May 13, 2011

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

SUBJECT: NRC INSPECTION REPORT NOS. 050-00295/11-02(DNMS); 050-00304/11-02(DNMS) – ZION NUCLEAR STATION UNITS 1 AND 2

Dear Mr. Christian:

On April 29, 2011, the U.S. Nuclear Regulatory Commission (NRC) completed an inspection at the permanently shutdown Zion Nuclear Station in Zion Illinois. The purpose of the inspection was to assess the safety of spent fuel storage in the Zion spent fuel pool as followup to the Fukushima Daiichi Nuclear Station event in Japan. NRC Inspection Procedure 60801, "Spent Fuel Pool Safety at Permanently Shutdown Reactors," and guidance from Temporary Instruction (TI) 2515/183, "Followup to the Fukushima Daiichi Nuclear Station Fuel Damage Event" were used to conduct the inspection. The enclosed inspection report presents the inspection results which were discussed on April 25, 2011, with Mr. D. Beckman and other members of your staff.

The objective of this inspection was to promptly assess the capabilities of the Zion Nuclear Station to respond to extraordinary consequences similar to those that have recently occurred at the Japanese Fukushima Daiichi Nuclear Station. The results from this inspection, along with the results from other inspections performed at operating commercial nuclear plants in the United States will be used to evaluate the U.S. nuclear industry's readiness to safely respond to similar events. These results will also be used by the NRC to determine if additional regulatory actions are warranted.

Areas examined during the inspection are identified in the enclosed report. Within these areas, the inspection consisted of an examination of procedures and representative records, walkdowns of systems, structures and components that support spent fuel pool function and interviews of personnel.

All of the potential issues and observations identified by this inspection are contained in this report. The NRC will further evaluate any issues to determine if future regulatory actions are necessary. These actions, if any, will be documented by the NRC in separate correspondence. You are not required to respond to this letter.

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

If you have any questions regarding this inspection, please contact Mr. Wayne Slawinski of my staff. You can reach Mr. Slawinski at (630) 829-9820.

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 050-00295/11-02(DNMS);
050-00304/11-02(DNMS)

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

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U. S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket Nos:	050-00295; 050-00304
License Nos:	DPR-39; DPR-48
Report Nos:	050-00295/11-02(DNMS) 050-00304/11-02(DNMS)
Licensee:	Zion*Solutions*, LLC
Facility:	Zion Nuclear Station
Location:	101 Shiloh Boulevard Zion, IL 60099
Dates of Inspection:	On-site April 13-15, and April 18, 2011
Inspectors:	Wayne Slawinski, Senior Health Physicist Rhex Edwards, Reactor Inspector
Approved by:	Christine A. Lipa, Chief Materials Control, ISFSI, and Decommissioning Branch Division of Nuclear Materials Safety

Enclosure

EXECUTIVE SUMMARY

Zion Nuclear Station, Units 1 and 2
NRC Inspection Report 050-00295/11-02 (DNMS); 050-00304/11-02 (DNMS)

This inspection assessed the Zion Nuclear Station's (Zion) ability to cope with design basis and beyond design events in response to the problems that occurred at the Fukushima Daiichi Nuclear Station in March 2011. The inspection focused on Zion's ability to respond to and implement mitigative strategies that result from station blackout conditions, seismic, tornado, flood, and fire events. These inspection results, along with the results from similar inspections at operating commercial nuclear plants in the United States, will be used to evaluate the U.S. nuclear industry's readiness to respond to similar events. The results will also be used by the U.S. Nuclear Regulatory Commission (NRC) to determine if additional regulatory actions are warranted.

Overall, the inspectors concluded that there would be minimal consequences to the health and safety of Zion's onsite staff and members of the public following a design basis event involving the spent fuel pool (SFP) at the Zion Nuclear Station. This conclusion is based on the availability of several sources of SFP make-up water including those that do not require offsite power. Additionally, Zion Nuclear Station staff has more than 10 days to implement compensatory actions before water level in the SFP would decrease to a level that potentially complicates recovery. Moreover, in the unlikely event that the SFP were to be completely drained of water, a zirconium fuel cladding fire (and potential fuel melt condition) is not credible due to the length of time the spent nuclear fuel has decayed in the SFP since its removal from the reactor vessels in 1997. Should this hypothetical drain event occur, the projected radiological dose to the public from the exposed nuclear fuel would be less than the protective action guidelines established by the Environmental Protection Agency's "Manual of Protective Action Guides and Protective Actions For Nuclear Incidents" (EPA 400-R-92-001).

