UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
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LISLE, IL 60532-4352

May 8, 2015

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

SUBJECT: NRC INSPECTION REPORT 05000295/2015007(DNMS); 05000304/2015007(DNMS); 07201037/2015001(DNMS) – ZION NUCLEAR POWER STATION

Dear Mr. Sauger:

On April 2, 2015, the U.S. Nuclear Regulatory Commission (NRC) completed onsite inspection activities for the first calendar quarter of 2015 at the permanently shut-down Zion Nuclear Power Station in Zion, Illinois. The inspection continued with in-office review through April 10, 2015. The purpose of the inspection was to determine whether regulated activities associated with the decommissioning project and independent spent fuel storage installation (ISFSI) operations were conducted safely and in accordance with NRC requirements. The enclosed report presents the results of this inspection, which were discussed with members of your staff on April 16, 2015.

During the quarterly inspection period, the NRC inspectors reviewed the execution of the site decommissioning project including various aspects of the occupational radiation safety program, safety evaluations related to Crib House demolition and biological remediation of canisters containing greater than class C (GTCC) waste, emergency plan change processes, the completion of the spent fuel transfer campaign and ongoing dry cask storage operations, and implementation of the corrective action program.

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 and with the conditions of your NRC licenses that are maintained under Title 10 of the *Code of Federal Regulations* (CFR) Part 50 and Part 72. Areas examined during the inspection are delineated 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, one violation of regulatory requirements was identified. The violation is associated with controls to prevent worker intake of radioactive material. The violation is categorized at Severity Level IV (very low safety significance). Since the safety significance of the violation is low and the issue is documented in your corrective action program, the violation is dispositioned as a non-cited violation (NCV) in accordance with Section 2.3.2 of the Enforcement Policy.

No response is required for the non-cited violation. However, if you contest the subject or severity level of the NCV, you should provide a response within 30-days of the date of this inspection report, with the basis for your denial, to the Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with copies to the Regional Administrator - Region III; and the Director, Office of Enforcement, Washington, DC.

In accordance with 10 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's Public Document Room or from the NRC's Agencywide Document Access and Management System (ADAMS), accessible from the NRC's website at http://www.nrc.gov/reading-rm/adams.html.

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

Sincerely,

/RA/

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

Docket Nos. 050-00295; 050-00304; 07201037
License Nos. DPR-39; DPR-48

Enclosure:
Inspection Report No. 05000295/2015007(DNMS);
05000304/2015007(DNMS); 07201037/2015001(DNMS)

cc w/encl: *ZionSolutions,* Service List

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U.S. NUCLEAR REGULATORY COMMISSION
REGION III

Docket Nos.:	050-00295; 050-00304; and 072-01037
License Nos.:	DPR-39; DPR-48
Report Nos.:	05000295/2015007(DNMS) 05000304/2015007(DNMS) 07201037/2015001(DNMS)
Licensee:	Zion*Solutions*, LLC
Facility:	Zion Nuclear Power Station (permanently shut-down)
Location:	101 Shiloh Boulevard Zion, IL 60099
Dates:	Onsite Inspection on January 26 – 30, February 17 – 20, March 9, 11 – 12, 16 – 19 and March 30 – April 2, 2015
NRC Inspectors:	Wayne Slawinski, Senior Health Physicist Matthew Learn, Reactor Engineer Bill Lin, Health Physicist
Observer:	Nicole Fields, Nuclear Safety Professional Development Program
Approved by:	Robert J. Orlikowski, Chief Materials Control, ISFSI, and Decommissioning Branch Division of Nuclear Materials Safety

Enclosure

EXECUTIVE SUMMARY

Zion Nuclear Power Station, Units 1 and 2
NRC Inspection Report No. 05000295/2015007(DNMS); 05000304/2015007(DNMS); and No. 07201037/2015001(DNMS)

The Zion Nuclear Power Station is a permanently shut-down and defueled power reactor facility that was maintained in a safe storage (SAFSTOR) condition with spent fuel in wet storage from 1998 through 2010. Active decommissioning began in 2011, and continued throughout this quarterly inspection period. The spent fuel transfer campaign commenced in late 2013, and was successfully completed in January 2015. This routine safety inspection reviewed the licensee's execution of the decommissioning project focusing on various aspects of the occupational radiation safety program, safety reviews related to Crib House demolition and biological remediation of greater than class C (GTCC) waste, emergency plan change processes, dry cask storage operations, and implementation of the corrective action program.

Operation of an Independent Spent Fuel Storage Installation

- Loading and transfer of dry fuel storage casks was conducted in a safe and methodical manner. During observations of field work, the inspectors determined that adequate radiological controls were used by the licensee (Section 1.1).

Self-Assessments, Audits and Corrective Actions

- Self-assessments and other licensee assessments were effective at identifying issues and improvement opportunities. Issues identified during assessments were entered into the corrective action program (CAP) and assigned corrective actions that were commensurate with safety significance (Section 2.1).

- Issues were identified at appropriate thresholds within various departments of the licensee's organization and entered into the CAP in most instances. Issues were screened and prioritized commensurate with safety significance. Licensee evaluations determined the significance of individual issues, while recurring issues and those with potential increased significance were being evaluated through appropriate means (Section 2.2).

Decommissioning Performance and Status

Radiological controls and work practices were adequate in most instances to maintain worker dose as-low-as-is-reasonably-achievable (ALARA). Workers followed radiation work permit instructions and were aware of the radiological conditions of the work area. Radiological barriers, postings and area controls satisfied regulatory requirements (Section 3.1).

Safety Reviews and Modifications

- Adequate safety screenings and evaluations were completed to assess the decommissioning impact of Crib House demolition and to demonstrate that biological buildup and pitting on the surfaces of the liners that housed GTCC waste would not adversely affect container performance (Section 4.1).

Decommissioning Emergency Preparedness Program Evaluation

- The emergency preparedness program was maintained overall in a state of operational readiness. Changes made to the emergency plan followed a defined Title 10 of the *Code of Federal Regulations* (10 CFR) 50.54(q) evaluation process (Section 5.1).

Inspection of Interim and Final Status Surveys

- Radiation Surveys completed prior to Crib House demolition demonstrated that systems, structures and components were evaluated adequately to justify the facility could be decommissioned as provided in the site work order (Section 6.1).

Occupational Radiation Exposure

- Evaluations were not performed to determine the need for engineering controls and/or respiratory protection equipment associated with work in the Unit 2 sandbox area, as required by 10 CFR 20.1701 and 20.1702. A non-cited violation was identified (Section 7.1).

- External radiological hazards were assessed to determine the appropriate type and positioning of dosimeters to monitor the occupational dose to the workforce, as required by 10 CFR 20.1502 (Section 7.2).

- Workers were monitored as required by 10 CFR 20.1502 to demonstrate compliance with regulatory dose limits. Records of individual monitoring results were maintained as required by 10 CFR 20.2106 and 20.2110 (Section 7.3).

- Personnel dosimeters were supplied and evaluated by a processor holding current National Voluntary Laboratory Accreditation Program (NVLAP) accreditation from the National Institute of Standards and Technology for the types and energies of radiation present. Secondary dosimetry devices were calibrated by a vendor at frequencies and using methods prescribed by industry standards. Quality controls ensured that dosimetry devices were used in a manner that allowed for accurate assessment of occupational worker dose (Section 7.4).

- Technically sound evaluations of neutron dose were completed as required by 10 CFR 20.1501, to demonstrate compliance with the dose limits of 10 CFR 20.1201 (Section 7.5).

- Exposure monitoring and control for embryo/fetal dose satisfied the requirements of 10 CFR 20.1208 and 20.2106 (e) (Section 7.6).

- Respiratory protection equipment used to limit the intake of radioactive material was certified, tested, properly maintained and issued as provided in 10 CFR 20.1703. Devices were used by adequately trained workers that were medically certified for respirator use consistent with the licensee's program (Section 7.7).

- Engineered processes were generally used effectively to control the concentration of radioactive material in air as provided in 10 CFR 20.1701 and 20.1702. Engineered

controls specified in radiation work permits (RWPs) and work instructions aligned with those established in the plant based on field observations (Section 7.8).

- Technically sound alternatives were established to validate protection factors provided by respiratory protection devices. Internal dose assessments were procedurally driven to yield accurate results (Section 7.9).

