August 7, 2012

Mr. John A. Christian, President
Zion*Solutions*, LLC
1750 Tysons Boulevard, Suite 1500
McLean, VA 22102

SUBJECT: NRC INSPECTION REPORT 050-00295/12-008(DNMS); 050-00304/12-008(DNMS) – ZION NUCLEAR POWER STATION

Dear Mr. Christian:

On June 28, 2012, the U.S. Nuclear Regulatory Commission (NRC) completed onsite inspection activities for the second calendar quarter of 2012 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. The enclosed report presents the results of this inspection, which were discussed with Mr. Daly and other Zion*Solutions* site management by telephone on July 18, 2012.

During the inspection period, the NRC inspectors reviewed the radioactive effluent monitoring and control program as provided in the Offsite Dose Calculation Manual (ODCM), spent fuel pool safety, plus elements of the radiation protection program including radiation survey protocols for the unconditional release of materials and equipment from the site.

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, observation of work activities, independent radiation measurements, and interviews with personnel.

Based on the results of this quarterly inspection effort, 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 Web site at http://www.nrc.gov/reading-rm/adams.html.

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 Nos. 050-00295; 050-00304
License Nos. DPR-39; DPR-48

Enclosure:
Inspection Report No. 050-00295/12-008(DNMS);
050-00304/12-008(DNMS)

cc w/encl: See next page

Letter to John Christian from Wayne Slawinski dated August 7, 2012

SUBJECT: NRC INSPECTION REPORT 050-00295/12-008(DNMS); 050-00304/12-008(DNMS) – ZION NUCLEAR POWER STATION

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, Zion*Solutions*, 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.:	050-00295/12-008(DNMS) 050-00304/12-008(DNMS)
Licensee:	Zion*Solutions*, LLC
Facility:	Zion Nuclear Power Station (permanently shut-down)
Location:	101 Shiloh Boulevard Zion, IL 60099
Dates:	Onsite Inspections on April 23 - 27, May 31, and June 25 - 28, 2012
NRC Inspectors:	Wayne J. Slawinski, Senior Health Physicist Jeremy E. 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 050-00295/12-008(DNMS); 050-00304/12-008(DNMS)

The Zion Nuclear Power Station is a permanently shut-down and defueled power reactor facility that was maintained in safe storage of spent fuel (SAFSTOR) condition with spent fuel in wet storage through 2010. In 2011, the site transitioned to active decommissioning as staffing was expanded, organizational and institutional controls were developed to support the decommissioning project, engineering evaluations were performed and dismantlement of the facility and systems commenced. This routine inspection reviewed the licensee's execution of the site decommissioning project focusing on the monitoring and control of radioactive effluents, spent fuel pool safety and implementation of the radiation protection program including radiation survey protocols for the unconditional release of materials and equipment.

Audits and Self-Assessments

- Licensee assessments and other evaluative activities were performed by qualified individuals, properly focused and thorough. However, actions to address problems with the corrective action program, employee concerns program and the overall work environment have not been fully successful based on the results of a recent site survey (Section 1.1).

Decommissioning Performance and Status

- Plant material condition and housekeeping were adequate and have not adversely impacted safe decommissioning. Workers followed work plans and industrial safety protocols in most instances and were aware of job controls specified in work instructions (Section 2.1).

Spent Fuel Pool Safety

- The spent fuel pool was maintained in accordance with design criteria provided in the Defueled Safety Analysis Report. No unanalyzed siphon or drain paths were identified. Adequate procedures are maintained to restore pool water level and mitigate adverse effects from a postulated drain down event (Section 3.1).

- Adequate processes, procedures and instrumentation were provided to maintain the safety of the spent fuel pool. Pool parameters were monitored adequately to ensure that negative trends would be identified in a timely manner (Section 3.2).

- Spent fuel pool chemistry was adequately monitored and controlled. The pool was kept free of foreign material and water cleanliness and clarity were maintained (Section 3.3).

- Criticality safety during fuel moves was ensured through procedural controls. Fuel move packages included required documentation and validations in accordance with site procedures (Section 3.4).

- The spent fuel pool was operated and maintained as described in the Defueled Safety Analysis Report. Pool systems conformed to design drawings and design basis information. Electrical power supply for the spent fuel building was unaffected by changes to other site electrical systems, as required (Section 3.5).

Occupational Radiation Exposure

- Radiological evaluations and work planning were adequate to control radiological hazards and to reduce occupational worker dose. However, the work package for movement of the Unit-2 upper core plate did not document whether lessons-learned from a recent similar lift were applied to maximize the benefit of water shielding (Section 4.1).

- The licensee implemented an adequate program for the unconditional release of both routine and non-routine materials and equipment from radiologically controlled areas. Nevertheless, the procedure governing the radiation survey protocol lacked specific guidance for the survey of non-routine items with the potential for inaccessible internal contamination (Section 4.2).

- The licensee implemented a Multi-Agency Radiation Survey and Assessment of Materials and Equipment (MARSAME) based program for materials and equipment to preclude the release of radioactive material offsite. Radiation protection staff performed adequate surveys in accordance with the requirements of the applicable survey packages to ensure radiological release criteria were met (Section 4.2).

Radiological Effluent Monitoring and Control

- The licensee maintained effluent monitoring and control systems as provided in General Design Criteria 60 and 64 of Appendix A to Title 10 of the Code of Federal Regulations (CFR) 50. Effluent flow paths and monitoring systems aligned with descriptions in the Defueled Safety Analysis Report and Offsite Dose Calculation Manual (ODCM) and were functional. However, containment building high efficiency particulate air filtration systems qualitatively credited in the ODCM for gaseous effluent reduction had not been tested to determine capabilities for the decommissioning project (Section 5.1).

- Annual Radioactive Effluent Reports were timely submitted for the three years preceding the inspection and satisfied ODCM and Technical Specification informational requirements (Section 5.2).

