

**ZION STATION RESTORATION PROJECT
LICENSE TERMINATION PLAN
CHAPTER 3, REVISION 2
IDENTIFICATION OF REMAINING SITE DISMANTLEMENT
ACTIVITIES**

TABLE OF CONTENTS

3.	IDENTIFICATION OF REMAINING SITE DISMANTLEMENT ACTIVITIES	3-1
3.1.	Introduction	3-1
3.2.	Completed and Ongoing Decommissioning Activities and Tasks	3-2
3.2.1.	Overview	3-2
3.2.2.	Spent Fuel Island and ISFSI Activities	3-3
3.2.3.	Demolition and Dismantlement of Initial Structures	3-3
3.2.4.	Dismantlement of East Yard Tanks.....	3-4
3.2.5.	Demolition and Dismantlement of Crib House Structure	3-5
3.2.6.	Additional Activities	3-6
3.3.	Future Decommissioning Activities and Tasks.....	3-7
3.3.1.	Overview	3-7
3.3.2.	Turbine Building (Unit 1 and Unit 2).....	3-7
3.3.3.	Auxiliary Building.....	3-8
3.3.4.	Unit 1 and Unit 2 Containments.....	3-10
3.3.5.	Fuel Handling Building	3-11
3.3.6.	Waste Water Treatment Facility (WWTF).....	3-12
3.3.7.	Miscellaneous Structures.....	3-12
3.3.7.1.	East and West Service Buildings	3-12
3.3.7.2.	Forebay, Forebay Valve Houses and Intake and Outflow Structures located in Lake Michigan	3-13
3.3.7.3.	NGET, ENC, South Warehouse, North Security Access Gatehouse.....	3-13
3.3.7.4.	Laundry Building, North Security Restricted Area Gatehouse, South Security Restricted Area Access, Restricted Area Fence and Vehicle Barrier System.....	3-14
3.3.7.5.	Steam Tunnels and Waste Handling Area	3-14
3.3.7.6.	Old Sewage Treatment Facility and Meteorological Tower.....	3-15
3.3.7.7.	Storm Drain System, Manholes and Fire Protection Buried Piping	3-16
3.3.7.8.	Surface Soils, Subsurface Soil and Groundwater	3-16
3.4.	Radiological Impacts of Decommissioning Activities	3-16
3.4.1.	Control Mechanisms to Mitigate the Recontamination of Remediated Areas.....	3-17
3.4.2.	Occupational Exposure.....	3-17
3.4.3.	Exposure to the Public.....	3-18
3.4.4.	Radioactive Waste Projections	3-18
3.5.	References	3-18

LIST OF TABLES

Table 3-1	Status of Major ZNPS Systems, Structures, and Components as of December 2018.....	3-20
Table 3-2	Radiation Exposure Projections for Decommissioning After 1/1/2018.....	3-22
Table 3-3	Projected Waste Quantities	3-23
Table 3-4	General Project Milestones	3-24

LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
ACM	Asbestos Containing Material
CST	Condensate Storage Tank
DSAR	Defueled Safety Analysis Report
EPA	Environmental Protection Agency
FOT	Fuel Oil Tank
FSS	Final Status Survey
GTCC	Greater than Class C
HVAC	Heating Ventilation Air Conditioning
ISFSI	Independent Spent Fuel Storage Installation
IRSF	Interim Radioactive Waste Storage Facility
LTP	License Termination Plan
MDC	Minimum Detectable Concentration
MMTC	Mechanical Maintenance Training Center
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
ODCM	Dose Calculation Manual
PSDAR	Post Shutdown Decommissioning Activity Report
PWST	Primary Water Storage Tanks
RA	Radiological Assessment
RCRA	Resource Conservation and Recovery Act
RWP	Radiation Work Permit
SFP	Spent Fuel Pool
SFPI	Spent Fuel Pool Island
SRP	Site Remediation Program
TSCA	Toxic Substances Control Act
TSD	Technical Support Document
URS	Unconditional Release Survey
WWTF	Waste Water Treatment Facility
ZNPS	Zion Nuclear Power Station
ZSRP	Zion Station Restoration Project

Page Intentionally Left Blank

3. IDENTIFICATION OF REMAINING SITE DISMANTLEMENT ACTIVITIES

3.1. Introduction

In accordance with 10CFR50.82 (a)(9)(ii)(B), the License Termination Plan (LTP) must identify the remaining major dismantlement and decontamination activities for the decommissioning at the time of submittal. The information includes those areas and equipment that need further remediation and an assessment of the potential radiological conditions that may be encountered. Estimates of the occupational radiation dose for completion of the scheduled task and the projected volumes of radioactive waste that will be generated are also included. These activities will be undertaken pursuant to the current 10 CFR 50 license, are consistent with the Zion Nuclear Station “*Post Shutdown Decommissioning Activity Report*” (PSDAR) (Reference 3-1), and do not depend upon LTP approval to proceed.

ZionSolutions primary goals are to decommission the Zion Nuclear Power Station (ZNPS) safely and to maintain the continued safe storage of spent fuel. ZionSolutions will decontaminate and dismantle the ZNPS in accordance with the DECON alternative, as described in NUREG-0586 “*Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1, Volume 1*” (Reference 3-2). Completion of the DECON option is contingent upon continued access to one or more low level waste disposal sites. Currently, ZionSolutions has access to the low-level waste disposal facility located in Clive, Utah.

Chapter 3 reflects site conditions as of January 6th 2018. Essentially the two Containment domes, Waste Water Treatment Facility, and upper Forebay surfaces are the only structures remaining to be demolished. Description of work completed prior to January 6th 2018 is referred to in past tense.

