

August 18, 2011

Mr. John A. Christian, President  
ZionSolutions, LLC  
900 17<sup>th</sup> Street, NW, Suite 1050  
Washington, D.C. 20006

SUBJECT: NRC INSPECTION REPORT 050-00295/11-01(DNMS); 050-00304/11-01(DNMS)  
ZION NUCLEAR POWER STATION

Dear Mr. Christian:

On July 1, 2011, the U.S. Nuclear Regulatory Commission (NRC) completed onsite inspection activities for the first and second calendar quarters of 2011 at the permanently shut-down Zion Nuclear Power Station in Zion, Illinois. The purpose of the inspection was to determine whether decommissioning activities were conducted safely and in accordance with NRC requirements.

Specifically, the inspectors reviewed the ZionSolutions design change and safety evaluation process, evaluated the adequacy of recently completed safety reviews, reviewed aspects of spent fuel pool safety, and portions of the occupational radiation safety and instrument calibration programs. In addition, the inspectors reviewed Zion Station staff response to offsite power outages, a fire in the auxiliary transformer and wind damage to site structures following storms that swept through the area. Qualifications of selected staff were also reviewed. After an in-office review following the onsite inspection activities, on July 22, 2011, one of the NRC inspectors involved in the inspection discussed the findings with Messrs. Daly and Thurman of your staff.

The inspection consisted of an examination of activities at the site 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, observations of activities in progress, and interviews with personnel.

Based on the results of this inspection, the inspectors did not identify any violations of NRC requirements that were of greater than minor safety significance.

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 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 Web site at <http://www.nrc.gov/reading-rm/adams.html>.

J. Christian

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

Sincerely,

**/RA/**

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

Docket No. 050-00295; 050-00304  
License No. DPR-39; DPR-48

Enclosure:  
Inspection Report 050-00295/11-01(DNMS); 050-00304/11-01(DNMS)

cc w/encl: C. Settles, Head Resident Inspection, Illinois Emergency Management Agency  
The Honorable Suzi Schmidt, Illinois General Assembly  
The Honorable JoAnn D. Osmond, Illinois General Assembly  
Barry A. Burton, Lake County Administrator  
Mark C. Curran, Jr., Lake County Sheriff  
Laurie Cvengros, Village Clerk, Village of Beach Park, Illinois  
Willard R. Helander, Lake County Clerk  
Joseph G. Klinger, Illinois Emergency Management Agency  
Jana Lee, Village Clerk, Village of Winthrop Harbor, Illinois  
Judy L. Mackey, City Clerk, City of Zion, Illinois  
Kent McKenzie, Lake County, Illinois  
Irene T. Pierce, Lake County, Illinois  
General Manager, Zion Nuclear Power Station, ZionSolutions, LLC  
Director Regulatory Affairs, Zion Nuclear Power Station, ZionSolutions, LLC  
Security Manager, Zion Nuclear Power Station, ZionSolutions, LLC

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**U.S. NUCLEAR REGULATORY COMMISSION**

**REGION III**

Docket Nos.: 050-00295; 050-00304

License Nos.: DPR-39; DPR-48

Report Nos.: 050-00295/11-01(DNMS)  
050-00304/11-01(DNMS)

Licensee: ZionSolutions, LLC

Facility: Zion Nuclear Power Station

Location: 101 Shiloh Boulevard  
Zion, IL 60099

Dates: On-site January 20 – 21, February 25,  
March 9 – 11, March 15, June 2 and  
June 27 – July 1, 2011

NRC Inspectors: Wayne Slawinski, Senior Health Physicist  
Jeremy Tapp, Health Physicist  
Lionel Rodriguez, Reactor Engineer

Approved by: Christine A. Lipa, 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 050-00295/11-01(DNMS); 050-00304/11-01(DNMS)**

The Zion Nuclear Power Station is a permanently shut-down and defueled power reactor facility in SAFSTOR condition (spent fuel in wet storage). In 2011, the site transitioned to active decommissioning status as staffing was expanded, organizational and institutional controls were developed to support the decommissioning project, engineering evaluations were performed and physical work commenced. This routine decommissioning inspection reviewed the licensee's preparations and its execution of the site decommissioning project focusing on facility design modifications and associated safety reviews, aspects of the occupational radiation safety and instrument calibration programs, and the site's response to severe weather induced events.

#### **Facility Organization, Management and Controls**

- Changes to the licensee's site organization and staffing satisfied regulatory requirements, and met site needs commensurate with the escalation in the decommissioning work (Section 1.1).

#### **Safety Reviews, Design Changes and Modifications**

- The licensee established adequate processes and procedures for performing Title 10 of the Code of Federal Regulations (CFR) 50.59 safety evaluations, engineering design changes and decommissioning impact evaluations (Section 2.1).
- The licensee performed adequate safety evaluations and/or screenings, completed design change evaluations and properly assessed decommissioning impacts of various work activities with some exceptions. Regulatory compliance issues of minor safety significance were identified with the 10 CFR 50.59 evaluation and work instruction for the containment building construction opening concrete removal work, and with insulation abatement from the station heating system (Section 2.2).

