenance Program," Revision 35
-REP-19939-037 "Annual Preventative Maintenance Plan for 150/25-Ton Unit 1 Cask Handling Crane Florida Power & Light St . Lucie Station (PSL)," American Crane & Equipment Corporation, dated July 11, 2003
REP-19939-038 "Annual Preventative Maintenance Plan for 150/25-Ton Unit 2 Cask Handling Crane Florida Power & Light St . Lucie Station (PSL)," American Crane & Equipment Corporation, dated July 11, 2003
-Procedure MMP-74.02 "Spent Fuel Cask Handling Crane Inspection," Revision 1A
-Procedure EMP-74.04 "Cask Crane Annual Inspection," Revision 0
-Condition Report (CR) 2006-21936 "U 1 Cask Crane PM Discrepancies"
-PCR-06-3762, "Bring into Line with ACECO PM and Incorporate Improvements Identified in CR-2006-21936"

Category: Crane Inspection/Maintenance ***Topic:*** Welding

Reference: NUREG 0554, Section 2.8; NUREG 0612, C-3 (3)

Requirement: All welding on load-sustaining members shall be in accordance with American Welding Society (AWS) structural welding code AWS D1.1, except as modified by AWS D14.1. All critical welds (joints whose failure could result in a drop of a critical load) should be post weld heat treated in accordance with AWS D1.1, Subarticle 3.9. As a substitute for post weld heat treatment of crane structures already built or in operation, the critical welds should be nondestructively examined to ascertain that the weldments are acceptable.

Finding: This requirement was not relevant to the crane support structures due to all on-site crane connections being bolted and not welded. The crane was brought to the site and assembled in large modules with bolts alleviating the need to weld structural joints which could lead to a failure involving a critical load.

Documents Reviewed:

Category: Crane Load Testing ***Topic:*** Cold Proof Testing

Reference: NUREG 0554, Section 2.4; NUREG 0612, C-2 (8)

Requirement: Minimum operating temperatures for the crane should be specified to reduce the possibility of brittle fracture of the ferritic load-carrying members of the crane. The minimum temperature can be determined by: 1) a drop weight test per ASTM E-208, 2) a Charpy test per ASTM A-370 or 3) a 125% cold proof test. If the crane is made of low alloy steel such as ASTM A514, cold proof testing should be done. If cold proof testing is omitted, the default minimum crane operating temperature is 70 degrees F. For crane operation at temperatures below 70 degrees F, cold proof testing must be performed and the ambient temperature at which the testing is conducted becomes the minimum crane operating temperature.

Finding: The minimum operating temperature was determined through Charpy tests by the crane and yoke manufacturer. The Charpy tests were performed at -2 degree F for crane components and at 0 degree F for the yoke. A review of site weather conditions in the Updated Final Safety Analysis Report for Unit 2, Section 2.3.2.1.2, "Temperature and Atmospheric Water Vapor," determined that the lowest temperature that has been recorded at the St. Lucie site was 28 degree F, well above the Charpy Test temperatures. Based on the Charpy test results, the St. Lucie cranes would be operable year round for cask loading activities.

Documents Reviewed:
-Work Order 20016 "American Crane and Equipment Corporation Commercial Grade Dedication Evaluation, Project: Palo Verde Units 1 and 2 (SFP Trolleys)"
-Purchase Order L27746 "Certificate of Compliance (10 CFR Part 50, Appendix B Orders, 10 CFR Applies), Certified Test Report MUS001-02-07-16889"
-Purchase Order L27743 "Certificate of Compliance (10 CFR Part 50, Appendix B Orders, 10 CFR Applies), Certified Test Report MUS001-02-07-16887"
-Purchase Order L27741 "Certificate of Compliance (10 CFR Part 50, Appendix B Orders, 10 CFR Applies), Certified Test Report MUS001-02-07-16890"
-Purchase Order L35526 "Certificate of Compliance (10 CFR Part 50, Appendix B Orders, 10 CFR Applies), Certified Test Report MUS001-02-10-24742"
-Purchase Order 20070093-1 "Certified Test Report CPS001-07-05-14575-1"
-Purchase Order 20070093-2,3 "Certified Test Report CPS001-07-05-12809-1"
-Material Test Report 0000032258 "Heavy Hexagonal Nut"
-Material Test Report 0000032268 "Heavy Hexagonal Structural Bolt"
-Material Test Report 0000032259 "Heavy Hexagonal Nut"
-Material Test Report 0000032267 "Heavy Hexagonal Structural Bolt"
-Updated Final Safety Analysis Report (UFSAR) for Saint Lucie Nuclear Power Station (Unit 1), Revision 22
-Updated Final Safety Analysis Report (UFSAR) for Saint Lucie Nuclear Power Station (Unit 2), Revision 17
-American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-ND-2226.4-ND-2311, ND-2311 "Material for Which Impact Testing is Required," 1986 Edition.
-ND-2226.4-ND-2331, ND-2331 "Pressure Retaining Material Other Than Bolting," 1986 Edition.-Purchase Order

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Category: Crane Load Testing ***Topic:*** Dynamic Load Testing

Reference: NUREG 0554, Section 8.2

Requirement: After the 125% static load test, the crane should be given a full performance test with 100% of the maximum critical load attached, for all speeds and motions for which the system is designed. This should include verifying all limiting and safety control devices. The features provided for manual lowering of the load and manual movement of the bridge and trolley during an emergency should be tested with the maximum critical load attached.

Finding: The trolley was static load tested at 125% load at the factory. At the site, the 100% load

test was performed first, followed by the 125% load test. Both the 100% load test and 125% load test included testing the brakes, moving the load across the entire span of the bridge and moving the bridge the full length of the runway. During the 100% load test, manual lowering of the load was performed for a distance of 4 feet using the hand pump and manual control knob on the hydraulic brake power unit.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-REP-19939-020 "Site Load Test Plan for Unit 1 Fuel Cask Crane," Revision 1
-REP-19939-036 "Site Load Test Plan for Unit 2 Fuel Cask Crane," Revision 1

Category: Crane Load Testing ***Topic:*** Hook Load Testing

Reference: NUREG 0554, Sect 4.3; ASME B30.10, Sect 10-1.1.2

Requirement: A 200% static load test should be performed for each load-attaching hook. For a duplex (sister) hook, the proof load shall be shared by the two sisters unless the hook is designed for unbalanced loading. Measurements of the geometric configuration of the hooks should be made before and after the test and the acceptance criteria is no permanent increase in throat opening in excess of 0.5% or 0.010 inches (0.25 mm). The load testing should be followed by a nondestructive examination that should consist of volumetric and surface examinations to verify the soundness of fabrication and ensure integrity of the hooks.

Finding: Prior to delivery to St. Lucie, a 200% (300 ton) static load test was performed on each load attaching point, the hook prongs, and pin hole for the main hoist. Measurements of the geometric configuration of each hook was made before and after the test. Hook nondestructive testing was performed including an ultrasonic testing of the base material prior to load testing followed by magnetic particle (MT) testing of the surface after the 200% load test.

During the 100% load test and 125% load test at the St. Lucie site, the hook throat opening was monitored. The main hook, for both the Unit 1 and Unit 2 hooks, had a throat opening measurement of 15.5" before each test. The opening size did not change after the load tests. After the 125% load test, a magnetic particle nondestructive test was performed on both hooks on November 11, 2003. The acceptance criteria listed in Section II.K.3 of REP-19939-020 and REP-19939-036 were no linear indications parallel to the hook contour greater than 1/8 inch long whose length is equal to or greater than 3 times its width. Indications transverse to the hook contour and/or cracks were not acceptable. The results of the magnetic particle tests were attached to REP-19939-020 for Unit 1 and REP-19939-036 for Unit 2. The hooks were found to meet the acceptance criteria.

Documents Reviewed: -American Crane & Equipment Corp. Report REP-19939-009 "NUREG 0554 Compliance Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)
-American Crane & Equipment Corp. Report REP-19939-014 "NUREG 0554 Safety Analysis Report for Fuel Cask Cranes Single Failure Proof Replacement Bridge Cranes at St. Lucie Units 1 & 2 Nuclear Generating Station," Revision 1 (Proprietary)

-REP-19939-020 "Site Load Test Plan for Unit 1 Fuel Cask Crane," Revision 1
-REP-19939-036 "Site Load Test Plan for Unit 2 Fuel Cask Crane," Revision 1

Category: Crane Load Testing ***Topic:*** Maximum Weight of Canister

Reference: N/A

Requirement: The maximum weight of the transfer cask containing the canister filled with water and fuel (including dynamic loads) that will be lifted by the crane is to be verified to be within the crane's rated capacity.

Finding: The spent fuel cask crane was rated for 150 tons with a yoke rated for 125 tons. Table 3.2.2 of the CoC 72-1030 FSAR lists the weight of an OS187H transfer cask loaded with spent fuel as 114.3 tons. At St. Lucie, the heavy lift of a loaded cask from the spent fuel building to the cask handling facility involved a fully loaded transfer cask filled with water. During the lift of the first loaded cask, the load cell on the crane indicated a reading of 119.5 tons. The load cell weight included the added weight of the yoke, rope and water in the canister.

Documents Reviewed: Certificate of Compliance 72-1030, Final Safety Analysis Report (FSAR), Revision 1

Category: Crane Load Testing ***Topic:*** Rated Load Marking

Reference: NUREG 0554, Section 8.5; ASME B30.2, Sect 2-1.1.1

Requirement: The rated load shall be marked on each side of the crane and, if the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or on its load block. This marking shall be legible from the ground or floor.