ZionSolutions is currently conducting active decontamination and dismantlement activities at ZNPS in accordance with the PSDAR. Decommissioning activities are being coordinated with the applicable Federal and State regulatory agencies in accordance with plant administrative procedures. Applicable Federal agencies include the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Environmental Protection Agency (EPA). Coordination with applicable State and local regulatory agencies are addressed in section 8.7.2 of Chapter 8. In order to minimize the impact of ongoing decommissioning activities, a Spent Fuel Pool Island (SFPI) was established to separate spent fuel storage functions from other plant functions and other decommissioning activities.

Decommissioning activities at the Zion Station Restoration Project (ZSRP) will be conducted in accordance with the Zion Station “*Defueled Safety Analysis Report*” (DSAR) (Reference 3-3), the NRC Docket Number 50-295, “*Facility Operating License Number DPR-39 (for Unit One)*” (Reference 3-4), NRC Docket Number 50-304, “*Facility Operating License Number DPR-48 (for Unit Two)*” (Reference 3-5), all associated Technical Specifications, and the requirements of 10 CFR 50.82(a)(6) and (a)(7). Currently the remaining activities do not involve any un-reviewed safety questions or changes in the Technical Specifications for ZNPS. If an activity requires prior NRC approval under 10 CFR 50.59(c)(2), or a change to the technical specifications or license, a submittal will be made to the NRC for review and approval before implementing the activity in question. Decommissioning activities are conducted under the

scrutiny of the existing *ZionSolutions* Radiation Protection Program, Industrial Safety Program, and Waste Management Program. Such activities will be conducted in accordance with these programs, which are well established and frequently inspected by the NRC. Activities conducted during decommissioning do not pose any greater radiological or safety risk than those conducted during operations, especially those during major maintenance and outage evolutions.

The remaining decontamination and dismantlement activities that will be performed are described in section 3.3. The specific system considerations that will be taken into account are discussed in sections 3.3.2 through 3.3.7. These sections provide an overview and describe the major remaining components of contaminated plant systems and, as appropriate, a description of specific equipment remediation considerations. Table 3-1 contains a list of major systems and components that have been or are to be removed.

On January 25, 2008, Exelon and *ZionSolutions* submitted an *Application for License Transfers and Conforming Administrative License Amendments* (Reference 3-6) requesting that the NRC approve the transfer of Exelon Corporation's Facility Operating Licenses for ZNPS to *ZionSolutions*. On September 1, 2010, the licenses were transferred from Exelon to *ZionSolutions* ("*Issuance of Conforming Amendments Relating to Transfer of Licenses for Zion Nuclear Power Station, Units 1 and 2*" [Reference 3-7]). Integral to the transfer of the licenses, *ZionSolutions* entered into an agreement with Exelon Corporation titled "*Zion Nuclear Power Station, Units 1 and 2 Asset Sale Agreement*" (Reference 3-8). This document presents the terms and conditions under which *ZionSolutions* would decommission ZNPS, construct an Independent Spent Fuel Storage Installation (ISFSI), place the spent nuclear fuel in dry cask storage and transfer the loaded fuel casks to the ISFSI, and remediate the site to the unrestricted release criteria as specified in 10 CFR 20.1402. Once the balance of the site is remediated and the as-left radiological conditions are demonstrated to be below the unrestricted release criteria, the 10 CFR Part 50 license will be reduced to the area around the ISFSI and the site will be transferred back to Exelon under the 10 CFR Part 50 license. *ZionSolutions* commenced the active decommissioning of ZNPS on October 13, 2010. Spent fuel and decommissioning activities completed to date are provided in section 3.2.

3.2. Completed and Ongoing Decommissioning Activities and Tasks

3.2.1. Overview

ZionSolutions and its subcontractors have completed all demolition activities with the exception of the demolition of the two Containment domes, Waste Water Treatment Facility, and upper surfaces of the Forebay.

Other completed Decommissioning activities include:

- Safely shipped and disposed of the Reactor Vessel Internals and Reactor Vessels.
- Safely shipped and disposed of all large components including the 8 steam generators.
- Safely completed preparation for and the implementation of open air demolition of the Auxiliary Building and Fuel Handling Building.

- Successfully completed all required remediation and sampling for non-Radiological/Environmental site closure under the Illinois Environmental Protection Agency's (IEPA) Site Remediation Program (SRP). This resulted in the issue of a 'No Further Remediation Letter' by IEPA to ZionSolutions on November 7, 2017
- Invested significant financial and management resources in ALARA measures/ALARA culture that allowed reduction in the project person-rem goal on 3 occasions from an original estimate of 1100 person-rem to the current estimate of 425 person-rem.

3.2.2. Spent Fuel Island and ISFSI Activities

A priority task for ZionSolutions was the construction of the ISFSI and the necessary licensing, training and infrastructure modifications required to transfer spent fuel from the SFP to the ISFSI. As part of this process, the Fuel Handling Building was upgraded with a new single-failure-proof crane. The ISFSI was constructed and became operational in late 2013. All (61) dry cask storage canisters (2226 spent fuel assemblies) and 4 Greater-Than-Class C (GTCC) waste canisters were safely and successfully moved to the ISFSI over a 366 day period.

3.2.3. Demolition and Dismantlement of Initial Structures



To date, with the exception of the two Containment domes, the Waste Water Treatment Facility, the discharge valve houses, and the upper surfaces of the Forebay, all on-site above grade structures have been safely demolished. The demolition of all remaining above grade structures is scheduled for completion by May of 2018.