Report Details

1.0 Spent Fuel Pool Safety

a. Inspection Scope

The objective of this inspection was to perform a broad overview of the licensee's capability and readiness to cope with design basis and beyond design basis events such as those that occurred at the Fukushima Daiichi Nuclear Station in Japan. The inspection assessed the licensee's capability to respond to and mitigate the consequences that result from station blackout conditions as well as design basis and beyond design basis seismic, tornado, flooding and fire events. In particular, the inspectors assessed the licensee's ability to implement mitigative actions upon loss of cooling and/or water inventory in the spent fuel pool (SFP). If necessary, a more specific follow-up inspection will be performed at a later date.

b. Observations and Findings

The following table documents the NRC inspection at the Zion Nuclear Station performed in accordance with IP 60801 and guidance from TI 2515/183.

c. Conclusions

These inspection results, along with the results from similar inspections at operating commercial nuclear plants in the United States, will be used to evaluate the U.S. nuclear industry's readiness to respond to a similar event. The results will also be used by the NRC to determine if additional regulatory actions are warranted.

2.0 Spent Fuel Pool Safety Inspection Results

2.01 Design Basis Information - Review the facility Defueled Safety Analysis Report (DSAR) or equivalent reports to identify design basis seismic, flood/seiche, tornado and fire events. Identify systems, structures and components (SSCs) that are intended to support fuel safety and radiation safety function (i.e., contain radioactive materials) and are designated as important to the defueled condition. The SSCs important to the defueled condition should be capable of performing their specified function(s) associated with design basis events. Within these reports, identify wind loading design, water level (flood) design, missile protection, fire and seismic qualification to understand their bases and to recognize potential vulnerabilities associated with SSCs.
Describe the licensee's design basis seismic, flood/seiche, tornado and fire events. Specifically, identify wind loading design, water level (flood) design, missile protection, fire and seismic qualification.
Seismic: For the Design Basis Earthquake (DBE), Seismic Class I equipment is designed to assure that it does not lose its capability to perform its function. The DBE at the Zion Nuclear Station is based on horizontal ground acceleration of 0.17g and vertical acceleration of 0.11g. Seismic Class I systems and components include: essential portions of the fire protection system; the applicable portions of the spent fuel pool cooling contained in seismic category I structures; and the spent fuel pool (SFP) and spent fuel storage racks. Flood/Seiche: Based on historical records, the maximum possible storm surge would raise water level 8.8 feet above the maximum high water level of Lake Michigan. This results in a maximum water level consistent with plant grade elevation. This storm surge combined with expected waves of approximately 1 to 2 feet in height are postulated to create transient water levels 2 feet above grade for approximately 20 minutes. This condition is not expected to cause flooding which would impair the operation of any equipment important to the defueled condition (ITDC) of the plant. The building containing the SFP has exterior doors designated as flood barriers that are procedurally verified to be intact during potential flooding conditions. Tornado: The maximum expected sustained wind speed at the Zion Nuclear Station is 80 miles per hour with a 1% possibility of occurrence every 100 years. The highest gust of wind expected in a 100-year period and a 50-year period is 104 miles per hour and 91 miles per hour, respectively. Seismic Class I structures, which includes the structure housing the SFP, are designed to withstand 300 mile per hour wind loads and specified tornado generated projectiles. Therefore, the components contained within a Seismic Class I structure are protected from the maximum predicted wind loads at the Zion Nuclear Station. Fire: On February 13, 1998, the licensee (ComEd) issued a certification of permanent cessation of operations for the Zion Station, and a certification of permanent fuel removal dated March 9, 1998. As such, the requirements of Appendix R to Title 10 of the Code of

Federal Regulations (CFR) 50 to safely shutdown the reactors during a fire were no longer applicable. Since that time, the licensee is required to satisfy the requirements of 10 CFR 50.48(f) which include requirements to detect fires and limit the radiological hazards associated with fire scenarios. The site's fire water header is normally supplied via the service water system. If the fire water header pressure falls, a motor-driven fire pump will automatically start to maintain pressure. If the motor-driven pump fails to start or a station blackout occurs, a diesel-driven fire pump will automatically start. Both of the fire pumps are rated for 2000 gpm and take suction from Lake Michigan. The area containing the SFP does not contain an automatic suppression system, but multiple means of fire detection are provided that alarm in the main control room. Manual fire suppression equipment, such as fire extinguishers and hose stations are also readily accessible to station staff. Surveillances are performed on fire station hoses every 18 months. Air flow from spent fuel pool areas is directed to a bank of high efficiency particulate air (HEPA) filters before being monitored and released to the atmosphere. The Crib House Building the houses the diesel-driven fire pump would not be radiologically impacted should a fire occur in other areas as it is physically separated from radiological areas. The Crib House is equipped with fire detection systems that provide indication in the control room. An automatic water suppression system is installed over the diesel-driven fire pump. Manual fire suppression equipment is also available in the area.
Identify systems, structures and components (SSCs) that are intended to support fuel safety and radiation safety function (i.e., contain radioactive materials) and are designated as important to the defueled condition (ITDC). understand their bases and to recognize potential vulnerabilities associated with SSCs.
In its permanently defueled condition, the following accidents remain applicable to the Zion Nuclear Station: fuel handling accident in the Fuel Building; a SFP event (loss of SFP cooling and a loss of water level); a radioactive waste handling accident; or a spent fuel cask drop. For each of these analyzed cases, off-site doses (without mitigation) are well within 10CFR100 guidelines. Therefore no SSCs are required to be classified as safety-related at Zion in its permanently defueled condition. Systems, structures and components which support a fuel safety or radiation protection safety function are designated as ITDC and are listed in the Zion DSAR.

