UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
2443 Warrenville Road, Suite 210
Lisle, IL 60532-4362

January 24, 2014

Mr. John Sauger
Senior Vice-President
and General Manager
Zion*Solutions*, LLC
101 Shiloh Boulevard
Zion, IL 60099

SUBJECT: NRC INSPECTION REPORT 05000295/2013013(DNMS); 05000304/2013013 (DNMS); 07201037/2012002(DNMS) – ZION NUCLEAR POWER STATION

Dear Mr. Sauger:

On December 17, 2013, the U.S. Nuclear Regulatory Commission (NRC) completed its inspection of pre-operational testing activities of the independent spent fuel storage installation (ISFSI) at the permanently shutdown Zion Nuclear Power Station. The purpose of the inspection was to assess whether the licensee had adequately demonstrated its readiness to safely transfer spent fuel from the spent fuel pool to the ISFSI. The enclosed inspection report documents the inspection results which were discussed on December 17, 2013, with members of your staff.

The inspection was an examination of the ISFSI pre-operational testing and preparatory activities as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. Specifically, the inspectors observed pre-operational testing activities, reviewed programs, and reviewed engineering evaluations pertaining to the safe loading, storage, and unloading of spent nuclear fuel at the Zion Nuclear Power Station.

The inspection was conducted per NRC Inspection Manual 2690, "Inspection Program for Dry Storage of Spent Reactor Fuel at Independent Spent Fuel Storage Installations and Guidance for Title 10 of the *Code of Federal Regulations* (CFR) Part 71 Transportation Packages," and used Inspection Procedures (IP) 60854.1 and IP 60856.1.

Based on the results of these inspections, the inspectors did not identify any violations of NRC requirements.

In accordance with Title 10 of the *Code of Federal Regulations* (CFR) 2.390 of the NRC's "Rules of Practice," a copy of this letter and the enclosed report will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's Agencywide Document Access and Management System (ADAMS), accessible from the NRC's website at http://www.nrc.gov/reading-rm/adams.html.

We will gladly discuss any questions you may have regarding this inspection.

Sincerely,

/RA/

Robert J. Orlikowski, Chief
Materials Control, ISFSI, and
Decommissioning Branch
Division of Nuclear Materials Safety

Docket Nos. 050-00295; 050-00304; 072-01037
License Nos. DPR-39; DPR-48

Enclosure:
Inspection Report Nos. 05000295/2013013(DNMS);
05000304/2013013(DNMS); 07201037/2012002(DNMS)

cc w/encl: Zion*Solutions* Service List

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos.:	050-00295; 050-00304; 072-01037
License Nos.:	DPR-39; DPR-48
Report Nos.:	05000295/2013013(DNMS) 05000304/2013013(DNMS) 07201037/2012002(DNMS)
Licensee:	Zion*Solutions*, LLC
Facility:	Zion Nuclear Power Station (permanently shut-down)
Location:	101 Shiloh Boulevard Zion, IL 60099
Dates:	Onsite inspection on December 13, 2012; April 10, 2013; May 22, 2013; July 8 through July 10, 2013; August 5, 2013; September 9 through September 12, 2013; October 18, 2013; October 21, 2013; November 4 through 7, 2013 with in office review through December 13, 2013.
NRC Inspectors:	Matthew C. Learn, (Team Lead) Reactor Engineer (RIII) Rhex A. Edwards, Reactor Inspector (RIII) James E. Neurauter, Senior Reactor Inspector (RIII) Wayne J. Slawinski, Senior Health Physicist (RIII) James J. Pearson, Senior Safety Inspector (NMSS) Jon N. Woodfield, Safety Inspector (NMSS) Kristina L. Banovac, Project Manager (NMSS) Clyde D. Morell, Storage & Transportation Safety Inspector (NMSS)
Approved by:	Robert J. Orlikowski, Chief Materials Control, ISFSI, and Decommissioning Branch Division of Nuclear Materials Safety

Enclosure

EXECUTIVE SUMMARY

Zion Nuclear Power Station, Units 1 and 2
NRC Inspection Report 05000295/2013013(DNMS); 05000304/2013013(DNMS); 07201037/2012002(DNMS)

The purpose of the inspection was to observe and evaluate the licensee's activities associated with pre-operational testing of an Independent Spent Fuel Storage Installation (ISFSI). During this inspection period, the inspectors observed pre-operational testing activities, reviewed programs, and reviewed engineering evaluations pertaining to the safe loading, storage, and unloading of spent nuclear fuel at the Zion Nuclear Power Station (ZNPS).