- Chemistry analytical equipment used for effluent analyses were well maintained and regularly tested to demonstrate performance prior to use. Effluent monitors were functional, calibrated and alarm setpoints conservatively set to meet regulatory requirements. However, monitor calibration and test procedures could not be fully implemented as written leading to “work arounds.” (Section 5.3).

- Sampling and analyses of liquid and gaseous effluents satisfied Technical Specification and ODCM requirements, including periods when effluent monitors were inoperable and there was reliance on compensatory sampling (Section 5.4)

- Results of effluent analyses were accurately input into the licensee’s dose assessment software, included required hard-to-detect radionuclides, and calculated doses were well within the 10 CFR 50, Appendix I objectives. Dose assessment software verification data could not be produced by the licensee; therefore, the accuracy of the current dose calculation methods and assumptions could not be validated by the inspectors (Section 5.5).

Report Details

Summary of Plant Activities

During the three-month inspection period, active decommissioning work was ongoing at the site focusing on continued segmentation of the Unit-2 reactor vessel internals concurrent with preparations for Unit-1 segmentation, completion of rail spurs and other radioactive waste shipment related preparations, initiation of vertical concrete cask (spent nuclear fuel assembly overpack) construction, and various preparatory activities associated with the future spent fuel dry cask storage campaign.

1.0 Audit and Self Assessment Activities (IP 40801)

1.1 Corrective Action and Safety Conscious Work Environment Program Assessments

a. Inspection Scope

The inspectors reviewed the results of assessments completed since mid-2011, related to the licensee's corrective action program (CAP), employee concerns program (ECP) and safety conscious work environment (SCWE) program. These reviews were performed to determine whether the licensee evaluated the effectiveness of programs relevant to the work environment at the site and therefore important to the NRC licensed decommissioning project.

b. Observations and Findings

The inspectors reviewed the results of two licensee contracted assessments completed by independent subject matter experts, and the results of a recent site-wide licensee survey of the SCWE. The assessments and SCWE survey were prompted by several factors including a series of low consequence but potentially significant events related to material handling and equipment operations in 2011, employee concerns and other information indicating flaws in these program areas and to fulfill commitments made to the NRC as a result of prior concerns.

The inspectors found that the assessment activities were focused and thorough; therefore, they accurately characterized the employee concerns and corrective action programs at the site. The inspectors found that the SCWE survey was developed by the licensee consistent with guidance in Regulatory Issue Summary (RIS) No. 2005-018. Results of the SCWE survey were tabulated, reviewed by the licensee, trended and conclusions were formulated to allow the development of remedial actions.

These assessment activities identified fundamental flaws with the development and use of the CAP, the management review committee (MRC) process, with certain attributes of the ECP and ongoing problems with the SCWE. A variety of corrective actions were completed by the licensee to improve the CAP and ECP programs such as training, organizational realignment including better delineation of roles and responsibilities and policy/procedural enhancements. Actions to address recently identified SCWE issues included a site wide communication to inform employees of the results and ongoing focus group interviews in an effort to better understand the problems. According to the licensee, additional actions will be developed after focus group results are evaluated.

The inspectors determined that the licensee's assessment and other evaluative mechanisms were adequate in that they were properly focused, independently performed by qualified individuals and results were well founded. However, while improvements have been realized and some progress has been made in the last year to improve these programs, results of the recent SCWE survey showed that work environment issues continue at the site.

No findings of significance were identified.

c. Conclusions

The licensee's assessments and other evaluative mechanisms were completed by qualified individuals, properly focused and thorough; however, actions to address identified issues have not been fully successful as work environment issues continue.

2.0 Decommissioning Performance and Status Review (IP 71801)

2.1 Plant Tours/Walkdowns

a. Inspection Scope

The inspectors performed 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, assessed area radiological conditions, radiological access control and associated posting/labeling, and reviewed the overall condition of systems, structures and components that support decommissioning. Independent radiation measurements were periodically made by the inspectors in areas toured and compared to licensee measured postings. The inspectors observed vessel internals segmentation work in Unit-2 and interference removal work inside the missile barrier of Unit-1 in preparation for reactor coolant system isolation.

b. Observations and Findings

The inspectors found that controls associated with Unit-1 & Unit-2 containment building work included administrative controls necessary to prevent unauthorized entry into highly contaminated areas and high radiation areas. Deficiencies with locked high radiation area boundaries at undesignated entry locations into the Unit -2 missile barrier were brought to the licensee's attention and rectified promptly. Similarly, the licensee promptly addressed industrial safety hazards in Unit-1 that were observed by the inspectors.

Air sampling was performed within the containment building as required by the ODCM during periods when the containment construction doors were open and/or the containment purge system was secured. Air samples were collected in general work areas, as warranted, to monitor work conditions and worker breathing zones, as provided in job specific radiation work permits (RWPs).

During walkdowns, the inspectors found that personnel followed work plans and demonstrated proper safety protocols with an isolated exception noted above, 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 industrial safety protocols in most instances and were aware of job controls specified in work instructions.

3.0 Spent Fuel Pool Safety (IP 60801)

3.1 Siphon and Drain Protection

a. Inspection Scope

The inspectors performed a walk-down of the Spent Fuel Pool (SFP) on April 24, 2012, and reviewed SFP system drawings to determine whether any conditions existed that could siphon or drain water out of the SFP. The walk down included portions of the Fuel Handling Building that contain support systems for the SFP such as the heat exchangers and SFP pump rooms.

Additionally, the inspectors interviewed licensee staff, reviewed site documents and procedures, to determine the impact of an inoperable weir gate seal between the SFP and the transfer canal.