Discuss general results including corrective actions by licensee.
The diesel driven fire pump is elevated several feet above the floor which provides margin to continued pump operation should the Crib House experience temporary flooding. However, the inspectors noted that one of two banks of starter batteries along with the diesel control cabinet lacked the same margin to flooding as the diesel itself. Should the primary make-up water sources to the SFP be unavailable, the diesel-driven fire pump would be the designated emergency source of make-up water. The licensee initiated a work request (WR 00366070) to evaluate the impact a design basis flood would have on the lower battery bank used to start the diesel driven fire pump. Additionally, the licensee planned to evaluate the impact that the battery bank elevation may have on the availability of the pump during a design basis flood.

2.02 Siphon and Drain Protection - Review the configuration of the spent fuel pool (SFP), SFP piping and any interconnected piping systems to determine whether the configurations represent a siphon or drain path. If anti-siphon devices are credited by the licensee in their spent fuel pool operational occurrences and/or design basis events, verify that the devices exist and are functional. Review maintenance and surveillance procedures to determine whether drain and anti-siphon systems are maintained and that temporary hoses are controlled to preclude unauthorized use. The licensee should be knowledgeable of any potential siphon or drain paths and have procedures that can identify, resolve and minimize the probability of occurrence of an undetected drain or siphon. These considerations should have been documented by the licensee in their response to NRC Bulletin 94-01. Information Notice No. 93-83 also provides pertinent information.
Describe the licensee's spent fuel pool configuration that represent a siphon or drain path. If anti-siphon devices are credited by the licensee in their spent fuel pool operational occurrences and/or design basis events, document if the devices exist and are functional.
The SFP piping is designed and configured so that any pipe failure will not drain the SFP below the top of the stored fuel. There are seven piping penetrations into the SFP including a penetration approximately 24.5 feet above the top of the stored fuel. The pipe terminates at a depth of approximately 8-feet above the top of fuel. An anti-siphon device exists in the underside of this pipe which is designed to prevent a siphon condition. The anti-siphon feature is checked every 18 months for blockage per site procedure; however, this design feature is conservatively not credited in the development of the worst-case pipe break scenario. Therefore, the most-limiting pipe break is conservatively assumed to drain the SFP to 8-feet above the top of stored fuel.
Describe the licensee's anti-siphon devices that are credited (and not credited) by the licensee in their spent fuel pool operational occurrences and/or design basis events, verify and document that the devices exist and are functional.
No devices are credited in the licensee's analyses although an anti-siphon device exists.

Describe the licensee's procedures that can identify, resolve and minimize the probability of occurrence of an undetected drain or siphon
The site has developed controls to conduct procedure reviews which include screening evolutions associated with work activities around the SFP for potential siphoning. The reviewer is tasked with ensuring proper precautions are incorporated into the procedure to preclude siphoning of water from the SFP. Additionally, the licensee has implemented administrative controls over equipment and tools usage in the SFP area. These controls are in place to minimize the possibility of dropping items into the pool or creating the possibility for a siphon.
Discuss general results including corrective actions by licensee.
The design of the SFP and the controls the licensee has in place reduce the possibility and mitigate the severity of draining the SFP.

2.03 Loss of Spent Fuel Pool Cooling - Review the Defueled Safety Analysis Report (DSAR) or equivalent reports to identify the time available to initiate compensatory measures in the event that forced cooling to the SFP is lost. Also, identify the resultant radiological impact in areas of the plant that need to be occupied to implement compensatory actions for the loss of cooling event. Identify the SFP heat load used to calculate the times available before the volume of water in the pool reaches: (1) saturation; (2) the time available for uncovering the assemblies due to boil-off; and (3) the required rate of make-up water necessary to match pool boil-off.

Describe the SFP heat load used to calculate the times available before the volume of water in the pool reaches saturation. Discuss the time available for uncovering the assemblies due to boil-off; and the required rate of make-up water necessary to match pool boil-off.