- An adequate number and type of survey instruments and personnel contamination monitors were maintained to support the decommissioning project. Instruments were functionally tested, calibrated, and alarm set points were established consistent with industry standards and licensee procedure. Non-routine maintenance on an instrument calibrator interlock without a procedure was identified by the inspectors and addressed through the corrective action program (Section 7.10).

Report Details

Summary of Plant Activities

During the quarterly inspection period, active decommissioning work continued at the site and consisted of Unit 1 reactor cavity cleanup and steam generator downsizing, processing of greater than class C (GTCC) waste, preparations for segmentation of the Unit 2 reactor vessel, decommissioning of the Crib House and waste packaging activities. Spent fuel transfer operations culminated on January 10, 2015, when the final spent fuel storage cask was transferred to the independent spent fuel storage installation.

1.0 Spent Fuel Transfer and Independent Spent Fuel Storage Installation (ISFSI) Operations (IP 60855.1/IP 60858)

1.1 Spent Fuel Transfer Operations

a. Inspection Scope

The inspectors evaluated the licensee's ongoing operation and maintenance of the ISFSI containing both spent fuel and GTCC waste canisters in dry cask storage, to verify compliance with the Certificate of Compliance, Technical Specifications, regulations and associated procedures.

During discussions with licensee staff, the inspectors evaluated the staff's familiarity with routine maintenance, routine surveillance, routine security, and emergency procedures; the amount of supervisory oversight; and the communication and coordination between and amongst work groups. The inspectors reviewed monitoring procedures and evaluated the licensee's adherence to these procedures. The inspectors also interviewed licensee staff and management to assess knowledge of and compliance with regulatory requirements.

The inspectors conducted an ISFSI pad walkdown to assess the material and radiological condition of the ISFSI pad and of the dry storage casks. During this walkdown, the inspectors evaluated radiological controls, radiological work permit (RWP) compliance, and reviewed radiological posting and labeling.

The inspectors interviewed staff and reviewed ISFSI area environmental dosimetry records to assess compliance with regulatory requirements governing radiation dose to individual members of the public.

The inspectors reviewed corrective action reports and the associated follow-up actions generated during the inspection quarter to determine whether the corrective action program was implemented as prescribed by procedure.

b. Observations and Findings

During the inspection quarter, the licensee completed the loading and placement of all 61 spent fuel Vertical Concrete Casks (VCCs) on the ISFSI pad. In addition to the spent fuel casks, four VCCs with GTCC waste were also loaded and placed on the ISFSI pad during this inspection quarter.

During interviews with licensee staff, the inspectors found the staff to be knowledgeable with regards to both routine and emergency procedures for the ISFSI.

During the walkdown of the ISFSI pad, the inspectors found the material condition of the ISFSI pad and the dry storage casks to be adequate. Radiological postings and controls at the ISFSI facility satisfied the requirements prescribed by 10 CFR Part 20 and staff was cognizant of measures to maintain radiological doses ALARA.

No findings of significance were identified.

c. Conclusions

The licensee operated and maintained the ISFSI in a safe and methodical manner including radiological controls to preclude unnecessary radiation exposure.

2.0 Self-Assessment, Audits and Corrective Actions (IP 40801)

2.1 Self Assessments and Audits

a. Inspection Scope

The inspectors reviewed licensee assessment reports and supporting documentation for 2013 through 2014 related to radiological instrumentation, external exposure control (dosimeters) and the respiratory protection program. The review was performed to determine whether internal assessment mechanisms were in place, adequately implemented, and that identified issues were being addressed through the corrective action program.

b. Observations and Findings

Self-assessments and other licensee assessments were typically effective at identifying issues as well as opportunities for improvements. The inspectors found that assessments were performed by subject matter experts or otherwise completed by personnel knowledgeable of the subject area and were generally thorough. Interviews of licensee staff involved in these assessment activities revealed that program reviews were correctly focused on areas of potential risk significance, areas associated with regulatory compliance and on overall program adequacy.

Corrective actions associated with identified deficiencies, recommendations or to address compliance based issues were entered into the CAP at a low threshold and actions were assigned commensurate with safety significance. The inspectors determined that the assessment process was capable of identifying and addressing individual deficiencies of potential significance and/or repetitive issues so as to preclude the likelihood of problem escalation.

No findings of significance were identified.

c. Conclusions

Self-assessments and other licensee assessments were typically effective at identifying issues and improvement opportunities. Issues identified during assessments were

entered into the CAP and assigned corrective actions that were commensurate with safety significance.

2.2 Identification, Resolution and Prevention of Problems

a. Inspection Scope

The inspectors reviewed a variety of CAP documents to determine if a sufficiently low threshold for problem identification existed, to determine the quality of follow-up evaluations including extent of condition, and to determine whether the licensee assigned timely and appropriate prioritization for issue resolution. Repetitive issues and those with the potential for safety or regulatory significance were evaluated by the inspectors to determine whether apparent cause, common cause or other appropriate evaluations were pursued by the licensee. Corrective actions associated with CAP issues were examined to determine if they were timely and adequately addressed the issues to prevent recurrence.

b. Observations and Findings

The inspectors determined that individual issues were identified by the licensee at an appropriate threshold and entered into the CAP in most instances. Issues were effectively screened and prioritized through the management review committee process and generally were assigned follow-up actions commensurate with safety significance as prescribed in the licensee's CAP procedures.

The inspectors found that the licensee took adequate actions to correct deficiencies and to improve overall program performance. However, the inspectors noted a potential increasing trend in the number of CAP issues related to industrial safety (compressed gas storage and fall hazards) and radiological safety (control of radiological boundaries and deficient radworker practices) that were addressed individually by the licensee mostly through coaching. The licensee contended that the issues were isolated and not symptomatic of broader problems that required further evaluation. The inspectors found that the scope and depth of those evaluations performed by the licensee such as issue reviews and apparent/common cause evaluations were sufficiently comprehensive in that they addressed the significance of issues and included a reasonable course of corrective action to prevent recurrence.

No findings of significance were identified.

c. Conclusions

Issues were being identified at appropriate thresholds within various departments of the licensee's organization and entered into the CAP. Issues were effectively screened and prioritized commensurate with safety significance. Licensee evaluations determined the significance of individual issues, while recurring issues and those with potential increased significance were generally being evaluated through appropriate means.

3.0 Decommissioning Performance and Status Review (IP 71801)

3.1 Plant Tours/Walkdowns and Work Observations

a. Inspection Scope

The inspectors conducted plant walkdowns throughout the inspection period to observe field conditions, to perform radiological observations and to assess the impact of work activities on safe decommissioning. Walkdowns were conducted primarily in the containment buildings while decommissioning work took place. During these walkdowns, the inspectors evaluated work controls and work oversight, assessed material as well as radiological conditions, and reviewed radiological controls, radiation work permit (RWP) compliance, posting/labeling and the overall condition of structures and components that supported decommissioning. Independent radiation measurements were made by the inspectors in areas toured to determine if those areas were controlled properly and posted as prescribed in 10 CFR Part 20.

b. Observations and Findings

The inspectors found that controls associated with work in the Unit-1 & Unit-2 Containment Buildings was adequate to maintain proper radiological safety, to prevent unauthorized entry into contaminated areas, high and locked high radiation areas and for purposes of control over radioactive material quantities of concern (RAMQC).

During walkdowns, the inspectors found that work coverage provided by the radiation protection staff was adequate in most instances for the work observed. The inspectors found that personnel were aware of job controls specified in work instructions and demonstrated an adequate level of radiological awareness.

During work observations early in the assessment period, the inspectors noted conditions that were not always consistent with industry best radiological practices. For example, the inspectors noted that workers involved in adjustment/maintenance of Unit 2 vessel segmentation equipment located inside a tented structure were not surveyed by the radiation protection staff for contamination upon departure from the immediate area. Although not specifically called-out in the RWP, routine personnel frisks were warranted due to the potential presence of discrete radioactive particles in the work area. Based on the observation, the licensee adjusted its survey protocol to align with best practices. In Unit 1, the inspectors noted that high radiation areas generated inside the missile barrier from segmented reactor coolant system (RCS) lines existed for an extended time period because actions to eliminate the condition were not taken timely. The radioactive waste piping had been accumulating in the area for a couple months as efforts to dismantle the RCS continued. The buildup of segmented RCS piping in general areas inside the missile barrier led to unnecessary radiation dose to workers. The licensee acknowledged the condition and prioritized its plans to collect and package radioactive waste stored in the area.