- The licensee demonstrated their capability to implement a preoperational testing and training program. The licensee demonstrated their ability through dry run demonstrations that they were capable of safely and securely performing loading and unloading activities in accordance with site procedures, industry standards, design specifications and Certificate of Compliance (CoC) requirements. (Section 1.1)

- The licensee performed evaluations as required by Title 10 of the *Code of Federal Regulations* (CFR) 72.212 in the ISFSI 10 CFR 72.212 Evaluation Report. The inspectors determined that applicable reactor site parameters were evaluated for acceptability with the bounding values specified in the Modular Advanced Generation Nuclear All-purpose Storage (MAGNASTOR) Safety Analysis Report (SAR) and the NRC Safety Evaluation Report (SER). The evaluations demonstrated that the design features for the MAGNASTOR System enveloped the site-specific characteristics of the ZNPS, or a site-specific analysis had been performed and evaluated against the requirements of 10 CFR 72.48, "Changes, Tests, and Experiments." (Section 1.2)

- The licensee characterized all 2228 fuel assemblies as well as all non-fuel inserters and hardware at the ZNPS and established loading plans for 61 casks in accordance with the requirements of the MAGNASTOR CoC Approved Contents. (Section 1.3)

- The licensee is utilizing the Exelon records system for management of ISFSI related records management to meet the requirements of 10 CFR 72.72. The licensee was able to demonstrate retrieval of documentation required to be maintained. (Section 1.4)

- The licensee established procedures that established requirements to ensure the safe handling and storage of spent nuclear fuel in accordance with NRC requirements. (Section 1.5)

- The licensee implemented the previously-approved ZNPS quality assurance program for ISFSI operations. The program was effectively developed and implemented to support the safe operation of the ISFSI operations. The licensee actively utilized the corrective action program in support of ISFSI operations. (Section 1.6)

- The licensee implemented a systematic approach to training for ISFSI in accordance with NRC training requirements. (Section 1.7)

- The licensee implemented their existing radiation protection program for ISFSI operations. The licensee established an as low as reasonably achievable (ALARA) dose plan for ISFSI operations and developed procedures to verify that dose rates and contamination levels were in compliance with applicable limits specified by in the CoC. (Section 1.8)

- The licensee implemented their control of heavy loads program for ISFSI operations. The licensee upgraded their Fuel Handling Building crane to meet the criteria of NUREG-0554. The licensee established procedures for the testing and utilization of overhead cranes, standard rigging, and special lifting devices in accordance with industry standards and CoC requirements. (Section 1.9)

Report Details

Summary of Facility Activities

Zion*Solutions* selected the NAC International Inc. (NAC) Modular Advanced Generation Nuclear All-purpose STORage (MAGNASTOR) System for dry storage of spent nuclear fuel at the Zion Nuclear Power Station (ZNPS). The Nuclear Regulatory Commission (NRC) had certified the MAGNASTOR system design under Certificate of Compliance (CoC) No. 72-1031, Amendment No. 3, effective July 25, 2013.

Demonstrations of loading, processing, and moving spent fuel from the Fuel Handling Building to the ISFSI using the MAGNASTOR System were conducted from July 8 to October, 2013. Throughout the inspection period, the inspectors performed an evaluation to determine if the ISFSI programs had been established, evaluations had been performed, personnel had been trained, the equipment had been tested, and the procedures had been developed to the extent necessary to safely load spent fuel into dry storage at the ISFSI.

Summary of MAGNASTOR System

The following is a description of the MAGNASTOR system as described in the CoC. The MAGNASTOR system consists of the following components: (1) transportable storage canister (TSC), which contains the spent fuel; (2) vertical concrete cask (VCC), which contains the TSC during storage; and (3) a moveable transfer cask (MTC), which contains the TSC during loading, transfer and unloading operations. The cask may store up to 37 pressurized water reactor (PWR) fuel assemblies.

The TSC is the confinement system for the stored fuel. The TSC assembly consists of a cylindrical shell with a welded bottom plate, a fuel basket, a closure lid, a closure ring, and two sets of redundant penetration port covers. The cylindrical shell plus the bottom plate, closure lid, and welded inner port covers are stainless steel and constitute the confinement boundary. The electroless nickelcoated carbon steel fuel basket is a developed-cell circular cylinder configuration with 37 PWR fuel assembly locations. The fuel assembly locations in the baskets include neutron absorber panels on up to four sides for criticality control. Each neutron absorber panel is covered by a stainless steel sheet to protect the material during fuel loading and unloading, and to maintain it in position.

The VCC is the storage overpack for the TSC and provides structural support, shielding, protection from environmental conditions, and natural convection cooling of the TSC during long-term storage. The VCC is a reinforced concrete structure with a carbon steel inner liner. The liner inner diameter incorporates standoffs to minimize impact loads on the TSC and to maintain convective heat flow paths under accident conditions. The concrete cask has an annular air passage to allow a passive convection air flow around the TSC. The air inlets and outlets are offset in elevation from the TSC to minimize radiation streaming. The spent fuel decay heat is transferred from the fuel assemblies to the TSC shell using pressurized helium circulated by convection through the fuel basket, conduction and radiation. Heat flows by convection from the TSC shell to the circulating air and by radiation from the TSC shell to the concrete cask liner. The heated air is exhausted, by convective flow, through the concrete cask air outlets. The top of the concrete cask is closed by a carbon steel and concrete lid bolted in place.

The MTC provides shielding during TSC movements between work stations, the concrete cask, or the transport cask. It is a multiwall design with retractable bottom shield doors that are used during loading and unloading operations.