#### **Decommissioning Performance and Status**

- Systems in the control room that monitor parameters that are important to the safe storage of spent fuel and to decommissioning activities were functional. Control room personnel were cognizant of monitoring responsibilities and response actions for off-normal conditions (Section 3.1)
- Plant material condition and housekeeping were adequate and had not adversely impacted safe decommissioning. Workers followed work plans and safety protocols and were aware of job controls specified in work instructions (Section 3.2).
- The licensee's response to severe weather related events occurring on successive days late in the inspection period was adequate to ensure the safe storage of spent fuel (Section 3.3).

### **Spent Fuel Pool Safety**

- The spent fuel pool was engineered and was adequately protected to prevent a siphon or drain down event. The licensee implemented adequate and timely corrective actions when one of two redundant spent fuel pool heat exchanger units was degraded (Section 4.1).
- The spent fuel pool had adequate instrumentation and control systems in place to allow the licensee to promptly identify a loss of pool water inventory event (Section 4.2).
- The licensee adequately maintained spent fuel pool chemistry control including boron concentration within the required values established by technical specification. The licensee adequately addressed abnormal chloride concentrations in pool water and implemented timely corrective actions to return concentrations to normal values (Section 4.3).

### **Maintenance and Surveillance**

- The licensee adequately assessed the potential radiological impact of a containment building ventilation system purge test, monitored appropriate plant locations for radioactivity during the test, and completed the test satisfactorily as provided in the test procedure (Section 5.1).

### **Occupational Radiation Exposure**

- Radiological evaluations, radiation survey plans, surveillance test documents and radiological work packages overall were adequately developed and properly executed to reduce occupational worker dose (Section 6.1).
- An adequate number and type of portable survey instruments and personnel contamination monitors were available to support the decommissioning project. Instruments were adequately tested before use to demonstrate functionality. However, alarm setpoints on portal monitors and sources used for functional testing these monitors did not fully align with current operating reactor standards (Section 6.2).
- A regulatory compliance issue of minor safety significance related to radiation work permit required contamination controls was identified. The licensee was slow to evaluate the issue following identification of the problem (Section 6.2).

## **Report Details**

### **Summary of Plant Activities**

During the six-month inspection period, active decommissioning work escalated as physical work continued throughout the period. Institutional and organizational controls continued to be developed as staffing was expanded to support the increased work activities. Engineering evaluations likewise escalated to support design changes to systems/structures and pending dismantlement of components.

#### **1.0 Facility Organization, Management and Controls (IP 36801)**

##### **1.1 Site Organization, Staffing and Qualifications**

###### **a. Inspection Scope**

The inspectors reviewed changes to the licensee's site organization and staffing, and evaluated the qualifications of certain radiation protection (RP) staff including the radiation protection manager and selected RP technicians to assess compliance with the Zion Nuclear Power Station Permanently Defueled Technical Specifications. The inspectors selectively determined whether licensee and contractor staffing satisfied regulatory requirements.

###### **b. Observations and Findings**

During the inspection period, the licensee continued to expand its staff to meet resource needs created by the escalation in decommissioning activities. Licensee staff was actively being supplemented with qualified contractor personnel in specialty areas to support the decommissioning project. Qualified operations department and radiation protection managers were appointed and several new RP supervisors and technicians were hired.

No findings of significance were identified

###### **c. Conclusions**

Changes to the licensee's site organization and staffing satisfied regulatory requirements, and met site needs commensurate with the escalation in the decommissioning project.

#### **2.0 Safety Reviews, Design Changes and Modifications (IP 37801)**

##### **2.1 Decommissioning Safety Review Program**

###### **a. Inspection Scope**

The inspectors reviewed the licensee's process for conducting safety reviews and design change evaluations to determine conformance with the requirements of 10 CFR 50.59. The inspectors reviewed procedures that control and implement design

changes, tests, facility modifications and safety reviews to determine whether the procedures provide adequate instruction to assure proper implementation, evaluation and management approval. The inspectors discussed implementation of the safety/design change evaluation program with involved staff to assess the rigor of the technical reviews.

b. Observations and Findings

The inspectors determined that the licensee had developed adequate procedures to control its 10 CFR 50.59 review process, facility design changes, tests and modifications and for decommissioning impact evaluations as provided in 10 CFR 50.82. Adequate procedures were also developed for engineering review of decommissioning activities and for configuration control of systems, structures and components during decommissioning. Discussions revealed that licensee staff had the necessary expertise to conduct adequate evaluations.

No findings of significance were identified.

c. Conclusions

The licensee established adequate processes and procedures for 10 CFR 50.59 safety evaluations, engineering design changes and for decommissioning impact evaluations.

2.2 Design Changes, Tests and Modifications

a. Inspection Scope

The inspectors selectively reviewed 10 CFR 50.59 screenings and/or evaluations and associated design change documentation for a variety of facility modifications and tests performed in 2011, in support of the licensee's decommissioning activities. The inspectors reviewed the details of the licensee's evaluations to determine whether safety judgments were appropriate and whether key considerations were effectively evaluated. The inspectors determined whether the licensee appropriately considered any inter-relationships between the modification and other systems potentially affected by the activity. Additionally, the inspectors sampled work conducted in the plant to ascertain whether the licensee made changes to their facility or systems without completing the necessary safety review.