No findings of significance were identified.

c. Conclusions

Radiological controls and work practices were adequate in most instances to maintain worker dose ALARA. Workers followed radiation work permit instructions and were aware of the radiological conditions of the work area. Radiological barriers, postings and area controls satisfied regulatory requirements.

4.0 Safety Reviews and Modifications (IP 37801)

4.1 Evaluation of Crib House Demolition and Processing of GTCC Waste

a. Inspection Scope

The inspectors reviewed the licensee's safety evaluations and supporting documentation for demolition of the Crib House and for the biological remediation of GTCC waste liners. The reviews were performed to determine whether the licensee implemented its review process to effectively maintain design basis to ensure decommissioning safety and safety of long term storage of radioactive waste. 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 the potential impact of the demolition and remediation activities, and the inter-relationships between those activities and other systems and structures potentially affected.

b. Observations and Findings

The licensee completed an engineering survey for the demolition of the Crib House to determine the condition of the existing framing, floors and walls and to identify load bearing structures. The engineering evaluation was performed and reviewed by competent individuals on the licensee's staff, as provided in 29 CFR 1926.32(f). The evaluation identified common structural components required to be retained during the demolition including load bearing walls and other structures to ensure safety during the project. A demolition sequence was developed to supplement the engineering evaluation to ensure the fore bay structure, the stop logs isolating the fore bay and associated support walls would be maintained. A screening consistent with the requirements of 10 CFR 50.59 was also completed to document which systems, structures and components in the Crib House did not need to be maintained (not important to the defueled condition as specified in the Defueled Safety Analysis Report (DSAR)). Justification was also provided to reclassify the systems, structures and components of the Crib House as "not required" apart from the stop logs and the north/south wall that formed the boundary of the fore bay.

During the approximate two year period when the reactor vessel internals were segmented, GTCC waste was housed in liners that were submerged in the flooded reactor cavity. Cavity water quality was maintained only as necessary to aide visualization while the internals were segmented. In preparation for liner processing, the liners were power-washed and visually inspected. The inspections revealed localized rust deposits on the exterior of the waste basket liners and an algae-like buildup on the GTCC waste and liners. Subsequent sampling and laboratory analyses showed that organic material was present. The licensee completed companion evaluations and 10 CFR 50.59 screenings to address the potential impact of the corrosion and biological growth on the GTCC waste basket liners to assess potential long term impact. These evaluations were supported by subject matter experts contracted by the licensee. The licensee suspected that the stainless steel liners may have contacted the carbon steel support railings of the seismic stand where the liners were stored during the internals segmentation project, causing the surface corrosion.

The licensee determined that superficial pitting on the waste liners would not impact long term storage of the transportable storage container (TSC). The licensee concluded that since the container was passivated because an inert atmosphere was established during processing (i.e., container was vacuumed dried and backfilled with helium), corrosion of the TSC would not occur.

In order to address biological growth, the license elected to treat the waste canisters with a sodium hydroxide solution after the TSC closure lid was welded in place prior to vacuum drying and helium backfilling. Samples taken before and after treatment demonstrated successful remediation of organic materials. The 10 CFR 50.59 screening evaluated the effects of the chemical treatment on the canisters that housed the GTCC waste. The evaluation concluded that the liners were not adversely impacted by biological growth and superficial surface pitting and retained their ability to lift, confine and provide structural support for the GTCC waste contents.

No findings of significance were identified.

c. Conclusions

The licensee completed adequate safety screenings and evaluations to assess the decommissioning impact of Crib House demolition and to demonstrate that biological buildup and pitting on the surfaces of the liners that housed GTCC waste would not adversely affect container performance.

5.0 Decommissioning Emergency Preparedness Program Evaluation (IP 82501)

5.1 Defueled Station Emergency Plan Change Process and Practices

a. Inspection Scope

The inspectors reviewed changes made by the licensee to the emergency preparedness program during the inspection period. The review was performed to determine whether the emergency preparedness program was maintained in a state of operational readiness and whether the changes negatively affected the overall state of emergency preparedness. The review focused on the licensee's 10 CFR 50.54(q) change process and practices.

b. Observations and Findings

During the inspection period, all remaining spent fuel was removed from the spent fuel pool and relocated to the ISFSI. Also, GTCC waste was packaged, processed and transferred from the reactor cavities to the ISFSI. Moreover, the facility operating license was amended to eliminate Technical Specifications associated with the spent fuel pool and pool maintenance, eliminate specifications for minimum operations staffing and to eliminate requirements related to the station's overall security plan. With these changes, the licensee elected to revise the Defueled Station Emergency Plan (DSEP) to conform to the conditions established in the amended license.

The changes were evaluated by the licensee as provided under 10 CFR 50.54(q) and were determined not to result in a decrease in effectiveness of the plan. The licensee's evaluations concluded that the revised DSEP continued to meet the requirements of

Appendix E to 10 CFR 50 and the planning standards of 10 CFR 50.47(b). Revision 15A of the DSEP was implemented on January 22, 2015, after the associated 10 CFR 50.54(q) evaluation was completed and internally approved by the licensee. However, following discussions with the U.S. Nuclear Regulatory Commission (NRC) staff, many of the changes made in Revision15A were reinstated with Revision 15B effective February 12, 2015. Specifically, initiating conditions and emergency action levels (EALs) related to spent fuel pool level or temperature that were eliminated in Revision 15A were reinstated, as were conditions and EALs related to security events in the fuel building. Additionally, the licensee reinstated changes made to two other EALs that related to potential initiating events in the fuel building.

The inspectors reviewed the licensee's 10 CFR 50.54(q) change process and the implementation of that process for Revisions 15A and 15B of the DSEP. The inspectors found that licensee staff that performed the evaluations understood the intent of the change and were cognizant of guidance provided in Regulatory Guide 1.219. The inspectors noted that the licensee's justification for deleting EALs relating to the spent fuel pool and Fuel Building were based on an NRC Safety Evaluation Report (SER) for the post fuel transfer license amendment and not the current DSEP SER. A condition report was generated by the licensee to document the elimination of fuel building related initiating conditions without a corresponding SER, which promptly led to Revision 15B.

The inspectors found that the screenings and evaluations for Revision 15A and 15B contained a level of detail sufficient to support the change notwithstanding the basis for it. The inspectors, however, questioned an EAL threshold in Revision 15B related to radiological conditions in the Fuel Building which replaced a predetermined radiation monitor measured value with a qualitative determination. The licensee submitted DSEP Revisions 15A and 15B along with conforming Emergency Plan Implementing Procedures to the NRC in letter dated February 23, 2015.

The inspectors found that DSEP changes did not negatively affect the overall state of emergency preparedness given the transfer of fuel and GTCC waste to the ISFSI, and recent changes to the Technical Specifications and the amended license. However, the inspector's review of the DSEP changes was not a formal safety evaluation and does not constitute NRC approval of the changes. Therefore, these changes remain subject to future NRC inspection. The inspectors noted that the licensee acted promptly to reinstate many of the changes in Revision 15A following discussions with NRC staff.

No findings of significance were identified.

c. Conclusions

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

6.0 Inspection of Interim and Final Status Surveys (IP 83801)

6.1 Implementation of Multi-Agency Radiation Survey and Assessment of Materials and Equipment (MARSAME) – Crib House

a. Inspection Scope

The inspectors selectively reviewed MARSAME related survey packages performed in support of the Crib House demolition project. The review was completed to determine if surveys were performed as specified in MARSAME implementing procedures as necessary to demonstrate that the Crib House could be decommissioned in a radiologically safe manner.

b. Observations and Findings

The purpose of the MARSAME program is to prevent the inadvertent release of radioactive material into the public domain through radiological analyses and/or asset recovery. Radiological analyses are completed through the controlled performance of statistically based radiological surveys of secondary side systems, structures and components at the site. These secondary side structures include the Crib House.

The inspectors found that Crib House radiation survey packages included the level of rigor needed to demonstrate that facility structures and systems were not radiologically impacted by plant operations and could be decommissioned safely without radiological controls.

No findings of significance were identified.

c. Conclusions

Survey results associated with MARSAME activities in the Crib House demonstrated that systems, structures and components were evaluated adequately to justify the facility could be decommissioned as provided in the site work order.