Finding: The 150-ton crane rating was properly labeled on the crane.

Documents Reviewed: N/A

Category: Crane Load Testing ***Topic:*** Static Load Testing

Reference: NUREG 0554, Section 8.2

Requirement: The crane should be static load tested at 125% of the maximum critical load. The test should be conducted at all positions generating maximum strain in the bridge and trolley structures and other positions as recommended by the designer or manufacturer.

Finding: An extensive load test program was established to test the new Unit 1 and Unit 2 spent fuel building cranes. This included pre-operational inspections of the crane's electrical, hydraulic and structural components; inspection of the rope, hook and yoke, including measurements of the hook throat openings; inspection of the brakes and safety systems; and the full range of movements of the trolley, bridge and hook. The 125% load test for the Unit 1 crane was conducted on November 7, 2003 using a test load of 376,014 lbs (188 tons). This met the 125% load test requirement (i.e. 125% x 150 tons = 187.5 tons). The Unit 2 crane was tested on November 4, 2003 using a 375,800 lb (187.9 ton) test weight. The trolley and bridge were moved through their full range of motions that would be experienced during the fuel cask movement activities.

Documents Reviewed:
-REP-19939-019 "Site Acceptance Test Plan for Unit 1 Fuel Cask Crane," Revision 2
-REP-19939-020 "Site Load Test Plan for Unit 1 Fuel Cask Crane," Revision 1
-REP 19939-035 "Site Acceptance Test Plan for Unit 2 Fuel Cask Crane," Revision 2
-REP-19939-036 "Site Load Test Plan for Unit 2 Fuel Cask Crane," Revision 1

Category: Crane Operation ***Topic:*** Minimum of Two Wraps of Rope

Reference: ASME B30.2, Section 2-3.2.3 (h)

Requirement: The load shall not be lowered below the point where two wraps of rope remain on each anchorage of the hoisting drum unless a lower-limit device is provided, in which case no less than one wrap shall remain.

Finding: Verification that at least two full wraps of rope were left on the drum was performed during the crane acceptance testing in 2003. This was documented in REP-19939-019 for Unit 1 and REP-19939-035 for Unit 2 during the main hoist low-low limit key switch test.

Documents Reviewed:
-REP-19939-019 "Site Acceptance Test Plan for Unit 1 Fuel Cask Crane," Revision 2
-REP 19939-035 "Site Acceptance Test Plan for Unit 2 Fuel Cask Crane," Revision 2

Category: Crane Operation ***Topic:*** Qualification For Crane Operator

Reference: ASME B30.2, Sections 2-3.1.2 and 2-3.1.6

Requirement: Qualification to operate a cab-operated or remote-operated crane requires the operator to pass a written or oral examination and a practical operating examination specific to the type of crane to be operated. In addition, the operator shall: a) have vision of at least 20/30 Snellon in one eye and 20/50 in the other with or without corrective lenses; b) be able to distinguish colors regardless of their position; c) have sufficient hearing capability for the specific operation with or without hearing aids; d) have sufficient strength, endurance, agility, coordination and reaction speed for the specific operation; e) not be subject to seizures, loss of control or dizziness; and f) have normal field of vision and depth perception.

Finding: Procedure 0010438, Section 8.1, "Crane Operator Qualification," stated that operators' eye exam would be successful with a vision of at least 20/40 in both eyes, with or without corrective lenses and physically fit without evidence of heart problems or seizures. The requirement for vision of 20/40 was not consistent with the ASME 20.2 requirement of 20/30 Snelling in one eye and 20/50 in the other. The physical examination criteria for the crane operators used by the FPL's clinic referenced ASME B30.2. The licensee issued Condition Report (CR) 2008-6488 to address consistency between Procedure 0010438, the physical examination criteria for the crane operators, and the ASME B30.2 standard. The other requirements in ASME B30.2 were adequately incorporated into the licensee's procedure.

Documents Reviewed:
-Physician Examination Criteria," FPL Medical Clinic," dated August 22, 2006
-Procedure 0010438 "Control of Heavy Loads," Revision 45
-Plant Training Material-IM No. 1302060, "Control of Heavy Loads," dated 3/9/2007.
-Learning Management System Output, "Learner Curriculum Item Status" (Crane Operators Qualifications)

-Condition Report (CR) 2008-6488 "AP-0010438, Control of Heavy Loads, Section 8.1.A, Annual Physical and Eye Exam"
-ASME B30.2 "Overhead and Gantry Cranes," dated 1976

Category: Crane Operation ***Topic:*** Warning Signals

Reference: ASME B30.2, Section 2-3.1.7 (e)

Requirement: If a warning device is furnished. It shall be activated each time before traveling, and intermittently when approaching workpersons.

Finding: The crane provides intermittent beeping whenever the crane was traveling. The crane was also equipped with a red light and a blue light. The red light was illuminated when the "load" was lifted and the operator was in the cab. The blue light was illuminated when the "load" was lifted and the operator was using the remote controls. During the dry run demonstrations, the area under the lift was roped off to keep personnel not involved with the lift out of the work area.

Documents Reviewed: Direct observation

Category: Drying/Helium Backfill ***Topic:*** Drying Final Pressure

Reference: CoC 1030, Tech Spec 3.1.1

Requirement: The 32PTH canister vacuum drying pressure shall be sustained at or below 3.0 torr (3 mm Hg) absolute for a period of at least 30 minutes following evacuation.

Finding: Procedure MMP-116.12, Step 6.11.13 required a final vacuum drying pressure of less than 2000 mtorr for 30 minutes. This is more conservative than the required 3 torr (3000 mtorr) in the technical specification to account for instrument error on the measuring devices.

Documents Reviewed: Procedure MMP-116.12 "ISFSI Dry Shielded Canister Sealing Operations," Revision 0

Category: Drying/Helium Backfill ***Topic:*** Drying Time Limits - Procedure C

Reference: CoC 1030, Tech Spec 3.1.1

Requirement: Technical Specification 3.1.1 establishes vacuum drying time limits for the canister based on the cask heat load, water temperature (180 degree limit) in the transfer casks, and when water is drained from the transfer cask cavity/annulus. Three situations are described and designated as Procedure A, B, or C with different criteria than can be selected by the licensee.

Finding: Procedure MMP-116.12 specified the use of Technical Specification LCO 3.1.1, "Procedure C," which is implemented by using a helium cover gas to facilitate the pumpdown and maintain the transfer cask annulus temperature below 180 degree F until such time that the transfer cask annulus is drained to facilitate canister heatup for vacuum drying. Procedure C specifies that for canisters with a heat load of less than 22.4 kW, there was no time limit for completing vacuum drying. For canisters over 22.4 kW, there was a 42-hour limit after the canister is drained or a 28-hour limit when the transfer cask cavity/annulus was drained, which ever was more limiting. Procedure

MMP-116.12 contained actions within Step 6.8, "Removing DSC Bulk Water using Pumpdown Method," to determine the vacuum drying time limitation based on the technical specification requirement and the heat load for each canister. Since the total heat load for each of the canisters being loaded in this initial loading campaign was less than 22.4 kW (see Table 4 of Calculation PSL-1FJF-07-002), the technical specification did not require a time limit for vacuum drying the canisters currently being loaded.

For the first canister loaded (DSC-2) at St. Lucie, the drying time was approximately 26 hours. The water in the transfer cask annulus was measured on an hourly basis throughout the time water was present and documented on Appendix B "Transfer Cask Annulus Water Temperature Control" to Procedure MMP-116.12. Initial water temperature was 90 degree F. Over the 80-hour period, the temperature eventually peaked at 136 degree F. A very slow rate of temperature increase was observed, averaging about 0.5 degree F/hour.

Documents Reviewed: -Procedure MMP-116.12 "ISFSI Dry Shielded Canister Sealing Operations," Revision 0
-Calculation PSL-1FJF-07-002 "St. Lucie Unit 1 - Irradiated Fuel Assembly Selection for Initial Dry Cask Loading Campaign," Revision 1

Category: Drying/Helium Backfill ***Topic:*** Helium Backfill Final Pressure

Reference: CoC 1030, Tech Spec 3.1.2

Requirement: The 32PTH helium backfill pressure shall be 1.5 to 3.5 psig and stable for 30 minutes after filling after completion of vacuum drying.

Finding: Procedure MMP-116.12, Steps 6.15.6 through 6.15.12 established the helium backfill pressure requirement as 2.5 psig +/- 0.5 psig, stable for 30 minutes after filling.

Documents Reviewed: Procedure MMP-116.12 "ISFSI Dry Shielded Canister Sealing Operations," Revision 4

Category: Drying/Helium Backfill ***Topic:*** Helium Pressure Test

Reference: FSAR 1030, Section 8.1.1.3.19a

Requirement: Following initial evacuation, backfill the canister with helium to 16.5 to 18.0 psig and hold for 10 minutes.

Finding: Procedure MMP-116.12, Steps 6.12.13, 6.12.14 and 6.12.15, required the canister to be backfilled with helium to a pressure of 16.75 to 17.75 psig for 10 minutes.

Documents Reviewed: Procedure MMP-116.12 "ISFSI Dry Shielded Canister Sealing Operations," Revision 0

Category: Drying/Helium Backfill ***Topic:*** Helium Purity

Reference: FSAR 1030, Section 8.1.1.3.14

Requirement: All helium used in backfilling operations shall be at least 99.99% pure.