The inspectors also reviewed the licensee's abnormal operating procedures to determine if proper actions would be directed during a SFP drain down event and to review changes implemented due to observations made during the post Fukushima Daiichi follow-up inspection documented in NRC Inspection Report Nos. 050-00295/11-02(DNMS) and 050-00304/11-02(DNMS).

b. Observations and Findings

Inspector walk-downs revealed no new or unanalyzed siphon or drain paths that could drain water from the SFP. Design drawings accurately depicted pool components and configurations were consistent with the Defueled Safety Analysis Report (DSAR).

The inspectors noted that the weir gate seal which allows the SFP to be isolated from the transfer canal was deflated, which allowed the SFP water to be in communication with water in the transfer canal. The inspectors were informed that the weir gate seal was no longer operable, and that the site did not plan on repairing it because there were no scenarios in which the licensee would be required to drain the transfer canal given the decommissioning status of the plant. The inspectors reviewed the DSAR and determined that the current SFP and transfer canal configuration was within the plant design basis. The transfer canal has two isolation valves, one on each end, to prevent SFP water from reaching the Unit-1 and Unit-2 reactor vessel cavities. Additionally, blind flanges on the ends of the transfer canal provide a second barrier preventing a loss of SFP water into the reactor vessel cavities. The inspectors reviewed the most current transfer canal leakage surveillance results and verified that the documented leakage rate was orders of magnitude below the maximum allowed rate.

When either reactor vessel cavity is flooded-up, a visual surveillance of leakage past the blind flanges is not possible. From discussions with licensee staff, SFP level monitoring instruments and operations staff surveillances are used to identify leakage into or out of the SFP in the unlikely event that the transfer canal isolation valves and the blind flanges fail successively. Furthermore, data from the licensee's weekly sampling of SFP water chemistry can detect changes indicative of possible leakage. The inspectors concluded that these leakage identification mechanisms were adequate to allow timely actions should problems arise.

A review of the licensee's abnormal operating procedures relating to a drain down event of the SFP demonstrated adequate actions to restore SFP water level and mitigate adverse effects from such events. As part of the procedural review, the inspectors reviewed the licensee's actions taken after the NRC's post Fukushima Daiichi follow-up inspection in May of 2011. To address NRC observations from that inspection, the licensee enhanced abnormal operating procedures and staged additional equipment inside the auxiliary building to support SFP makeup capabilities that do not require access to the FHB. Additionally, the licensee developed an administrative requirement for minimum water inventory to be kept in the site's Condensate Storage Tanks that provide make-up water to the SFP.

No findings of significance were identified.

c. Conclusions

The spent fuel pool was maintained in accordance with the design basis information provided in the DSAR. No unanalyzed siphon or drain paths were identified during the inspection. Adequate procedures are maintained to restore SFP water level and mitigate adverse effects from a drain down event.

3.2 SFP Instrumentation, Alarms, and Leakage Detection

a. Inspection Scope

On April 24, 2012, the inspectors accompanied an operator during one of the daily surveillance rounds of the SFP to review the licensee's monitoring process for the SFP, and the actual conditions of the SFP. The inspectors also reviewed the licensee's procedures for monitoring spent fuel parameters and toured the control room to observe the licensee's SFP monitoring equipment.

Additionally, the inspectors reviewed calibration documentation for SFP monitoring equipment to determine whether the equipment was calibrated and provided the desired monitoring information. This review included the results of the SFP parameter alarm system functional test. The inspectors also reviewed the documented results of SFP evaluations for a recent heat up test and a recent determination of SFP and transfer canal leakage.

b. Observations and Findings

The SFP surveillance observed by the inspectors was well documented. All pool parameters observed, including level and temperature, were within the required acceptance criteria. The SFP cooling equipment was operational and had no indications

of problems. The frequency of operator rounds was sufficient to detect negative trends of SFP parameters.

The inspectors toured the control room and observed the licensee's SFP monitoring capabilities. The inspectors found that control room operators were cognizant of annunciator alarm response procedures. The licensee uses a Spent Fuel Nuclear Island (SFNI) Data Acquisition System (DAS) equipped with alarming pager capability to provide continuous, real time monitoring of SFP parameters such as level, temperature, fuel building radiation, pump and cooling tower operational status. The inspectors reviewed the results of the most recent annual functional test of the DAS alarm system and verified it was completed successfully.

The inspectors reviewed the calibration documentation for a SFP level instrument and verified that it was calibrated and maintained. The inspectors also reviewed the calibration documentation for the pool perimeter area radiation monitors. The review demonstrated that the instruments were within the calibration frequency as required by the ODCM. During the inspection period, the licensee identified a discrepancy between the ODCM required calibration frequency and the manufacturer recommended calibration frequency of the area radiation monitors that they placed into their corrective action program.

The SFP heat up test demonstrated that the time required for the SFP water to begin boiling after a loss of SFP cooling would be approximately 200 hours. The inspectors also reviewed the results a recent SFP liner and transfer canal surveillance. The leakage rate was on the order of drops per minute, well below the maximum allowed 1 gallon per minute action limit. Test results did not identify any negative trends when compared to previous leakage results.

No findings of significance were identified.

c. Conclusions

Adequate processes, procedures and instrumentation were in place to maintain the safety of the SFP. The pool was monitored adequately to ensure that negative trends would be identified in a timely manner.

3.3 SFP Chemistry and Cleanliness Control

a. Inspection Scope

The inspectors reviewed SFP chemistry data from January 2011 to April 2012, to identify any negative trends related to SFP chemistry. Additionally, the inspectors toured the SFP and observed the licensee's controls around the pool to preclude foreign material intrusion.

b. Observations and Findings

Weekly SFP chemistry data for the past year did not indicate any negative trends. Boron levels in the pool remained significantly above the minimum Technical Specification required concentration. The boron concentration samples usually contained about 1900 parts per million (ppm) of boron, compared to a 500 ppm

Technical Specification limit. A tour of the SFP did not identify any foreign material in the SFP. Physical barriers were in place to preclude the introduction of foreign materials.