1.0. Zion ISFSI Activities

1.1 Preoperational Test Program

a. Inspection Scope (Inspection Procedure (IP) 60854.1)

The CoC for the MAGNASTOR System for the storage of irradiated fuel requires the licensee to conduct preoperational testing to demonstrate the loading, processing, and transfer of the cask system prior to the first loading of spent fuel assemblies. The NRC conducted a series of onsite inspections to observe the licensee's demonstration of the required activities. The inspection consisted of field observations, interviews with licensee personnel, and review of licensee documentation.

b. Observations and Findings

CoC Technical Specification Section 5.8, Preoperational Testing and Training Exercises, states that a dry run training exercise on loading, closure, handling, unloading, and transfer of the MAGNASTOR system shall be conducted by the licensee prior to the first use of the system to load spent fuel assemblies. The training exercise shall not be conducted with spent fuel in the TSC. The dry run may be performed in an alternate step sequence from the actual procedures, but all steps must be performed. The dry run shall include, but is not limited to, the following:

a. Moving the VCC into its designated loading area
b. Moving the MTC containing the empty TSC into the spent fuel pool
c. Loading one or more dummy fuel assemblies into the TSC, including independent verification
d. Selection and verification of fuel assemblies to ensure conformance with appropriate loading configuration requirements
e. Installing the closure lid
f. Removal of the MTC from the spent fuel pool
g. Closing and sealing of the TSC to demonstrate pressure testing, vacuum drying, helium backfilling, welding, weld inspection and documentation, and leak testing
h. MTC movement through the designated load path
i. MTC installation on the VCC
j. Transfer of the TSC to the VCC
k. VCC lid assembly installation
l. Transport of the VCC to the ISFSI
m. TSC removal from the VCC
n. TSC unloading, including re-flooding and weld removal or cutting

The inspectors reviewed the procedures for the dry run activities. The inspectors verified the procedures were comprehensive and adequately addressed key aspects of the evolutions.

During the period of July 8 through October, 2013, the inspectors observed and evaluated the dry run activities, including fuel handling and TSC/MTC movement in and

around the SFP, processing of the TSC within the MTC, welding and nondestructive examinations of the TSC, transfer of the TSC from the MTC into the VCC, transportation of the loaded VCC to the ISFSI along the designated haul path, and placement of the VCC onto the ISFSI storage pad. The inspectors also observed and evaluated activities associated with TSC unloading from a VCC. The licensee conducted a pre-job briefing each day during the demonstration with personnel involved with the dry run activities. The briefings were comprehensive and effectively covered key aspects of the evolution, including procedural adherence expectations, safety aspects of the activities, and Quality Assurance (QA) hold points. Procedure compliance was followed during the performance of the activities. Radiological conditions were simulated to provide a degree of realism including simulated radiological postings to prepare workers for the radiological conditions that could be encountered during actual transfer of spent fuel. The inspectors interviewed cognizant personnel to verify their knowledge of procedural requirements and responsibilities. The inspectors also noted that activities were performed in a deliberate manner. The responsible supervisor maintained the work package/procedure in his possession throughout the performance of the activity and procedure steps were carefully followed. Throughout the dry run exercise, the work package was periodically reviewed by the inspectors to verify compliance with procedures and related work documents.

ISFSI project personnel were qualified or in the process of qualification to perform their assigned functions and were knowledgeable of their responsibilities. Procedures and work-related documentation were accurate and procedural compliance was demonstrated by workers in the field.

The inspectors attended licensee post job debriefs and critiques. The inspectors noted that the staff performing in field activities as well as licensee management attended the meetings. The inspectors observed that licensee staff communicated openly and documented issues identified during dry run activities. The licensee incorporated independent auditors to provide an independent third party review of dry run activities. Many observations identified by the inspectors were noted by either the licensee staff or independent auditors prior to the inspectors bringing the observations to the attention of the licensee. Observations and issues were tracked for corrective action prior to initial loading.

c. Conclusions

The licensee demonstrated their capability to implement a preoperational testing and training program. The licensee demonstrated their ability through dry run demonstrations that they were capable of safely and securely performing loading and unloading activities in accordance with site procedures, industry standards, design specifications and CoC requirements.

1.2 Review of Evaluations

a. Inspection Scope (IPs 60856.1 and 60857)

A general license for the storage of spent fuel in an ISFSI at power reactor sites is granted per 10 CFR 72.210, General license issued. Per 10 CFR 72.212, “Conditions of general licenses issued under 72.210,” the holder of the general license is required to perform written evaluations prior to use to establish that the ISFSI storage system

design can be used at that site and that site operations can accommodate operation of an ISFSI. The ZNPS holds a general license for operation of its ISFSI.

ZNPS documented the results of the required evaluations in the Independent Spent Fuel Storage Installation 10 CFR 72.212 Evaluation Report. The inspectors reviewed the technical report and various referenced supporting documents to evaluate the licensee's compliance with the requirements of 10 CFR 72.212. The inspectors also conducted interviews with cognizant licensee personnel.

b. Observations and Findings

72.212 Evaluation Report

The inspectors reviewed a copy of the ZNPS 72.212 Evaluation Report. Based on the review, the inspectors assessed that, overall, the evaluation report was comprehensive and adequately addressed the areas required to be evaluated under 72.212(b)(5) through (13). The 72.212 Evaluation Report was found to be acceptable; it contained sufficient objective evidence that the written evaluations confirmed that the conditions set forth in the CoC had been met, the ISFSI pad had been designed to support the stored load of the casks, and the requirements of 10 CFR 72.104 had been met for the radiological impact to members of the public.

