



**UNITED STATES
NUCLEAR REGULATORY COMMISSION**

REGION III
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LISLE, IL 60532-4352

August 15, 2016

Mr. John Sauger
General Manager
Zion Restoration Project
ZionSolutions, LLC
101 Shiloh Boulevard
Zion, IL 60099

SUBJECT: NRC INSPECTION REPORT NO. 05000295/2016002(DNMS);
05000304/2016002(DNMS); 07201037/2016001(DNMS)
ZION NUCLEAR POWER STATION

Dear Mr. Sauger:

On July 18, 2016, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at the permanently shut down Zion Nuclear Power Station (ZNPS). The NRC inspectors discussed the results of this inspection with Mr. Jerry Houff and other members of your staff. The inspectors documented the results of this inspection in the enclosed inspection report.

This inspection report documents a review of the following aspects of onsite activities: operation of an Independent Spent Fuel Storage Installation (ISFSI), emergency preparedness exercise performance, occupational radiation safety exposures, and final status surveys. The inspection consisted of an examination of activities at the sites as they relate to safety and compliance with the Commission's rules and regulations. Areas examined during the inspection are identified in the enclosed report. Within these areas, the inspection consisted of a selective examination of procedures and representative records, observation of work activities, and interviews with personnel.

Based on the result of this inspection, no violations of NRC requirements were identified. In accordance with Title 10 of the *Code of Federal Regulations* (CFR) 2.390, "Public Inspections, Exemptions, Request for Withholdings," of the NRC's "Rules of Practice," a copy of this letter and its enclosure, will be made available electronically for public inspection in the NRC's Public Document Room or from the Publicly Available Records System (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS). ADAMS is accessible

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from the NRC's website at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

/RA/

Michael Kunowski, Chief
Materials Control, ISFSI, and
Decommissioning Branch
Division of Nuclear Materials Safety

Docket Nos. 050-0295; 050-00304;
072-01037
License Nos. DPR-39; DPR-48

Enclosure:
IR 05000295/2016002 (DNMS);
05000304/2016002 (DNMS);
07201037/2016001(DNMS)

cc w/encl: *ZionSolutions*, 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: 05000295/2016002(DNMS)
05000304/2016002(DNMS)
07201037/2016001(DNMS)

Licensee: ZionSolutions, LLC

Facility: Zion Nuclear Power Station

Location: Zion, Illinois

Dates: April 13, 2016, through July 18, 2016

Inspectors: Bill C. Lin, Health Physicist
Matthew C. Learn, Reactor Engineer
Peter J. Lee, Reactor (Decomm) Inspector, Ph.D., CHP

Approved by: Michael A. Kunowski, Chief
Materials Control, ISFSI, and
Decommissioning Branch
Division of Nuclear Materials Safety

Enclosure

EXECUTIVE SUMMARY

ZION NUCLEAR POWER STATION, UNIT 1 and 2 NRC Inspection Report 05000295/2016002(DNMS); 05000304/2016002(DNMS); AND 07201037/2016001(DNMS)

The Zion Nuclear Power Station (ZNPS) is a permanently shut-down and defueled power reactor facility that was maintained in a safe storage (SAFSTOR) condition from 1998 through 2010. Active decommissioning began in 2011, and continued throughout the inspection period. This routine safety inspection reviewed licensed activities associated with the storage of spent nuclear fuel at the ZNPS Independent Spent Fuel Storage Installation (ISFSI), emergency preparedness (EP) exercise performance, occupational radiation safety exposures, and final status surveys.

Operation of an Independent Spent Fuel Storage Installation

- The licensee implemented its ISFSI surveillance and maintenance program in accordance with applicable regulations, the License, and Technical Specifications (TS).
- The licensee established and maintained its environmental monitoring program as it pertains to the ISFSI in accordance with applicable 10 CFR Part 20, 50, and 72 regulations, the License, and TS.
- The licensee implemented its Corrective Action Program (CAP) in accordance with the applicable regulations and site quality assurance requirements. Through the CAP, issues were effectively identified and corrected by the licensee. (Section 1.0)

Decommissioning Emergency Preparedness Scenario Review and Exercise Evaluation

- The licensee's exercise scenario provided sufficient opportunities to demonstrate the capability to protect public health and safety.
- The licensee demonstrated adequate performance to identify weaknesses during the conduct of a critique following an emergency exercise. Identified weaknesses were entered into the CAP as appropriate. (Section 2.0)

Decommissioning Emergency Preparedness Program Evaluation

- The EP program was maintained in a state of operational readiness. Changes made to the emergency plan followed a defined 10 CFR 50.54(q) change process. (Section 3.0)

Occupational Radiation Exposure

- Radiation Work Permits (RWPs) and As Low As Is Reasonably Achievable (ALARA) controls provided contamination controls and dose reduction measures appropriate for the work activities. Workers adhered to the radiological controls provided in the RWPs and ALARA plans and followed the Radiation Protection (RP) staff instruction.