No findings of significance were identified.

c. Conclusions

Spent fuel pool chemistry was adequately monitored and controlled. The pool was kept free of foreign material and water cleanliness and clarity were well maintained.

3.4 Criticality Controls

a. Inspection Scope

The inspectors reviewed a move sheet package in support of a fuel sipping campaign completed in March of 2012, to determine if procedural requirements were followed to ensure criticality safety.

b. Observations and Findings

The inspectors determined that the move sheet package was adequately documented, contained all of the necessary sign-offs, and was prepared in accordance with procedures. The move sheet package verifications ensured that fuel moves were within the requirements of the Technical Specifications for placing fuel in Region 2 of the SFP. Additionally, the inspectors verified that SFP boron concentration was maintained above the Technical Specification requirement of 500 ppm during the actual fuel moves. The move sheet package included move sheet variations due to an equipment problem with the fuel handling bridge crane during the sipping campaign. The variations were adequately documented, and contained all the necessary verifications and sign-offs.

No findings of significance were identified.

c. Conclusions

Procedures for fuel moves ensured that criticality safety was maintained. Fuel move records contained all of the appropriate documentation and sign-offs in accordance with site procedures.

3.5 SFP Operation and Power Supply

a. Inspection Scope

The inspectors toured the SFP systems inside the Fuel Handling Building (FHB) on April 24, 2012, and the SFNI cooling towers outside the FHB on April 26, 2012 to verify that the systems were maintained and operated as provided in the DSAR. The inspectors verified the as-built conditions of the systems against those described in the DSAR and other site drawings to determine if any discrepancies existed. This review included a review of the electrical power supply to the SFNI. The inspectors also reviewed a list of corrective action documents to identify any significant equipment issues related to the SFP.

The inspectors reviewed the licensee's abnormal operating procedures for actions to be taken during a station black out. The inspectors reviewed these procedures to determine if adequate compensatory and remedial measures would be provided, and to follow-up on observations made during the post Fukushima Daiichi follow-up inspection documented in NRC Inspection Report Nos. 050-00295/11-02(DNMS) and 050-00304/11-02(DNMS).

b. Observations and Findings

The inspectors determined that SFP systems and components conformed to design basis documents. Spent fuel pool system components such as heat exchangers, pumps, the SFNI cooling towers plus interconnected piping showed no signs of leakage or degradation. A review of SFP system corrective action documents did not identify any significant equipment issues or emerging negative trends. The licensee's corrective action system adequately identified and addressed equipment issues to ensure the continued safe operation of the SFP.

The inspectors noted that the licensee was making changes to the onsite electrical system on the week of April 23, 2012. Interviews with licensee personnel and a review of the DSAR showed that the power supply system to the SFP and its essential systems was unaffected by these changes. The SFNI system design provided complete electrical isolation from other electrical systems on the site, as required.

The inspectors determined that the licensee maintained adequate procedures to cope with station black out events. In addition, the licensee had diesel generator connections available for the SFNI busses to provide a ready means of powering the essential equipment with an off-site diesel generator, if needed.

The inspectors reviewed procedural enhancements implemented by the licensee in response to the NRC's Fukushima Daiichi follow-up inspection in May 2011. The licensee enhanced abnormal operating procedures and included a list of diesel generator supplier contact information to expedite the timely sourcing of a diesel generator. The licensee also enhanced procedures to require a verification of onsite diesel fuel oil during a station blackout to ensure prolonged electrical supply.

The inspectors also reviewed the licensee's results of an evaluation of flooding impacts on the diesel driven fire pump lower bank batteries. The evaluation was prompted by NRC observations during the post Fukushima Daiichi follow-up inspection. The licensee's evaluation determined that the maximum design basis flood would not reach the elevation of the lower battery bank; hence, there would be no impact to the batteries. Furthermore, the evaluation concluded that the diesel driven fire pump's upper battery bank, which is approximately 3 feet higher than the lower bank, would remain available if the lower bank were rendered inoperable.

No findings of significance were identified.

c. Conclusions

The spent fuel pool was operated and maintained as described in the DSAR. Pool systems were built according to system design drawings consistent with descriptions in the DSAR. The SFNI electrical power supply was unaffected by changes to the site's

other electrical systems, as required. The licensee developed adequate abnormal operating procedures to cope with a station black out event.

4.0 Occupational Radiation Exposure (IP 83750)

4.1 Radiological Work Planning, Preparations and Work Execution

a. Inspection Scope

The inspectors selectively reviewed RWPs, work instructions, and as-low-as-is-reasonably-achievable (ALARA) plans to determine if the licensee developed appropriate measures to identify and address radiological hazards and thereby reduce worker dose.

Work instructions and associated radiological information were reviewed for the movement of the upper core plate in the Unit-2 cavity, ongoing Unit-2 reactor internals segmentation and for removal of interferences from Unit-1. The information was reviewed to determine if planning and preparation for these work activities was adequate. The inspectors observed execution of these work activities to determine if plans were followed and radiological controls were adequate.

b. Observations and Findings

The inspectors determined that radiological evaluations and work plans were adequately developed and documented with the exception of the plan for movement of the upper core plate. For that work package, the inspectors noted that the licensee had not documented whether lessons that were learned months earlier during lift of the lower internals assembly were applied or otherwise determined not to be warranted. Specifically, the work plan did not address whether quantitative means were necessary to control the lift height of the plate to ensure sufficient water shielding. Dose rates on the plate could have created high radiation area conditions in occupied areas near the reactor cavity if the plate was lifted too close to the surface of the water.

Prior to execution of the work, the inspectors questioned the lack of quantitative methods to limit the height of the lift. In response to the query and just prior to commencement of the move, the licensee implemented the use of a laser to detect real time location of the plate. The lift was completed successfully without radiological consequence. Afterward, the inspectors were informed that the use of quantitative measuring devices had been discussed as part of pre-job briefings and determined not to be necessary given the existing water shielding margin. Condition Report 2012-000387 was generated by the licensee to address the application of lessons learned and how they are captured in work plans.