Evaluations reviewed by the inspectors included those associated with the containment building "construction opening" which consisted of containment building concrete extraction, containment liner cutting and heavy lift rail system installation. Other evaluations reviewed by the inspectors included containment building ventilation system testing and insulation abatement on systems potentially important to the defueled condition or that otherwise impacted decommissioning activities.



b. Observations and Findings

Containment Ventilation System Testing

The licensee planned to use the containment building purge system to control air flow in containment during certain work evolutions and under specified conditions. Specifically, the purge system was intended to be used to ensure negative pressure was maintained in the building relative to the outside environment. The purge system had not been operated or functionally tested since the plant shutdown and fuel was removed from the reactor vessels in the late 1990s. The licensee performed a 10 CFR 50.59 required screening review for a newly developed containment purge test procedure to determine if the proposed activity required a more in-depth evaluation by the licensee or may warrant a license amendment from the NRC. The licensee's screening review correctly concluded that a formal 10 CFR 50.59 evaluation or NRC license amendment was not required. The inspectors found the screening review satisfied the requirements of 10 CFR 50.59, that key considerations were properly reviewed and documentation demonstrated that the proposed use of the ventilation system was bounded by the descriptions in the Defueled Safety Analysis Report (DSAR) and did not require NRC approval.

Containment Building Construction Opening

In April 2011, the licensee initiated physical work to extract concrete, rebar and post-tensioned tendon sleeves from the Unit-2 Containment Building. The concrete extraction created an approximate 34 X 31 foot opening in the containment building wall to accommodate subsequent installation of a heavy lift rail system. The rail system was intended to facilitate removal of large components from the containment building through the construction opening and would be used throughout the decommissioning project. The work plan called for concrete to be chipped-out from the exterior side of containment building with care to preserve the interior (metal) liner plate and liner plate stiffeners on the interior side of the concrete.

Prior to work commencement, an engineering change evaluation was completed by site engineering staff along with an associated 10 CFR 50.59 screening and technical review. The removal of the concrete was not to create a breach of the radiological boundary (i.e., containment metal liner) and therefore not impact the design function of the containment building. The work instruction included a precaution that care be taken so as not to penetrate the containment inner liner. The work instruction also included cautionary steps to stop work and affect repairs should the metal liner be inadvertently breached.

Licensee contractors commenced the concrete chipping on April 29, 2011. On April 30, 2011, contractors identified a small (approximately 2.5 inch by 0.25 inch) tear of the containment metal liner during ongoing concrete extraction. Noticing the tear, work was stopped and notifications to licensee management were made while the tear was patched with foam sealant. As an immediate follow-up to the incident, operations staff verified that auxiliary building to containment building differential pressure was negative. Also, radiological surveys were performed (contamination smears and air samples) to demonstrate the no radiological release to the environment occurred from the small tear. On May 2, 2011, the original work instruction was revised to require continuous

radiological monitoring inside the containment building as concrete was chipped from the exterior side. A revised 10 CFR 50.59 evaluation was performed which specified that the auxiliary building ventilation system be operated throughout the work activity with the equipment hatch open to allow for proper air flow to prevent a potential environmental release. Additionally, the work plan was adjusted to ensure the impact angle and stroke of the concrete chisel preserved liner integrity. Following that, work recommenced and both Unit 2 and Unit 1 concrete extraction projects were completed without further incident.

NRC inspectors determined that the original 10 CFR 50.59 screening completed by the licensee did not fully evaluate the impact of the concrete removal on the containment structure design basis function, as provided in the DSAR. The design basis function of the containment building (and its metal liner) was to provide a barrier against radioactivity release to the environment. In particular, the original 10 CFR 50.59 evaluation failed to adequately address the methods to ensure the design function of the liner was maintained throughout the work. As a result, a violation of 10 CFR 50.59 was identified for an inadequate evaluation. Corrective action program (CAP) documents were generated to capture the liner puncture incident and the problem with the 10 CFR 50.59 evaluation.

The violation was categorized as a violation of minor safety significance as provided in the NRC Enforcement Policy because: (1) the design change to the containment building would not have required NRC approval; and (2) no radiological impact to the environment occurred and the potential impact was minimal given the small size of the tear coupled with the radiological source term (amount of loose radioactivity) present in the containment building. Additionally, the inspectors identified flaws in the original work instruction because it did not include all appropriate measures to preserve liner integrity and in the revised instruction because it did not address actions to maintain liner design function (e.g., through verification of negative air flow) as provided in the revised 10 CFR 50.59 evaluation.

#### Station Heating System

In May and June 2011, the licensee initiated insulation abatement on portions of the station heating system piping located in the turbine building. In June, work was on-hold after insulation had been removed from an approximate 40–50 foot section of turbine building heating system piping. The station heating system is described in the DSAR and is defined as a required system by licensee procedure ZS-EG-101, "Configuration Control of Structures, Systems and Components During Decommissioning." Therefore, both 10 CFR 50.59 and the licensee's procedure require an evaluation should the station heating system be modified and/or its design altered. Contrary to these requirements, the licensee failed to complete the required engineering and design change evaluation for the station heating system before any insulation was removed from turbine building piping. The licensee indicated that they had not recognized the potential impact of turbine building asbestos removal before work commenced. As a result, a violation of 10 CFR 50.59 was identified for the failure to perform an evaluation for a design change to a system described in the DSAR. An extent of condition evaluation and 10 CFR 50.59 review for the heating system issue were captured by the licensee in CAP documents.