The Interim Radioactive Waste Storage Facility (IRSF), the Mechanical Maintenance Training Center (MMTC) & Warehouse, and the Fire Maze complex were selected as initial test cases to demonstrate that the plans, programs, and procedures put in place by ZionSolutions for the demolition of buildings and structures on the site were ready for implementation. ZionSolutions instituted a "Cold, Dark and Dry" methodology that consisted of the following basic activities:

- Identification of any operable systems that may have to be replaced or relocated. For these initial structures, none were identified.
- Isolation of all electrical and mechanical systems servicing the structures.
- Issuance of a contract to a subcontractor designated as the Demolition Contractor to complete demolition activities. For the test case buildings and structures, contracted demolition activities included the installation of any required environmental controls and the demolition and removal of all above grade structures, systems and components. All foundations were either completely removed or demolished and removed to a depth of 3 feet below grade. None of the initial test case structures had sub-grade basements. All buried piping (service air, service water and sewer lines) were removed with the structures. Electrical services (conduits and cables)



were removed to a depth of 3 feet below grade. The remaining excavation void was radiologically surveyed and then backfilled using clean fill to the existing grade.

- Inspection of each structure for all universal, Resource Conservation and Recovery Act (RCRA) or Toxic Substances Control Act (TSCA) wastes that would require removal prior to demolition. These materials included mercury switches, light lamps, electrical ballasts and Asbestos Containing Material (ACM). For the initial test case structures, most of the wastes were directly removed and dispositioned by ZionSolutions. The exceptions were mineral oil in a de-energized transformer and the oil and brake shoes in the overhead crane in the IRSF. These wastes were identified to the selected Demolition Contractor and subsequently abated as part of the contracted work scope.
- Completion of unconditional release surveys (URSS) of each structure to ensure the structures can be demolished and free-released. Surveys were performed in accordance with the site procedure for the unconditional release of materials to verify that the material was free of plant-derived radioactive material. ZionSolutions Technical Support Document (TSD) 17-010, “Final Report – Unconditional Release Surveys at the Zion Station Restoration Project” (Reference 3-9), has been provided to the NRC with an analysis of all unconditional release survey data to ensure that all statistical data requirements were met. For compliance, dose from fill is based the Minimum Detectable Concentration (MDC) of the instrumentation.
- Surveyed and verified concrete debris resulting from the building demolition that was designated for reuse as clean hard fill as radiologically clean. This concrete debris was then processed to remove all exposed rebar and to ensure that individual debris pieces were smaller than 10 inches in diameter. The processed concrete debris was then transported to a designated storage area where it was stockpiled for use as potential backfill material. These stockpile areas are isolated and controlled to prevent the inadvertent introduction of potentially contaminated materials and periodic surveillances are performed.
- All other construction demolition debris that was not stockpiled as potential backfill material was packaged and transported to an appropriate landfill for disposal or to an off-site recycling center. At the ZSRP, all bulk material not leaving site as radwaste, regardless of origin or destination, passes through a radiological truck monitor.



3.2.4. Dismantlement of East Yard Tanks

The next structures to be demolished were the set of tanks located in the east yard of the “Security-Restricted Area”. These tanks included the Primary Water Storage Tanks (PWST) and the Condensate Storage Tanks (CST) for both units, the Fuel Oil Tank (FOT), the De-Chlorination and Chlorination tanks for both units and concrete pads and “shacks” constructed to service and house tanks, systems and components. The logic for the removal of the tanks as the next structures in the demolition sequence included;

- The tanks were located within the “Security-Restricted Area” and were considered to be radiologically impacted. Removal of the tanks would allow for the initial use and assessment of the plans, procedures and processes for open-air demolition on radiologically contaminated structures and systems and allow the Demolition Contractor to become acclimated to working in a radiologically controlled environment.
- The radiological contamination of the tanks required contamination mitigation and engineering controls to be implemented as part of the work scope.
- The removal of the tanks provided needed space for the eventual planned demolition of the Crib House and the Turbine Building.



Prior to commencing the dismantlement and demolition of the yard tanks, the tanks and systems were prepared in accordance with the “Cold, Dark and Dry” approach implemented at ZSRP. In order to retire the CSTs as part of this process, it was necessary to design and install a new Demineralized Water Processing system.

The interior and exterior of both PWSTs and CSTs were radiologically surveyed prior to commencing physical dismantlement activities. The survey results indicated that the interiors of the tanks were radiologically contaminated. As a contamination control measure, a fixative was applied to the interior surfaces of the tanks. Following the application of the fixative, a survey was performed to verify that the radiological conditions of the structures met the criteria for open-air demolition as presented in TSD 10-002, “*Technical Basis for Radiological Limits for Structure/Building Open Air Demolition*” (Reference 3-10). Compliance with these criteria minimized the implementation of additional contamination controls that would be required for open-air demolition and allows for the use of heavy equipment to perform the demolition. The intent is to perform this type of survey to verify the radiological conditions in all radiologically-impacted structures, components and systems prior to demolition.

The soils surrounding the tanks were radiologically surveyed as part of the site characterization. No soils were identified during the characterization that would necessitate excavation and removal as radioactive waste. During the course of the tank dismantlement, additional surveys and soil samples were taken of the soil surrounding the tanks. No soil was identified with residual radioactivity in excess of the release criteria. The PWSTs and the CSTs for both units were dismantled, properly packaged and dispositioned as low-level radioactive waste. All radioactive waste was loaded and transported under the direction of ZionSolutions Waste Department personnel to the licensed Energy Solutions radioactive waste disposal facility in Clive, Utah. Sampling of surface and subsurface soil and groundwater in this area has been performed. Preliminary results demonstrate that some soil will require remediation and disposal off site due to the presence of polynuclear aromatic hydrocarbons above the Illinois EPA limits.