No findings of significance were identified.

c. Conclusions

Radiological evaluations and work planning were adequate to control radiological hazards and to reduce occupational worker dose with the exception of the upper core plate lift in the Unit-2 reactor cavity. The work package for movement of the Unit-2

upper core plate did not document whether lessons-learned from a recent similar lift were applicable to maximize the benefit of water shielding.

4.2 Control of Radioactive Materials, Contamination, Surveys and Monitoring

Unconditional Release Program

a. Inspection Scope

The inspectors reviewed the licensee's radiological survey procedure for performing free (unconditional) release of materials and equipment from radiologically controlled areas. The inspectors observed radiation protection technicians perform free release of materials and equipment from the radiological control point. Through these observations and reviews, supplemented by interviews of licensee personnel, the inspectors determined if the licensee's survey program was sufficient to prevent the inadvertent release of contaminated materials.

b. Observations and Findings

Radiation protection staff performed adequate surveys of equipment and materials being released from the radiologically controlled area to ensure it met the licensee's free release (no detectable) criteria. The procedure governing the free release surveys was adequate to ensure consistent survey practices were used to release most materials and equipment. However, the inspectors noted that the procedure did not include specific guidance for surveys of non-routine items with the potential for internal contamination such as gauges, motors, electronic equipment and other materials with internal areas that were difficult to access. The inspectors determined through discussions with radiation protection staff that there was a consistent approach among those interviewed to obtain supervisor direction for surveying questionable or non-routine items. Each supervisor interviewed described an adequate survey methodology to release non-routine equipment and materials. The licensee generated Condition Report 2012-000697 to capture the observation and determine if procedure enhancements are necessary.

No findings of significance were identified.

c. Conclusions

The licensee implemented an adequate program for the unconditional release of both routine and non-routine materials and equipment from the radiologically restricted area. However, the procedure governing the free release survey protocol lacked specific guidance for the release of non-routine items with the potential for inaccessible internal contamination.

Multi-Agency Radiation Survey and Assessment of Materials and Equipment (MARSAME) Program

a. Inspection Scope

The inspectors evaluated the licensee's procedure and technical basis for radiological release of materials and equipment from the site using MARSAME guidance. The

inspectors reviewed a selection of MARSAME release packages to determine if the equipment and materials released met the applicable release criteria. The inspectors also observed the licensee perform MARSAME surveys in the south parking lot to release asphalt debris.

b. Observations and Findings

Radiation protection staff used appropriate survey instrumentation and techniques to adequately survey the asphalt debris in accordance with the applicable MARSAME survey package. The survey scope was commensurate with the potential for the material to be contaminated. The procedure for developing MARSAME survey packages was technically sound and overall was adequate to ensure the appropriate MARSAME guidance was used to justify an adequate survey method. Workers responsible for developing survey packages and for performing the surveys were qualified and trained so as to execute the program adequately.

No findings of significance were identified.

c. Conclusions

The licensee adequately implemented a MARSAME survey program for materials and equipment to preclude the release of radioactive material offsite. Radiation protection staff performed adequate surveys in accordance with the requirements of the applicable survey packages to ensure the radiological release criteria were met.

5.0 Radiological Effluent Monitoring and Control (IP 84750)

5.1 Offsite Dose Calculation Manual (ODCM) & Defueled Safety Analysis Report (DSAR)

a. Inspection Scope

The inspectors reviewed the DSAR and ODCM to identify sources of radiological effluents and their respective flow paths, monitoring and measuring systems, sampling and analysis requirements including systems intended to reduce effluent discharges. The inspectors walked-down selected components of the gaseous and liquid discharge systems to determine if current equipment configuration and flow paths aligned with ODCM/DSAR descriptions. The ODCM was evaluated to determine whether it contained the methodology and parameters necessary for the calculation of offsite doses resulting from radioactive gaseous and liquid effluents. Additionally, the inspectors determined whether the ODCM contained limitations on the functional capability of the radioactive liquid and gaseous effluent monitoring instrumentation, limitations for effluent dose and for dose projections as required by technical specifications. The inspectors reviewed changes to the ODCM made by the licensee since 2009 to determine if consistency was maintained with respect to guidance in NUREG-1301 and Regulatory Guides 1.21 and 4.1, and whether the changes were adequately evaluated.

b. Observations and Findings

The inspectors determined that the licensee maintained effluent monitoring and control systems as provided in General Design Criteria 60 and 64 of Appendix A to 10 CFR 50, consistent with descriptions in the ODCM. However, while the plant design included

means to suitably control the release of radioactive materials in gaseous and liquid effluents during plant operations, not all installed effluent reduction systems had been tested recently to demonstrate capabilities. Specifically, the inspectors identified that the containment building ventilation exhaust treatment system (high-efficiency particulate air (HEPA) filters) had not been tested during the SAFSTOR dormancy period through the date of the inspection to determine their effectiveness for the reduction of gaseous effluents in particulate form. The HEPA filters are qualitatively credited in the ODCM as a gaseous effluent reduction system. Periodic in-place testing using a dioctyl phthalate (DOP) challenge aerosol is an industry recognized approach endorsed by ASME N510, "Testing of Nuclear Air Treatment Systems." The licensee was in the process of performing bounding calculations to justify the elimination of the containment HEPA filtration system from the ODCM since their use was not likely to be necessary for effluent control during the decommissioning project. Condition Report 2012-000612 was generated by the licensee to capture the issue.