The violation was categorized as a violation of minor safety significance as provided in the NRC Enforcement Policy because: (1) the design change to the station heating system would not have required NRC approval; and (2) no adverse impact to systems described in the DSAR occurred or were likely to have occurred.

No findings of significance were identified.

c. Conclusions

The licensee performed adequate safety evaluations or screenings, completed design change evaluations and properly assessed decommissioning impacts of various work activities with some exceptions. Regulatory compliance issues of minor safety significance were identified for an inadequate 10 CFR 50.59 evaluation and work instruction for the containment building construction opening concrete removal work, and lack of an evaluation for insulation abatement from the station heating system.

**3.0 Decommissioning Performance and Status Review (IP 71801)**

3.1 Decommissioning Operations

Control Room Observations & Conduct of Facility Activities

a. Inspection Scope

The inspectors performed walkdowns of the control room to review the operations of selected systems used to monitor parameters related to the safe storage of spent fuel and to monitor systems for safe decommissioning. Systems reviewed included those for monitoring gaseous effluents, building ventilation system operation, spent fuel pool water level, water temperature and heat exchanger operation and to monitor the area radiological conditions in the fuel handling building. The inspectors discussed monitoring responsibilities with control room operators to assess their cognizance of facility conditions and required response actions should an anomalous condition arise. The inspectors reviewed control room logs to assess the quality of the recorded information. The inspectors reviewed selected systems important to decommissioning to determine if system function and plant configuration control boundaries were maintained.

b. Observations and Findings

The inspectors determined that control room personnel were cognizant of their monitoring duties and response actions, were aware of facility conditions important to safe decommissioning and maintained adequate control room logs.

No findings of significance were identified.

c. Conclusions

Monitoring systems in the control room that are important to the safe storage of spent fuel and decommissioning were functional. Control room staff was cognizant of monitoring responsibilities and response actions.

### 3.2 Plant Tours/Walkdowns

#### a. Inspection Scope

The inspectors performed numerous plant tours to observe field conditions, discuss job safety with workers, and to assess the potential impact of work activities on safe decommissioning. During these walkdowns, the inspectors evaluated material condition and housekeeping, area radiological conditions, radiological access control and associated posting/labeling, and assessed the overall condition of systems, structures and components that support decommissioning. Independent radiation measurements were made by the inspectors in many of the areas toured and were compared to licensee measured results and postings. The inspectors observed ongoing work in the Unit 2 Containment Building in preparation for isolation of the reactor coolant system piping. Work on various phases of the construction opening was observed throughout the inspection period to determine if adequate safety and radiological controls were in-place.

#### b. Observations and Findings

The inspectors found that controls associated with Unit 2 Containment Building work included administrative controls necessary to prevent unauthorized entry into contaminated areas and high radiation areas. Air sampling was performed as required by the recently revised Offsite Dose Calculation Manual during periods when the containment construction doors were open and/or the containment purge system was secured. During walkdowns, the inspectors found that personnel followed work plans and safety protocols, and were aware of job controls specified in work instructions.

No findings of significance were identified.

#### c. Conclusions

Plant material condition and housekeeping were adequate and have not adversely impacted safe decommissioning. Workers followed work plans and safety protocols and were aware of job controls specified in work instructions.

### 3.3 Event Follow-up

#### a. Inspection Scope

The inspectors reviewed the licensee's response to events that occurred on successive days late during the inspection period. Severe weather caused minor facility damage, interrupted power to important systems and degraded the construction opening doors late in the evening on June 30, 2011. The next night, an auxiliary transformer caught fire. For each event, the inspectors reviewed the impact on those systems important to the safe storage of spent fuel and for the control and monitoring of radioactivity to the environment. The inspectors reviewed operator logs, evaluated implementation of auxiliary operating procedures and the licensee's overall response actions and decision-making for each event.

b. Observations and Findings

The inspectors found that control room logs included sufficient detail to document station conditions. The licensee's response actions and decision-making followed auxiliary operating procedures and were consistent with the licensee's emergency plan. Systems and/or facilities impacted by the events were either repaired or taken out-of-service while adequate provisional measures were implemented. A portable emergency generator was obtained at the site to generate power to those systems important for the safe storage of spent fuel in a reasonable time following one of the offsite electrical power outages.

No findings of significance were identified.

c. Conclusions

The licensee's response to abnormal events occurring on successive days late in the inspection period was adequate to ensure the safe storage of spent fuel.