The Zion Nuclear Station DSAR conservatively evaluates a loss of SFP cooling using the fuel heat load that existed in 1998 after the reactor vessels were defueled. In this analysis it was concluded that upon a loss of SFP cooling approximately 39 hours are available before saturation conditions occur in the SFP. The time for water to boil-off down to level where the resultant radiological conditions begin to complicate recovery is approximately 250 hours. Therefore approximately 289 hours (12 days) exist before an alternative method of SFP cooling would need to be initiated. These values are conservative as significant cooling and decay has occurred over the approximate thirteen years since these calculations were performed. The licensee performed recent estimates of expected times to initiate compensatory actions and determined that an additional 30 days was available to initiate alternative methods of cooling.

Describe the radiological impact in areas of the plant that need to be occupied to implement compensatory actions for the loss of cooling event.

The resultant radiological conditions at the perimeter of the SFP after 289 hours following loss of spent fuel cooling would not preclude occupancy of the area by licensee staff to affect mitigating actions. As a result, sufficient time exists for the licensee to implement compensatory actions before access into the area may be radiologically impacted.

In addition, the licensee performed calculations to determine the dose rates at the exclusion area boundary (EAB) in the unlikely event that the SFP be completely drained (a beyond design basis event). The calculated dose rate from external radiation at the EAB should this occur is predicted to be less than one mrad/hr. These radiation levels pose minimal risk to the public and are well within the environmental protective agency’s (EPA’s) protective action guidelines.

Discuss general results including corrective actions by licensee.

Should a design basis loss of cooling event occur the site has approximately 289 hours (12 days) to initiate compensatory action.

2.04 Loss of Spent Fuel Pool Inventory - Review the DSAR or equivalent reports to identify the time available to initiate compensatory measures in the event that the worst case postulated fuel pool inventory event occurs. This may include rupture of cooling and/or drain lines that could cause the pool to gravity drain to the lowest elevation postulated.

Identify the resultant radiological impact in areas of the plant that need to be occupied to implement compensatory actions for the rupture event. Identify the times available before the volume of water in the pool reaches saturation; the time to uncover the fuel assemblies due to the combined effects of drain-down and boil-off; and the required rate of make-up water necessary to match losses.

Additionally, identify the radiological impact of the worst case (beyond postulated) condition such as a catastrophic failure (crack or hole) in the SFP that lowers cooling water to the bottom of the active fuel.

Determine the predicted heat-up time to fuel melt, if applicable, should drain-down occur. If applicable, the inspector should review the licensee's action plan in response to a zirconium fire resulting from a drain-down event.

Describe the time available to initiate compensatory measures in the event that the worst case postulated fuel pool inventory event occurs.

Failure of any piping in the SFP support systems will not drain the pool to a level that exposes the irradiated fuel assemblies. The worst-case credible loss of pool inventory event would occur if the piping that reaches to the lowest depth in the pool ruptures and a siphon is created that partially drains the pool. At the Zion Nuclear Station, this worst case condition drains the pool level to 8-feet above the top of fuel. Consistent with the analysis performed on the loss of spent fuel cooling, this event is evaluated in the DSAR conservatively using the fuel heat load that existed in 1998. Assuming the level of the water instantly drops to 8-feet above the irradiated assemblies, approximately 21 hours are available before a saturation condition exists in the pool. It would take an additional 56 hours to boil-off water down to a level where the resultant radiological conditions would complicate recovery. Therefore, the total time to initiate compensatory actions is minimally 77 hours. Mitigating actions involve providing a source of make-up water to compensate for boil-off. Currently, the licensee estimates that approximately 256-hours (greater than 10 days) are actually available to initiate compensatory measures given the additional thirteen years of decay heat loss since these calculations were performed in 1998.
Discuss the resultant radiological impact in areas of the plant that need to be occupied to implement compensatory actions for the rupture event. Identify the times available before the volume of water in the pool reaches saturation; the time to uncover the fuel assemblies due to the combined effects of drain-down and boil-off; and the required rate of make-up water necessary to match losses.
During the worst case postulated combined loss of cooling and simultaneous water inventory accident, the resultant radiological conditions at the edge of the SFP would not preclude worker access to the area. Specifically, under these conditions and based on conservative 1998 decay heat loads, the required make-up rate of water is approximately 20.5 gallons per minute (gpm) with a make-up time of approximately 77 hours before the radiological conditions potentially impact area access. In 2011, the calculated make-up rate is approximately six gpm with several additional days make-up time compared to 1998 predictions.
Discuss the radiological impact of the worst case (beyond postulated) condition such as a catastrophic failure (crack or hole) in the SFP that lowers cooling water to the bottom of the active fuel.
The site performed calculations to determine the dose rates at the exclusion area boundary (EAB) should the SFP be completely drained (a hypothetical beyond design basis event). The calculated external dose rate at the EAB if the pool were completely drained would be less than one mrad/hr. These radiation levels pose a minimal risk to the public.