3.2.5. Demolition and Dismantlement of Crib House Structure

The Crib House contained the Circulating Water pumps, the Service Water Pumps and the Fire Protection pumps. In order to implement the “Cold, Dark and Dry” approach in the Crib House,



a number of design modifications were necessary to replace the functioning systems in the Crib House that were required for the operation of operating systems, such as component cooling and fire protection. These included:

- The retirement of the station fire pumps and the integration of a modified fire water ring header that is connected to the city water system for the Town of Zion as a replacement. This modification also resulted in changing the pressurized fire suppression system at ZNPS to a dry system that would be supplied from a new exterior connection for the Town of Zion Fire Department.
- The retirement of the Service Water pumps required the installation of a new pump to supply circulating water to certain systems. This new pump was installed in the Forebay in a manner that would allow for the demolition of the Crib House to proceed. This pump system provided dilution flow for liquid waste releases into the Forebay and also served as a source of emergency make up water to the SFP. The previous Heating Ventilation Air Conditioning (HVAC) functions performed by Service Water were replaced by temporary, local heating and cooling installations and the relocation of certain functions (Hot and Cold Laboratories and Counting Room) to other areas.

Once the system modifications were in place and the Crib House had been successfully made “Cold and Dark”, the Crib House was surveyed for unconditional release. Surveys were performed in accordance with the site procedure for the unconditional release of materials to verify that the material was free of plant-derived radioactive material. In addition, all electrical and mechanical systems were isolated and removed as commodities. Once the structure was successfully surveyed and system removal was completed, the above grade portions were demolished by the Demolition Contractor. In order to perform system removal and perform unrestricted release surveys of the deep pump well areas, stop logs and dewatering pumps were installed to isolate the sub-grade areas from the Forebay and Lake Michigan. These measures were implemented by the Demolition Contractor, who also supplied temporary power, lighting and all other support required for the survey performance. Due to the depth of the Circulating Water (centerline elevation 33 feet below grade) and Service Water (centerline elevation 12 feet below grade) headers, they were sealed off at the west wall of the Crib House. These pipe headers were also surveyed for compliance with the unrestricted release criteria prior to being isolated, abandoned in place and filled with grout or fill as appropriate. All concrete structures were removed to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement. All remaining structures below 3 feet below grade were surveyed to demonstrate compliance with the unrestricted release criteria as specified in 10 CFR 20.1402.

3.2.6. Additional Activities

Additional activities that have been completed or are ongoing include, but are not limited to the following:

- Continued assessment of the functional requirements for plant systems, structures, and components.

- Identification of plant systems, structures, and components needed to support safe storage of the spent fuel, support SFP cooling, and facilitate ongoing plant activities.
- Design, installation and operation of a new Liquid Radioactive Waste Processing system.
- Detailed planning and project scheduling.

The Liquid Radioactive Waste system at ZNPS had become degraded since the shutdown of the units and was not capable of successfully processing liquid radwaste for effluent discharge. Consequently, *ZionSolutions* elected to design and install a new Liquid Radioactive Waste Processing system. This system was used to process liquid radwaste at ZNPS and to process the water from each of the reactor cavities (approximately 500,000 gallons each) and the SFP (approximately 700,000 gallons including the transfer canal), once all spent fuel had been moved to the ISFSI. The Turbine Building and Auxiliary Building could not be completely placed in a “Cold, Dark and Dry” status until this liquid waste processing was completed in 2015.

3.3. Future Decommissioning Activities and Tasks

3.3.1. Overview

Spent fuel movement to the ISFSI was completed on January 10th 2015. Once the movement of the spent fuel was complete, other significant dismantlement and decommissioning tasks took place. The removal of the spent fuel from the Fuel Handling Building allowed *ZionSolutions* to implement a license amendment to the 10 CFR 50 license for each unit to remove operational requirements and technical specifications specifically required for the maintenance of spent nuclear fuel in wet pool storage. These license amendments allowed the remaining structures to be placed into a “Cold, Dark and Dry” state, to complete the processing of the remaining liquid radioactive waste, to allow for the complete removal of all remaining commodities and to enhance the ability to freely move material and personnel around the site.

3.3.2. Turbine Building (Unit 1 and Unit 2)



Large component removal in the Turbine Building was completed in 2015. Initial component removal included the dismantlement and removal of most of the large components in Unit 1, including the turbines, generator, moisture separator reheaters, feedwater heaters and coolers, and several feedwater heaters and coolers in Unit 2. In parallel with this effort, the *ZionSolutions* Characterization/License Termination personnel performed surveys for the unconditional release of materials, equipment and structural surfaces throughout the building. In

addition, inspections were completed to identify any remaining waste streams. Surveys were performed in accordance with the National Emissions Standards for Hazardous Air Pollutants (NESHAP) to identify any potential ACM, and all accessible friable ACM was removed. Any remaining identified potential ACM that was not accessible, including but not limited to gaskets in piping systems, caulking around windows, floor and wall barrier seals, was appropriately handled and abated by the Demolition Contractor as part of the contracted work scope.