**4.0 Spent Fuel Pool Safety (IP 60801)**

4.1 Siphon and Drain Protection

a. Inspection Scope

The inspectors reviewed the spent fuel pool (SFP) configuration, SFP piping penetrations and interconnected piping systems to determine whether any operational conditions could produce a siphon or drain path. Procedures were reviewed to determine if controls were in-place to prevent use of equipment that could inadvertently lead to an unanalyzed drain-down condition. As part of this review, the inspectors evaluated the licensee's remedial actions following a SFP cooling system heat exchanger tube leak.

b. Observations and Findings

The inspectors performed a walk down of the SFP, accessible SFP cooling system piping, and areas of SFP makeup water piping. Prior to the inspection, one train of the SFP cooling system was identified by the licensee with a degraded (leaking) heat exchanger. A tube leak in the heat exchanger caused minimal ingress of SFP cooling water into the SFP. Draining of the SFP water inventory did not occur because the shell side pressure of the SFP cooling loop in the heat exchanger was kept at a higher pressure than that of the tube side SFP water loop. The inspectors verified that the SFP cooling system was aligned to the redundant train of the operational heat exchanger. The inspectors confirmed that the shell side pressure of the operational heat exchanger was maintained at a higher pressure than the tube side.

The inspectors evaluated the licensee's plan to repair the degraded heat exchanger and determined it to be adequate. A work order had been initiated and parts had been ordered to complete the repair.

A review of the DSAR identified the lowest SFP water inventory level to be above the top of active fuel during the worst-case postulated siphon or drain event. The NRC inspectors verified by visual inspection that the drain paths were as described in the DSAR. The inspectors found that makeup water sources for the pool were as described in the DSAR and available for use.

No findings of significance were identified.

c. Conclusions

The SFP was adequately protected from a siphon or drain down event. Furthermore, the inspectors determined that the licensee implemented adequate and timely corrective actions when a degraded heat exchanger was identified.

4.2 SFP Instrumentation, Alarms, and Leakage Detection

a. Inspection Scope

The inspectors reviewed the SFP instrumentation, alarms, and leakage detection systems to determine if they were as described in the DSAR. Procedures, operator logs, and data trends were reviewed to assess the licensee's ability to promptly detect a loss of SFP water inventory.

b. Observations and Findings

Control room and local indications provide immediate information of SFP water inventory level, temperature and other key parameters. The inspectors observed that level indication shown by the digital system reflected actual SFP level. The inspectors reviewed operator logs covering several months in 2011, for any indications of adverse trends. None was identified. Additionally, the inspectors determined that SFP water level and temperature were maintained within the values required by technical specification.

No findings of significance were identified.

c. Conclusions

The SFP had adequate instrumentation and control systems in place to allow the licensee to promptly identify a loss of SFP water inventory event.

4.3 SFP Chemistry and Cleanliness Control

a. Inspection Scope

The inspectors reviewed the licensee's SFP chemistry data to determine whether water purity standards and boron concentration technical specification requirements were met.

b. Observations and Findings

The inspectors performed a visual inspection of the SFP. The inspectors reviewed chemistry data for January - March 2011, to determine if technical specification chemistry and boron concentration requirements were satisfied. An abnormal trend of chloride concentrations in the SFP was identified by the licensee and investigated, which led to the identification of the degraded heat exchanger described above.

No findings of significance were identified.

c. Conclusions

The licensee adequately maintained SFP chemistry controls including boron concentration within the required values established by technical specifications. The licensee adequately addressed abnormal chloride concentrations in the SFP water and implemented timely corrective actions to return the chloride concentrations to normal values.

**5.0 Maintenance and Surveillance (IP 62801)**

5.1 Work Planning and Controls

a. Inspection Scope

The inspectors evaluated the licensee's activities surrounding the performance of a surveillance test of the containment purge ventilation system. The inspectors reviewed the system design drawing, the test procedure, and interviewed licensee personnel to determine the potential impact of the test. The inspectors reviewed the test planning, its scheduling, equipment tag-outs and the approval mechanism. The inspectors also observed the pre-job brief and subsequent test to determine it was performed safely with appropriate controls per the approved procedure.

b. Observations and Findings

The licensee planned to use the containment building purge system to support planned decommissioning activities to ensure proper airborne radioactivity control. The purge system was intended to maintain the containment building atmosphere at a lower pressure than the outside environment so as to minimize the potential for radioactive material to be released to the environment through the construction opening. The purge system test was conducted to verify that motors, fans and ventilation control equipment functioned as designed. The inspectors determined the licensee performed an adequate assessment of the potential for airborne radioactive materials during the test through air monitoring in designated plant locations.

The inspectors noted that operations personnel demonstrated a questioning attitude throughout the test. The inspectors also noted that the licensee performed the test per procedure, used three way communications, and utilized conservative decision-making when unexpected conditions arose.

c. Conclusions

The licensee adequately assessed the potential impact of the purge test, monitored appropriate plant locations during the test, and completed the test satisfactorily consistent with the test procedure.

**6.0 Occupational Radiation Exposure (IP 83750)**

6.1 Radiological Work Planning and Preparations

a. Inspection Scope

The inspectors reviewed radiological work packages including RWPs, as-low-as-is-reasonably-achievable (ALARA) plans and total effective dose equivalent (TEDE) ALARA evaluations (i.e., respiratory protection analyses) to determine if the licensee developed appropriate measures to identify and address radiological hazards and thereby reduce worker dose. The methods and calculations used by the licensee to perform respirator evaluations were examined to determine compliance with the requirements of 10 CFR 20.1701 and 20.1702. During walkdowns, the inspectors reviewed radiological work controls to determine whether the required measures were in-place and work was executed as provided in the work package. Additionally, survey records including air sampling data and worker dose information were reviewed to validate the effectiveness of the work controls.