In 2009 and 2011, the licensee modified the station gaseous effluent monitoring systems to reduce the number of effluent release points and monitoring locations since the plant was in a permanently shutdown condition. These monitoring systems have remained as described in Inspection Reports 05000295/10-03; 05000304/10-03 and 05000295/12-07; 05000304/12-07. In particular, the Unit-1 vent stack continued to monitor only Unit-1 containment building purge (particulate) exhaust while the Unit-2 auxiliary building vent stack monitored particulate and noble gas effluents from the common fuel and auxiliary building release point and from Unit-2 containment building purge exhaust.

In 2004, the waste disposal system lake discharge effluent monitor was taken out-of-service as batch discharges of liquid radwaste had ceased. Continuous discharges of liquid from secondary plant systems containing little to no measurable levels of radioactivity continue to be monitored by the turbine building fire sump discharge monitor as provided in the DSAR and ODCM.

The inspectors determined that changes to the gaseous effluent system configuration associated with modified vent stack releases and the addition of an 'unventilated' building release associated with the Unit-2 containment building construction opening were evaluated, technically justified and documented in the ODCM. Inspector walkdowns confirmed that effluent flow paths and monitoring systems were as described in the ODCM and were functional.

No findings of significance were identified.

c. Conclusions

The licensee maintained effluent monitoring and control systems as provided in General Design Criteria 60 and 64 of Appendix A to 10 CFR 50. Effluent flow paths and monitoring systems aligned with descriptions in the DSAR and ODCM and were functional. However, containment building HEPA filtration systems qualitatively credited in the ODCM as a gaseous effluent reduction system had not been tested to determine functionality for the decommissioning project.

5.2 Annual Radioactive Effluent Release Reports

a. Inspection Scope

The inspectors reviewed the licensee's Radioactive Effluent Release Reports for 2009, 2010 and 2011, to determine if the reports were timely submitted and included information required by the ODCM. The inspectors reviewed supplemental report information and discussed anomalous and/or unexpected results and trends with the licensee to determine if effluent issues was understood, documented in the corrective action program and adequately resolved.

b. Observations and Findings

The inspectors determined that annual effluent reports were submitted to the NRC in a timely manner and that the informational content satisfied regulatory criteria. The inspectors discussed radioactive effluent monitor operability issues reported by the licensee, as required by the ODCM, and found that those issues were adequately documented and resolved.

Effluent reports documented no detectable radioactivity in liquid effluents and minimal activity in gaseous effluents. Offsite dose from effluents in 2009 – 2011 was calculated to be a small fraction of regulatory limits, as expected given the small quantities released and their duration. The inspectors determined that the expected correlation existed between the effluent release information and environmental monitoring data, as provided in Section IV.B.2 of Appendix I to 10 CFR 50.

No findings of significance were identified.

c. Conclusions

Annual Radioactive Effluent Reports were timely submitted for the three years preceding the inspection and satisfied ODCM and Technical Specification informational requirements.

5.3 Instrumentation and Equipment

a. Inspection Scope

The inspectors walked-down the licensee's gaseous effluent monitoring system for the Unit-1 and Unit-2 vent stacks and the liquid effluent monitoring system for both the active turbine building sump and the out-of-service lake discharge waste disposal system. The walk-downs were performed to determine if monitoring systems were functional, if required, and whether their configurations aligned with ODCM descriptions. The inspectors reviewed channel calibration and functional test results for these effluent monitors to determine if the monitors were tested with radiation sources traceable to industry standards and were of appropriate energies and with sufficient range to encompass instrument alarm setpoints.

The inspectors reviewed effluent monitor alarm setpoint technical documents and corresponding procedures to determine if calculational assumptions were consistent with

setpoint bases provided in the ODCM, so as to meet Radiological Effluent Technical Specifications (RETS) requirements.

Performance checks and calibration documents for laboratory analytical instruments used by the licensee for effluent radiological analyses (gamma spectroscopy systems and liquid scintillation counters) were reviewed to determine whether instrument performance was satisfactory.

b. Observations and Findings

Effluent monitors and associated flow measuring devices were functional with their alarm/trip setpoints established to meet ODCM criteria. Alarm setpoint bases were technically sound and setpoint values were conservatively established to meet RETS and 10 CFR 20 effluent concentration limits and the more limiting design constraints in Appendix I of 10 CFR 50, as provided in the ODCM.

Effluent monitors were calibrated with appropriate sources traceable to the National Institute of Standards and Technology and of sufficient output to encompass instrument alarm setpoints. Functional tests demonstrated instrument operability including remote alarm function. However, the inspectors identified that certain non-critical aspects of the calibration and functional tests could not be completed as delineated in procedures due to equipment modification and/or equipment degradation. Procedural "work arounds" were noted in several instrument calibration and test procedures because they had not been revised to reflect steps which were no longer applicable largely resulting from equipment modifications. While the intent of the calibration and test procedures was met in that instruments were demonstrated to meet their intended function, procedure work arounds could lead to compliance issues should they not be rectified. Condition Report 2012-000611 was generated by the licensee to capture the problem.

Chemistry analytical equipment used for effluent analyses was routinely tested to demonstrate performance and was calibrated using industry recognized methods. Gamma spectroscopy systems were properly maintained and functioned adequately despite the age of some of the equipment.

No findings of significance were identified.

c. Conclusions

Effluent monitors were functional, calibrated and alarm setpoints conservatively set to meet regulatory requirements. However, calibration and test procedures could not be fully implemented as written leading to "work arounds." Chemistry analytical equipment used for effluent analyses was well maintained and regularly tested to demonstrate performance prior to use.

5.4 Effluent Sampling and Analyses

a. Inspection Scope

The inspectors reviewed the licensee's procedures and practices for sampling and for analysis of liquid and gaseous effluents to determine compliance with ODCM Tables

12.3-2 and 12.4-1. Detection capabilities for analytical equipment based on current count times were compared to lower limits of detection (LLDs) required by the ODCM.