All systems and materials that were identified by radiological survey as contaminated with detectable plant-derived radioactive material were removed by *ZionSolutions* personnel and dispositioned and properly disposed of as radioactive waste. The remaining structure and materials in the Turbine Building were demonstrated to meet the unconditional release criteria. Surveys were performed in accordance with the site procedure for the unconditional release of materials to verify that the material was free of plant-derived radioactive material. The remaining structure were then made “Cold, Dark and Dry” and turned over to a Demolition Contractor as a non-radiologically controlled structure for demolition as a contracted work scope.

The selected Demolition Contractor removed and dispositioned all remaining commodities, and demolished the structure to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement. All remaining structures below 3 feet below grade were subjected to a Final Status Survey (FSS) in accordance with the requirements of Chapter 5 to demonstrate compliance with the unrestricted release criteria as specified in 10 CFR 20.1402. All equipment and components were removed from the structure with the exception of the underground circulating water headers, discharge tunnels and buried service water piping running between the Crib House location and the Auxiliary Building. All remaining buried and piping embedded in concrete has been surveyed for compliance with the unrestricted release criteria prior to being isolated, abandoned in place and filled with grout or fill as appropriate.

Concrete debris from the building demolition was designated for beneficial reuse as clean hard fill. Only concrete which met the non-radiological definition of clean concrete demolition debris and where a URS/FSS demonstrated that the concrete was free of plant derived radionuclides above background was used. This concrete debris was then processed to remove all exposed rebar and to ensure that individual debris pieces were smaller than 10 inches in diameter. The processed concrete debris was then transported to a designated on-site storage area where it was stockpiled for use as potential backfill material. All other construction demolition debris that was not appropriate for reuse as potential backfill material was packaged and transported to an appropriate landfill for disposal or to an off-site recycling center, following final assessment for the presence of any residual radioactive contamination by passing through a radiological truck monitor. Compliance with the unrestricted release criteria was demonstrated, including the completion of confirmatory surveys. The Turbine Building void was backfilled using concrete debris suitable for reuse as clean hard fill and/or clean fill to the original site grade and contours, with at least the top 3 feet as soil only. The top 3 feet of fill will be soil only (i.e. concrete clean hard fill was only utilized as fill up to the 588 foot elevation).

3.3.3. Auxiliary Building

Component and system removal was completed in the Auxiliary Building in 2016. Radiological surveys were performed to verify that as-left contamination levels were below the criteria established as suitable for open-air demolition. Any material identified with radiological contamination in excess of the open-air demolition limits were removed prior to commencing structural demolition. All radioactive waste was loaded and transported under the direction of *ZionSolutions* Waste Department personnel to the licensed Energy *Solutions* radioactive waste disposal facility in Clive, Utah. All structural decontamination activities were performed in



accordance with an approved Radiation Work Permit (RWP) and under the oversight of ZionSolutions Radiation Protection personnel.

Structural surfaces were decontaminated to the open-air demolition limits in accordance with TSD 10-002, and the Auxiliary Building was placed in a “Cold, Dark and Dry” configuration. The selected Decommissioning Contractor demolished the structure to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement. All below grade interior floors (560 and 579 foot elevations) and walls were removed. Contamination control methods (vacuuming, wiping, etc.) were used to mitigate loose surface contamination on the remaining exposed structural surfaces. All construction debris resulting from the demolition of the Auxiliary Building structure was treated as low level radioactive waste and was shipped to the licensed Energy Solutions radioactive waste disposal facility in Clive, Utah by gondola railcar. All remaining structures below 3 feet below grade will be surveyed to demonstrate compliance with the unrestricted release criteria as specified in 10 CFR 20.1402.

Five 24-inch diameter sleeves that are buried in soil between each of the two containments and the Auxiliary Building 542 foot elevation will be surveyed for compliance with the unrestricted release criteria prior to being isolated, abandoned in place and filled with grout or fill as appropriate. Two of the five sleeves have been capped and were never used. The remaining three sleeves housed 20-inch diameter Recirculating Sump Suction lines, which have been removed.

Several other sections of piping systems associated with the Auxiliary Building may also remain. The bounding list of buried piping, penetrations and embedded piping to remain is provided in ZionSolutions TSD 14-016, “*Description of Embedded Pipe, Penetrations, and Buried Pipe to Remain in Zion End State*” (Reference 3-11). The decision to remove or abandon in place will be made based on the results of a cost-benefit analysis that will be performed once access to the pipe sections become possible. In all cases, any buried or embedded piping that will remain will be surveyed for compliance with the unrestricted release criteria prior to being isolated, abandoned in place and filled with grout or fill as appropriate.

Once the remaining concrete structure located 3 feet below grade (extending between the 542 foot and 588 foot elevation) has been satisfactorily surveyed and compliance with the unrestricted release criteria has been demonstrated and, contingent upon the completion of confirmatory surveys, the Auxiliary Building void will be backfilled using concrete debris suitable for reuse as clean hard fill and/or clean fill to the original site grade and contours. The top 3 feet of fill will be soil only (i.e. concrete clean hard fill will only be utilized as fill up to 588 foot elevation).

3.3.4. Unit 1 and Unit 2 Containments

Component and system removal was completed in the Unit 1 and Unit 2 Containment Buildings in 2016. Radiological surveys were performed to verify as-left contamination levels were below the criteria established as suitable for open-air demolition in accordance with TSD 10-002. Any material identified with radiological contamination in excess of the open-air demolition limits was removed. All radioactive waste was loaded and transported under the direction of *ZionSolutions* Waste Department personnel to the licensed *Energy Solutions* radioactive waste disposal facility in Clive, Utah. All structural decontamination activities were performed in accordance with an approved RWP(s) and under the oversight of *ZionSolutions* Radiation Protection personnel.