Finding: The license purchased standard grade helium from a vendor for use in backfilling the canisters. The licensee had the purity of the helium confirmed using an independent analytical laboratory using gas chromatography and other analytical techniques against

certified standards. The Certificate of Analysis from the independent laboratory for three helium cylinders was reviewed. The analysis for all three cylinders confirmed the helium gas exceeded 99.999% purity.

Documents Reviewed: -Matheson Tri-Gas, Purchase Order 00110686 "Certificate of Analysis," dated March 6, 2008
-FPL/FPLE QA Surveillance 08.06.MTGIL.08.1(A) of Mathison Tri-Gas dated March 6, 2008

Category: Emergency Planning ***Topic:*** Emergency Plan

Reference: 10 CFR 72.32(c)

Requirement: For an ISFSI that is located on the site of a nuclear power plant licensed for operation, the Emergency Plan required by 10 CFR 50.47 shall be deemed to satisfy the requirements of this section.

Finding: The St. Lucie Radiological Emergency Plan identified the ISFSI in Table 3-1 "Emergency Classification Table." Emergency Plan Implementing Procedure - 01, Sections 4.2, "Emergency Classes," and Section 4.3, "Classification Table," described the Emergency Action Levels (EALs) for the St. Lucie site. An EAL for an Unusual Event was included for ISFSI-related accidents.

Documents Reviewed: -Radiological Emergency Plan, Revision 52
-Emergency Plan Implementing Procedure - 01, Revision 15

Category: Emergency Planning ***Topic:*** Emergency Plan Changes

Reference: 10 CFR 72.44(f)

Requirement: Within six months of any changes made to the emergency plan, the licensee shall submit a report containing a description of the changes to the appropriate regional office and headquarters.

Finding: The licensee complied with 10 CFR 50.4, which requires a change to the emergency plan be submitted to the NRC within thirty days. Compliance with 10 CFR 50.4 satisfies the requirements of 10 CFR 72.44(f). Revisions 51 of the St. Lucie Radiological Emergency Plan was reviewed. Revision 51 was implemented on December 27, 2007. The change was submitted to the NRC via letter dated January 15, 2008, well within the 30-day requirement. Revision 52 was recently issued and the submittal to the NRC was scheduled to be transmitted to the NRC by April, 3, 2008, within the 30-day requirement of 10 CFR 50.4.

Documents Reviewed: Radiological Emergency Plan, Revision 52

Category: Fire Protection ***Topic:*** Fire Protection Plan

Reference: 10 CFR 50.48(a)(1)

Requirement: Each operating nuclear power plant must have a fire protection plan that satisfies Criterion 3 of Appendix A to Part 50. This fire protection plan must describe the overall

fire protection program for the facility.

Finding: Fire protection planning for St. Lucie, Unit 2 was described in Administrative Procedure 2-1800023. Appendix I included planning for response to a fire associated with ISFSI activities and movement of a loaded cask between the cask handling building and the ISFSI. During the dry run activates observed by the NRC, the licensee stationed personnel along the transport route with instructions to keep vehicles and personnel away from the cask during transport. This ensured that no unanalyzed combustionable sources were introduced to the transport route due to other site activities. Arrangements were established for emergency personnel to have access to the ISFSI area. Annual training, site tours and fire drills related to the ISFSI operations had been coordinated with offsite fire department.

Documents Reviewed:
- Administrative Procedure 2-1800023 "Unit 2 Fire Fighting Strategies," Revision 28
- St. Lucie Plant Training Report "Local Fire Department Overview of Plant ISFSI Facility and Site Location," dated Feb. 18, 2008, Feb. 19, 2008, and Feb. 20, 2008
- Annual Fire Drill with St. Lucie County Fire Department, dated September 6, 2007

Category: Fire Protection ***Topic:*** Offsite Emergency Support

Reference: 10 CFR 72.122(g)

Requirement: Structures systems and components important to safety must be designed for emergencies. The design must provide accessibility to emergency equipment, facilities and services such as hospitals, fire and police departments, ambulance services, and other emergency agencies.

Finding: The licensee's plans for responding to an emergency at the site, including the ISFSI and during transport of a loaded cask to the ISFSI, included arrangements for notifying offsite emergency response organizations (i.e. ambulance and fire department) and for response personnel to have access to the ISFSI area. Administrative Procedure 2-1800023, Appendix I described the emergency response plans related to the ISFSI. Annual training, site tours and fire drills related to the ISFSI operations have included coordination with offsite response organizations.

Documents Reviewed:
- Administrative Procedure 2-1800023 "Unit 2 Fire Fighting Strategies," Revision 28
- St. Lucie Plant Training Report "Local Fire Department Overview of Plant ISFSI Facility and Site Location," dated February 18, 2008, February 19, 2008, and February 20, 2008
- Annual Fire Drill with St. Lucie County Fire Department, dated September 6, 2007

Category: Fuel Selection/Verification ***Topic:*** Approved Contents

Reference: CoC 1030, Tech Spec 2.1.d

Requirement: The 32PTH canister is authorized for storage of 32 intact fuel assemblies, or up to 16 damaged fuel assemblies with the balance being intact assemblies.

Finding: The limit of 16 damaged fuel assemblies per canister was specified in Engineering Package PC/M 07130 and was verified in the loading patterns described in Attachment 1 to PC/M 07130 and Calculation PSL-1FJF-07-002.

Documents Reviewed: -Engineering Package (EP) - PC/M 07130 "Fuel Selection and Initial Dry Cask Loading Campaign at St. Lucie Unit 1," Revision 6
-Calculation PSL-1FJF-07-002 "St. Lucie Unit 1 - Irradiated Fuel Assembly Selection for Initial Dry Cask Loading Campaign," Revision 1

Category: Fuel Selection/Verification ***Topic:*** Approved Spent Fuel Types

Reference: CoC 1030, Tech Spec 2.1.b

Requirement: Spent fuel assemblies authorized for storage in the 32PTH are limited to the fuel types specified in Table 1. Equivalent reload fuel assemblies that are enveloped by the fuel assembly design characteristics listed in Table 2 for a given fuel assembly class are also acceptable for storage.

Finding: The fuel-related specifications in Table 1 of Calculation PSL-1FJF-07-002, were reviewed and were found to reflect the requirements of Tables 1 and 2 referenced in Technical Specification 2.1.b.

Documents Reviewed: Calculation PSL-1FJF-07-002 "St. Lucie Unit 1 - Irradiated Fuel Assembly Selection for Initial Dry Cask Loading Campaign," Revision 1

Category: Fuel Selection/Verification ***Topic:*** Classifying Damaged Fuel

Reference: Interim Staff Guidance ISG-1

Requirement: The process for classifying spent fuel as intact or damaged should be consistent with Interim Staff Guidance ISG-1. Fuel assemblies discharged from operating cycles with no chemistry indications of cladding breaches may be classified as intact without further evaluation. Fuel assemblies discharged from operating cycles with chemistry indications of cladding breaches shall be classified as damaged, pending fuel sipping or ultrasonic testing results confirming the fuel assembly has not experienced cladding failure. Fuel assemblies with visible cladding breaches shall be classified as damaged.

Finding: Table 3 of Calculation PSL-1FJF-07-002 classified each of the 192 assemblies, identified as candidates for loading, as either "intact" or "damaged." The classification of each "intact" assembly was based on post-discharge sipping and/or post-discharge ultrasonic testing or by reactor coolant system chemistry analysis. These methods were consistent with the guidance in ISG-1. The first canister loaded at St. Lucie included only intact fuel assemblies.

Documents Reviewed: -Calculation PSL-1FJF-07-002 "St. Lucie Unit 1 - Irradiated Fuel Assembly Selection for Initial Dry Cask Loading Campaign," Revision 1
-NRC Interim Staff Guidance (ISG) - 1 "Damaged Fuel," Revision 1

Category: Fuel Selection/Verification ***Topic:*** Decay Heat Load

Reference: CoC 1030, Tech Spec 2.1.c

Requirement: The maximum heat load for a single fuel assembly, including insert components, is 1.5 kW. The maximum heat load for a 32PTH canister is 33.8 kW for CE 14 X 14 fuel assemblies.

Finding: Engineering Package PC/M 07130 established the conditions for St. Lucie Unit 1's first loading campaign which will consist of six- PTH type C canisters loaded with both intact or damaged CE 14 x 14 fuel assemblies. Calculation PSL-1FJF-07-002 verified that the calculated maximum heat load for each individual assembly selected for this first loading campaign was below 1.5 kW. Attachment 1 "Fuel Loading Pattern - DSC" listed each individual assembly showing their calculated heat load. Table 4 documented the calculated total heat load for each of the six canister to be loaded in this first campaign. All canisters were below the Technical Specification limit of 33.8 kW.

Procedure 1-NOP-116.01 was used by the licensee to load the first canister (DSC-2) on March 10, 2008. The heat load for the 32 spent fuel assemblies loaded in canister DSC-2 ranged from 0.3982 kW to 0.5969 kW. The total heat load of the canister was 15.517 kW.

Documents Reviewed: -Procedure 1-NOP-116.01 "Dry Shielded Canister Fuel Loading, St. Lucie Unit 1," Revision 2
-Engineering Package (EP) - PC/M 07130 "Fuel Selection and Initial Dry Cask Loading Campaign at St. Lucie Unit 1," Revision 6
-Calculation PSL-1FJF-07-002 "St. Lucie Unit 1 - Irradiated Fuel Assembly Selection for Initial Dry Cask Loading Campaign," Revision 1

Category: Fuel Selection/Verification ***Topic:*** Fuel Design Characteristics

Reference: CoC 1030, Tech Spec 2.1.e

Requirement: Spent fuel assemblies authorized for storage in the 32PTH are limited to the design characteristics (dimensions and weights) specified in Table 2.