Fire and Explosion Evaluation of Hauling and Storage

The inspectors reviewed several supporting documents referenced in the 72.212 Evaluation Report which performed a site-specific fire and explosion hazards evaluation for use of the MAGNASTOR system at ZNPS. The evaluation assessed a variety of onsite hazards that were in proximity to a loaded VCC either along the heavy haul path or the ISFSI pad. The licensee determined that the hazards present onsite were within the hazards evaluated in the MAGNASTOR system design.

MAGNASTOR® and ISFSI Dose Limits

10 CFR 72.104, "Criteria for radioactive materials in effluents and direct radiation from an ISFSI or MRS (Monitored Retrievable Storage Installation)", requires that the annual dose equivalent to any *real individual* located beyond the controlled area must not exceed 25 millirem (mrem) to the whole body.

NRC Interim Staff Guidance-13 defines the *real individual* as an individual at or beyond the controlled area, and dose to any *real individual* must not exceed the limits specified in 72.104 from both the storage facility and other surrounding fuel cycle activities. For example, a *real individual* may be anyone living, working, or recreating close to the facility for a significant portion of the year. The licensee performed an evaluation to determine the most limiting *real individual*. The *real individual* was chosen based upon distance from the ISFSI, and estimated time of occupancy at that location. The licensee determined that the most limiting *real individual* would reside at the nearest campsite to the ISFSI at the Illinois State Beach Park Southern Unit. It was assumed that the *real individual* would reside at the campsite 24 hours a day for 9 months at a time. The licensee calculated dose rates as a result of a loaded ISFSI and ongoing decommissioning activities at the ZNPS. The licensee determined that the most limiting dose to a *real individual* would be 14.5 mrem/year which is less than the regulatory requirement of 25 mrem/year. The inspectors reviewed the licensee's dose evaluations and determined that the licensee had conservatively evaluated dose to a *real individual* in accordance with 10 CFR 72.104.

ISFSI Pad Parameters and Haul Path Evaluations
The results of the Zion ISFSI pad inspection are documented in NRC Inspection Report Nos. 05000295/2013012(DNMS); 05000304/2013012(DNMS); 07201037/2012001(DNMS).

The inspectors reviewed the design and construction of the ISFSI heavy haul path from the Fuel Handling Building to the ISFSI Pad. The heavy haul path consists of sections of the plant original roadway and new sections that were designed and constructed exclusively for the fuel transfer project. The inspectors determined that the haul path could support the loads of the VCC and would not pose any additional impacts on site operation.

Site-Specific Parameters
The licensee performed a review, documented in the 72.212 report, of the dry cask storage program to ensure compliance with the requirements of 10 CFR 72, Subpart K, "General License for Storage of Spent Fuel at Power Reactor Sites". The inspectors determined that applicable reactor site parameters, such as seismic loads, tornado winds and wind-generated missile impacts, flooding, normal and extreme temperatures, fire and explosion, and snow loading, were evaluated for acceptability with the bounding values specified in the MAGNASTOR Safety Analysis Report (SAR) and the NRC Safety Evaluation Report (SER). The evaluations demonstrated that the design features for the MAGNASTOR System enveloped the site-specific characteristics of ZNPS, or a site-specific analysis had been performed and evaluated against the requirements of 10 CFR 72.48, "Changes, Tests, and Experiments."

72.48 Screening and Evaluation
The inspectors observed that the ZNPS had implemented a process to make changes, under 10 CFR 72.48, to its dry fuel storage program.

The licensee performed 10 CFR 72.48 applicability reviews, screenings, and evaluations related to the dry fuel storage project. The inspectors reviewed screenings and evaluations to ensure that the requirements of 10 CFR 72.48 were appropriately implemented at the site.

50.59 Screening and Evaluation
The loading, transportation, and storage operations of the MAGNASTOR System at ZNPS were reviewed by the licensee under the 10 CFR 50.59, changes, tests, and experiments, process. Reliability of structures, systems, and components (SSCs) important to the defueled condition was evaluated. A 10 CFR 50.59 screening of the construction and operation of the ISFSI and plant interfaces had been performed by the licensee to demonstrate that neither changes to plant technical specifications nor a license amendment were required.

c. Conclusions

The licensee performed evaluations as required by 10 CFR 72.212 in the Independent Spent Fuel Storage Installation 10 CFR 72.212 Evaluation Report. The inspectors determined that applicable reactor site parameters were evaluated for acceptability with the bounding values specified in the MAGNASTOR SAR and the NRC SER. The evaluations demonstrated that the design features for the MAGNASTOR System

enveloped the site-specific characteristics of the ZNPS, or a site-specific analysis had been performed and evaluated against the requirements of 10 CFR 72.48, “Changes, Tests, and Experiments.”

1.3 Fuel Characterization and Verification

a. Inspection Scope (IP 60854.1)

The CoC for the MAGNASTOR dry cask storage system specifies the parameters that must be met in order to allow spent fuel to be stored at the ISFSI. The inspectors evaluated licensee programs to verify that spent fuel assemblies selected for storage met the applicable requirements of the CoC. The inspection consisted of interviews with licensee personnel and review of documentation.

b. Observations and Findings

The inspectors reviewed documents associated with the characterization, and selection of fuel assemblies for storage at the ISFSI. Technical Specifications require that selected fuel assemblies be visually inspected, independently identified, and be within specified limits for such parameters as fuel enrichment, burn-up, and decay heat output. The inspectors discussed the fuel selection process with licensee personnel and determined that individuals were knowledgeable of the technical specification requirements.