7.0 Occupational Radiation Safety (IP 83750)

7.1 Radiological Evaluations and Job Controls – Work in Unit 2 Sandbox Area

a. Inspection Scope

The inspectors reviewed two separate radiological issues that occurred on December 7 and December 10, 2014, associated with cleanup activities in the Unit 2 sandbox area in preparation for vessel segmentation. During these two separate events, four individuals had small intakes of radioactivity. The inspectors reviewed the RWPs that governed the work, the associated ALARA plan, personnel contamination event reports, post event radiation surveys, internal dose calculation worksheets, alpha and beta/gamma radioactivity calculation sheets, and the total effective dose equivalent (TEDE) ALARA evaluations for the work activities completed before and after the events. The inspectors also interviewed the Radiation Protection (RP) supervisor responsible for the Unit 2 sandbox work. The reviews were performed to determine whether the licensee had identified the radiological hazards before the work commenced, and provided for appropriate worker protection through engineering controls and/or through the use of respiratory protection equipment.

b. Observations and Findings

During the event that occurred on December 7, 2014, three workers entered the Unit 2 sandbox to clean-up potential asbestos debris from the area. Non-fixed (smearable) contamination levels in the work area ranged up to 60,000 disintegrations per minute (dpm). The workers used a portable vacuum cleaner and foxtail (hand broom) to clean-up the debris. Also, the workers, at times, crawled on their hands and knees through the work area which further disturbed the contamination and created an airborne hazard. Neither engineering controls nor respiratory protection equipment were used during the work because communications between the work crew and RP staff were not sufficient to understand how the work would be performed. Air samples collected in general areas external to the sandboxes during the cleanup work showed that low levels of airborne radioactivity were generated. Worker intakes were self-revealed when contamination monitors alarmed as the workers attempted to leave the radiologically controlled area (RCA) after completing the clean-up.

The RWP did not specifically address the work performed by the crew or the radiological controls required. The inspectors determined that the licensee failed to evaluate the potential radiological impact of the work and had not determined the need for engineering controls and/or respiratory protection equipment as required by 10 CFR 20.1701 and 20.1702. Given the work performed and the hazards present, an evaluation was warranted to determine the controls needed to limit the concentration of radioactive material in the air and to prevent the potential spread of contamination. Worker whole body counts performed shortly after the incident showed that each worker had a small intake of primarily cesium-137. Followup counts were not conducted because the workers left the site and did not return. The licensee assumed that the intakes were through the inhalation pathway and conservatively calculated that the maximally exposed individual dose (committed effective dose equivalent) was approximately 11 mrem.

On December 10, 2014, a worker used a cutting tool to extract concrete supports in the Unit 2 sandbox area. A TEDE ALARA evaluation was not performed specific to the week activity. As a result, respiratory protection equipment was not worn by the worker. However, a portable High Efficiency Particulate Air (HEPA) filter unit was used to control the radiological hazards present and likely would have provided an adequate means of control had it been optimally positioned relative to the cut location. Similar to the incident that occurred three days earlier, the licensee failed to evaluate the potential radiological impact of the work activity to ensure that controls were established to prevent airborne radioactivity or intakes. The incident was also self-reveled as the individual attempted to leave the RCA and alarmed egress contamination monitors. Initial and followup whole body counts showed a small cesium-137 intake and the corresponding internal dose was calculated to be approximately 5 mrem conservatively based on an inhalation pathway.

Title 10 CFR 20.1501 requires, in part, that the licensee make or cause to be made surveys that are necessary to comply with the regulations in 10 CFR Part 20 and that are reasonable under the circumstances to evaluate the potential radiological hazards that could be present. Pursuant to 10 CFR 20.1003, survey is defined as an evaluation of the radiological conditions and potential hazards incident to the presence and use of radioactive material or to other sources of radiation.

Title 10 CFR 20.1701/20.1702 requires the licensee to use engineering controls and or respiratory protection equipment to control the concentration of radioactive material in air

to maintain the total effective dose equivalent ALARA. Contrary to this requirement, the licensee failed to conduct radiological evaluations to assess the impact of cleanup activities and cutting of concrete in the Unit 2 sandbox area on Dec 7 and 10, 2014. While worker intakes were small and calculated dose less than 1% of the regulatory limits, workers were placed at increased radiological risk due to the contamination levels present and the work activities conducted. Consequently, the violation was of more than minor safety significance. The violation was categorized at Severity Level IV, as provided in Section 6.7 of the NRC Enforcement Policy. Although the violation was NRC identified and the incident self-revealed, it is being disposition as a non-cited violation (NCV) consistent with the Enforcement Policy because the issue was documented in the licensee's corrective action program and met the other NCV criteria provided in the Enforcement Policy (NCV 05000295/2015007-01; 05000304/2015007-01).

Condition reports were not developed promptly following either incident even though required by the licensee's CAP procedure due to the facial contaminations and intakes that occurred. A condition report was subsequently generated following discussion with the inspectors (CR No. 2015-000075). Corrective actions were taken to ensure better communication with work crews and improved supervisory oversight of field activities.

One non-cited violation of regulatory requirements was identified.

c. Conclusions

The licensee did not perform adequate evaluations to determine the need for engineering controls and/or respiratory protection equipment associated with work in the Unit 2 sandbox area as required by 10 CFR 20.1701 and 20.1702.

7.2 External Exposure Monitoring

a. Inspection Scope

The inspectors reviewed the licensee's procedures and practices for site radiological access as it relates to personnel radiation monitoring. The inspectors reviewed the licensee's methods for determining external radiation hazards and for monitoring worker dose as required by Subpart C and D of 10 CFR 20. The inspectors also evaluated how the licensee monitored worker dose in situations that involved radiation gradients that produced non-uniform exposure to the whole body or instances when the shallow dose to an extremity could greatly exceed the deep dose equivalent. Additionally, the inspectors reviewed methods and practices for calculating shallow (skin) dose should a worker be contaminated from exposure to discrete radioactive particles or from distributed contamination. The inspectors reviewed radiation survey records, RWPs and ALARA documents along with the use of non-routine (special) dosimetry to determine if workers were properly monitored for radiation exposure.

b. Observations and Findings

The inspectors found that radiologically risk-significant activities that involved external radiation dose to areas of the body not accurately monitored by standard dosimeter placement were evaluated adequately through the ALARA planning process. As part of that process, radiation protection staff identified work in areas with known or suspected radiation dose gradients and determined through industry experience the type and

placement of dosimeters for radiation dose monitoring. The inspectors noted that the actions taken by the ALARA organization for extremity monitoring, whole body dosimeter placement and for use of multi-dosimeters aligned with industry guidance and met the requirements of 10 CFR 20.1201. Area radiation survey data, worker exposure records and ALARA reviews collectively showed that the licensee monitored external exposure to the part of the body that received the highest expected dose as required by 10 CFR 20.1201(a) and (c). The inspector also found that alarm setpoint values for electronic dosimeters (ED) were established such that they provided meaningful indications of unexpected conditions based on pre-job work area radiological assessments.

However, the inspectors found that while the licensee monitored extremity dose as warranted and also monitored that part of the whole body receiving the highest exposure, the procedural specified threshold for relocation of worker whole body dosimeters was not consistent with industry guidance. Should the licensee implement the procedure as written, a non-conservative determination of deep dose equivalent would result. A condition report (CR) was generated to document the issue which the licensee planned to address through a procedure modification.

The inspectors found that shallow dose equivalent to the skin from distributed and particle contamination was determined consistent with the licensee's procedure using NRC endorsed industry methods. The calculations were based on isotopic analyses, fractional abundances, dose factors and applied appropriate attenuation coefficients in instances when clothing was contaminated.

No findings of significance were identified.

c. Conclusions

External radiological hazards were assessed by the licensee to determine the appropriate type and positioning of dosimeters to monitor the occupational dose to the workforce as required by 10 CFR 20.1502.

7.3 External Exposure Control

a. Inspection Scope

The inspectors reviewed individual exposure monitoring records for occupational workers at the site to determine compliance with the dose limits of 10 CFR 20.1201 and the requirements of 10 CFR 20.2106 and 20.2110. The licensee's administrative dose limits were reviewed as were the method and justification for approving dose extensions. The inspectors reviewed the licensee's process for investigating higher than expected exposures, unexpected radiation levels that were self-revealed through ED alarms or should workers be exposed to measurable levels of radiation without wearing dosimetry.

b. Observations and Findings

The licensee maintained records of doses received by individuals for whom monitoring was required as provided by 10 CFR 20.2106. Monitoring records for 2013 and 2014 demonstrated that all monitored workers satisfied the NRC exposure limits of 10 CFR 20.1201. Additionally, administrative dose limits prescribed by the licensee's

exposure control program were satisfied. No individuals were granted dose limit extensions in 2013 and 2014. Records showed that neutron dose associated with fuel transfer operations was a fraction of regulatory limits as was worker extremity dose. Annual reports demonstrated that workers were provided exposure information as required by 10 CFR 19.13.