The Containment Buildings were then placed in a “Cold, Dark and Dry” configuration. In both Containment basements, concrete was removed from the interior side of the steel liner above the 565 foot elevation, leaving only the remaining exposed liner below the 588 foot elevation, the concrete in the In-core Instrument Shaft leading to and including the area under vessel (or Under-Vessel area), and the structural concrete outside of the liner. Contamination control methods (vacuuming, wiping, etc.) were used to mitigate loose surface contamination on the remaining exposed structural surfaces. All construction debris resulting from the demolition of each of the Containment Building internal structures was treated as low level radioactive waste and was shipped to the licensed *EnergySolutions* radioactive waste disposal facility in Clive, Utah by gondola railcar. The exposed steel liner below the 588 foot elevation and Under-Vessel concrete will be surveyed for compliance with the unrestricted release criteria as specified in 10 CFR 20.1402, including any required confirmatory surveys. Once the Containment structural surfaces located 3 feet below grade (588 foot elevation) have been satisfactorily surveyed and compliance with the unrestricted release criteria has been demonstrated and, contingent upon the completion of confirmatory surveys and regulatory concurrence the Containment Building basements will be filled to above the 588 foot elevation using clean fill or concrete debris suitable for reuse as clean hard fill. The top 3 feet of fill will be soil only.

After backfilling each Containment basement with clean fill, both Containment shells will be demolished to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement. Demolition will include the removal of the pre-stressing tendons and the gradual demolition of the containment shells from grade, using ram-hoes to chip away the concrete along the bottom circumference of the shell and allowing the weight of the remaining structure to slowly demolish the structure to grade. This is a similar approach to that used to demolish the Containment structure during the decommissioning of the Connecticut Yankee Atomic Power Company’s Haddam Neck Nuclear Power Plant. The process will also allow for the removal of all exposed rebar and to ensure that individual debris pieces are smaller than 10 inches in diameter. Concrete debris resulting from the building demolition may be designated for beneficial reuse as clean hard fill, if it meets the non-radiological definition of clean concrete demolition debris and if URS/FSS demonstrates that the concrete is free of plant derived

radionuclides above background. The processed concrete debris will then be transported to a designated storage area where it will be stockpiled for use as potential backfill material. If the material is not used as clean hard fill, then it will be packaged and transported to an appropriate landfill for disposal or to an off-site recycling center, following final assessment for the presence of any residual radioactive contamination by passing through a radiological truck monitor.

3.3.5. Fuel Handling Building

The dismantlement and decommissioning of the Fuel Handling Building was completed in early 2017 following the placement of all spent nuclear fuel located in the SFP into dry cask storage and transfer of the packaged fuel to the ISFSI facility. The SFP water was processed by the Liquid Radioactive Waste system, sampled and discharged through the normal effluent release pathway into Lake Michigan upon meeting the radiological release criteria. The 23 empty spent fuel storage racks were removed from the pool, packaged and shipped for disposal as radioactive waste.



With the pool empty and dry, all known radioactively contaminated systems and components were removed by a subcontracted Demolition Contractor and properly disposed of as radioactive waste. This included the steel liner of the SFP. In parallel, *ZionSolutions* Radiation Protection personnel performed surveys of the exposed SFP concrete to verify as-left contamination levels were below those established for open-air demolition. All radioactive waste was loaded and transported under the direction of *ZionSolutions* Waste Department personnel to the licensed *EnergySolutions* radioactive waste disposal facility in Clive, Utah. All structural decontamination activities were performed in accordance with an approved RWP(s) and under the oversight of *ZionSolutions* Radiation Protection personnel.

Following commodity removal and structural decontamination, the Fuel Handling Building was turned over to a subcontracted Decommissioning Contractor. The Decommissioning Contractor demolished all of the remaining interior systems, structures, and components down to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement. All construction debris resulting from the demolition of the Fuel Handling Building was treated as low level radioactive waste and was shipped to the licensed *Energy Solutions* radioactive waste disposal facility in Clive, Utah by gondola railcar.

Once any remaining concrete structures located below the 588 ft. elevation, which include the concrete sub-slab for the SFP, have been satisfactorily surveyed and demonstrated to be in compliance with the unrestricted release criteria as specified in 10 CFR 20.1402 and, contingent upon the completion of confirmatory surveys, the void where the Fuel Handling Building once stood will be backfilled using concrete debris suitable for reuse as clean hard fill and/or clean fill to the original site grade and contours. The top 3 feet of fill will be soil only (i.e. concrete clean hard fill will only be utilized as fill up to 588 foot elevation).

3.3.6. Waste Water Treatment Facility (WWTF)

The Wastewater Treatment Facility (WWTF) was designed to treat non-radioactive and low-level radioactive liquid from ZNPS sources including building roof run-off and the Turbine Building Fire Sump, which received liquid waste from the Turbine Building Equipment and Floor Drains, and the Fuel Pool Cooling Tower Blowdown. The WWTF was designed to remove suspended solids and oil to ensure compliance with the facility National Pollutant Discharge Elimination System (NPDES) permit. Since the wastewater discharge rates were variable, an equalization tank was installed. The WWTF also includes other equipment such as mixing tanks, mixers, oil skimmers, flocculators, oil coalescers, clarifiers, sludge drying beds and filters. Discharge from the WWTF was by gravity to the Forebay. During ZNPS operations, liquid waste with detectable low-level radioactive contamination was processed by the WWTF. Consequently, the internal surfaces of the WWTF systems are considered as potentially contaminated.