The inspectors reviewed documentation associated with the characterization of fuel assemblies in accordance with approved procedures. The characterization process is performed to categorize fuel assemblies as either intact or damaged and to compile and verify the necessary fuel assembly attributes to ensure the fuel assemblies are in compliance with the approve content limitations of the CoC.

The characterization process compiled and assessed information from: historical core power data, historical fuel assembly records, historical core chemistry, historical ultrasonic testing, historical vacuum sipping, recently performed vacuum sipping of select fuel assemblies, and recently performed four sided visual inspection of all fuel assemblies at ZNPS.

The licensee determined all 2228 fuel assemblies located within the spent fuel pool are within the approved contents requirements of the CoC. Of the 2228 fuel assemblies, 37 were determined to be high burn-up fuel assemblies, and 60 were determined to be damaged fuel assemblies; it was determined that both high burn-up fuel assemblies and damaged fuel assemblies would be loaded into damaged fuel canisters.

Early in the licensee’s review, the licensee identified that 1481 fuel assemblies were subject to top nozzle guide tube intergranular stress corrosion cracking. The licensee subsequently performed modification to all subject assemblies by installing an instrument tube tie rod installation on 1478 fuel assemblies and guide tube anchor installation on 3 fuel assemblies.

The licensee characterized non-fuel inserts and hardware including: tube plugging devises, burnable poison rod assemblies, wet annular burnable assembles, reactor control cluster assembles, hafnium reduction assemblies, and neutron source

assembles. The licensee determined that all non-fuel inserts and hardware were within the approved contents parameters of the CoC.

Once the licensee appropriately characterized the fuel for storage, the licensee developed 61 individual TSC loading plans for each TSC to be loaded at the ZNPS in accordance with approved procedures. The licensee optimized the fuel loading plan to minimize offsite dose. Licensee documentation supported the proper selection of fuel assemblies to be loaded into each TSC and was in compliance with design parameters specified in the CoC.

The licensee characterized and developed their loading plans to comply with draft requirements for the NAC Modular Advanced Generation Nuclear All-purpose TRANsportation (MAGNATRAN) system. The NAC MAGNATRAN is a proposed spent nuclear fuel transportation cask system that is designed for use with MAGNASTOR TSCs. The MAGNATRAN system has not yet been approved by use by the NRC. Accordingly the inspectors did not review documentation regarding the acceptability of the fuel assemblies for transportation in the NAC MAGNATRAN system.

c. Conclusions

The licensee characterized all 2228 fuel assemblies and all non-fuel inserters and hardware at the ZNPS and established loading plans for 61 TSCs in accordance with the requirements of the MAGNASTOR CoC Approved Contents.

1.4 Records

a. Inspection Scope (IP 60854.1)

Title 10 CFR 72.72 requires that a licensee keep records showing the receipt, inventory, disposal, acquisition, and transfer of all special nuclear material. In addition, 10 CFR 72.212(b) requires that a licensee maintain a copy of the CoC and documents referenced therein for each cask model used for storage of spent fuel, until use of the cask model is discontinued, and that a copy of the 10 CFR 72.212 Evaluation Report shall be retained until spent fuel is no longer stored under the general license issued under § 72.210.

b. Observations and Findings

Zion*solutions* plans to transfer ownership of the ISFSI to Exelon as the registered user upon completion of decommissioning of the ZNPS site. At that time, the TSC/VCC and ISFSI records will be transferred in compliance with the requirements of 10 CFR 72.212(d). However, the Exelon system for processing documents is currently being used for all documentation associated with the ISFSI.

The Document Control Center at the ZNPS is staffed with Exelon employees. ZNPS document control receives a hard copy of all ISFSI project documents, reviews the documents, and then sends the documents to the Exelon Records Center in the Services and Training Center. By using Exelon's document processing system, all the ISFSI documents are being turned over to Exelon immediately.

The inspectors also evaluated the receipt inspection process for all the vendor fabrication documentation associated with the TSCs, MTCs, and VCCs. After reviewing all the documentation associated with each of these components and accepting possession, Zion*Solutions* sends all the documentation to the Zion Document Control Center. The inspectors reviewed one TSC, one MTC, and one VCC to package to verify if the fabrication documentation for each was in the Exelon records system. The team verified in the ZNPS document control center that the vertical concrete cask and transfer cask documentation for the samples had been placed in the records processing system and could be retrieved as needed.

c. Conclusions

The licensee is utilizing the Exelon records system for management of ISFSI related records management to meet the requirements of 10 CFR 72.72. The licensee was able to demonstrate retrieval of documentation required to be maintained.