The inspectors discussed compensatory actions should effluent monitors be inoperable to determine if sampling and analyses were conducted as provided in the ODCM. For compensatory sampling, the inspectors reviewed the licensee's practices to determine if representative samples were obtained and were collected at the required frequency.

b. Observations and Findings

The inspectors observed that chemistry technicians sampled effluent streams in the manner prescribed by procedure. The inspectors found that procedures included means to ensure that samples were representative of the effluent stream through flushing of sample lines, continuous system recirculation or through the use of composite sampling devices. The inspectors selectively verified that compensatory samples were collected in those instances when effluent monitoring equipment was inoperable. The inspectors found that compensatory sampling was infrequent which indicated that effluent monitors generally remained operable.

The inspectors found that waste stream analyses included hard-to-detect (HTD) radionuclides at the ODCM required LLDs. Review of laboratory inter-comparison program results verified the analytical capabilities of the vendor laboratory used by the licensee for HTD analyses.

No findings of significance were identified.

c. Conclusions

Sampling and analyses of liquid and gaseous effluents satisfied ODCM/RETS requirements, including periods when effluent monitors were inoperable and there was reliance on compensatory sampling.

5.5 Dose Calculations

a. Inspection Scope

The inspectors reviewed significant (factor of 5 or more) changes in reported effluent dose values for 2009, 2010 and 2011, to determine if the licensee was aware of the variations and understood the causes and contributors.

The inspectors reviewed radioactive liquid and gaseous effluent discharge packages to determine whether the projected doses to members of the public were accurately input into the dose assessment software. The inspectors determined whether the required HTD radionuclide results were included in the analyses.

Results of recent calculated doses and the associated data inputs were reviewed to determine whether doses were within 10 CFR 50, Appendix I objectives.

b. Observations and Findings

The inspectors found that the licensee used a dose calculation software program inherited from the former license holder which was reportedly last verified and validated for the site in 2001. According to the licensee, no substantive changes were known to have been made to the calculation program since it was last validated. However, the scope and details of the validation performed in 2001 was unknown; therefore, the accuracy of the current calculational method and assumptions could not be demonstrated to the inspector. The licensee planned to search for the validation information to ensure the version currently used is viable or otherwise independently verify that meteorological dispersion factors, deposition factors, receptor information and other important dose calculation factors remain valid. Condition Report 2012-000698 was generated to capture the issue.

No findings of significance were identified.

c. Conclusions

Effluent sample results were accurately input into the licensee's dose assessment software, included required HTD radionuclides and calculated dose results were well within the 10 CFR 50, Appendix I objectives. Dose assessment software validation documents could not be produced by the licensee; therefore, the accuracy of the current dose calculation methods and assumptions could not be determined.

6.0 Exit Meeting

The inspectors presented the results of each onsite inspection segment to licensee management throughout the second quarter of 2012. On July 18, 2012, an exit meeting was conducted by telephone to provide the results of the quarterly inspection effort. 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, Vice President, Engineering, Operations & Nuclear Security
*S. Chris Baker, Vice President, Environmental Health & Safety
*P. Thurman, Vice President, Regulatory Affairs
*D. Brown, Vice President, D&D and Construction
*T. Bejma, Director, Quality Assurance
R. C. Keene, Director, Radiation Protection
R. Boyce, Exelon Radiation Protection Supervisor

*Those participating in the July 18, 2012 exit meeting telephone discussion.

INSPECTION PROCEDURES USED

IP 40801	Self-Assessment and Corrective Actions at Permanently Shutdown Reactors
IP 71801	Decommissioning Performance and Status Review at Permanently Shutdown Reactors
IP 60801	Spent Fuel Pool Safety at Permanently Shutdown Reactors
IP 83750	Occupational Radiation Safety
IP 84750	Effluent and Environmental Monitoring

ITEMS OPENED, CLOSED, AND DISCUSSED

None

PARTIAL LIST OF DOCUMENTS REVIEWED

Offsite Dose Calculation Manual Chapter 3 & 4 (Revision 3), Chapter 10 (Revision 14), Chapter 11 (Revision 4), Chapter 12 (Revision 22) and Appendix F (Revision 3)

Radioactive Effluent Release Report for 2009 (dated April 22, 2010), 2010 (dated April 27, 2011), and 2011 (dated April 26, 2012)

QA Surveillance Report S-11-020; Corrective Action Program; dated September 7, 2011

Independent Assessment of Zion*Solutions* Employee Concerns Program; dated February 24, 2012

ZCP-307; Sampling Program for Continuous Gaseous Releases; Revision 25

CR 2012-00212; Unit-1 Purge System Air Flow Exceeds ODCM; dated March 5, 2012

ZRP-5821-50/5821-33; Documentation & Control of Radiation Monitor Setpoints/Documentaton and Adjustment of Radiation Monitor Parameters; Revision 9/12

Efficiency Calibrations for Gamma Spectroscopy Detectors 352B, 818B, 314A, 324B; dated various periods in 2010 and 2011.

2012 LLD Data for Various Geometries of Gamma Spectroscopy Detectors 352B, 818B, 314A, 324B

Liquid Scintillation Counter No. 401631 & No. 403413 Performance Check Data; various dates in 2011 – June 2012

2F-PR53; U-2 Vent Stack Velocity Monitor Flow Loop Calibration; dated February 9, 2012

FT-2PR49; U-2 Vent Stack Monitor Functional Test; dated January 25, 2012

1F-PR53; U-1 Vent Stack Velocity Monitor Flow Loop Calibration; dated November 9, 2011

OR-PR25; Turbine Building Fire Sump Monitor Calibration; dated February 5, 2010 and August 16, 2011

FT-1R49; Functional Test of U-1 Vent Stack Process Radiation Monitor; dated November 10, 2011

2R-PR49; U-2 Vent Stack SPING Monitor Calibration; dated January 25, 2012

ZS-RP-105-004-002; Release of Materials and Equipment Using MARSAME Guidance; dated April 20, 2012