Discuss the predicted heat-up time to fuel melt, if applicable, should drain-down occur. If applicable, discuss the licensee's action plan in response to a zirconium fire resulting from a drain-down event.
The maximum obtainable cladding temperature should the pool be completely drained was determined by the licensee to be below the critical temperature at which oxidation of zircalloy cladding occurs. The highest calculated temperature was conservatively determined using heat loads from 1999. Thus a zircalloy fire and melting of the stored fuel is not a credible scenario at the Zion Nuclear Station.
Discuss general results including corrective actions by licensee.
Should a design basis loss of inventory occur the site has in excess of 77 hours to initiate compensatory actions. In the unlikely event of complete drain-down of the SFP, minimal radiological risk would exist to the public from external radiation exposure.
2.05 Station Black Out (SBO) Mitigating Strategies - Review the DSAR or equivalent reports to identify the primary alternating current (AC) and backup AC and/or Direct Current (DC) power supplies. Walk down the primary and backup power supplies to identify potentially adverse conditions, material condition problems and/or system line-ups that could be outside system design or detrimental to long-term system operability. Identify backup power supplies intended to ensure SFP cooling, make-up water, instrumentation, alarms, and leakage detection are maintained upon SBO conditions. Verify through walk downs that backup power supplies are available and functional. Review surveillance protocols and test results which demonstrate functionality of the backup power supplies. Determine that materials necessary to support backup power supplies are adequate, including fuel oil supply in day tanks and other onsite storage tanks. Determine whether these materials are adequate, properly staged and maintained in a state of readiness. If battery powered supplies are intended for use, determine if the battery system is rated for a capacity equivalent to that credited by the licensee in the DSAR or as provided in station auxiliary or emergency operating procedures (AOPs/EOPs), as applicable. Verify through walk downs that procedures (AOPs/EOPs) for response to SBO conditions are developed and executable including the availability of necessary support equipment and supplies. Review training and qualification information to determine whether personnel are sufficiently knowledgeable to execute the

procedures.

Describe the primary alternating current (AC) and backup AC and/or DC power supplies, and identify backup power supplies intended to ensure SFP cooling, make-up water, instrumentation, alarms, and leakage detection are maintained upon SBO conditions.

Two independent offsite power supplies provide power to separate busses which power the spent fuel pool support systems, control room indications and alarms. The busses are configured such that one power supply could provide power to the other bus should one offsite power line be unavailable. If the site were to lose all offsite power, the capability exists for a portable diesel generator (500kVA) to be brought to the site and connected to the switchgear to support SFP cooling. Should power not be restored and alternate backup power not be obtained, make-up water can be provided by the diesel driven fire pump and/or the Zion municipal water supply.

SFP cooling, electrical instrumentation and alarms would be lost during a station blackout. However, the site is equipped with a paging system that alerts operators of the condition. The system is regularly tested to verify operational readiness. Water temperature and level in the SFP would be measured locally at the SFP under these conditions.

Describe results from the walk down of the primary and backup power supplies to identify potentially adverse conditions, material condition problems and/or system line-ups that could be outside system design or detrimental to long-term system operability. Describe if materials necessary to support backup power supplies are adequate, including fuel oil supply in day tanks and other onsite storage tanks. Describe whether these materials are adequate, properly staged and maintained in a state of readiness.

The site does not routinely maintain an emergency diesel generator onsite that is capable of powering SFP cooling systems. The tools and cabling needed for the connections are pre-staged to expedite emergency generator installation should it be necessary. In the interim, water level in the pool would be maintained through the alternative make-up sources.

The inspectors noted that the redundant electrical busses are collocated such that if one bus is adversely impacted by an external event the other bus may be affected. Additionally, the connection of an emergency diesel generator is limited to only one of the busses; therefore, should the dedicated bus be impaired, a portable diesel generator would not be capable of providing power to the other bus.

The site maintains a diesel fuel oil tank onsite. However, an administrative limit has not been established by the licensee to ensure a minimum desired capacity of fuel oil is maintained in the tank.

Discuss procedures (AOPs/EOPs) for response to SBO conditions that are developed and executable including the availability of necessary support equipment and supplies.

The site maintains abnormal operating procedures (AOPs) to restore electrical power to the electrical busses and have developed coping procedures for a station blackout event. The procedures include instructions on how to conduct switchgear operations and various other actions, including the use a temporary diesel generator to power the busses that provide power to the spent fuel pool support systems. The site maintains several small diesel generators onsite which are not intended to power SFP cooling systems. These generators are available and staged in selected locations to provide temporary power during a blackout event. These generators are intended to power small loads such as battery chargers and laboratory equipment. The inspectors performed walk downs and observed operators simulate execution of various AOPs to verify their adequacy.
Discuss general results including corrective actions by licensee.
The Licensee initiated a work request (WR 00366067) to update applicable site procedures to identify available sources capable of supplying a portable diesel generator sufficient to cope with SFP cooling during a station blackout event. The licensee initiated a work request (WR 00366068) to evaluate the need for alternate methods of electrical power to the SFP support systems should a single event damage both busses. The licensee plans to review both design basis and beyond design basis scenarios in its evaluation.