Based on the licensee's records, the inspectors determined that personnel exposure investigations were completed timely and adequately as required by procedure in instances when dosimetry was lost, damaged or electronic dosimeters (EDs) malfunctioned or alarmed. Similarly, the inspectors found that an adequate exposure evaluation was performed for an incident that occurred during the assessment period when two workers were observed working at elevation near the Unit-1 heavy lift rail system without dosimetry.

No findings of significance were identified.

c. Conclusions

Workers were monitored as required by 10 CFR 20.1502 to demonstrate compliance with regulatory dose limits. Records of individual monitoring results were maintained as required by 10 CFR 20.2106 and 20.2110. No exposures in excess of occupational dose limits occurred in 2013 or 2014.

7.4 Use of External Dosimetry Devices

a. Inspection Scope

The inspectors reviewed the licensee's program for the assessment of occupational external radiation dose through the use of personnel dosimeters, including primary dosimeters that require processing and secondary dosimeters used for initial dose tracking. Dosimetry which required processing to determine the radiation dose was reviewed to determine if the devices were evaluated by a processor holding current dosimetry accreditation thru the NVLAP of the National Institute of Standards and Technology for the types and energies of radiation present. The licensee's quality control program was also reviewed to determine if adequate measures were in-place to independently validate the dosimetry vendors processing capabilities.

Additionally, the inspectors reviewed the use of EDs, the calibration of that dosimetry and the licensee's assessment of ED response and reliability as a secondary dosimetry system.

b. Observations and Findings

The inspectors determined that personnel dosimeters (primary dosimetry) were supplied and evaluated by a processor holding current NVLAP accreditation from the National Institute of Standards and Technology for the types and energies of radiation that currently exit at the site, including neutron/photon mixtures. Personnel dosimetry performance test data was reviewed for the whole body dosimetry device used by the licensee to validate that no angular dependence or other bias existed in the measurements. Test data demonstrated that the licensee's vendor could accurately process dosimetry for test categories, ranges and tolerances provided in ANSI /HPS

N13.11-2009 for photons, beta and neutron emitters and for mixtures as prescribed in the standard. Proficiency testing for neutron categories was suspended by NVLAP in late 2010 but reinstated in the last year following resolution of industry issues. Neutron proficiency test data demonstrated the licensee's dosimetry processor met the testing standard for moderated neutrons mixed with photons.

The inspectors found that EDs used by the licensee as secondary dosimetry devices were calibrated by a vendor at frequencies and using methods prescribed by HPS N13.11-1993 and ANSI N323A-1997. The inspectors determined that the licensee routinely compared primary to secondary dosimeter response to identify differences and to develop correction factors should secondary dosimeters be necessary to assign the dose of record. The correction factors were established to ensure that worker exposures would be tracked, conservatively determined and would not exceed administrative limits on a real-time basis. The inspectors also found that other dosimetry quality controls were instituted as provided in the licensee's procedure to ensure that dosimetry devices were stored, used and processed in a manner that allowed for accurate assessment of occupational worker dose.

No findings of significance were identified.

c. Conclusions

Personnel dosimeters were supplied and evaluated by a processor holding current NVLAP accreditation from the National Institute of Standards and Technology for the types and energies of radiation present. Secondary dosimetry devices were calibrated by a vendor at frequencies and using methods prescribed by industry standards. Quality controls ensured that dosimetry devices were used in a manner that allowed for accurate assessment of occupational worker dose.

7.5 Assessment of Neutron Exposure

a. Inspection Scope

The inspectors reviewed the licensee's program for neutron monitoring and worker dose assessment that was implemented for the dry cask storage campaign in 2014, as well as the licensee's plans for neutron dose assessment for continued ISFSI operations. Survey methods, technical support documents including a vendor study, personnel monitoring device capabilities and neutron survey instrumentation were reviewed to determine whether the licensee's neutron monitoring and assessment was sufficient to meet 10 CFR 20.1201 and 20.1501.

b. Observations and Findings

Fuel transfer operations were the principal source of neutron exposure at the site in 2014. The licensee continued to use personnel monitoring devices supplied and processed by a vendor that maintained NVLAP accreditation for neutron monitoring as prescribed in ANSI N13.11-2009, for a moderated neutron (californium (Cf-252) energy spectrum. The licensee correctly determined that neutron emissions associated with loading spent fuel during the dry cask storage campaign were primarily from fission generated actinides of uranium, plutonium and curium with an average energy of approximately 4 million electron volts (Mev). As a result, a moderated Cf-252 energy spectrum associated with

the NVLAP accreditation equated to the actual neutron spectrum present during the fuel loading campaign.

During the first quarter of the cask loading campaign, real-time estimates of worker neutron dose were based on a series of gamma and neutron dose rate measurements performed with portable survey instrumentation and estimated worker stay times. Ratios established through those measurements were applied to determine real-time neutron dose by multiplying the gamma ED measured value by the ratio. Ratios were established in various cask loading areas and at the ISFSI installation. The licensee then compared the real-time estimated doses to the results reported by its dosimetry vendor. Those comparisons showed that the licensee's estimates of real-time neutron dose exceeded the dosimetry vendor results because of conservatism introduced through time-keeping and survey measurements. As a result, the licensee purchased and began using combination gamma/neutron EDs which allowed for more accurate real-time gamma and neutron dose determinations.

A vendor was contracted by the licensee to perform a detailed neutron characterization study to further validate the licensee's dose assessments. The characterization study involved a series of measurements made with a tissue equivalent proportional counter (TEPC) to provide reference measurements and generate site specific neutron correction factors. Several TEPC measurements were made of a loaded cask at the ISFSI installation and of a loaded cask during vacuum drying operations in the fuel building. The TEPC results were compared to: (1) dosimeters irradiated on ANSI N13.11 compliant phantoms and processed by the dosimetry vendor; (2) values determined using the licensee's gamma/neutron EDs; and (3) measurements made with neutron survey instruments. The study demonstrated that the licensee conservatively determined worker neutron dose throughout the fuel transfer campaign and during ISFSI operations, demonstrating compliance with the dose limits of 10 CFR 20.1201. The licensee generated a CR to summarize the results of the characterization study and to determine if adjustments to the dosimetry vendor's algorithm would be made to more accurately record future neutron dose at the site.

No findings of significance were identified.

c. Conclusions

The licensee's completed technically sound evaluations of neutron dose at the site as required by 10 CFR 20.1501, to demonstrate compliance with the dose limits of 10 CFR 20.1201.

7.6 Monitoring of Declared Pregnant Workers

a. Inspection Scope

The inspectors reviewed the adequacy of the licensee's methods for informing workers of the risks of radiation exposure to the embryo/fetus. The inspectors reviewed the licensee's monitoring methods and procedures, radiation exposure controls, and the training information provided to declared pregnant women to determine if an adequate program was established to limit embryo/fetal dose.

b. Observations and Findings

The license established a procedure for informing individuals of the regulatory options to monitor and control radiation exposure for declared pregnant or nursing women. The inspectors found that the procedure provided adequate instruction for workers and supervisors regarding the declaration of pregnancy process, including the declaration to become pregnant and for newborn or infant child nursing. The inspectors determined that instructions provided through the licensee's Nuclear General Employee Training (NGET) included supplemental information relevant to prenatal radiation exposure recommended in Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure."

One individual declared pregnancy in 2014 through the inspection assessment period. Radiation dose for that individual was being closely tracked by the licensee. The inspectors determined that the individual completed the procedural specified declaration form and the licensee accurately determined the individual's radiation dose from the estimated date of conception. The inspectors found that the primary dosimeter issued to the individual was exchanged and processed by the licensee monthly as required by procedure. The inspectors also found that the licensee implemented procedure improvements and more closely monitored dose to address problems documented in NRC Inspection Report No. 05000295/2013008(DNMS); 05000304/2013008(DNMS). The inspectors verified that the pregnancy declaration and the associated radiation dose to the embryo/fetus during the gestation period satisfied the requirements of 10 CFR 20.1208 and 20.2106 (e).

No findings of significance were identified.

c. Conclusions

Exposure monitoring and control for embryo/fetal dose satisfied the requirements of 10 CFR 20.1208 and 20.2106 (e).