All systems, component and materials associated with the WWTF that are or will be identified by radiological survey as contaminated with detectable plant-derived radioactive material will be removed by ZionSolutions personnel and dispositioned and properly disposed of as radioactive waste. The remaining structure will then be made “Cold, Dark and Dry”. Once this is complete, all remaining commodities and all structural surfaces will be demolished to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement. All remaining structural surfaces from the WWTF below the 588 ft. elevation will undergo a survey to demonstrate compliance with the unrestricted release criteria as specified in 10 CFR 20.1402.

Once the remaining concrete structure located below 3 feet below grade (588 foot elevation) has been satisfactorily surveyed and compliance with the unrestricted release criteria has been demonstrated and, contingent upon the completion of confirmatory surveys, the WWTF void will be backfilled using concrete debris suitable for reuse as clean hard fill and/or clean fill to the original site grade and contours. The top 3 feet of fill will be soil only (i.e. concrete clean hard fill will only be utilized as fill up to the 588 foot elevation).

3.3.7. Miscellaneous Structures

3.3.7.1. East and West Service Buildings



These two structures were demolished in 2016 and were located to the south of the Unit 1 Turbine Building and were utilized primarily as office space and a machine shop. Both were steel framed structures with no sub-grade basement. The remaining structures and materials in the East and West Service Buildings were surveyed to demonstrate meeting the unconditional release criteria. The remaining structures were then made “Cold, Dark and Dry” and turned over to a Demolition Contractor as a non-radiologically controlled structures for demolition as a contracted work scope. The concrete base slabs and edge beams were removed to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement, and all associated buried piping systems associated

with these buildings are targeted for complete removal and disposal as waste. Any voids created by the demolition of these structures were surveyed by the ZionSolutions Characterization/License Termination group and documented as a Radiological Assessment (RA) as part of Continuing Characterization. Upon completion of the RA and acceptance of the survey results, the building footprints were returned to the original site grade and contours.

3.3.7.2. Forebay, Forebay Valve Houses and Intake and Outflow Structures Located in Lake Michigan

The Circulating Water Intake Piping and Discharge Tunnels located at the bottom of Lake Michigan will remain and be abandoned in place. These structures were surveyed in place to demonstrate compliance with the unrestricted release criteria as specified in 10 CFR 20.1402.



The accessible Forebay surfaces above the 588 foot elevation and the Valve Houses will be radiologically surveyed to demonstrate that the structural surfaces and materials meet the unconditional release criteria. Surveys will be performed in accordance with the site procedure for the unconditional release of materials to verify that the material is free of plant-derived radioactive material. The Valve Houses and the Forebay will then be made “Cold, Dark and Dry” and turned over to a Demolition Contractor as a non-radiologically controlled structure for demolition as a

contracted work scope. The structural surfaces of the Forebay located below the 588 foot elevation have been surveyed to demonstrate compliance with the unrestricted release criteria as specified in 10 CFR 20.1402.

Contingent upon regulatory concurrence, the selected Demolition Contractor will remove and disposition all remaining commodities and completely demolish the Valve Houses and demolish the Forebay structure to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement. The Contractor will backfill the Forebay using clean fill or concrete debris suitable for reuse as clean hard fill to the original site grade and contours. The top 3 feet of fill will be soil only (i.e. concrete clean hard fill will only be utilized as fill up to 588 foot elevation). All other construction demolition debris that is not appropriate for beneficial reuse as potential backfill material will be packaged and transported to an appropriate landfill for disposal or, to an off-site recycling center following final assessment for the presence of any residual radioactive contamination by passing through a radiological truck monitor.

3.3.7.3. NGET, ENC, South Warehouse, North Security Access Gatehouse

The NGET, ENC, South Warehouse, North Security Access Gatehouse structures were demolished in 2017. They were located in the “Radiologically-Restricted Area” and had been utilized primarily as office and storage space. All were steel framed structures with no sub-grade basement. Radiological surveys were performed in accordance with the site procedure for the unconditional release of materials to verify that the structural surfaces and materials in each of these buildings were free of plant-derived radioactive material. No recycled materials will

remain on site. The structures were then made “Cold, Dark and Dry” and turned over to a Demolition Contractor as non-radiologically controlled structures for demolition as a contracted work scope. The concrete base slabs and wall foundations were removed to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement and all associated buried piping systems associated with these buildings are targeted for complete removal and disposal as waste. All electrical services were de-energized and removed to a depth of 3 feet below grade. Any void created by the demolition of these structures was surveyed by the *ZionSolutions* Characterization/License Termination group and documented as a RA. Upon completion of the RA and acceptance of the survey results, any voids were backfilled to the original site grade and contours.

3.3.7.4. Laundry Building, North Security Restricted Area Gatehouse, South Security Restricted Area Access, Restricted Area Fence and Vehicle Barrier System



These structures were demolished in 2016-2017. They were located in the “Security-Restricted Area” and were primarily used for security. These structures were no longer required once all the spent nuclear fuel was moved to the ISFSI. The structures were a mix of steel frame, slab on grade and reinforced concrete construction. Radiological surveys were performed in accordance with the site procedure for the unconditional release of materials to verify that the structural surfaces, and materials in each of these buildings were free of plant-derived radioactive material. The structures were then made “Cold, Dark and Dry” and turned over to a Demolition Contractor as non-radiologically controlled structures for demolition as a contracted work scope. The concrete base slabs and wall foundations were removed to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement and all associated buried piping systems associated with these buildings are targeted for complete removal and disposal as waste. All electrical services were de-energized and removed to a depth of 3 feet below grade. Any void created by the demolition of these structures was surveyed by the *ZionSolutions* Characterization/License Termination group and documented as a RA. Upon completion of the RA and acceptance of the survey results, any voids were backfilled to the original site grade and contours.