- Decommissioning activities were executed in general alignment with planning documents and as provided in RWPs and ALARA reviews. Radiation surveys were performed adequately to identify the hazards present. Command and control of radiologically significant activities was executed in a manner that was safe and achieved the desired result.
- NRC inspectors reviewed the results of the licensee's investigation of the contamination event that occurred on March 16, 2016. (Section 4.0)

Final Status Surveys

- NRC inspectors reviewed the results of the confirmatory surveys of the basement of the turbine building (TB) and un-impacted land areas. The confirmatory surveys were performed by Oak Ridge Associated Universities (ORAU) for final status surveys (FSSs).
- NRC inspectors reviewed the survey results of the embedded piping for equipment and floor drains in the TB. Based on the review of the survey and analytical results, the inspectors determined it was appropriate for the embedded piping to be classified as a Class 3 area and that the residual contamination in the pipes contributed insignificant source term to the basement inventory limit (BIL) of the turbine building.
- NRC inspectors reviewed the surveys and the cleaning results of the embedded piping for equipment and floor drains in the auxiliary building. The licensee currently classified this area as a Class 1 area. Following cleaning, the auxiliary building embedded piping still contains significant activity that could potentially exceed the BIL of the auxiliary building. The licensee is in the process of selecting the appropriate options to ensure that the BIL of the auxiliary building will not be exceeded and the NRC inspection is ongoing. (Section 5.0)

Report Details

Summary of Plant Activities

During the inspection period, the licensee performed source term surveys of the TB basement, the embedded piping in the auxiliary and turbine building, and decommissioning work in the fuel handling building and auxiliary building. In addition to the ongoing decommissioning work, the licensee performed its bi-annual emergency planning exercise and its RP medical drill.

1.0 Operation of an Independent Spent Fuel Storage Installation (Inspection Procedure (IP) 60855)

1.1 Surveillance and Maintenance

a. Inspection Scope

The inspectors reviewed the licensee's surveillance and maintenance program associated with dry fuel storage to verify compliance with the applicable regulations, the License, and TS. The inspectors walked down the ISFSI pad, observed daily surveillance activities, interviewed personnel, and reviewed select documents.

b. Observations and Findings

The inspectors conducted a walk down of the ISFSI pad and observed licensee staff perform daily surveillances of the casks including inlet and outlet screen checks to ensure they were free of significant blockage or damage. The inspectors also evaluated the structural condition of the pad and casks. The inspectors found that the licensee performed and documented the surveillance activities as required by TS and site procedures.

No findings were identified.

c. Conclusion

The licensee implemented its surveillance and maintenance program in accordance with applicable regulations, the License, and TS.

1.2 Environmental Monitoring

a. Inspection Scope

The inspectors reviewed the licensee's annual Radioactive Effluent Release Report for 2015. The inspectors also reviewed quarterly radiological survey results performed by the licensee in 2015 and 2016. This review evaluated whether the licensee complied with the off-site dose requirements prescribed by 10 CFR 72.104.

b. Observations and Findings

The licensee performed environmental radiological monitoring as required for the ISFSI. The survey results indicated that the licensee was well under the limits of 10 CFR 72.104.

No findings were identified.

c. Conclusion

The licensee established and maintained its environmental monitoring program as it pertains to the ISFSI in accordance with applicable 10 CFR Part 20, 50, and 72 regulations, the License, and TS.

1.3 Quality Assurance

a. Inspection Scope

The inspectors verified through document reviews and conduct of interviews whether changes were appropriately controlled and done in accordance with QA requirements. Corrective action reports from 2015 and 2016 were reviewed to determine whether the licensee effectively identified, resolved, and prevented problems.

b. Observations and Findings

The inspectors reviewed 10 CFR 72.48 evaluations performed during 2015 and 2016. A review of Condition Reports written during 2015 and 2016 indicated that the licensee was effectively identifying and correcting facility issues.

c. Conclusion

The licensee implemented its CAP in accordance with the applicable regulations and site QA requirements. Through the CAP, issues were effectively identified and corrected by the licensee.