Finding: The dimensions and weights specified in Table 2 of Technical Specification 2.1.e were verified to be the limiting characteristics incorporated in Calculation PSL-1FJF-07-002.

Documents Reviewed: Calculation PSL-1FJF-07-002 "St. Lucie Unit 1 - Irradiated Fuel Assembly Selection for Initial Dry Cask Loading Campaign," Revision 1

Category: Fuel Selection/Verification ***Topic:*** Loading Configurations

Reference: CoC 1030, Tech Spec 2.1.b and c

Requirement: Fuel assemblies may be qualified for four (4) heat load zones designated as Zones 1a, 1b, 2, and 3. Figure 2 shows the heat load zone locations. Table 4 identifies the acceptable combinations of enrichment, burnup and cooling times for each heat load zone.

Finding: Engineering Package PC/M 07130 established the technical specification heat load zone requirements and used the fuel burnup, cooling time, and enrichment limits in Table 4 of the technical specifications for the selection of the assemblies to be inserted into each load zone. The specific loading patterns for each canister were established in the Calculation PSL-1FJF-07-002. The criteria used was consistent with the requirements in Technical Specification 2.1.b and c including heat load, fuel burnup, cooling time, enrichment limits, and a prohibition on loading fuel assemblies with non-fuel assembly hardware. The loading pattern used for the loading of the first canister on March 10, 2008, as identified in Data Sheet #2 "DSC Loading Diagram" and Data Sheet #6 "Fuel

Movement Data Sheet" of completed Procedure 1-NOP-116.01 was compared to the fuel loading pattern specified in PC/M 07130, Attachment 1 "Fuel Loading Pattern-DSC2" and was found to be consistent.

Documents Reviewed:
-Engineering Package (EP) - PC/M 07130 "Fuel Selection and Initial Dry Cask Loading Campaign at St. Lucie Unit 1," Revision 6
-Calculation PSL-1FJF-07-002 "St. Lucie Unit 1 - Irradiated Fuel Assembly Selection for Initial Dry Cask Loading Campaign," Revision 1
-Procedure 1-NOP-116.01 "Dry Shielded Canister Fuel Loading," Revision 2

Category: Fuel Selection/Verification ***Topic:*** Non-Fuel Assembly Hardware

Reference: CoC 1030, Tech Spec 2.1.b

Requirement: Non-Fuel Assembly Hardware (NFAH) stored integral to the assemblies shall be limited to Burnable Poison Rod Assemblies (BPRAs), Thimble Plug Assemblies (TPAs), and Vibration Suppressor Inserts (VPIs). The NFAH stored shall have acceptable combinations of burnup and cooling time described in Table 5. CE 14 X 14 fuel assemblies are stored without NFAH.

Finding: Technical Specification 2.1.b does not allow CE 14 x 14 fuel assemblies to be stored with non-fuel assembly hardware (NFAH). Engineering Package PC/M 07130 did not allow non-fuel assembly hardware in any of the 192 fuel assemblies selected to be loaded into the six canisters planned for the initial loading campaign.

The Engineering Package stated that lumped burnable absorber rods (LBAR) displaced fuel rods in certain St. Lucie reload batches and therefore were not considered non-fuel assembly hardware. This was established in Calculation PSL-1FJF-07-002 where the implication of loading CE 14 x 14 fuel assemblies containing lumped burnable absorber rods was evaluated. The calculation stated that another calculation, performed by Transnuclear, found that the effects of loading 32 CE-type assemblies, each containing 16 lumped burnable absorber rods, was insignificant relative to the Safety Analysis Report evaluation of criticality, shielding and internal canister pressure. Therefore, Calculation PSL-1FJF-07-002 concluded that the existing analyses and analysis assumptions in the Safety Analysis Report remain valid and that the St. Lucie Unit 1 fuel remains bounded by the Safety Analysis Report for CoC 1030 as long as the total number of lumped burnable absorber rods per canister remained below 512 (16 lumped burnable absorber rods/assembly x 32 assemblies/canister). Calculation PSL-1FJF-07-002 stated that the storage pattern for the initial Unit 1 cask loading campaign conformed to the limit of 512 lumped burnable absorber rods per canister.

Documents Reviewed:
-Engineering Package (EP) - PC/M 07130 "Fuel Selection and Initial Dry Cask Loading Campaign at St. Lucie Unit 1," Revision 6
-Calculation PSL-1FJF-07-002 "St. Lucie Unit 1 - Irradiated Fuel Assembly Selection for Initial Dry Cask Loading Campaign," Revision 1

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Category: Fuel Selection/Verification ***Topic:*** Spent Fuel Assembly Mis-Loading

Reference: FSAR 1030, Sect 8.1.1.2.7; CoC 1030, TS Spec 2.2

Requirement: After all assemblies have been placed in the canister, verify their identities. If any functional or operating limit of Technical Specification 2.1, "Fuel To Be Stored In The 32PTH Canister", is violated, the following actions shall be completed: a) the affected fuel assemblies shall be placed in a safe condition, b) within 24 hours, notify the NRC Operations Center, c) within 30 days, submit a special report which describes the cause of the violation and the actions taken to restore compliance and prevent recurrence.

Finding: The requirement to perform post loading verification of the assemblies was implemented in Steps 6.2.10 and 6.2.11 of Procedure 1-NOP-116.01. The requirement for notification of a mis-loading was incorporated into Administrative Procedure 0010721, Appendix K "ISFSI Related Non-Routine Reports." This appendix included the requirement to place the affected fuel assemblies in a safe condition if a functional or operational limit of Technical Specification 2.1 was discovered. The 24-hour notification to the NRC as an ENS notification and a 30-day written notification were specified.

Documents Reviewed: -Procedure 1-NOP-116.01 "Dry Shielded Canister Fuel Loading, St. Lucie Unit 1," Revision 2
-Administrative Procedure 0010721 "NRC Required Non-Routine Notifications and Reports," Revision 62

Category: General License ***Topic:*** Cask Design Compatible With Part 50

Reference: 10 CFR 72.212(b)(4)

Requirement: Prior to use of the general license, determine whether activities related to storage of spent fuel involve a change in the facility technical specifications or require a license amendment for the facility pursuant to Part 50.59(c)(2). Results of this determination must be documented in the 10 CFR 72.212 Evaluation Report.

Finding: Section 4.5 of the 72.212 evaluation report documented the performance of 10 CFR 50.59 evaluations for spent fuel movement associated with Unit 1. The 50.59 evaluation concluded that no Part 50 technical specification change was required nor was a licenses amendment required. The 50.59 evaluation, PSL-ENG-ISFS-08-001, was reviewed and no concerns were identified with the analysis.

Documents Reviewed: -PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0
-PSL-ENG-ISFS-08-001 "ISFSI Dry Cask Storage Loading and Unloading Operations"

Category: General License ***Topic:*** Dose to the Public - Normal Operations

Reference: 10 CFR 72.212(b)(2)(i)(C); 10 CFR 72.104(a)

Requirement: The general licensee shall perform a written evaluation that establishes that the requirements of 10 CFR 72.104, "Criteria for Radioactive Materials in Effluents and Direct Radiation from an ISFSI", have been met. 10 CFR 72.104 requires the annual dose equivalent to any real individual located beyond the controlled area must not exceed 25 mrem to the whole body during normal operations and anticipated occurrences.

Finding: Section 4.3 of the 72.212 evaluation report addressed the issue of compliance with 10 CFR 72.104 criteria and concluded that the St. Lucie ISFSI complies with all requirements.

After the first canister was placed in the ISFSI, dose rate measurements were taken around the ISFSI fence at numerous locations. The typical dose rate measured was 0.006 mR/hr (6 microR/hr) at the fence boundary, which is background levels. The highest reading was 0.015 mR/hr, which is 0.009 mR/hr over background.

Documents Reviewed: -PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0
-HP Survey Form-170 "ISFSI," completed March 15, 2008

Category: General License ***Topic:*** Evaluation Report Changes

Reference: 10 CFR 72.212(b)(2)(ii)

Requirement: Changes to the approved 72.212 evaluation report shall be made using the requirements of 72.48(c). A copy of the completed 72.48 evaluation shall be retained until spent fuel is no longer stored under the general license issued.

Finding: The above-referenced document addressed the performance of 10 CFR 72.212 evaluations. Step 5.5 of the procedure addressed the need to perform a 72.48 review for changes made to the 72.212 evaluation after initial issuance.

Documents Reviewed: ENG-QI 2.10 "10 CFR 72.212 Evaluation," Revision 0

Category: General License ***Topic:*** HSM - Storage Pad Soil Liquefaction

Reference: CoC 1030, Tech Spec 4.2.2

Requirement: For sites for which soil-structure interaction is considered important, the license is to perform site-specific analysis considering the effects of soil structure interaction (SSI). Amplified seismic spectra at the location of the HSM-H center of gravity (CG) is to be developed based on the SSI responses. The storage pad location shall have no potential for liquefaction at the site-specific level earthquake.

Finding: Section 4.2.4 of the 72.212 evaluation report addressed the issue of liquefaction. Based on a specific analysis for liquefaction potential at the ISFSI, it was concluded that the engineered soil column (upon which the ISFSI pad sits) is not liquefiable.