2.06 Make-up Water and Mitigating Strategies Identify all the SFP make-up water supplies as provided in the DSAR or other equivalent reports. Also, identify any other make-up sources that the licensee may use if conditions warrant. Walk down selected pumps, valves and piping associated with make-up water supplies. Review SFP system configurations to determine if they correspond with the Piping and Instrumentation Diagrams (P& IDs) and licensing basis documents. For make-up water supplies, ensure that appropriate capacities exist and that the make-up rate is sufficient to overcome loss rate. Verify through walk downs that equipment for delivery of make-up water is available and functional. Review equipment surveillance and test records, as applicable. If hoses, portable pumps, and other temporary equipment is intended for use, verify that equipment is staged and in a state of readiness. Verify procedures are developed to ensure make-up water is provided in a timely manner to mitigate consequences. Also, determine if make-up water can be provided uninterrupted for a duration consistent with anticipated recovery needs. Determine what make-up sources and strategies are developed (or planned) to ensure make-up supplies are available for prolonged periods in the event of a beyond design basis event. Verify training and qualifications of operators and support staff needed to implement procedures are adequate. Determine if a sufficient number of qualified staff is available for procedure implementation.
Discuss all the SFP make-up water supplies as provided in the DSAR or other equivalent report and identify any other make-up sources that the licensee may use if conditions warrant. In addition, discuss capacities for make-up rate vs. loss rate.
The primary supply for adding water to the SFP is the onsite Condensate Storage Tanks. The site maintains approximately 300,000 gallons of water in these tanks at any given time. The flow rate from this make-up source exceeds the makeup rate necessary to compensate for the simultaneous loss of cooling and water inventory worst-case postulated event. An alternative water supply is available from the Zion municipal water supply. Municipal water provides an essentially unlimited supply of water. Water from the condensate tanks or the municipal supply can be directed, if desired, through a demineralizer system at a makeup rate of eight gpm. The demineralizer can be bypassed to provide additional make-up rate. Additionally, the fire header is capable of providing an emergency source of make-up water. The fire header is pressurized from the service water system which takes its suction from Lake Michigan essentially providing an unlimited supply of water. Water from the fire header is piped to a location at the edge of the SFP. In addition, a fire hose from a nearby station could be placed near the pool edge and used for make-up water. If the fire water header pressure falls, the motor-driven fire pump will automatically start to maintain pressure. If the motor-driven pump fails to start or a station blackout occurs, a diesel-driven fire pump will automatically start. Both of the fire pumps are rated for

2000 gpm and take suction from Lake Michigan.
Discuss the results of the walk down of selected pumps, valves and piping associated with make-up water supplies. Describe the availability and condition of hoses, portable pumps and other temporary equipment intended for use specifically if the equipment is staged and in a state of readiness.
The inspectors performed walk downs and observed operations staff demonstrate valve line-ups for make-up water to the SFP. The inspectors noted that there is not an administrative limit specified for the desired minimum volume needed in the condensate storage tanks for SFP make-up water. The site maintains a diesel fuel oil tank onsite. However, no administrative limit has been established by the licensee to ensure a minimum desired capacity is maintained. The site maintains a contract for the supply of diesel fuel oil with an offsite source.
Describe procedures that are developed to ensure make-up water is provided in a timely manner to mitigate consequences. Also, determine if make-up water can be provided uninterrupted for a duration consistent with anticipated recovery needs. Describe what make-up sources and strategies are developed (or planned) to ensure make-up supplies are available for prolonged periods in the event of a beyond design basis event.
The inspectors determined that procedures to initiate make-up water to the SFP are executable and require minimal operator action and only hours to complete. The inspectors also determined that these actions would not be precluded by site radiological conditions. Due to the close proximity to Lake Michigan, the site has essentially an unlimited water supply and several days to initiate SFP make-up. The site is considering new strategies to cope with unanticipated emergencies including looking at alternative methods of providing make-up water to the SFP.
Discuss general results including corrective actions by licensee.
The licensee initiated a work request (WR 00366069) to evaluate the need to provide minimum Condensate Storage Tank water inventory procedural requirements. The licensee initiated a work request (WR 00366071) to evaluate the need to establish measures to ensure adequate fuel oil is maintained onsite. The licensee initiated a work request (WR 00366072) to evaluate the need for procedural enhancements for providing alternate SFP

make-up actions that do not require access into the fuel handling building.