1.5 Procedures and Technical Specifications

a. Inspection Scope (IP 60854.1)

The CoC for the MAGNASTOR System, in conjunction with the associated Technical Specifications, specifies requirements to ensure the safe handling and storage of spent nuclear fuel. The inspectors confirmed that copies of the CoC and referenced documents were current.

b. Observations and Findings

The inspectors reviewed licensee procedures and documentation to confirm that the TS requirements were incorporated into ISFSI work-related documents and work packages. The inspectors noted that TS requirements were incorporated into a series of ISFSI-related procedures. The licensee developed procedures to address: inspection of the VCC and TSC prior to loading; preparing the TSC to receive spent fuel assemblies; placing the TSC into the TC; moving the TSC/TC into the Spent Fuel Pool (SFP) to receive spent fuel assemblies; fuel assembly loading; removing the TSC/TC from the SFP; TSC de-watering, welding, non-destructive evaluations, vacuum drying, and helium backfilling; loading the TSC/TC onto the VCC; preparing the VCC for transport to the ISFSI; VCC storage at the ISFSI; retrieving the TSC from the VCC; and fuel assembly unloading. The procedures adequately addressed key aspects of the evolutions. The procedures contained sufficient detail to support safe handling and movement of the TSC, MTC, and VCC. The inspectors noted that the procedures covered all aspects of dry spent fuel handling, loading, and storage requirements, as required by the TSs.

c. Conclusions

The licensee established procedures that specified requirements to ensure the safe handling and storage of spent nuclear fuel.

1.6 Quality Assurance Program

a. Inspection Scope (IP 60854.1)

Per CoC 1031, Condition 3, Quality Assurance (QA), activities at the ISFSI shall be conducted in accordance with a Commission-approved quality assurance program which satisfies the applicable requirements of 10 CFR Part 72, Subpart G, QA, and which is established, maintained, and executed with regard to the cask system. Title 10 CFR 72.140(d), Previously-approved programs, accepts a QA program previously approved by the Commission which satisfies the requirements of Appendix B to Part 50 to be acceptable as satisfying these requirements.

As notified by letter dated February 23, 2011**,** to the U.S. Nuclear Regulatory Commission, QA associated with ISFSI activities was executed through the licensee's existing previously-approved QA program that satisfies the applicable criteria of 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants. The involvement and role of QA were evaluated to ensure that sufficient independence was established to verify that the ISFSI program was effectively developed and implemented to support the safe operation of the ISFSI facility. The use of the corrective action program in support of ISFSI activities was also evaluated. The inspection consisted of field observations, interviews with licensee personnel, and review of licensee documentation.

b. Observations and Findings

The inspectors reviewed the licensee's control of measuring and test equipment to verify that measures were established 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.

The inspectors reviewed the QA program documents and procedures related to non-conformances to verify that measures were established to control materials, parts, or components that do not conform to their requirements in order to prevent their inadvertent use or installation.

The inspectors reviewed licensee self-assessments. The results of the audited areas were documented and tracking items were identified for unresolved items.

The inspectors reviewed corrective action documents to verify that the licensee was adequately implementing its 10 CFR Part 50 corrective action program as it pertained to the ISFSI program and related activities. The inspectors noted that action items were identified and being tracked to closure and that issues required to be addressed prior to the first loading of spent fuel were completed or closed. The inspectors reviewed the corrective actions related to issues concerning ISFSI activities to verify that resolution was appropriate, the issue was properly documented, and that appropriate levels of management were notified.

The inspectors noted that QA personnel attended the dry run briefings and were actively engaged in field activities and verified that hold points, technical specifications, and work

order requirements were implemented in accordance with approved procedures and related work documents.

c. Conclusions

The licensee implemented the previously-approved ZNPS QA program for ISFSI operations. The program was effectively developed and implemented to support the safe operation of the ISFSI operations. The licensee actively utilized the condition reporting program in support of ISFSI operations.

1.7 Training and Qualifications

a. Inspection Scope (IP 60854.1)

The licensee's training program was reviewed to verify that appropriate training requirements were identified for ISFSI-related tasks and that personnel were qualified to perform ISFSI-related activities. The licensee's training program was also reviewed to verify that the required elements described in 10 CFR 72, Subpart I, Training and Certification of Personnel, and TS Section 5.7, Training Program, were incorporated into the ISFSI training program to ensure the safe handling and storage of spent nuclear fuel. The inspection consisted of a review of licensee documentation, interviews with cognizant personnel, and field observations.

b. Observations and Findings

A training program directly related to the NAC MAGNASTOR system had been developed under the ZNPS systematic approach to training. The inspectors interviewed training personnel regarding the training and qualification of personnel performing ISFSI-related activities. The inspectors reviewed selected training modules. The inspectors noted that the licensee designated individuals qualified to perform a given task based upon successful completion of the required training modules. The inspectors reviewed selected names from the qualification matrix and reviewed training records to verify that the individuals observed in the field were qualified for the tasks that they were performing.

Based on this sample of personnel reviewed, the inspectors concluded that the individuals conducting ISFSI activities were properly trained and qualified to perform their assigned functions.

c. Conclusions

The licensee implemented a systematic approach to training for ISFSI operations to fulfill the requirements of 10 CFR 72, Subpart I, and TS Section 5.7.

1.8 Radiation Protection

a. Inspection Scope (IP 60854)

The licensee's radiation protection program was evaluated to verify that the elements of 10 CFR 72.126, Criteria for radiological protection, had been incorporated into procedures for ISFSI related tasks and that they were effectively implemented by

licensee personnel. The inspectors evaluated the effectiveness of the licensee's plans and preparations for controlling radiological activities by direct observation, by reviewing documents, and interviewing individuals with radiation protection responsibilities.

b. Observations and Findings

The inspectors reviewed the licensee's radiation protection program, including documents associated with the operating procedures of the ISFSI, the radiation protection program of the loading campaign, and radiation protection program for the controlled area boundary of the ISFSI.