Documents Reviewed: PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0

Category: General License ***Topic:*** HSM Storage Arrays

Reference: CoC 1030, Tech Spec 4.6.1

Requirement: HSM-Hs are placed together in single rows or in back-to-back arrays. An end shield wall is placed on the outside of any loaded outside HSM-H. A rear shield wall is placed on the rear of any single row loaded HSM-H.

Finding: Attachment 1, CoC Section 4.6.1, of the 72.212 evaluation report, stated that the ISFSI was comprised of back-to-back arrays and therefore utilized end shield walls. Physical inspection by the inspector of the HSM-Hs placed to-date on the ISFSI pad verified that the back-to-back array configuration was the one in use and that end shield walls were in place.

Documents Reviewed: PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0

Category: General License ***Topic:*** Reactor Site Parameters - Fire and Explosion

Reference: CoC 1030, TS 4.6.3.6; FSAR 1030, Sect 4.1.1.1

Requirement: The potential for fires and explosions shall be addressed, based on site-specific considerations. The bounding condition assumed in the fire accident analysis is a 300-gallon diesel fuel fire engulfing the transfer cask for 15 minutes at a temperature of 1,475 degrees F. The bounding condition assumed in the explosion analysis is a blast force of less than 1.0 psi. The general license shall determine whether the site fire and explosion hazards are enveloped by the cask design basis. This determination must be documented in the 72.212 evaluation report.

Finding: Engineering evaluations for the fire/explosion hazards analyses were detailed and used a systematic approach to evaluate all potential fixed and transient fire/explosion hazards. Conservative and appropriate assumptions involving administrative controls were placed in the appropriate ISFSI operating procedures.

Documents Reviewed: -PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0
-Calculation FPL009-CALC-011 "Explosion Hazard Calculation for the PSL ISFSI Cask Hauling and Storage," Revision 0
-Calc FPL009-CALC-010 "Fire Hazards Evaluation for the St. Lucie ISFSI Cask Hauling and Storage," Revision 0
-Procedure MMP-116.14 "ISFSI DSC Transport from CHF to HSM," Revision 1

Category: General License ***Topic:*** Reactor Site Parameters - Flood Conditions

Reference: CoC 1030, Tech Spec 4.6.3.2; 10 CFR 72.212(b)(2)

Requirement: The NUHOMS HD System is certified for use at reactor sites with maximum flood levels of 50 feet, and maximum water velocities of 15 feet per second. The user shall verify the site-specific maximum flood levels and water velocities are within the limits of the certification, and shall document that verification in the 72.212 evaluation report.

Finding: Section 4.4.2 of the 72.212 evaluation report addressed the issue of flooding. The ISFSI pad surface was located at approximately 18 feet. The maximum surge height of water from a hurricane was 17.2 feet. Although refracted waves from the intake canal would reach the ISFSI pad at an elevation about 2.5 inches above the ISFSI pad surface, the stillwater elevation was still below the ISFSI pad surface, and any resulting water surge was not sufficient to block the HSM vents.

Documents Reviewed: PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant

ISFSI Units 1&2," Revision 0

Category:	General License	***Topic:***	Reactor Site Parameters - Normal Temperatures

Reference: CoC 1030, Tech Spec 4.6.3.4; 10 CFR 72.212(b)(2)

Requirement: The NUHOMS HD System is certified for use at reactor sites with normal ambient temperature ranges of 0 degrees F to 100 degrees F. The user shall verify the site-specific normal temperatures are within the range of the certification and shall document that verification in the 72.212 evaluation report.

Finding: Section 4.4.8 of the 72.212 evaluation report addressed the issue of ambient air temperature limits at the site. The NUHOMS HD ambient temperature requirements bound those of the site.

Documents Reviewed: PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0

Category:	General License	***Topic:***	Reactor Site Parameters - Roof Snow Loading

Reference: CoC 1030, Tech Spec 4.6.3.3; 10 CFR 72.212(b)(2)

Requirement: The NUHOMS HD System is certified for use at reactor sites where the roof snow loading will not exceed 110 pounds per square foot. The user shall verify the site-specific 100 year roof snow loading is within the limits of the certification, and shall document that verification in the 72.212 evaluation report.

Finding: Section 4.4.4 of the 72.212 evaluation report documented that no significant snow fall has ever occurred at the site and therefore will not exceed the NUHOMS HD design value for snow loading. Also, any accumulation of ice that may occur in winter periods will not challenge the design value.

Documents Reviewed: PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0

Category:	General License	***Topic:***	Reactor Site Parameters - Seismic Loads

Reference: CoC 1030, Tech Spec 4.6.3.8; 10 CFR 72.212(b)(2)

Requirement: The NUHOMS HD System is certified for use at reactor sites with peak horizontal seismic acceleration loads of 0.30g's and peak vertical seismic acceleration loads of 0.20g's. The user shall verify the site-specific seismic acceleration loads are within the limits of the certification, and shall document that verification in the 72.212 evaluation report.

Finding: Section 4.4.3 of the 72.212 evaluation report addressed the issue of earthquake at the ISFSI. Evaluation revealed that the verified acceleration value exceeded the HSM-H design value (0.2g) for the ISFSI pad; however, further seismic evaluation concluded that the HSM-H and DSC are qualified to the site-specific accelerations.

Documents Reviewed: PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0

Category:	General License	***Topic:***	Reactor Site Parameters - Temperature Extremes

Reference: CoC 1030, Tech Spec 4.6.3.5; 10 CFR 72.212(b)(2)

Requirement: The NUHOMS HD System is certified for use at reactor sites with off-normal ambient temperature extremes of minus 20 degrees F without solar insolation and plus 115 degrees F with full solar insolation. The user shall verify the site-specific off-normal ambient temperature extremes are within the limits of the certification, and shall document that verification in the 72.212 evaluation report.

Finding: Attachment 1, CoC Section 4.6.3.5, of the 72.212 evaluation report, documents that the extreme high temperature recorded at the St. Lucie site was 99.8 degrees F and the extreme low was 28.4 degrees F. These values are bounded by the NUHOMS HD design temperature limits of -20 degree F and plus 115 degree F.

Documents Reviewed: PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0

Category:	General License	***Topic:***	Reactor Site Parameters - Tornado Wind Speeds

Reference: CoC 1030, Tech Spec 4.6.3.1; 10 CFR 72.212(b)(2)

Requirement: The NUHOMS HD System is certified for use at reactor sites with maximum tornado wind speeds of 290 mph rotational and 70 mph translational. The user shall verify the site-specific maximum tornado wind speeds are within the limits of the certification, and shall document that verification in the 72.212 evaluation report.

Finding: Section 4.4.1 of the 72.212 evaluation report documented that the reactor site tornado parameters of 360 mph (300 mph rotational and 60 mph translational) are bounded by the NUHOMS HD design parameters of 360 mph (290 mph rotational and 70 mph translational).

Documents Reviewed: PSL-ENG-ISFS-08-002 "72.212 Evaluation Report For The St. Lucie Nuclear Plant ISFSI Units 1&2," Revision 0

Category:	Heavy Loads	***Topic:***	Heavy Loads Safety Review

Reference: CoC 1030, Condition 5

Requirement: Each lift of the canister and transfer cask must be made within the existing heavy loads requirements and procedures of the licensed facility at which the lift is made. A plant-specific safety review (under 10 CFR 50.59 or 10 CFR 72.48, if applicable) is required to show operational compliance with existing plant-specific heavy loads requirements.

Finding: St. Lucie, Unit 1 and 2, certified their spent fuel cask cranes as single-failure proof in accordance with NUREG-0612 and NUREG-0554 in a letter to the NRC on December 11, 2003. The cranes were manufactured by American Crane and Equipment Company (ACECO), rated for a maximum critical load of 150 tons with an auxiliary hoist rated at 25 tons. The 25-ton auxiliary hoists are not designated as single-failure proof. The new cranes were installed in the fourth quarter of 2003. The cranes are located outside the fuel buildings, supported by a superstructure above the north end of the respective unit's

fuel handling building. The cranes' function is to transfer shielded casks containing spent fuel between the cask pit area in the fuel handling building and the outside laydown area. The St. Lucie cranes are similar in design as single-failure proof cranes installed at Oyster Creek and Palo Verde. St. Lucie completed a 10 CFR 50.59 safety evaluation for the crane installation and developed a matrix demonstrating compliance with NUREG-0554. The safety evaluation and the NUREG-0554 matrix were reviewed during this inspection. The licensee had completed a thorough review of the crane design against the single-failure proof crane requirements listed in NUREG-0554.

Documents Reviewed: -Letter # L-2003-309 from St. Lucie to the NRC dated December 11, 2003 (ML033490185)
-Letter # L-2002-111 from St. Lucie to the NRC dated July 18, 2002 (ML022040006)
-NUREG-0612 "Control of Heavy Loads at Nuclear Power Plants," dated January 1980
-NUREG-0554 "Single Failure Proof Cranes for Nuclear Power Plants," dated May 1979

Category: Heavy Loads ***Topic:*** Safe Load Paths

Reference: NUREG 0612, Section 5.1.1 (1)

Requirement: Safe load paths should be defined for the movement of heavy loads to minimize the potential for heavy loads, if dropped, to impact irradiated fuel in the reactor vessel and in the spent fuel pool, or to impact safe shutdown equipment. The path should follow, to the extent practical, structural floor members, beams, etc., such that if the load is dropped, the structure is more likely to withstand the impact.