The inspectors reviewed the licensee's survey plan and design documents along with a sample of the completed surveys for the planned free release of the Dry Activated Waste (DAW) Building. Similarly, the inspectors reviewed the survey plan and results associated with the removal of containment building (construction opening) concrete.

The inspectors evaluated the licensee's activities surrounding the performance of a test of the containment purge ventilation system, focusing on the radiological impact of the test. The inspectors also observed the pre-job brief and subsequent test to determine if it was performed with appropriate radiological controls. Air sampling records were reviewed by the inspectors to determine whether the test created airborne radioactivity in the plant.

b. Observations and Findings

Work Package Assessment

The inspectors found that work packages were adequately developed and work was properly executed to control worker dose. The inspectors determined through direct observation that the licensee used process and/or engineering controls to the extent practicable to control contamination and limit concentrations of airborne radioactivity. The inspectors noted that portable ventilation systems, surface wetting and air monitoring were used as provided in RWP packages.



### Radioactive Waste Building Demolition

The DAW Building was a stand-alone structure adjacent to the Unit 2 Containment Building located just below the planned construction opening. The licensee planned to demolish the building and developed a survey plan to determine if the structure could be disposed of at an industrial landfill or other site without radiological control (free released), as provided by NRC regulations. The licensee used the industry endorsed guidance contained in Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual (MARSAME) to develop its survey plan.

The inspectors determined that the plan incorporated static measurements and scans, and a sufficient number of smear surveys to assess the structures potential radioactivity concentrations consistent with MARSAME principles. The inspectors selectively reviewed survey data and verified compliance with the survey plan. The data revealed that the building could not be free released and therefore the licensee planned to dispose of building rubble as radioactive waste.

### Containment Purge System Testing

The inspectors determined the licensee adequately monitored for the potential generation of airborne radioactivity during the test through air sampling at various plant locations. In addition, all purge system air ventilated to the environment passed through an alarming radiation monitor to ensure any radioactivity released was within regulatory limits. The inspectors verified the airborne radioactivity levels did not increase due to the test. The inspectors observed the pre-job brief and system test and concluded both were adequately executed.

### Containment Concrete Removal

The licensee formulated a survey plan to assess the radiological conditions of the containment building concrete both before work started and after concrete was extracted. The plan was developed to obtain data to assist with future decision-making on the appropriate disposal of the concrete from the site and/or its potential use as clean fill material. As part of their plan, the licensee performed exterior surface scans and fixed (static) radiological measurements of the concrete at the containment wall openings to check for beta/gamma contamination. No contamination was identified above the licensee's established minimum detectable activities. Radiological smear surveys were also taken of the exterior concrete surfaces at various locations which likewise identified no detectable contamination. Following concrete extraction from Units 1 and 2, samples of concrete rubble were collected and qualitatively analyzed for radioactivity through gamma spectroscopy. No plant derived radionuclides were identified in the concrete. The inspectors determined that the licensee's evaluations satisfied the requirements of 10 CFR 20.1501 and were adequate to demonstrate that the piles of concrete rubble did not require posting and/or labeling as provided in 10 CFR 20.1902 and 20.1904. Results of quantitative analyses were pending which will have bearing on the future use or ultimate disposition of the concrete.

No findings of significance were identified.

c. Conclusions

Radiological evaluations, survey plans, surveillance test documents and overall radiological work packages were adequately developed and properly executed to reduce occupational worker dose and control the release of radioactivity to the environment.

6.2 Control of Radioactive Materials, Contamination, Surveys and Monitoring

a. Inspection Scope

The inspectors reviewed the licensee's radiological survey instrumentation to determine if a sufficient number and type of instruments was available to support the decommissioning project. The inspectors evaluated the licensee's procedures and practices for functional testing portable survey instruments and personnel portal/contamination monitors to assess instrument readiness for use. Portal and personnel contamination monitor calibration methods and alarm setpoints were also reviewed for adequacy, as provided in industry standards.

The inspectors selectively reviewed area contamination controls and independently assessed Unit 2 Containment Building radiological conditions through job site walkdowns, data review and discussions with radiation protection staff.

b. Observations and Findings

Radiological Instrumentation

Radiation protection staff used appropriate radiation sources and methods to functionally test portable survey instruments prior to use each day. Procedures developed for functional testing portable instruments were adequate to ensure that the instruments were operationally checked on all appropriate scales. Adequate methods were in-place to log-out and return instruments back into storage or tag them out-of-service should an instrument fail its functional check.

Portal (gamma sensitive) monitors and personnel (beta sensitive) contamination monitors were located at the main radiologically controlled area egress and additional portal monitors were maintained at the security gatehouse. The portal monitors function as passive monitors to identify the potential presence of internally deposited radioactive material in workers and to identify potential external contamination not detected by the personnel contamination monitors. While these monitors are functionally checked daily, the inspectors noted that portal monitor alarms were set at a threshold above the current standard established for operating reactors. The inspectors also noted that the licensee used a check source with an activity greater than desired to challenge the monitor's response near its alarm setpoint value. The licensee generated a CAP (No. 00375550) to capture the issue.