2.07 Flood and Fire Protection Mitigating Strategies

Identify internal and external flooding events (including a seiche if applicable) and fire events as provided in the station DSAR. Identify SFP equipment and system vulnerabilities from these postulated events.

Walk down potential flood impacted areas to determine if required barriers, curbing, walls, and door penetration seals are in-place and intact.

Assess the thoroughness of the licensee's walk downs and inspections of equipment needed to mitigate fire and flood events to identify equipment vulnerabilities. Determine that procedures or plans have been developed to address those vulnerabilities.

Verify that applicable agreements are in place to mitigate the consequences of a fire such as agreements with offsite fire departments and other emergency responders.

Describe any SFP equipment and system vulnerabilities from natural phenomenon.

The diesel-driven fire pump is elevated several feet above the floor and provides margin should the area experience temporary flooding greater than design basis. However, the inspectors noted that one of two banks of starter batteries and the diesel control cabinet did not have the same margin to flooding as the diesel itself. Should the primary sources of make-up water to the SFP be unavailable, the diesel-driven fire pump is designated as an emergency source of make-up water.

Describe the results of walk downs of potential flood impacted areas.

The inspectors noted that one of two banks of starter batteries and the diesel control cabinet lacked the same margin to flooding as the diesel itself.

Discuss agreements in place to mitigate the consequences of a fire such as agreements with offsite fire departments and other emergency responders.
Zion Nuclear Station maintains agreements with the local fire and police departments as well as the local hospital. The licensee has not established an onsite fire brigade due to the close proximity of the city fire department. The station relies on the local fire department for other than small fires extinguishable by a portable fire extinguisher. The site does not maintain self-contained breathing apparatus (SCBAs) nor are the licensee's emergency response personnel qualified for SCBA use. In the unlikely event that a catastrophic drain-down of the SFP occurred, access into some areas of the Fuel Building may be precluded without SCBA equipment and qualified personnel.
Discuss general results including corrective actions by licensee.
The licensee initiated a work request (WR 00366070) to evaluate the impact of a design basis flood on the lower battery bank used to start the diesel driven fire pump. Additionally, the licensee plans to document the impact that the battery bank elevation will have on the availability of the pump during a design basis flood.

2.08 Mitigating Strategy Enhancement Review newly developed or planned mitigating strategies for identified vulnerabilities. For example, the licensee may have performed walk downs and inspections of equipment important to the defueled condition such as water storage tanks, fuel oil tanks, auxiliary transformers, DC power supplies, plant water intake structures, and fire/flood response equipment and developed mitigating strategies to cope with the loss of that important equipment.
Discuss newly developed or planned mitigating strategies for identified vulnerabilities.
In response to the events at the Fukushima Daiichi Nuclear Station, Zion Nuclear Station conducted an internal review of the normal and emergency sources of make-up water to the SFP and the normal and backup power supplies. Walk downs were also performed by operations personnel using procedures designed to cope with loss of power, SFP inventory, and abnormal weather. The licensee determined that procedures were adequate to implement actions sufficient to mitigate design basis events. However, some procedural enhancements were identified and a work request (W/R 00364165) was generated to develop those enhancements. Additionally, the licensee identified alternative methods for make-up water to the SFP that do not require entry into the Fuel Handling Building and is in the process of institutionalizing those methods.
Discuss general results including corrective actions by licensee.
The site determined that their procedures were adequate to cope with design basis events. However, some procedural enhancements were identified and the licensee initiated a work request (W/R 00364165) to develop those enhancements. Additionally, the site is developing additional strategies to cope with unanticipated emergencies including alternative methods to provide make-up water to the SFP.

2.09 Environmental/Radiological Conditions and Special Tools

Evaluate radiological conditions that operators may encounter while traveling to the area where manual actions will be performed and within the areas those actions will take place. Conditions to be verified include:

- Capability to assess radiological conditions including provisions for planned special exposures
- Availability and functionality of respiratory protection equipment (including self-contained breathing apparatus)
- Availability and functionality of fixed and portable emergency lighting along access routes and manual operating stations
- Availability and functionality of communications equipment
- Availability and functionality of fire protection equipment
- Availability of special tools necessary to implement mitigating actions

Discuss general results including corrective actions by licensee.

The licensee does not maintain a respiratory protection program for its operations staff nor is SCBA equipment available onsite. Condition Report No. 00367106 was generated by the licensee to evaluate this issue.

The licensee's station blackout procedure provides for radiation monitoring equipment to execute the emergency plan. However, the licensee has not dedicated the equipment necessary to ensure the plan can be effectively implemented. Condition Report No. 00367107 was generated to address this issue.