The inspectors reviewed the As Low As is Reasonably Achievable (ALARA) work plan and dose estimate for loading the first TSC. The inspector noted that applicable procedures specified the need to perform radiological surveys at critical steps of the loading sequence and when handling and transporting the loaded canister. Verification steps were incorporated into approved procedures to verify that dose rates and contamination levels were in compliance with applicable limits specified by TS.

c. Conclusions

The licensee's implemented their existing radiation protection program to comply with the requirements of 10 CFR 72.126. The licensee established an ALARA plan for ISFSI operations and developed procedures to verify that dose rates and contamination levels were in compliance with applicable limits specified by technical specifications.

1.9 Control of Heavy Loads

a. Inspection Scope (IP 60854, 60856.1)

The inspectors reviewed the licensee's implementation of the control of heavy loads program for ISFSI operations including design, inspection, testing, and maintenance documentation associated with the Fuel Handling Building crane, cask lift yoke, and cask trunnions.

b. Observation and Findings

Heavy load movements conducted in the Fuel Handling Building to support dry cask storage activities are governed by 10 CFR Part 50 regulations and Zion*Solutions* commitments to the NRC.

By letters dated May 31, 2012, and October 25, 2012, ZNPS submitted an application, pursuant to 10 CFR 50.90 requesting a License Amendment at ZNPS. The proposed amendment requested approval of the upgraded Fuel Handling Building crane. On September 19, 2013, the NRC issued a license amendment and associated safety evaluation regarding the ZNPS Fuel Handling Building Crane. The NRC determined the crane upgrade conforms to the American Society of Mechanical Engineers, NOG-1, 2004 Edition, "Rules for Construction of Overhead and Gantry Crane," as an acceptable means of meeting the criteria in NUREG-0554, "Single-Failure-Proof Cranes for Nuclear Power Plants," and conforms to any applicable criteria listed in NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants: Resolution of Generic Technical Activity A-36," Appendix C.

The Fuel Building crane structure and main hook are designed for a seismic event with the critical load 125-tons on the hook. The lifting yoke and transfer cask are designed, fabricated and tested to the requirements of American National Standards Institute, N14.6, "Radioactive Materials - Special Lifting Devices for Shipping Containers Weighing 10000 Pounds (4500 kg) or More" and are designed to lift the weight of a loaded transfer cask with an adequate safety factor with respect to yield stress. The ZNPS Defueled Safety Analysis Report (DSAR) has been revised to reflect the upgrade of the Fuel Building Crane to a single-failure proof crane which will allow the crane to handle heavy loads (i.e., greater than 1800 pounds) over the spent fuel pool.

Written procedures provide the operational guidance for the movement of heavy loads including use of overhead hoisting systems, rigging attachments, and special lifting devices. The inspectors reviewed procedures associated with the planning of lifts, training, inspection, testing, maintenance, and operation of rigging hardware, lifting equipment, and cranes.

The inspectors reviewed the licensee's evaluation of laydown areas and seismic restraints within the Fuel Handing Building to ensure compliance with the FSAR and DSAR design basis.

c. Conclusions

The licensee implemented their control of heavy loads program for ISFSI operations. The licensee upgraded their Fuel Handling Building crane to meet the criteria of NUREG-0554. The licensee established procedures for the testing and utilization of overhead cranes, standard rigging, and special lifting devices in accordance with industry standards.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Anthony Bejma, Quality Assurance Manager
Bill Szymczak, Nuclear Fuel Specialist
Brian Wood, Dry Cask Storage Vice President
Bruce Holmgren, Dry Cask Storage Vice President
Gerry Van Noordennen, 10 CFR 72.212 Specialist
Hayes, Morgan, ISFSI Weld Supervisor
Jack Bailey, ISFSI Senior Licensing Consultant
John Ferguson, Fuel Techncial Support Manager
Michael Miller, Fuel Transfer Operations Manager
Rick Williams, Fuel Engineering Manager

INSPECTION PROCEDURES USED

IP 60854.1 Pre-Operational Testing of ISFSIs at Operating Plants

IP 60856.1 Review of 10 CFR 72.212 (b) Evaluations at Operating Plants

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened	Type	Summary

None

Closed

None

LIST OF DOCUMENTS REVIEWED

10 CFR 50.59, 50.82, 71, 72.48 Tracking Log
22N-D-142-X-00003; Characterization of Zion Spent Fuel Assemblies and Inserts for Dry Cask Storage; Revision 3
22N-D-142-X-0004; Classification of Zion Spent Fuel Assemblies and Inserts for Dry Cask Storage; Revision 2
22N-D-142X-0008; Zion Restoration Project Aircraft Crash Hazard Assessment Update; Revision 0
36675-13; Site Acceptance Test Procedure; Zion Fuel handling Building Single Failure Proof Trolley; Revision 3
50.59 2013-230; Fuel Transfer Operations; Revision 0
510-19; Heavy Loads Program; Revision 0
630073-2025; VCC Tipover Calculation; Revision 2
71160-P-02 MAGNASTOR Operating Manual; Revision 8