7.7 Respiratory Protection Program

a. Inspection Scope

The inspectors reviewed the licensee's program for the use of individual respiratory protection equipment to assess compliance with 10 CFR 20.1702 and 20.1703. As part of that review, the inspectors evaluated the procedure and protocol for performing total effective dose equivalent (TEDE) ALARA evaluations to determine the suitability of respiratory protection equipment in lieu of or in addition to engineering controls. Respiratory protection equipment was visually inspected and individuals involved in issuance, maintenance and testing were interviewed by the inspectors.

b. Observations and Findings

The inspectors found that respiratory protection devices were routinely used to maintain dose ALARA, following a TEDE ALARA evaluation as provided in 10 CFR 20.1701. The inspectors noted through field observation that engineering controls were used to the extent practicable in most instances to minimize airborne radioactivity before the use of respirators was invoked. The inspectors selectively reviewed work activities that required

respirators to reduce the intake of radioactive materials and concluded that further engineering controls were not practical and that use of respirators was ALARA.

The inspectors determined that respiratory protection devices used by the licensee to limit radioactive material intake were tested and certified for the use intended as provided in 10 CFR 20.1703(b). The inspector reviewed the two principal types of radiological respiratory devices used by the licensee to determine that these devices were used consistent with their respective National Institute for Occupational Safety and Health (NIOSH) certification. In particular, the inspectors verified that the licensee flow tested powered air-purifying respirators prior to use. Also, the inspectors determined through review of a vendor test protocol that reused respirator filters were efficiency tested after each use as provided in Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection."

The licensee's respirator training, fit testing and medical certification program were reviewed by the inspectors and determined to satisfy the requirements of 10 CFR 20.1703 (c) and (d). The inspectors selected several individuals qualified to use respiratory protection devices, and determined that they were trained, fit tested as applicable, and were deemed medically ready to use the devices by a licensed physician, as delineated in the licensee's procedure. However, based on discussions with licensee personnel, the inspectors noted that the practical (hands-on) training did not always correspond with the lesson plan which specified that each trainee demonstrate proficiency in respirator use. Also, the inspectors identified that the respirator medical qualification procedure did not address use of medical evaluation questionnaires besides the one provided in the licensee's procedure even though alternate questionnaires were used by contractor staff. The questionnaire is required by the OSHA respiratory standard of 29 CFR 1910.134. The licensee generated a condition report to capture the inspector's observation. Through discussions and field observations, the inspectors concluded that individuals that used respiratory equipment understood how to safely use the devices.

The inspectors randomly inspected multiple respiratory protection devices staged for use in the issuance area. The inspectors found the device components to be in a condition appropriate for use, consistent with the licensee's respirator issuance procedure. The individual responsible for device testing, maintenance and issuance demonstrated knowledge of the device manufacturer's instructions and the licensee's use and care procedures.

No findings of significance were identified.

c. Conclusions

Respiratory protection equipment used to limit the intake of radioactive material was certified, tested, properly maintained and issued as provided in 10 CFR 20.1703. Devices were used by adequately trained workers that were medically certified for respirator use generally consistent with the licensee's program.

7.8 Engineering Controls for Airborne Radioactivity

a. Inspection Scope

The inspectors reviewed the licensee's program to control the concentration of radioactive material in air through the use of engineered mechanisms to assess compliance with 10 CFR 20.1701 and 20.1702. Engineered controls specified in RWPs and work instructions were compared to those established in the plant.

b. Observations and Findings

The inspectors determined that the licensee used both permanent (installed plant) and temporary (portable) ventilation systems as part of its engineering controls to reduce airborne radioactivity. The inspectors found that installed plant systems such as containment purge and auxiliary building ventilation were routinely used for at-risk activities such as when the containment construction doors are open, during steam generator segmentation or during other decommissioning activities that could generate airborne radioactivity. The inspectors noted that the flow patterns and filtration capabilities of these systems had been tested to ensure effectiveness. Based on the results of general area air sampling, the inspectors concluded that installed ventilation systems maintained concentrations of radioactivity below those of an airborne radioactivity area to the extent practicable.

The inspectors observed temporary HEPA ventilation and vacuum systems, along with tents and other enclosures used to support work in contaminated areas, and found that use of these systems aligned with the ALARA concept. These portable systems were regularly used either as the sole means of airborne control or in combination with respiratory protection devices, as dictated by the radiological conditions and the work activity. The inspectors found that the licensee established a program to test the HEPA filtration systems in portable units and to preclude unauthorized or inadvertent use of these units. Deficiencies documented in NRC Inspection Report No. 05000295/2013009(DNMS); 05000304/2013009(DNMS) were rectified through these established programs. A procedure was developed to provide instructions for the issuance, use and storage of portable HEPA filtered units and to track their use. Inspection of the two primary storage areas for portable filtration units located in the Auxiliary Building revealed no problems as filter canisters were locked, tagged appropriately and hose ends taped closed when not in use.

The inspectors determined that the licensee continued to implement adequate means to determine the presence of alpha emitting radionuclides through area contamination surveys and air sampling. The methods included trigger points that aligned with the Electric Power Research Institute's Alpha Monitoring Guidelines for Operating Nuclear Power Stations. The inspectors determined that continuous air monitors (CAMs) positioned in Unit 1 & 2 to monitor/alert workers of changing airborne concentrations were set to alarm before 10 CFR 20, Appendix B, derived air concentration values would be approached as is the industry practice.

No findings of significance were identified.

c. Conclusions

The licensee generally used engineered processes effectively to control the concentration of radioactive material in air as provided in 10 CFR 20.1701 and 20.1702. Engineered controls specified in RWPs and work instructions aligned with those established in the plant based on field observations.

7.9 Internal Dose Assessment

a. Inspection Scope

The inspectors reviewed the licensee's methods for dose assessment from internally deposited radionuclides based on airborne monitoring and calculations of derived air concentration (DAC), or through alternative methods such as whole body counting. The review was performed to determine whether accurate results could be achieved through the methods employed.

b. Observations and Findings

The inspectors determined that the licensee established technically acceptable methods to determine that the level of protection (Appendix A, 10 CFR 20 applied protection factors) afforded by respiratory protection devices was equivalent or better than that applied in the licensee's TEDE ALARA evaluations, as required by 10 CFR 20.1703(i). The licensee relied primarily on whole body count analyses to assess intake and validate respiratory device protection factors; however, procedures also addressed lapel air sampling and DAC calculations as an alternative. Procedures addressed methods for differentiating between internal and external contamination, route of intake and accurate assessment of worker dose. The impact of alpha emitting transuranic material was factored into the licensee's internal dose assessment protocol.

No findings of significance were identified.

c. Conclusions

Technically sound alternatives were established to validate protection factors provided by respiratory protection devices. Internal dose assessments were procedurally driven to yield accurate results.

7.10 Radiological Instrumentation

a. Inspection Scope

The inspectors reviewed the licensee's radiological instrumentation program to determine if a sufficient number and type of instruments were available to support the decommissioning project and to assess the methods used to determine instrument accuracy and readiness for use. The review included the licensee's instrument inventory and issuance process, methods and practices for calibration and functionally testing portable survey instruments, area radiation monitors, instruments used to monitor workers and items for contamination, laboratory instrumentation used for radiological analysis, and the instrumentation used to monitor vehicles transporting potentially contaminated equipment and debris offsite. The device used for calibration and functional tests of portable survey instruments was also reviewed to determine whether its output parameters were routinely verified.

b. Observations and Findings

The inspectors found that radiation protection staff used appropriate radiation sources and methods to functionally test portable survey instruments prior to use. Procedures

developed for functional testing instruments ensured that instruments were operationally checked on all appropriate scales. Adequate methods were used to log-out and return instruments back to the storage area or tag them out-of-service should an instrument fail a functional check. However, the inspectors noted that instrumentation records were not well organized, which impacted instrument availability and assurance that calibrations were performed at required intervals.

Telepole

The inspectors observed staff properly issue, tag-out, calibrate, and functionally source check Telepoles that were to be used to conduct radiation surveys in RCAs. Staff practices aligned with procedures. The inspectors found that the licensee's radiation instrumentation (RI) technician used appropriate radiation sources and methods to response check the instruments in accordance with established procedures. Procedures aligned with industry standards to ensure that the instruments were operationally checked on all scales using sources appropriate for the intended field application. The inspectors randomly selected several Telepoles and verified they had current calibrations and had been source checked prior to use. The RI technician demonstrated adequate radiological practices when manipulating calibration and check sources.