Control of Radioactive Materials and Contamination

On various dates in January 2011, the licensee removed mirror insulation from piping throughout the lower elevation of the Unit 2 Containment Building including insulation on the steam generator cross-over legs from inside the missile barrier. Following removal,

the insulation was stored in various areas inside the missile barrier. Insulation was decontaminated prior to and after its removal, depending on the contamination levels present on the insulation as determined by RP staff. Radiation Work Permit (RWP) No. 2011-2-002 governed the work activities. Radiation protection technicians provided continuous work coverage and assisted in the decontamination (wipe-down) of the insulation as the activities progressed.

Pre-removal surveys of the insulation identified smearable (removable) contamination levels generally between 1000 to 10,000 disintegrations per minute (DPM), with some pieces of insulation in excess of one million DPM. The RWP required, in part, that insulation with removable contamination in excess of 10,000 DPM that could not be decontaminated be "packaged" as specified by the RP staff to prevent /minimize the spread of contamination.

On January, 25, 2011, insulation was removed from the A, B and C steam generator cross-over legs, subsequently decontaminated and placed in the designated lay-down areas. Pre-decontamination surveys on January 25, 2011, identified contamination levels in excess of 100,000 DPM up to about 1 million DPM on portions of the insulation pieces. Post-decontamination survey data was not available so the contamination levels present on the insulation following wipe downs was unknown. None of the insulation was bagged or wrapped to prevent the potential spread of contamination nor was physical access to the lay-down areas controlled through use of radiological (rope) boundaries as is the routine industry practice. Subsequently, surveys performed by the licensee on insulation stored in the lay-down areas on February 28, 2011, identified several pieces of unpackaged (not wrapped, bagged or covered) insulation with contamination levels in excess of 10,000 DPM, ranging up to 85,000 DPM.

The insulation remained unwrapped/unbagged and not labeled until the condition was questioned by NRC inspectors during an onsite inspection on March 9, 2011. Licensee management did not recognize the RWP compliance issue until it was brought to their attention by the inspectors. The following day, the insulation was covered with tarps and labeled by the licensee to indicate the radiological hazards present. On March 11, 2011, the inspectors verified that the insulation was wrapped and labeled adequately to satisfy the RWP, consistent with industry radiological practices.

One violation was identified for failure to follow the RWP which is required to be implemented by Technical Specification 5.5. The Technical Specification requires that procedures be established/implemented consistent with Regulatory Guide 1.33, Revision 2. The Regulatory Guide requires radiation protection procedures for contamination control and procedures which include a radiation work permit system.

The insulation was not disturbed and remained safely stored in the designated lay-down areas during the time period it was unwrapped. Given the contamination levels on the insulation, the storage location and the very low probability of a radiological consequence, the violation was determined to be of minor safety significance as provided in the NRC Enforcement Policy. The inspectors also assessed the overall implementation of RWP No. 2011-2-002 and found no other compliance issues. The insulation removal project was completed as planned without radiological consequence. The cumulative dose for the project was approximately 50 % less than projected (about 350 millirem) primarily because the work was completed in less time than anticipated.

The licensee generated a CAP document to capture the compliance issue following its identification by the inspectors; however, the licensee failed to timely process the document and a second CAP (No. 00366040) was generated about one month later. The licensee's follow-up investigation of the matter concluded that its organizational response to the issue was less than adequate.

No findings of significance were identified.

c. Conclusions

An adequate number and type of portable survey instruments and personnel contamination monitors were available to support the decommissioning project. Instruments were adequately tested before use to demonstrate functionality. However, alarm setpoints on portal monitors and sources used for functional testing were non-conservative compared to current operating reactor standards.

An RWP compliance issue of minor safety significance related to contamination control practices was identified. The licensee was slow to evaluate the issue following identification of the problem.

**7.0 Exit Meeting**

The lead inspector presented the results to licensee management following the conclusion of the onsite inspection on July 22, 2011. The licensee acknowledged the results presented and did not identify any of the documents reviewed by the inspectors as proprietary.

ATTACHMENT: SUPPLEMENTAL INFORMATION

## **SUPPLEMENTAL INFORMATION**

### **PARTIAL LIST OF PERSONS CONTACTED**

P. Daly, General Manager  
G. Bouchard, Decommissioning Plant Manager  
P. Thurman, Regulatory Affairs Manager  
D. Roth, Engineering Director  
R. Chris Keene, Director, Radiation Protection

### **INSPECTION PROCEDURES (IPs) USED**

IP 36801	Organization, Management, & Cost Controls at Permanently Shutdown Reactors
IP 37801	Safety Reviews & Modifications at Permanently Shutdown Reactors
IP 40801	Self-Assessment & Corrective Actions at Permanently Shutdown Reactors
IP 71801	Decommissioning Performance & Status Review at Permanently Shutdown Reactors
IP 60801	Spent Fuel Pool Safety
IP 62801	Maintenance and Surveillance
IP 83750	Occupational Radiation Safety

### **ITEMS OPENED, CLOSED, AND DISCUSSED**

Opened/Closed	None
Discussed	None

### **LIST OF DOCUMENTS REVIEWED**

Zion Annex to Offsite Dose Calculation Manual; Chapter 10, Revision 10; Chapter 12, Revision 17 and Appendix F, Revision 3