Finding: The requirement to analysis a safe load path does not apply to the use of the new cranes installed at St. Lucie Units 1 and 2 because they are single failure proof. However, the removal of the old cranes in 2003 involved the use of a mobile crane during dismantlement of the trolley, bridge, cab and crane structures. Because this work effort was near the fuel building and underground cables, and the removal effort involved the heavy lifts of the trolley (90,100 lbs) and bridge (106,890 lbs), the licensee performed an analysis to determine if any impact would occur on safety-related structures, systems and components (SSC). The analysis determined that underground cabling could be impacted from a drop during the dismantlement effort. Each of the cables was analyzed to determine the impact of opening or shorting the cables. The analysis showed that no safe shutdown function would be adversely affected during the demolition activities.

Documents Reviewed: Minor Engineering Package (MEP)-PC/M 02061M "Unit 2 Cask Crane Demolition and Site Preparation," dated October 31, 2002

Category: Procedures & Tech Specs ***Topic:*** Canister Gas Sampling During Unloading

Reference: FSAR 1030, Section 8.2.2.12

Requirement: Once the vent and drain port cover plates are removed, obtain a sample of the canister atmosphere. Confirm acceptable hydrogen concentration and check for presence of fission gas indicative of degraded fuel cladding.

Finding: Procedure MMP 116.13 "ISFSI DSC Lid Removal," Steps 6.3.4 and 6.3.27 required gas sampling of the canister atmosphere during canister unloading operations once the vent and drain port cover plates are removed. Acceptable hydrogen concentrations were

specified in Step 6.3.4 as less than 2.4% hydrogen. For fission gases, Step 6.3.27 of the procedure required a gamma analysis of the collected gas to determine if any fission products were present.

Documents Reviewed: Procedure MMP-116.13 "ISFSI DSC Lid Removal," Revision 0

Category: Procedures & Tech Specs ***Topic:*** Canister Unloading - Reflooding

Reference: FSAR 1030, Section 8.2.2.14

Requirement: Fill the canister with water through the drain port with the vent port open. The vented steam and gas should be routed though a monitored and filtered pathway. Monitor the vent pressure and regulate the fill rate to ensure canister pressure does not exceed 15 psig.

Finding: Procedure MMP-116.13 "ISFSI DSC Lid Removal," established the process for canister re-flooding. Step 3.3 required the spent fuel pool ventilation system to be in operation and the Note prior to Step 6.4.20 established the process to re-flood the canister, including filling from the drain port with the vent port open. The vented steam is routed to the spent fuel pool. Gases from the spent fuel pool are captured by the ventilation system which exhausts through the fuel handling building vent stack, after passing through a prefilter, a HEPA filter bank, and charcoal absorbers. The vent pressure is monitored by the vent port pressure gauge. Step 6.4.20 specified the 15 psig limit on the canister pressure.

Documents Reviewed: Procedure MMP-116.13 "ISFSI DSC Lid Removal," Revision 0

Category: Procedures & Tech Specs ***Topic:*** Cask Maintenance - Annual Inspections

Reference: CoC 1030, Condition 2; FSAR 1030, Section 9.2

Requirement: Written procedures shall be prepared for cask maintenance. The procedures shall require performance of the following transfer cask inspections within one year of each loading or unloading campaign: a) dye penetrant examination of the top trunnion bearing surfaces and accessible welds; b) leak testing of the transfer cask lid, ram access cover, vent and drain cover o-rings, vent and drain quick-connect fittings and neutron shield fittings. If bubble leak testing is performed, no leak indication is allowed. If pressure drop or helium leak testing is used, the maximum allowable leak rate for each component is 1.0 X 10(-3) ref-cc/sec.

Finding: The transfer cask is leased from Transnuclear and will be leaving the site after the first loading campaign. Therefore, the licensee stated that FPL is not required to perform the annual transfer cask inspections described in the Certificate of Compliance and Final Safety Analysis Report.

Documents Reviewed: Transnuclear Lease Agreement with Florida Power and Light Co. for NUHOMS Transfer and Auxiliary Equipment.

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Category: Procedures & Tech Specs ***Topic:*** Cask Operation

Reference: CoC 1030, Condition 2; Tech Spec 5.2.2

Requirement: Written procedures shall be prepared for cask handling, loading, and movement. The procedures shall control: a) fuel qualification and loading; b) rigging and handling; c) loading operations; d) unloading operations; e) auxiliary equipment operation; f) transfer operations; g) radiation protection; and h) off-normal and accident conditions, responses and corrective actions.

Finding: Fuel qualification and loading was performed in accordance with the methodology in Calculation PSL-1FJF-07-002. Rigging and handling was performed in accordance with Procedures MMP-116.07 and MMP-116.08. Loading 0perations were performed in accordance with Procedures 1-NOP-116.01. Unloading operations were performed in accordance with Procedure 1-NOP-116.03. Auxiliary equipment operation was performed in accordance with procedures above and Procedures MMP-116.03, MMP-116.04, MMP-116.11, MMP-116.12, MMP-116.13, and MMP-116.14. Transfer operations were performed in accordance with Procedures MMP-116.11 and MMP-116.14. Radiation Protection was performed in accordance with procedure HPP-85. Off-normal conditions, accident conditions, responses and corrective actions were performed in accordance with Procedure MMP-116.15.

Documents Reviewed:
-Calculation PSL-1FJF-07-002 "St. Lucie Unit 1 - Irradiated Fuel Assembly Selection for Initial Dry Cask Loading Campaign," Revision 1
-Procedure 1-NOP-116.01 "Dry Shielded Canister Fuel Loading," Revision 2
-Procedure 1-NOP-116.03 "Dry Shielded Canister Fuel Off-Load"
-Procedure MMP 116-03 "ISFSI TC/DSC Handling Operations for Fuel Off-Loading," Revision 0
-Procedure MMP 116-04 "ISFSI DSC Upending and Cold Fit Test," Revision 0A
-Procedure MMP-116.07 "ISFSI TC and DSC Preparation for Loading"
-Procedure MMP-116.08 "ISFSI TC/DSC Handling Operations for Fuel Loading," Revision 3
-Procedure MMP 116.11 "ISFSI Transport DSC from HSM to CHF," Revision 0
-Procedure MMP-116.12 "ISFSI Dry Shielded Canister Sealing Operations," Revision 0
-Procedure MMP-116.13 "ISFSI DSC Lid Removal," Revision 0
-Procedure MMP-116.14 "ISFSI DSC Transport from CHF to HSM," Revision 1
-Procedure MMP-116.15 "ISFSI Contingency Plan," Draft 2/28/08
-Procedure HPP-85 "ISFSI Radiological Controls," Revision 1

Category: Procedures & Tech Specs ***Topic:*** Cask Surveillance - HSM Air Vent Inspections

Reference: CoC 1030 Condition 6; TS 5.2.5.b; FSAR, Sect 4.4.2

Requirement: Written procedures shall be prepared for cask surveillance. Site personnel shall conduct a daily visual inspection of the air vents to ensure that the HSM air vents are not blocked for more than 34 hours, and that blockage will not exist for longer than the 36 hours assumed in the safety analysis.

Finding: Procedure 1-OSP-100.01 contained daily steps to visually inspect the loaded HSM-Hs to ensure the inlet and outlet air vents were not blocked and to clean the screens (within 34 hours) if there is a blockage.

Documents Reviewed: Procedure 1-OSP-100.01 "Schedule of Periodic Tests, Checks, and Calibrations Week 1, St. Lucie Unit 1," Revision 31

Category: Procedures & Tech Specs ***Topic:*** Criticality - Minimum Boron Concentration

Reference: CoC 1030, Tech Spec 3.2

Requirement: The dissolved boron concentration of the spent fuel pool water and the water added to the cavity of a loaded canister shall be at least the boron concentration shown in Table 7 for the basket type and fuel enrichment selected. The boron concentration will be determined within 4 hours prior to commencing LOADING operations and 48 hours thereafter while water is in the canister. The boron concentration will be determined within 4 hours prior to flooding the canister during UNLOADING operations and 48 hours thereafter while water is in the canister. All boron concentrations shall be determined by two independent measurements.

Finding: The fuel selected for the first loading campaign was CE Type 14 x 14 fuel assemblies in a Type C DSC basket with a maximum average initial enrichment of 3.65 wt. % U-235. For this configuration, Technical Specification Table 7 required a minimum boron concentration of 2000 ppm. During the loading of the first canister, the boron concentration in the spent fuel pool and in the water added to the basket was 2216 ppm.

Procedure MMP 116.08, Step 6.1.11 required the boron concentration to be determined within 4 hours prior to commencing loading operations and Step 6.1.12 required boron samples 48 hours thereafter while water is in the canister. Procedure 1-NOP-116.01, Step 6.2, required this determination to be made by two independent measurements.

For unloading of a canister, Step 6.4.2 of Procedure MMP 116.13, required the boron concentration to be determined within 4 hours prior to flooding the canister during unloading operations and Step 6.1.6 required the boron concentration to be determined 48 hours thereafter while water is in the canister. Step 6.4.2 required this determination to be made by two independent measurements. Also, Step 4.14 of Procedure 1-NOP-116.03 contained the same requirement.

Documents Reviewed:
- Procedure MMP-116.08 "ISFSI TC/DSC Handling Operations for Fuel Loading," Revision 3
- Procedure MMP-116.13 "ISFSI DSC Lid Removal," Revision 0
- Procedure 1-NOP-116.01 "Dry Shielded Canister Fuel Loading," Revision 2
- Procedure 1-NOP-116.03 "Dry Shielded Canister Fuel Off-Load," Revision 0

Category: Quality Assurance ***Topic:*** Approved QA Program

Reference: 10 CFR 72.140(d)

Requirement: A Quality Assurance program previously approved by the Commission as satisfying the requirements of Appendix B to Part 50 will be accepted as satisfying the requirements of Part 72. In filing the description of the QA program required by Part 72.140(c), each licensee shall notify the NRC of it's intent to apply it's previously approved QA program to ISFSI activities. The notification shall identify the previously approved QA program by date of submittal, docket number and date of Commission approval.