Air Monitor (AMS-4)

The inspectors found that the licensee's operation and calibration procedures for the AMS-4 air monitors were based on the manufacturer's recommendations and were implemented as intended. The inspectors observed that weekly source checks of the AMS-4 instruments in the fuel building were performed with radiation sources and utilized methods established in the licensee's procedures. The inspectors found that all of the AMS-4s located in the fuel building were calibrated on an annual basis as required. The RI staff understood proper protocols for tagging out defective AMS-4 instruments. The alarm set points for each of the AMS-4s in the fuel building were set in accordance with the licensee's procedures.

Area Radiation Monitor

The inspectors found that the DCA Model 3090 Area Alarming Radiation Monitors were operated, calibrated and functionally source checked as specified in the licensee's procedures. The inspectors observed that the licensee's RI staff performed source checks with appropriate radiation sources and used methods specified in the licensee's procedure. Each of the DCA Model 3090's alarm set points are determined by RP supervision on a case-by-case basis, as dictated by the expected area radiological conditions to provide early indication of unexpected problems.

Small Article Monitor (SAM)

The inspectors found that the calibration and source checks of the SAM unit that was located in the turbine building was performed consistent with procedure using a radiation source that aligned with the predominant plant isotopic mix. The inspectors observed that the RI technician properly checked-out and secured all radioactive material involved in the calibration and source checks. The RI technician was cognizant of potential issues that could occur during the calibration and was aware of the proper tag-out procedure for defective equipment.

Laboratory Equipment

The inspectors toured the chemistry lab facilities. The inspectors reviewed the licensee's calibration and daily performance check records for the Apex Gamma Spectroscopy Counter. The inspectors also observed that all of the high purity germanium gamma detectors in the laboratory were calibrated and source checked in accordance with procedures. Additionally, the inspectors found that the licensee's portable gamma spectroscopy instrument was properly calibrated before it was last utilized in the field. The chemists and chemistry supervisors were knowledgeable of the technical aspects of the equipment such as counting geometries, background radiation influence and the quality control action levels.

Electronic Pocket Dosimeter (EPD), Electronic Neutron Dosimeter (END), and Radiological Materials ALARM Vehicle Monitor

The inspectors found that an adequate supply of electronic dosimetry (EPDs and ENDs) was maintained to accommodate the current work activities for the decommissioning project. The inspectors found that the licensee's procedure for operation of the MGP DMC 2000 electronic dosimeter was developed based on the manufacturer's recommendations. Electronic dosimeter calibrations were performed by a vendor every six months for EPDs and annually for ENDs. The licensee rotated the calibration of EPDs to ensure that an adequate supply was maintained for the decommissioning project.

The inspectors found that the radiological materials monitor (truck monitor) at the site egress was source checked at a frequency sufficient to detect operational problems. The monitor is used to detect low levels of radiation before vehicles depart the site. The licensee demonstrated that the monitors would alarm should detectable radioactivity be present in the vehicle.

Portal and Personnel Contamination Monitors

Gamma sensitive portal monitors and beta sensitive personnel contamination monitors located at the main RCA egress and at alternate locations were determined to be set to alarm at sufficiently low levels and functionally checked daily consistent with operating reactor standards. The inspectors observed that the licensee performed source checks of both the new PCM-1C and the IPM-8 contamination monitors with the appropriate radiation source and in accordance with the established procedures. Records revealed that instrumentation was calibrated as required by the licensee's procedure, consistent with regulatory standards.

Whole Body Counter

The inspectors reviewed the licensee's Apex Fastcan Whole Body Counting (WBC) System procedure and the most recent calibration report of the WBC system performed by the licensee's contractor. The inspectors found that the WBC system was properly calibrated within the time frame established by the licensee's procedure and used a mixed gamma calibration source with National Institute of Standards and Technology (NIST) pedigree representative of the plant source term. A pre-use source and background check of the counting system demonstrated to the inspectors was completed

appropriately as specified by procedure. No anomalous results or indications of degraded instrument performance were identified.

Instrument Calibrator

The inspectors observed that the RI staff used the portable survey instrument calibration unit as specified by procedure and were cognizant of backscatter issues that could impact measured results. The inspectors selectively compared the current calibrator output measured values with the calculated expected values and found that they correlated. The RI technician demonstrated proficiency in calibrator use to source check high range portable survey instruments.

While reviewing instrument calibrator interlock check records, the inspectors discovered that on July 8 and 9, 2014, the licensee performed maintenance on the device interlocks without an established procedure. The factory installed interlocks prevent worker exposure to significant levels of radiation that can be generated within the device. An individual with experience on the calibrator device gained at another facility replaced interlock components and parts between calibrator ports. Components from a calibrator port that was not used were removed and installed on a frequently used port to maintain that port functional. The licensee performed the non-routine maintenance activity without a procedure and instead relied on an individual's knowledge obtained at another NRC licensed facility. The licensee agreed that an approved procedure was warranted for safety component related maintenance to ensure: (1) work aligns with the manufacturer's recommendations; and (2) interlocks are not adversely impacted causing a radiological problem. An authorized service vendor subsequently verified that the interlocks functioned as designed.

A CR was generated to capture the issue and a procedure was subsequently developed to limit maintenance to non-safety related components of the device. The new procedure requires that maintenance or repair on any safety interlocks be performed by a qualified contractor.

No findings of significance were identified.

c. Conclusions

An adequate number and type of survey instruments and personnel contamination monitors were maintained to support the decommissioning project. Instruments were functionally tested, calibrated, and alarm set points were established consistent with industry standards and licensee procedure. Non-routine maintenance on an instrument calibrator interlock performed without a procedure was addressed through the corrective action program.

8.0 Exit Meeting

The inspectors presented the results of the inspection to Messrs. Orawiec, Van Noordennen and other staff during an onsite meeting on April 16, 2015. 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

*T. Orawiec, Decommissioning Plant Manager
D. (Nick) Williams, Vice President, Radiological and Environmental Controls
*G. Van Noordennen, Vice President, Regulatory Affairs
R. C. Keene, Director, Radiation Protection
M. (Shawn) Miller, Manager, Fuel Transfer Operations
*M. Manninen, Technical Manager, Radiological Programs
J. Bailey, Senior Licensing Consultant

*Participated in exit meeting on April 16, 2015

INSPECTION PROCEDURES (IPs) USED

IP 60855.1	Operation of an Independent Spent Fuel Storage Installation
IP 40801	Self-Assessments, Audits and Corrective Action
IP 71801	Decommissioning Performance and Status Review
IP 37801	Safety reviews, Design Changes and Modifications
IP 82501	Decommissioning Emergency Preparedness Program Evaluation
IP 83801	Inspection of Interim and Final Status Surveys
IP 83750	Occupational Radiation Exposure

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened & Closed	Type	Summary
05000295/15007-01 05000304/15007-01	NCV	Failure to conduct radiological evaluations required by 10 CFR 20.1701/20.1702

Attachment

PARTIAL LIST OF DOCUMENTS REVIEWED

Focused Self Assessment Report; External Exposure Control; dated June 10, 2014

Focused Self Assessment Reports; Respiratory Protection Program; dated April 24, 2013 and July 31, 2014

MARSAME Survey No. 2014-UO-CH-010; Crib House Fire Pump Room Grids 22, 31 and 41; dated June 12, 2014

MARSAME Survey No. 2014-UO-CH-008; Crib House Fire Pump Room Ceiling; dated June 10, 2014

MARSAME Survey No. 2014-UO-CH-007; Crib House Fire Pump Room Interior Floor; dated June 9, 2014

MARSAME Survey No. 2014-UO-CH-004; Crib House Traveling Screens; dated June 4, 2014

MARSAME Survey No. 2014-UO-CH-001; Crib House Traveling Screens and Strainer Room; dated June 2, 2014

CR/IR No. 2015-00080; Near Miss on High Radiation Area Violation; dated March 2, 2015

HEPA Ventilation and Vacuum Inspection (Polyalphaolefin) Test Records; Various Units and Dates between August 2013 – December 2014

ZS-RP-106-002-004; Use of HEPA Vacuum Cleaners in Radiological Controlled Areas; Revision 1

ZRP-5510-06; Quantitative Respirator Fit Testing; Revision 8

CR-2014-000905; Unable to Comply with ZS-SA-104; dated August 13, 2014

RP-ZN-441; Evaluation and Selection Process for Radiological Respirator Use; Revision 8