Emergency direct current (DC) lighting is provided in the FHB at various locations around the SFP and in other support areas. These systems are equipped with internal batteries to illuminate egress pathways should a loss of power occur to allow safe exit of personnel. One of these lights near the perimeter of the SFP was found to be inoperable by the inspectors. The licensee initiated a work order (WO 01430342) for the repair of this light. Additionally, while the site maintains the station batteries for emergency lighting, the hardwired DC lighting in the FHB is no longer maintained by the licensee and not fully functional.

2.10 Staffing and Training Review license shift staffing to determine whether enough qualified personnel are available to perform the required compensatory actions for prolonged periods. Determine if response staff is knowledgeable and trained on compensatory actions and associated procedures.
Discuss general results including corrective actions by licensee.
Sufficient staffing exists to execute the site AOPs to ensure compensatory measures are implemented for design basis events. The inspectors conducted walk downs with different members of the operations staff, had them simulate procedure implementation and found them to be sufficiently knowledgeable about the site and in the execution of the procedures.

2.11 <u>Problem Identification and Resolution</u> - Review corrective actions documents that relate to SFP cooling system functionality, SFP liner leaks and other problems that impact SFP safety. Determine if design changes were made that could impact safety or that are inconsistent with the DSAR. Review any open corrective action documents to identify vulnerabilities that may be outstanding. For a sample of selected issues, determine if corrective actions were appropriate.
Discuss general results including corrective actions by licensee.
In 1996, Zion staff repaired a leak in the Fuel Transfer Canal liner. This leak was repaired in accordance with the American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section XI, Division 1 Repair Program. The repairs consisted of welding stainless steel plates to the existing Fuel Transfer Canal liner. In 2011, the licensee isolated and successfully repaired a leak in one of its redundant SFP heat exchangers. No outstanding SFP vulnerabilities were identified. No design changes were identified that could impact safety or that were inconsistent with the DSAR.

3.0 Exit Meeting

The inspectors presented the inspection results to Mr. D. Beckman at the conclusion of the inspection during a telephone discussion on April 25, 2011. The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

ATTACHMENT: SUPPLEMENTAL INFORMATION

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

P. Daly, Zion Solutions, General Manager
G. Bouchard, Zion Solutions, Vice President Operations, Nuclear Security and Decommissioning Plant Manager
T. Printz, Exelon, Plant Operations and Engineering Manager
P. Thurman, Zion Solutions, Regulatory Affairs Director
D. Beckman, Zion Solutions, Consultant
J. Ashley, Exelon, Decommissioning Engineer.

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened	None
Closed	None
Discussed	None

LIST OF DOCUMENTS REVIEWED

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

Zion Administrative Procedure (ZAP) ZAP-1200-09; Spent Fuel Pool Risk Management Program; Revision 10

Calculation Number 22S-0-110M-0063; Maximum Cladding Temperature for Uncovered Spent Fuel Rod; Revision 1

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

PT-218A; Fire Protection Piping Flush via the Hose Reel Connections; Revision 5

AOP-6.2; Spent Fuel Pit/Transfer Canal Uncontrolled Loss of Level; Revision 11

AOP-6.4; Loss of Spent Fuel Pit Cooling; Revision 11

PT-201; Monthly Check Sheet for Fire Suppression Water System; Revision 13

SOI-75D; Spent Fuel Pit Makeup; Revision 23

ZAP-0300-21; Station Blackout; Revision 2

WO 00735051 01; Install Cabling for EDG (Contingency)

AOP-8.6; SFNI Loss of Power; Revision 4

Calculation Number 22N-0-110M-0067; Gamma Shine Dose at the Exclusion Area Boundary Resulting from Spent Fuel Pool Dewatering Event; Revision 0

Zion Station Fire Protection Report; Amendment 7

ZAP-900-02; Fire Protection Areas and Zones; Revision 9

PT-232; Inspection of Fire Doors; Revision 7

AOP-8.4; Severe Weather Conditions; Revision 6

Work Request (W/R) 00366067; Standby Diesel Generator; April 27, 2011

W/R 00366069; Condensate Storage Tank (CST) Inventory; April 27, 2011

W/R 00366071; Onsite Fuel Oil Supply; April 27, 2011

Work Order 01430342; Make Repairs to EBL #FB-6; April 26, 2011

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
AOP	Auxiliary Operating Procedure
CFR	Title 10 of the Code of Federal Regulations
DC	Direct Current
DSAR	Defueled Safety Analysis Report
EAB	Exclusion Area Boundary
EPA	Environmental Protection Agency
GPM	Gallons Per Minute
ITDC	Important to the Defueled Condition
NRC	U.S. Nuclear Regulatory Commission
P&ID	Piping and Instrumentation Diagrams
SBO	Station Blackout
SCBA	Self-Contained Breathing Apparatus
SFP	Spent Fuel Pool
SSC	Systems, Structures and Components