Gamma Spectroscopy Analyses of Unit 2 Containment Rebar and Concrete; May 3-26, 2011

ZCP-401, Chemistry – Worksheets/Data Forms/Logs; Revision 37

ZCP 321-1, Auxiliary System Surveillance Requirements; Revision 20

SOI-75BB, SFNI Cooling System Operation, January 29, 2010

SOI-75, Spent Fuel Pool Operations, November 17, 2009

SOI-75D, Spent Fuel Pit Makeup, February 10, 2011

Air Sample Analyses Following Liner Puncture; dated April 30, 2011

Work Request No. 0366519; Tear in Unit 2 Containment Liner; dated April 30, 2011

Work Instruction Task No. 01409411-02; Remove Concrete, Rebar and Tendon Tubes from Former Construction Opening in Unit 2 Containment Wall; Revisions 0 and 1

Work Plan and Inspection Record No. 641-1; Containment Concrete Removal; dated April 18 – May 11, 2011

Engineering Change Notice No. 383167; Unit 2 Containment Concrete Removal for Construction Opening; dated April 7, 2011

ZAP-100-06, Attachments D & E; 50.59 Screening No. 2011-012; Detensioning and Removal of Containment Building Pre-Stressed Tendons; Revision 0

ZAP-100-06, Attachments D & E; 50.59 Screening No. 2011-046; Removal of Concrete, Rebar and Abandoned Post-Tensioned Tendon Sleeves for Containment Construction Access Opening; Revisions 0 and 1

ZAP-100-06, Attachments D, E and G; 50.59 Screening and Evaluation No. 2011-054; Liner Plate Removal in Support of Unit 2 Construction Opening; Revision 0

Engineering Change Notice No. 384392; Unit 2 Containment Access Opening Liner Removal; dated June 9, 2011

RWP No. 2011-2-0025; Remove Interferences and Cut U-2 Liner in Support of HLRS Installation; Revision 2

Engineering Change Notice No. 384794; Install Unit 2 Heavy Lift Rail System; dated June 22, 2011

ZAP-100-06, Attachments D & E; 50.59 Screening No. 2011-064; U2 Containment Heavy Lift Rail System Installation; Revision 0

ZS-EG-101; Configuration Control of Systems, Structures & Components During Decommissioning; Revision 1

ZAP-100-09; 10 CFR 50.82 Decommissioning Impact Evaluation; Revision 3

ZS-EG-100; Engineering Review of Decommissioning Activities; Revision 0

ZAP-100-06; 10 CFR 50.59 Review Process; Revision 23

ZS-WC-100; Work Control Process for Major Decommissioning of Structures, Systems and Components; Revision 0

Defueled Station Emergency Plan; Revision 13

Air Sample Analyses at Construction Opening; dated June 30 – July 2, 2011

Auxiliary Operating Procedure 8.4; Severe Weather Conditions; Revision 7

Auxiliary Operating Procedure 8.6; Spent Fuel Nuclear Island Loss of Power; Revision 4

Work Request No. 00373369; Removal of Station Heating System Insulation without Design Change; dated July 6, 2011

Work Request No. 00366040; Concerns of Loose Surface Contamination Levels on RCS Piping; dated April 28, 2011

RWP No. 2011-2-0002; Remove Mirror Insulation on 568-foot Elevation; Revision 1

SOI-75CC, Spent Fuel Pool Cooling System Operation, October 9, 2007

SOI-75DD, Spent Fuel Pool Filtration System Operation, June 22, 2004

OSP-10-001, Containment Purge System and Containment Mini-Purge System Operational Test; Revision 1

ZAP 100-06, Attachment D, 50.59 Review Coversheet Form; Activity/Document Number: OSP-10-001; Revision 0

ZAP 100-06, Attachment F, 50.59 Screening Form; 50.59 Screening No: 2011-014; Revision 0

Survey Package #: U2-DAW-BLD-592-001, DAW Building, North of Unit 2 Containment; dated February 24, 2011

ZS-RP-108-004-010, Attachment 7, Scan Surveys – Beta; DAW Bldg SW Wall and Roll up Doors; dated March 2, 2011

ZS-RP-108-004-010, Attachment 7, Scan Surveys – Beta; DAW Bldg South Wall; dated March 1, 2011

ZS-RP-108-004-010, Attachment 7, Scan Surveys – Beta; Ceiling and overhead Structures; dated March 2, 2011

ZS-RP-108-004-010, Attachment 7, Scan Surveys – Beta; DAW Bldg. Upper Steel Support

## **LIST OF ACRONYMS USED**

ADAMS	Agencywide Document Access and Management System
ALARA	As-Low-As-Is-Reasonably-Achievable
CAP	Corrective Action Program
CFR	Code of Federal Regulations
DAW	Dry Activated Waste
DNMS	Division of Nuclear Materials Safety
DPM	Disintegrations Per Minute
DSAR	Defueled Safety Analysis Report
MARSAME	Multi-Agency Radiation Survey and Assessment of Materials and Equipment
NRC	U.S. Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
RP	Radiation Protection
RWP	Radiation Work Permit
SAFSTOR	Safe Storage of Spent Fuel
SFP	Spent Fuel Pool
TEDE	Total Effective Dose Equivalent
ZAP	Zion Administrative Procedure