Respirator and Cartridge Recertification Using the TDA-100P; Revision 0

Use and Care of the 3M L-905, L-905Sg and L-905SG PAPRs; Revision 5

ZS-SA-IST-CLAS-001; Zion Level 1 Respiratory Training; Revision 01

RP-ZN-440; Respiratory Protection Program; Revision 6

HR-ZN-07-106; Respirator Surveillance Exam; Revision 0

Reactor Vessel Segmentation HEPA Filtration System Test Results; dated December 2013

Technical Manual for Ludlum Model 12-4 Survey meter with HE-3 Neutron Detector; dated October 2011

ZS-RP-102-003-002; Expected or Declared Pregnant or Nursing Woman Exposure Control; Revision 2

Technical Support Document No. 14-103, Neutron Dosimetry Evaluation at Zion Nuclear Power Plant; Revision 00

Technical Support Document No. 13-001; Neutron Exposure Monitoring and Dose Assignments; Revision 00

CR-2015-000166; Neutron Characterization Study; dated March 25, 2015

NVLAP Certificate of Accreditation to ISO/IEC 17025:2005 for Mirion Technologies; Effective July 2014 – June 2015

Personnel Dosimetry Performance Testing for Mirion Technologies, Inc. at Pacific Northwest National Laboratory; Various test categories and dates between May 2013 and February 2014

ZS-RP-102-000-000; Site Radiological Access and Personnel Monitoring Program; Revision 10

ZS-RP-102-002-002; Special Dosimetry; Revision 8

ZS-RP-102-004-004; Skin Dose Calculations; Revision 0

ZS-RP-102-002-001; Dosimetry Issue, Change Out and Processing; Revision 6

Occupational Radiation Exposure Reports for 1st – 4th Quarters of 2013 and 2014

ZS-RP-102-003-001; Dose Limit Extension; Revision 6

ZS-RP-102—004-003; Personnel External Exposure Investigations; Revision 2

Haley and Aldrich; Assessment of GTCC Canister and Unit -2 Reactor Cavity Residuals; October 9, 2014

CR-2014-000957; GTCC Liner Unsatisfactory Rust; dated August 23, 2014

ZS-FT-600; Mold Remediation of the GTCC Canisters; Revision 1

Sperko Engineering Services, Inc; Rust on Stainless Steel MagnaStor GTCC Waste Liner; dated August 29, 2014

50.59 Screening No. 2014-0194; Perform Disinfectant of the Unit 2 GTCC TSCs; Revision 0

50.59 Screening No. 2014-128; NCR 2014-030, GTCC Waste Basket 71160-211-99-004; Revision 0

ZS-AD-103; Control of Systems, Structures or Components Turnover from ZionSolutions to Demolition Contractor; Revision 0b

50.59 Screening No. 2015-005; Reclassification of Crib House Systems, Structures and Components; Revision 6

Crib House Demolition Engineering Survey; dated October 8, 2014

CR-2015-000066; Emergency Plan Revision 15A has Errors; dated January 29, 2015

10 CFR 50.54(q) Evaluation No. 2015-003; Defueled station Emergency Plan Revision 15B

10 CFR 50.54(q) Evaluation No. 2015-001; Defueled station Emergency Plan Revision 15A

ZS-RP-108-000-001; Instrument Issue and Operational Testing; Revision 3

ZS-RP-108-000-000; Radiological Instrumentation Program; Revision 5

ZS-RP-108-004-003; Operation and Calibration of the Telepole; Revision 3

ZS-RP-108-005-004; Calibration of Air Samplers; Revision 2

ZS-RP-108-005-011; Operation of the Eberline AMS-4 Continuous Air Monitor; Revision 0

ZS-RP-108-005-009; Calibration of the Eberline AMS4- Continuous Air Monitor; Revision 1

ZS-RP-102-004-002; Apex Fastscan Whole Body Counting System Operation; Revision 2

ZS-RP-108-003-012; Calibration and Operation of the DCA Model 3090 Area Alarming Radiation Monitor; Revision 1

ZS-RP-108-006-004; Operation of the Canberra LabSCOCS/ISOCS Genie-2000 Portable Gamma Spectroscopy System; Revision 1

ZS-RP-108-006-002; Operation and Calibration of the PCM-1C Portal Monitor; Revision 0

ZS-RP-108-006-008; Operation and Calibration of the Apex Gamma Spectroscopy Counter with Labsocs; Rev 3

ZS-RP-108-006-003; Operation of the Ludlum Model 54 Series Small Article Monitor; Revision 2

ZS-RP-108-006-007; Calibration of the Ludlum Model 54 Series Small Article Monitor; Revision 0

ZS-RP-108-002-002; Operation and Use of the MGP DMC 2000S Electronic dosimeter; Revision 2

Calibration Record for MGP Instrument Model DMC 2000 GN, No 812357, 811806, 812774, 812821, 812429, 812421, 815235, 811807, 812764, 810582, 812560, 814305, 812383, 812754, 812794, 812391, 812693, 812799, 812807, 812775; dated June 27, 2014

Focused Self Assessment Report; Radiation protection Instrumentation Calibration Maintenance and Inventory; dated December 22, 2014

ZS-RP-108-003-018; Cs-137 Calibration Source Characterization; Revision 1

Calibration Recertification Points For Shepherd Calibrator; Instrument Serial 26-0698 RadCal; dated September 4, 2013

Certificate of Conformance for Electrometer/ion Chamber 20X6-60, No 31861, 32421; dated May 1, 2012

Certificate of Conformance for Electrometer/ion Chamber 20X5-3, No 4937, dated May 1, 2012

Certificate of Conformance for Electrometer/ion Chamber 20X5-180, No 6917, dated May 1, 2012

Certificate of Conformance for Electrometer/ion Chamber 2026C, No 26-1498; dated May 1, 2012

Calibration Record for SAM Model 54, No 278971; dated March 16, 2015

Source Check Record for lane 01-RPM-01-Alarm; dated March 31, 2015

Calibration Record of the Apex-Invivo Canberra Fastscan WBC system at the Zion facility in Zion, Illinois, dated February 18, 2014

ZS-RP-003-008; Operation and Calibration of the AMP 50, 100, and 200 Series Instruments; Revision 2

ZS-RP-108-001-003; Operation and Use of the Shephard Model 89 Shielded Calibrator; Revision 2

ZS-RP-102-004-001; CDE and CEDE Determination for the December 7 and December 10, 2014 Incidents; dated January 20, 2015

Inventory Master Listing with Maintenance for the Electronic Pocket Dosimeters; dated January 21, 2015

Personnel Contamination Event Reports for December 7 and December 10, 2014 Incidents; dated December 10, 2014

Personnel Contamination Event Reports for March 30, 2015 Incident; dated April 1, 2015

ALARA Review for Permit Number 2014-2-2102; dated October 14, 2014

Master Inventory List for Radiation Protection Instruments; dated January 29, 2015

Radiation and Contamination Surveys for the December 7 and December 10, 2014 Incidents; dated December 1, December 7, December 8, 2014, December 9, and December 10, 2014

TEDE ALARA Evaluation Worksheet for the December 7and December 10, 2014 Incidents; dated December 11, 2014

TEDE ALARA Evaluation Screening Worksheet for the December 7 and December 10, 2014 Incidents; dated December 11, 2014

Beta/Gamma Airborne Radioactivity Calculation Sheet for the December 7 and December 10, 2014 Incidents; dated December 11, 2014

Alpha Airborne Radioactivity Calculation Worksheet for the December 7 and December 10, 2014 Incidents; dated December 11, 2014

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
CR	Condition Report
GTCC	Greater Than Class C
DNMS	Division of Nuclear Materials Safety
DSEP	Defueled Safety Analysis Report
ED	Electronic Dosimetry
HEPA	High Efficiency Particulate Air
ISFSI	Independent Spent Fuel Storage Installation
MARSAME	Multi-Agency Radiation Survey and Assessment of Materials and Equipment
NIST	National Institute of Standards and Technology
NCV	Non-Cited Violation
NRC	Nuclear Regulatory Commission
NVLAP	National Voluntary Laboratory Accreditation
RCA	Radiologically Controlled Area
RI	Radiation Instrument
RP	Radiation Protection
RPT	Radiation Protection Technician
RWP	Radiation Work Permit
TEDE	Total Effective Dose Equivalent
TEPC	Tissue Equivalent Proportional Counter
TSC	Transportable Storage Container
VCC	Vertical Concrete Cask
ZNPS	Zion Nuclear Power Station