Finding: The licensee is using its NRC-approved Part 50 QA program for the ISFSI. Florida Power & Light Company notified the NRC on October 11, 2006, of its intent to apply its previously approved Part 50 QA program to the ISFSI program in a letter from J.A. Stall to the Director of the Spent Fuel Project Office.

Documents Reviewed: Letter from J.A. Stall, Florida Power & Light Company to Director, Spent Fuel Project Office, NRC entitled "Notification of Intent to Apply Previously Approved 10 CFR 50 Appendix B Quality Assurance Program to Independent Spent Fuel Storage Activities," dated October 11, 2006.

Category: Quality Assurance ***Topic:*** Control of Measuring and Test Equipment

Reference: 10 CFR 72.164

Requirement: The licensee shall establish measures to ensure that tools, gauges, instruments and other measuring and testing devices used in activities affecting quality are properly controlled, calibrated, and adjusted at specific periods to maintain accuracy within necessary limits.

Finding: Procedure QI-12-PR/PSL-1 defined the requirements for the control and calibration of measuring and test equipment and calibration standards. "ISFSI Test Equipment for Technical Specification Measurements" listed test equipment required to demonstrate conformance with the technical specifications and specified range and accuracy requirements. Calibration certificates for a sample of equipment were found to be current.

Documents Reviewed:
-Quality Assurance Topical Report FPL-1
-Procedure QI-12-PR/PSL-1 "Control and Calibration of Measuring and Testing Equipment (MT&E)"
-ISFSI Test Equipment for Technical Specification Measurements

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Category: Quality Assurance ***Topic:*** Corrective Actions

Reference: 10 CFR 72.172

Requirement: The licensee shall establish measures to ensure that conditions adverse to quality, such as failures, malfunctions, deficiencies, deviations, defective material and equipment, and nonconformances are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures must ensure that the cause of the condition is determined and corrective action taken to preclude repetition. This must be documented and reported to appropriate levels of management.

Finding: Procedure NAP-204 provided the process for identifying and resolving conditions adverse to quality. The Station Issue Tracking & Information System (SITRIS) was used to document and track significant conditions adverse to quality (SCAQ) and conditions adverse to quality (CAQ). NAP-204 required that significant conditions adverse to quality receive root cause analysis and identify corrective actions to prevent recurrence, and be reported to the Chief Nuclear Officer and direct reports.

The licensee maintained a status of condition reports pertaining the ISFSI and identified condition reports requiring resolution prior to fuel loading. A sample of condition reports was reviewed and no discrepancies were noted.

Documents Reviewed: -Quality Assurance Topical Report FPL-1
-Procedure NAP-204 "Condition Reporting"

Category: Quality Assurance ***Topic:*** Handling and Storage Controls

Reference: 10 CFR 72.166

Requirement: The licensee shall establish measures to control, in accordance with work and inspection instructions, the handling, storage, and preservation of material and equipment to prevent damage or deterioration. When necessary for particular products, special protective environments, such as inert gas atmosphere and specific moisture content and temperature levels must be specified and provided.

Finding: Procedure MMP-116.01 provided storage requirements for HSM components. Procedure MMP-116.04 provided storage requirements for the DSC and associated DSC components.

Documents Reviewed: -Quality Assurance Topical Report FPL-1
-Procedure MMP-116.01 "ISFSI HSM Material Identification, Control and Storage," Revision 2
-Procedure MMP-116.04 "ISFSI DSC Upending and Cold Fit," Revision 0A

Category: Quality Assurance ***Topic:*** Nonconforming Material and Parts

Reference: 10 CFR 72.170

Requirement: The licensee shall establish measures to control materials, parts or components that do not conform to their requirements in order to prevent their inadvertent use or installation. These measures must include procedures for identification, documentation, segregation, disposition and notification to affected organizations. Nonconforming items must be reviewed and accepted, rejected, repaired, or reworked in accordance with documented procedures.

Finding: Procedure QI-15-PSL-1 established the requirements, mechanisms, and responsibilities for documentation, control, evaluation, and disposition of nonconforming items or services.

Documents Reviewed: -Quality Assurance Topical Report FPL-1
-Procedure QI-15-PSL-1 "Control of Nonconforming Materials, Parts, Components and Services for St. Lucie Plant"

Category: Quality Assurance ***Topic:*** Procurement Controls

Reference: 10 CFR 72.154(a)/(b)/(c)

Requirement: The licensee shall establish measures to ensure that purchased material, equipment, and services conform to procurement documents. These measures must include provisions for source evaluation and selection, objective evidence of quality furnished by the contractor/subcontractor, inspection at the contractor/subcontractor source and examination of product on delivery.

Finding: Procurement of ISFSI materials was done under existing St. Lucie procedures.

Procedure QI-4-PSL-1 provided the method for material procurement and the control of material procurement documents. Two sample purchase orders for material to be used on the ISFSI project were reviewed. One purchase order was for the calibration of four display and transducer sets and the other was for calibrated digital pressure gauges. No discrepancies were noted.

Documents Reviewed:
-Quality Assurance Topical Report FPL-1
-Procedure QI-4-PSL-1 "Procurement of Materials"
-Purchase Order 00082306
-Purchase Order 00110076

Category: Radiation Protection ***Topic:*** ALARA Measures

Reference: 10 CFR 72.104(b)

Requirement: Operational restrictions shall be established to meet ALARA objectives for direct radiation levels associated with ISFSI operations.

Finding: Operational restrictions were established in Procedure HHP-85 to meet ALARA objectives for direct radiation levels associated with ISFSI operations. These restrictions included performing radiological surveys; using special procedural cautions for specific activities; using-extender type survey instruments and temporary shielding; and decontaminating the transfer cask, tools, equipment, and work areas. The first canister loaded had a heat load of 15.5 kW. The total estimated radiation dose received during the loading was 0.128 manrem. The final manrem dose may be revised once the TLD badges are processed and results are received. This is a low radiation level compared to many other reactor sites which have loaded canisters. The licensee contributes this low number to the fact the annulus and transfer cask water jackets were kept filled, thereby providing extra shielding. The NRC also noted that many of the workers had previous experience at other sites loading canisters and were more efficient in getting tasks completed than would be the case for individuals with less experience.

Documents Reviewed: Procedure HHP-85 "ISFSI Radiological Controls," Revision 1

Category: Radiation Protection ***Topic:*** Contamination Survey of Canister

Reference: CoC 1030, Tech Spec 5.2.4.d

Requirement: Following placement of each loaded transfer cask into the cask decontamination area and prior to transfer to the ISFSI, the smearable surface contamination levels on the outer top 1 foot surface of the canister shall be less than 2,200 disintegrations per minute (dpm) per 100 square cm from beta and gamma emitting sources and less than 220 dpm/100 square cm from alpha emitting sources. The contamination limits are based on the allowed removable external radioactive contamination specified in 49 CFR 173.443.

Finding: The licensee had established more conservative smearable contamination limits than required by Technical Specification 5.2.4.d. Procedure HHP-85, Steps 6.3.7.A and 6.7.1 established acceptable contamination limits as less than 1000 disintegrations per minute (dpm) per 100 square cm from beta and gamma emitting sources and less than 20 dpm/100 square cm from alpha emitting sources. Step 6.3.11 of Health Physics Procedure - 85 required the contamination smear to be taken on the outer top 1 foot

surface of the canister prior to any decontamination of that area. During the first cask loading, smearable contamination levels were measured at less than 1000 dpm beta/gamma per 100 square cm and less that 20 dpm alpha per 100 square cm.

Documents Reviewed: Procedure HHP-85 "ISFSI Radiological Controls," Revision 1

Category: Radiation Protection ***Topic:*** Criticality - Monitoring and Alarm System

Reference: 10 CFR 72.124.c

Requirement: A criticality monitoring system shall be maintained in each area where special nuclear material is handled, used, or stored which will energize clearly audible alarm signals if accidental criticality occurs. Underwater monitoring is not required, nor is monitoring of dry storage areas where special nuclear material is packaged in its stored configuration. The NRC has defined "packaged" to begin when the canister lid closure weld is complete.

Finding: Two area radiation monitors (ARMs) are located in the fuel building to provide a warning to workers should an accidental criticality occurs. One is on the south wall and one on the north wall at the 62 foot level. These ARMs readout in the control room. During the dry run, testing of the south wall ARM provided a noticeable alarm level.

For the cask handling facility, Procedure HPP-85, Step 4.20 stated, "A criticality monitor shall be in operation in the cask handling facility while working with a spent fuel loaded dry shielded canister." According to members of the cask handling facility crew, the criticality monitoring system emits a clearly audible alarm signal easily heard by the workers in the area.

Documents Reviewed: -Procedure MMP-116.12 "ISFSI Dry Shielded Canister Sealing Operations," Revision 2B
-Procedure HHP-85, "ISFSI Radiological Controls," Revision 1

Category: Radiation Protection ***Topic:*** HSM-H Dose Rate Evaluation

Reference: CoC 1030, Tech Specs 5.4.1 through 5.4.3

Requirement: The licensee shall perform an analysis to confirm that the limits of 10 CFR Part 20 and 10 CFR 72.104 will be satisfied under actual site conditions, assuming a fully loaded ISFSI. On the basis of the analysis, the licensee shall establish dose rate limits for the HSM-H front surface, door centerline, and end shield wall exterior. The dose rate limits established based on the analysis shall not exceed 800 mrem/hour at the front bird screen, 2 mrem/hour on the door centerline, and 2 mrem/hour on the end shield wall exterior.