71160-P-02; Operating Manual for the MAGNASTOR System; Revision 8
71173-106; Auxiliary Lifting Rigs, Cask Operations; dated July 17, 2013
72.48 2013-0059; Revise of EHS TSD 13-007, TSD 13-008, and TSD 13-009 for Compliance with 10 CFR 72.104(a); dated November 21, 2013
72.48 2013-034; Zion ISFSI Fire and Explosion Hazard Analysis; Revision 0
72.48 2013-063; 10 CFR 72.212 Evaluation Report; Revision 0
72.48 2013-184; Fuel Transfer Operations Path; Revision 0
Condition Reports Generated During the Inspection Relating to Either the Fuel Handling Building Crane, ISFSI Construction or Fuel Transfer Operations Were Reviewed by the Inspectors
DVT-ZS-NMC; Direct Visual Examination; Revision 5981-00
DVT-ZS-NMC; Direct Visual Inspection; Revision 5981-00
EHS TSD-13-007; Evaluation of Waste Classification A,B and C Storage and Staging Dose Rates: Revision 00
EHS TSD-13-008; Evaluation of ISFSI and Associated Processes Dose Rates; Revision 00
EHS TSD-13-009; Member of the Public Dose from All Onsite Sources; Revision 00
FHI-22 Fuel Handling Building Overhead Crane Procedure; Revision 16
Fuel Selection Package; Fuel Selection Package Numbers ZIO-0001 through ZIO-0061
Fuel Transfer Operations ALARA Plan; September 25, 2013
HTPT-ZS-NMC; High Temperature Liquid Penetrant Examination; Revision 5981-00
Independent Readiness Review for Spent Fuel Dry Cask Storage; October 8, 2013
Liquid Penetrant Qualification at Nonstandard Temperatures. Qualification Number PT-1001; dated September 4, 2013
NF-ZN-310-2000; Special Nuclear Material Core Component Movement Requirements; Revision 3
NF-ZN-622; Fuel Selection and Documentation for Dry Cask Loading; Revision 2
NF-ZN-625; MAGNASTOR TSF Fuel Space Damaged Fuel Can Cell Block Matrix; Revision 0
QA Surveillance Report S-13-033; Airgas [Backfill Helium]; October 9, 2013
STPT-ZS-NMC- Standard Temperature Liquid Examinations; Revision 5981-00
STPT-ZS-NMC' Standard Temperature Liquid Penetrant Examination Using the Color Contrast Solvent-Removable Method; Revision 5981-00
ZION-FT-2013-0018; TSC Loading Summary/Maximum Cask Heat Load; Revision 0
ZION-FT-2013-0034; Zion ISFSI Fuel Load Planning/Development Process and Compliance Matrices; Revision 0
ZION-001-CALC-003; Dry Cask Storage System Operations Load Path Structural Evaluation Inside the FHB; Revision 0
ZION001-CALC-009 Zion ISFSI Fire and Explosions Hazards Analysis; Revision 2
ZION-001-CALC-015; Stack-Up Seismic Overturning Restraint; Revision 0
ZION-001-CALC-038; Vertical Concrete Cask Restraint; Revision 0
ZION-001-RPT-001 ISFSI and Heavy Haul Path Hazards Evaluation; Revision 2
ZION-CALC-009 Fire and Explosion Hazards; Revision 3
ZS-FT-200; General Welding Standard; Revision 1
ZS-FT-201; Welding Procedure Specifications and Qualifications; Revision0
ZS-FT-2013-0015; Cask Loading Requirements Memorandum/General Information for Loading of 61 Fuel Cask at Zion; Revision 1
ZS-FT-2013-0035; Cask Loading Plan Data for Zion ISFSI Campaign; Revision 0
ZS-FT-202; Welder and Welding Operator Qualifications; Revision 1
ZS-FT-203; Weld Filler Material Control; Revisin1
ZS-FT-210; MAGNASTOR Canister Welding Standard; Revision 1
ZS-FT-400; Transportable Storage Canister Receipt Inspection; Revision 5
ZS-FT-401; TSC Loading Operations; Revision 0

ZS-FT-402; TSC Closure Operations; Revision 0
ZS-FT-403; VCC Loading Operations; Revision 0
ZS-FT-404; Site Transportation; Revision 0
ZS-FT-405; FTO Contingency Plans; Revision 0
ZS-FT-406; VCC Unloading Operations; Revision 0
ZS-FT-407; TSC Unloading Operations; Revision 0
ZS-FT-408; Dry Cask Storage Special Lifting Device Inspections; Revision 0
ZS-FT-409; Fuel Transfer Operations Lift Plans; Revision 0
ZS-FT-410; Vertical Cask Transporter Operation; Revision 2
ZS-FT-411; Annulus Circulating water System Operation; Revision 0
ZS-FT-412; vertical Concrete Cask Pre-Use Inspections; Revision 0
ZS-RP-105-001-004; MTC TSC Radiation and Contamination Surveys; Revision 0
ZS-RP-105-001-005; VCC Radiation Survey; Revision 0
ZS-RP-105-001-006; ISFSI Radiation Survey; Revision 0