2.0 Decommissioning Emergency Preparedness Scenario Review and Exercise Evaluation (IP 82401)

2.1 Inspection Scope

The inspectors conducted document reviews, performed interviews, and observed an EP exercise to assess:

- Whether the exercise scenario provided sufficient opportunities to demonstrate the licensee's capability to perform key skills in principal functional areas to protect public health and safety; and

- The adequacy of the licensee's conduct of an exercise and ability to assess a formal critique to identify and correct weaknesses.

2.2 Observations and Findings

The inspectors reviewed and determined that the exercise scenario provided sufficient opportunities to demonstrate key skills in principal functional areas to protect public health and safety. Additionally, through direct observation of the emergency response organization during an emergency exercise, the inspectors confirmed the scenario provided sufficient opportunities to demonstrate the licensee's capability. Following the exercise, the inspectors observed portions of the licensee's critique and concluded that the licensee adequately assessed performance and entered identified weaknesses into the CAP as appropriate.

No findings were identified.

2.3 Conclusions

The inspectors determined that the licensee's exercise scenario provided opportunities to demonstrate the capability to protect public health and safety. Additionally, the licensee demonstrated adequate performance to identify weaknesses during the conduct of a critique following an emergency exercise. Identified weaknesses were entered into the CAP as appropriate.

3.0 Decommissioning Emergency Preparedness Program Evaluation (IP 82501)

3.1 Inspection Scope

The inspectors reviewed the licensee's EP program to determine whether the EP program had been maintained in a state of operational readiness and whether changes made to the EP program continue to meet license commitments and the NRC's regulatory requirements, and have not negatively affected the overall state of EP at Zion. The inspection consisted of interviews with the licensee and a review of procedures and records. The inspectors reviewed the classification, notification, and augmentation procedures to ensure compliance with EP plan requirements. The inspectors conducted a review of the Emergency Response Organization (ERO) augmentation staffing requirements to ensure the system was adequate to allow meeting ERO augmentation staffing commitments.

The inspectors reviewed corrective action reports to ensure EP deficiencies were adequately captured and corrected. The inspectors reviewed 10 CFR 50.54(q) evaluations to determine whether the EP program was maintained in a state of operational readiness and whether changes made to the licensee's EP program continue to meet commitments, NRC requirements, and have not resulted in a reduction in effectiveness of the EP plan.

3.2 Observations and Findings

The inspectors determined that the licensee's EP plan implementing procedures were adequate to meet the EP plan requirements for classification, notification, and augmentation. The inspectors also noted that changes made to the EP plan did not reduce its effectiveness and that screenings and evaluations contain the appropriate level of detail and sufficient basis to support the change.

However, this review is not a formal safety evaluation and does not constitute formal NRC approval of the changes. Therefore, these changes remain subject to future NRC inspection in their entirety.

No findings were identified.

3.3 Conclusions

Overall, the EP program was maintained in a state of operational readiness. Changes made to the emergency plan followed a defined 10 CFR 50.54(q) change process.

The inspectors verified that when issues were identified that licensee personnel appropriately documented the issue in the CAP.

4.0 Occupational Radiation Exposure (IP 83750)

4.1 Inspection Scope

The inspectors reviewed documents and interviewed plant personnel to assess the licensee's performance in the following areas:

- Planning and preparation for radiation work were adequate and if licensee management supported radiation protection planning;
- Personal dosimetry for external exposure met requirements;
- Management and administrative controls of external radiation exposure met requirements and were designed to make exposures ALARA;
- Processes or engineering controls were used to the extent practicable to limit concentrations of airborne radioactive materials;
- Survey and monitoring activities were performed as required;
- Control of radioactive materials and contamination met requirements;
- Effective implementation of the ALARA program; and
- Issues, events, or problems were identified and resolved, and actions were taken to prevent future problems in the area of radiological controls.

4.2 Observations and Findings

The inspectors reviewed the RWP and ALARA plans associated with removal of the fuel pool liner and spent resin. The inspectors reviewed the air sampling and survey results. The inspectors also reviewed the licensee's bioassay results for the fuel pool liner evolution. The air sampling, survey, and bioassay results did not indicate any unexpected radiological hazards or any internal contamination. The inspectors also interviewed various licensee RP staff and supervisors. All licensee personnel were knowledgeable about the hazards of the evolutions being performed and the proper RP protocols for any radiological incidents. The inspectors also observed the licensee don the appropriate personal protection equipment, such as respirators and dosimetry, and followed appropriate ALARA practices.