Finding: Procedure HHP-85, Attachment A, Table 3 established the dose rate limits for the horizontal storage modules (HSMs) as 752 mrem/hour at the front bird screen, 1.6 mrem/hour on the door centerline, and 1.4 mrem/hour on the end shield wall exterior. These limits are within the limits established in the technical specification. After the first canister (DSC-2) was placed in the ISFSI, surveys were conducted of HSM-2 on March 15, 2008 to confirm compliance with the technical specifications. Survey results were documented on Procedure MMP-116.14, Section 6.19 and on HP Survey Form-170. Dose rates on HSM-2 measured 25-32 mR/hr beta/gamma and 6.6 mrem/hr neutron on contact at the bird screen for a total of 36.6 mrem/hr. The dose rate at the HSM door

centerline was 0.4 mrem/hr. The dose rate at the end shield wall exterior was 0.1 mrem/hr. No smearable contamination was detected.

Documents Reviewed:
-Procedure HHP-85 "ISFSI Radiological Controls," Revision 0
-Procedure MMP-116.14 "ISFSI DSC Transport from CHF to HSM," Revision 2
-HP Survey Form -170 "ISFSI," completed March 15, 2008
-HP Survey Form-181 "ISFSI Horizontal Storage Modules Front View," completed March 15, 2008

Category: Radiation Protection ***Topic:*** Neutron Energies for Dosimetry

Reference: FSAR 1030, Table 5-13

Requirement: FSAR Section 5.4.7.1 states that 85% of the neutron spectrum from the spent fuel will be represented by spontaneous fission of Cm-244. While water is in the cask, the neutrons will be adequately thermalized similar to the neutron energy levels typically encountered in the plant. However, once the water is removed from the cask, a higher neutron energy spectrum will be emitted from the cask. FSAR Table 5-13 provides the design basis neutron energy spectrum for the canister. Since the neutron energy will be higher when the water has been removed from the cask during drying, helium backfill and transport to the ISFSI pad, than the normal thermal energies of neutrons found in work areas of the plant, calibration considerations should be made for personnel monitoring of neutrons at these higher energies.

Finding: The licensee had established a special program to asses the neutron dose to workers when the water was removed from the canister and a higher energy spectrum would result in the areas near the cask. Special neutron dosimeters were used that were sensitive to the higher neutron energies using a CR39 badge, which would be energy independent for intermediate and fast neutrons between 150 keV to 10 MeV. The higher energy neutron dosimeters were color coded differently than the normal neutron dosimetry worn at the plant. A REM 500 Tissue Equivalent Proportional Counter was used to measure the neutron fields around the cask. In addition, several neutron badges were placed on the ISFSI pad fence line to assess the neutron doses. After six casks are placed in the horizontal storage modules (HSM), the dosimeters will be collected and analyzed.

Documents Reviewed:
-Certificate of Compliance 1030, Final Safety Analysis Report, Revision 1
-Condition Report 2008-8058 "ISFSI Neutron Pilot Monitoring Project," dated March 7, 2008
-FPL Memo from B.K. Mouring "ISFSI Neutron Pilot Monitoring Plan White Paper," dated March 5, 2008

Category: Training ***Topic:*** Approved Training Program

Reference: 10 CFR 72.44(b)(4)

Requirement: The licensee shall have a training program in effect that covers the training and certification of personnel that meet the requirements of Subpart I before the licensee receives spent fuel at the ISFSI.

Finding: The training and certification of personnel for ISFSI activities was conducted under the

licensee's Part 50 training program. The Nuclear Projects Group was responsible for ensuring training was developed, planned, scheduled, and conducted for personnel involved in the ISFSI project. The ISFSI training program was described in the "St. Lucie Plant Training ISFSI Program for NUHOMS HD CoC 1030."

Documents Reviewed: St. Lucie Plant Training ISFSI Program for NUHOMS HD CoC 1030

Category: Training ***Topic:*** Cask System Overview

Reference: CoC 1030, Tech Spec 5.2.2

Requirement: Training modules shall be developed to include an overview of the NUHOMS-HD system design, ISFSI facility design, Systems, Structures and Components (SSCs) Important To Safety, NUHOMS-HD System FSAR and the NRC SER. The modules shall include more specific training on the Certificate of Compliance (CoC) conditions, NUHOMS-HD system technical specifications, applicable regulatory requirements, required instrumentation and use, and operating experience reviews.

Finding: The "St. Lucie Plant Training ISFSI Program for NUHOMS HD CoC 1030" addressed, and Lesson Plan PSL OPS SYS 208A LPC provided overview training for the NUHOMS-HD system design; ISFSI facility design, structures, systems and components (SSCs) important to safety; NUHOMS-HD System final safety analysis report (FSAR), and the NRC safety evaluation report (SER). The lesson plan also included more specific training on the certificate of compliance (CoC) conditions, NUHOMS-HD system technical specifications, applicable regulatory reviews and operating experience.

Documents Reviewed: -St. Lucie Plant Training ISFSI Program for NUHOMS HD CoC 1030
-Lesson Plan PSL OPS SYS 208A LPC "Independent Spent Fuel Storage Installation"

Category: Training ***Topic:*** Cask System Procedures

Reference: CoC 1030, Tech Spec 5.2.2

Requirement: Training modules shall be developed for the operation and maintenance of the NUHOMS-HD System and the ISFSI. These modules shall include the procedures used for: a) fuel loading; b) rigging and handling; c) loading operations as described in Chapter 8 of the FSAR; d) unloading operations including reflooding; e) auxiliary equipment operation; f) transfer operations; g) surveillance operations; h) radiation protection; i) maintenance as described in Section 9.2 of the FSAR; and j) off-normal and accident conditions responses and corrective actions.

Finding: The ISFSI Training Program was developed using a systematic approach to training and was described in the "St. Lucie Plant Training ISFSI Program for NUHOMS HD CoC 1030." The program identified operations requiring training and a training group matrix of applicability. Lesson Plan PSL OPS SYS 208A LPC provided overview training that was tailored to each training group based on need and covered all the required training topics.

Documents Reviewed: -St. Lucie Plant Training ISFSI Program for NUHOMS HD CoC 1030
-Lesson Plan PSL OPS SYS 208A LPC "Independent Spent Fuel Storage Installation"

Category: Training ***Topic:*** Certification of Personnel

Reference: 10 CFR 72.190

Requirement: Operations of equipment and controls that have been identified as important to safety in the SAR and in the license must be limited to trained and certified personnel or be under the direct visual supervision of an individual with training and certification in the operation. Supervisory personnel who personally direct the operation of equipment and controls that are important to safety must also be certified in such operations.

Finding: Procedure MMP 116.07 required that only certified personnel or personnel under the direct supervision of a certified person may operate equipment important to safety. The TriVis personnel and supervisors that will perform cask loading operations had completed classroom training and were in the process of completing the On-Job Training (OJT) and Task Performance Evaluation (TPE) requirements at the time of the dry run demonstration.

Documents Reviewed: -St. Lucie Plant Training ISFSI Program for NUHOMS HD CoC 1030
-Learning Management System Database
-Procedure MMP-116.07 "ISFSI TC and DSC Preparation for Loading," Draft Revision B6

Category: Training ***Topic:*** Dry Run Training Exercise

Reference: CoC 1030, Condition 8

Requirement: A dry run training exercise of the loading, closure, handling, unloading and transfer of the NUHOMS-HD System shall be conducted by each licensee prior to first use of the system to load spent nuclear fuel assemblies. The loading operations shall include: a) fuel loading; b) canister sealing; c) drying and backfilling operations; d) transfer cask downending and transport to the ISFSI; and e) canister transfer into the HSM-H. The unloading operations shall include: a) canister retrieval from the HSM-H; b) flooding the canister; and c) opening the canister.

Finding: Two dry run training exercises were completed by the licensee in preparation for the first loading operations. During the week of December 17-21, 2007, an inspection of portions of the ISFSI dry run work was conducted at the TriVis, Inc. headquarters in Pelham, Alabama. The inspection included canister sealing via welding and the associated non-destructive examinations (NDE); canister drying and backfilling operations via dewatering, drying, vacuuming, and helium gas inputting; and mechanical cutting of a mockup of the Transnuclear NUHOMS-HD 32PTH Type 1 canister. These activities were documented in Section 4OA5.5 of NRC Inspection Report 05000335/2007005, 05000389/2007005.

During the week of February 25-29, 2008, an inspection of on-site dry run activities was conducted. The operations reviewed included canister retrieval from the horizontal storage module (HSM); canister transport from the HSM to the cask handling facility, including upending from the transport trailer via the overhead crane; flooding the canister; opening the canister; and fuel loading using a dummy fuel assembly. These activities were inspected to confirm the adequacy of procedures, personnel training /qualification, and equipment. Although the inspectors did not observe the specific

activities of transfer cask downending and transport to the ISFSI, or canister transfer into the HSM, the activities which were reviewed were deemed to be equivalent or more difficult to complete.

Documents Reviewed: NRC Inspection Report 05000335/2007005, 05000389/2007005 , dated February 1, 2008 (Adams Document # ML080350408)