ES&H TSD 11-002; Radiation Clearance Plan for Radiological Survey and Release of Materials and Equipment (M&E) Using Guidance from MARSAME at Zion*Solutions*; Revision 1

ZRP 6020-3; Radiological Surveys; Revision 9

CR-2012-000136; Aggregated Survey not Performed on Service Water Discharge Headers; dated 2/16/2012

WR No. 00386541; FASA: Release of Material from RCA Requires Survey; dated 12/01/2011

CR-2012-000207; No programmatic training for performing upcoming surveys associated with MARSSIM; dated 3/5/2012

CR-2012-000208; Develop required reading for the RP License Termination Group (LTG); dated 3/5/2012

CR-2012-000102; Truck Monitor Alarm; dated 2/7/2012

CR-2012-000232; Tool monitor appears to need battery replacement; 3/8/2012

Survey Package U0-NRL-ASPH-592-017; Asphalt adjacent to, and covering, the Unit-1 rail spur inside double fence and continuing to the Unit-1 Turbine Building; Revision 1

Survey Package U2-TB-642-STM-001; Cross-Over Steam Piping; Revision 1

Survey Package U0-Turbine Bldg Roof -001; Turbine Building Roof – 712' Elevation; Revision 1

Survey Package U1-steam tunnel-570-001; U1 Steam Tunnel – West End - 570' Elevation; Revision 0

Survey Package U0-EXT-592-Switch yard Soils – 003; Revision 0

AOP-6.2, Spent Fuel Pool/Transfer Canal Uncontrolled Loss of Level, Revision 12

AOP-6.4, Loss of Spent Fuel Pit Cooling, Revision 12

AOP-8.6, SFNI Loss of Power, Revision 5

CR-2012-000216; A SFNI Pump Failed to Start on First Att., dated March 6, 2012

CR-2012-000217; B SFNI Pump Tripped, Low Flow Trip Block Installed, dated March 6, 2012

CR-2012-000226; Spent Fuel Pool Bridge Crane SE Guide Ro, dated March 7, 2012

Move Sheet Package # 2012-40, Sipping Check, Package #20, dated March 2, 2012

NF-AA-309, Special Nuclear Material & Core Component Move Sheet Development, Revision 3

NF-ZN-310-2000, Special Nuclear Material and Core Component Movement Requirements for Zion Station, Revision 2

ODCM, Offsite Dose Calculation Manual, Revision 21

OSP-01-002, Spent Fuel Pool Heat Up Data Collection Procedure, Revision 1

PT-0 App. D, Operator Surveillance Check Sheet Defueled, Revision 64

PT-0 App. N, Source Check of Radiation Monitors, Revision 12 and 14

SOI-75D, Spent Fuel Pit Makeup, Revisions 24 and 25

SOI-75N, Lowering the Spent Fuel Pit Level, Revision 8

Spent Fuel Pool Chemistry Data, dates from January 1, 2011 to April 17, 2012

TSS 15.6.104, Determination of Spent Fuel Pit Liner and Transfer Canal Liner Leakage, Revision 3

TSS 15.6.179 Rev. 3, DAS Alarm System Functional Test, Revision 3

WO 00366070, Diesel Driven Fire Pump (DDFP) Batteries, dated April 27, 2011

WO 01064804 01, IM – PM 4/yr – Cal – SFP Separator Hi/Lo Level Alarm Float Switch, dated March 14, 2009

WO 01250105 02, Ship Out and Calibrate/Replace Detectors for 0RT/AR-21/22, dated January 20, 2011

WO 01300016 01, Spent Fuel Pool Temperature, and Results of Surveillance, dated June 28, 2011

WO 01359724, DAS Alarm System Function Test – TSS 15.6.179, dated June 22, 2011

WO 01433161, NRC Inspection Observation – DDFP Batteries, dated September 23, 2011

ZAP 0300-21, Zion Administrative Procedure Station Blackout, Revision 3

ZAP 300-04, ZNPS Special Nuclear Material Program, Revision 20

ZAP-500-09, Certification of Participants to ANSI-Recognized Discipline Standards, Revision 9

Zion Drawing No. M-1500, P & ID Spent Fuel Pool Cooling Towers System Spent Fuel Nuclear Island, Revision A dated October 20, 2000

Zion Drawing No. M-63, Diagram of Spent Fuel Pit Cooling & Cleanup Piping Zion Station Unit-1 & 2, Revision AE dated September 13, 1996

Zion Nuclear Power Station Permanently Defueled Technical Specifications, Amendment Nos. 180 and 167

Zion Station Defueled Safety Analysis Report (DSAR) October 2010

Zion Station DSAR Figure 3-39A, Spent Fuel Pool Secondary Loop Cooling System, dated October 2000

Zion Station DSAR Figure 3-45A October 2000, Spent Fuel Nuclear Island Offsite Power Supply

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
DAS	Data Acquisition System
DNMS	Division of Nuclear Materials Safety
DOP	Dioctyl Phthalate
DSAR	Defueled Safety Analysis Report
ECP	Employee Concerns Program
FHB	Fuel Handling Building
HEPA	High Efficiency Particulate Air
HTD	Hard-to-Detect
LLD	Lower Limit of Detection
MARSAME	Multi-Agency Radiation Survey and Assessment of Materials and Equipment

MRC	Management Review Committee
NRC	U.S. Nuclear Regulatory Commission
ODCM	Offsite Dose Calculation Manual
PPM	Parts Per Million
RIS	Regulatory Issue Summary
RETS	Radiological Effluent Technical Specifications
RWP	Radiation Work Permit
SAFSTOR	Safe Storage of Spent Fuel
SCWE	Safety Conscious Work Environment
SFNI	Spent Fuel Nuclear Island
SFP	Spent Fuel Pool
ZNPS	Zion Nuclear Power Station