The inspectors reviewed the RWP associated with embedded pipe cleaning and surveys. The inspectors reviewed the air sampling results during the pipe cleaning with a high capacity vacuum system. The air sampling results did not indicate any concern radionuclides. Based on the observation of health physics practices during the inspection, the inspectors determined that the licensee was effective in controlling radiation worker personal exposures.

The inspectors completed a review of the licensee's Apparent Cause Evaluation (ACE) regarding a March 16, 2016, contamination event. The ACE determined that the contamination was a discrete radioactive Cobalt 60 (Co-60) particle. The licensee performed a dose calculation to show that the worker did not exceed any NRC regulatory dose limits.

No findings were identified.

4.3 Conclusions

RWP and ALARA reviews provided contamination controls and dose reduction measures appropriate for the work activities. Workers adhered to the radiological controls provided in the RWPs and ALARA plans and followed the RP staff instruction.

Decommissioning activities were executed in general alignment with planning documents and as provided in RWPs and ALARA reviews. Radiation surveys were performed adequately to identify the hazards present. Command and control of radiologically significant activities was executed in a manner that was safe and achieved the desired result. Licensee had also completed the ACE regarding the contamination event that occurred on March 16, 2016.

5.0 Inspection of Final Status Surveys at Permanently Shutdown Reactors (IP 83801)

5.1 Inspection Scope

The inspectors conducted document reviews, observations, and interviews with plant personnel to assess the licensee's performance as it related to the following areas:

- Permanently shutdown power reactor sites were decontaminated to acceptable residual radioactivity levels in accordance with the License Termination Plan (LTP)

requirements for unrestricted or restricted use.

- Radiological measurements, surveys, and documentation of remedial action support surveys and FSSs were conducted in accordance with the licensee's LTP and implementation procedure.
- Licensee's implementation or completion of remediation surveys were adequately performed and the survey units have been prepared and were acceptable for the performance of FSSs.
- Licensee's implementation of the FSS program was appropriate and to confirm the acceptability of the FSS results.

5.2 Observations and Findings

a. Turbine Building Basement/Un-Impacted Land Area

The inspectors observed ORAU perform confirmatory surveys in the TB basement and un-impacted land area. ORAU performed surface scans of the TB basement and un-impacted land area with Ludlum Model 44-10 sodium iodide detectors coupled to Ludlum Model 2221 ratemeter-scalers with audible indicators. In addition to the surface scans, ORAU also performed quantitative gamma radiation measurements during the surface scans inside the TB basement. There were six judgmental in situ gamma spectroscopy measurements in addition to 11 additional gamma spectroscopy measurements in random locations. In addition to the surface scan and quantitative analysis, ORAU collected three soil samples during the scan of the un-impacted land area. ORAU also collected three soils samples and one water sample during the survey in the TB basement. The final results of the confirmatory survey will be issued by ORAU at a later date.

b. Turbine Building

The inspectors reviewed and evaluated the survey package for embedded pipes, equipment, and floor drains. The inspectors also observed the licensee survey certain sections of pipe during the inspection. Based on the review of survey results and analytical results of the debris collected from pipes, the inspectors determined that the inner surface of the pipe was appropriately classified as a Class 3 area. Because of that, it was appropriate for the licensee to conduct the judgmental survey in selected section of pipe to assess the activity. The licensee conducted static gamma measurements at 1 foot intervals along the selected length of pipes. Based on the review of survey results, the inspectors determined that the residual contamination in the pipes contributed insignificant source term to the BIL of the TB.

c. Auxiliary Building

The inspectors reviewed and evaluated the cleaning and survey packages of embedded pipes, and equipment and floor drains. The inspectors also observed the licensee clean and survey certain sections of embedded pipes during the inspection. The licensee cleaned the embedded pipes by using a mechanical rotary cleaning tool to loosen debris obstructing or adhering to the inner surface of the pipe, and a high capacity vacuum

system to draw the loosened material out of the pipe and deposit it in the vacuum collection canister. The licensee classified the inner surface of the pipes as a Class 1 area. The sizes of the pipes were 2", 4", and 6" and the total length of the pipes was about 2356 feet. The licensee conducted static gamma measurements at 1-foot intervals along the pipes. Based on a review of the survey results after cleaning, the inner surface of the pipes still contain significant activities. Because of that, the source terms of the pipes and the basement floor might exceed the BIL of the Auxiliary Building. The source terms of the basement floor stated in the LTP were based on 17 biased core samples, the actual source terms should be lower. Also, the current calibration of the detector used for pipe measurement was based on Cesium 137, which was based on the characterization of the Auxiliary Building prior to the dismantlement and remediation. But, based on the current isotopic analyses, the debris contained Co-60 up to 78% of the total activity. Because of that, the actual efficiency of the detector will be higher and the source terms in the pipes will be lower than the current assessment. To determine if the source terms will meet the BIL, the licensee should either reassess the source terms of embedded pipe based on the detector efficiency of actual mixture of radionuclides of concern, and/or determine the actual source terms of basement floor using In Situ Object Counting Systems measurements.

No findings were identified.

5.3 Conclusions

NRC inspectors reviewed the results of the confirmatory surveys of the basement of the TB and un-impacted land areas. The confirmatory surveys were performed by ORAU for FSSs.

NRC inspectors reviewed the survey results of the embedded piping for equipment and floor drains in the TB. Based on the review of the survey and analytical results, the inspectors determined it was appropriate for the embedded piping to be classified as a Class 3 area and that the residual contamination in the pipes contributed insignificant source term to the BIL of the turbine building.

NRC inspectors reviewed the surveys and the cleaning results of the embedded piping for equipment and floor drains in the auxiliary building. The licensee currently classified this area as a Class 1 area. Following cleaning, the auxiliary building embedded piping still contained significant activity that could potentially exceed the BIL of the auxiliary building. The licensee was in the process of selecting the appropriate options to ensure that the BIL of the auxiliary building would not be exceeded; NRC inspection of this surveying is ongoing.

6.0 **Exit Meeting**

The inspectors presented the results of the inspection to Mr. Jerry Houff and other members of the ZNPS staff at a telephone exit meeting on July, 18, 2016. The licensee acknowledged the results presented and did not identify any of the information discussed as proprietary.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

G. Van Noordennen, Vice President of Regulatory Affairs
J. Ashley, Zion Licensing Engineer
J. Houff, Licensing Manager
J. Smith, Radiological Engineer
T. Orawiec, Plant Manager
B. Yetter, Characterization/License Termination Manager
C. Keene, RP Director

INSPECTION PROCEDURES (IPs) USED

IP 60855 Operation of an Independent Spent Fuel Storage Installation
IP 82401 Decommissioning Emergency Preparedness Scenario Review
IP 82501 Decommissioning Emergency Preparedness Program Evaluation
IP 83750 Occupational Radiation Exposure
IP 83801 Inspection of Final Status Surveys at Permanently Shutdown Reactors

ITEMS OPENED, CLOSED, AND DISCUSSED

None

PARTIAL LIST OF DOCUMENTS REVIEWED

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

- Surveys of the turbine building basement
- Surveys of the fuel building
- Surveys of the spent resin evolution
- Cesium-137 investigational surveys and job aid
- LT-JA-003; Site Characterization/License Termination; May 4, 2016
- Auxiliary Building Drain Surveys
- Auxiliary Building Drain Map
- Source Term Survey Preliminary Data Assessment
- Report of Annual and RP Medical Drill; June, 2016
- 2016 Medical and RP Drill Scenario; June 2016
- 2016 Biennial Defueled Station Emergency Plan (DSEP) Exercise; June 06, 2016
- Zion Station DSEP; June 29, 2015; Revision 17
- Zion Station DSEP Emergency Action Level Basis Document; June 29, 2015; Revision 0
- Zion Station Emergency Preparedness Administration; EO-3; June 29, 2015; Revision 0
- Zion Station Emergency Preparedness Implementation; EO-4; June 29, 2015; Revision 0
- Apparent Cause Evaluation for Condition Report 2016-000106; May 09, 2016

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
ALARA	As Low As Is Reasonably Achievable
BIL	Basement Inventory Limit
CAP	Corrective Action Program
CFR	Code of Federal Regulations
Co-60	Cobalt 60
DNMS	Division of Nuclear Materials Safety
DSEP	Defueled Station Emergency Plan
EP	Emergency Preparedness
ERO	Emergency Response Organization
IR	Inspection Report
ISFSI	Independent Spent Fuel Storage Installation
LTP	License Termination Plan
NRC	U.S. Nuclear Regulatory Commission
ORAU	Oak Ridge Associated Universities
PARS	Publicly Available Records System
RP	Radiation Protection
RWP	Radiation Work Permit
SAFSTOR	Safe Storage
TB	Turbine Building
TS	Technical Specifications
ZNPS	Zion Nuclear Power Station