3.3.7.5. Steam Tunnels and Waste Handling Area

The Steam Tunnels are buried structures that connect the Unit 1 and Unit 2 Containment Building with the Turbine Building at the 570 foot elevation. The roofs of the Steam Tunnels were demolished and removed in 2016. They were constructed of reinforced concrete. The Waste Handling Area was a steel frame building built on an on-grade concrete slab that was also demolished in 2016. Both of these structures underwent radiological surveys to verify that as-left contamination levels were below those established for open-air demolition prior to commencing decommissioning. Based upon the results of these surveys, the remaining systems, components and structural surfaces required to be removed or decontaminated prior to permitting “open air demolition” in accordance with TSD 10-002 were removed or successfully decontaminated prior to structural demolition. All radioactive waste was loaded and transported

under the direction of *ZionSolutions* Waste Department personnel to the licensed *EnergySolutions* radioactive waste disposal facility in Clive, Utah.

Once all identified radioactive systems were removed and all required remediation was completed, the structures were then be made “Cold, Dark and Dry” and turned over to a Decommissioning Contractor for demolition as a contracted work scope. The Waste Handling Building was completely removed, including the concrete slab. The roof of the Steam Tunnels was exposed by excavation. The concrete roof slabs were demolished and removed. All remaining commodities in the Steam Tunnels were removed through the opening created by removing the roof. Concrete debris resulting from the building demolition was designated for beneficial reuse as clean hard fill. Only concrete that met the non-radiological definition of clean concrete demolition debris and where URS/FSS demonstrated that the concrete is free of plant derived radionuclides above background was used. All clean construction debris that was not appropriate for reuse as potential backfill material was packaged and transported to an appropriate landfill for disposal or, to an off-site recycling center following final assessment for the presence of any residual radioactive contamination by passing through a radiological truck monitor.

The remaining structural surfaces of the Steam Tunnels located below the 588 foot elevation were surveyed to demonstrate compliance with the unrestricted release criteria as specified in 10 CFR 20.1402. Once the compliance survey was completed , and contingent upon the completion of confirmatory surveys, the selected Decommissioning Contractor demolished the Steam Tunnel structures to a depth of 3 feet below grade in accordance with the requirements of the Asset Sale Agreement.

Following completion of FSS, the Steam Tunnels’ voids were backfilled using concrete debris suitable for reuse as clean hard fill and/or clean fill to the original site grade and contours. The top 3 feet of fill consisted of soil only (i.e. concrete clean hard fill will only be utilized as fill up to 588 foot elevation).

3.3.7.6. Old Sewage Treatment Facility and Meteorological Tower

The Old Sewage Treatment Facility and the Meteorological Tower were demonstrated as meeting the unconditional release criteria and demolished in 2016. Surveys were performed in accordance with the site procedure for the unconditional release of materials to verify that the material was free of plant-derived radioactive material. The structures were then made “Cold, Dark and Dry” and turned over to a Decommissioning Contractor as non-radiologically controlled structures for demolition as a contracted work scope. The structures, concrete slabs all associated buried piping systems associated with these buildings were completely removed and disposed of as waste. All electrical services were de-energized and removed to a depth of 3 feet below grade. Any void created by the demolition of these structures was surveyed by the *ZionSolutions* Characterization/License Termination group and documented as Continuing Characterization. Upon completion of the Continuing Characterization and acceptance of the survey results, any voids were backfilled to the original site grade and contours.

3.3.7.7. Storm Drain System, Manholes and Fire Protection Buried Piping

The existing fire protection piping (including hydrants and valves) and a majority of the storm drain system (including the oil separators) were removed and disposed of as clean waste in 2017. Several sections of storm drain pipe are still located in the west yard of the “Security-Restricted Area”. This remaining pipe is not radiologically contaminated and is scheduled to be removed completely in 2018.

If a situation occurs where difficulty is encountered with ground water infiltration, some of the piping and/or catch basins located greater than a depth of 5 feet below grade may be abandoned in place. In these cases, any piping or catch basins that remain will be surveyed for compliance with the unrestricted release criteria as specified in 10 CFR 20.1402 prior to being isolated and abandoned in place. Any voids created by excavation to support the removal of these systems will be surveyed by the *ZionSolutions* Characterization/License Termination group and documented as a RA. Upon completion of the RA and acceptance of the survey results, any voids will be backfilled to the original site grade and contours.

3.3.7.8. Surface Soils, Subsurface Soil and Groundwater

Characterization survey results and historical survey data indicate that there is minimal residual radioactivity in soil and no groundwater contamination identified to date. As needed, additional investigations will be performed to ensure that any changing soil radiological contamination profile during decommissioning is adequately identified and addressed. Chapter 5 discusses soil sampling and survey methods.

The release criteria (Base Case Derived Concentration Guideline Levels) that will be used to demonstrate compliance with the 25 mrem/yr dose criterion are provided in Tables 5-5 and 5-6 of Chapter 5. Throughout the course of the decommissioning and through site closure, ZSRP will continue to survey and characterize soils as they are exposed by excavation during building demolition or made accessible by the removal of structures or components. If residual radioactivity is discovered in surface or subsurface soils, ZSRP will excavate, package and dispose of any soil contaminated with residual radioactivity at concentrations greater than the unrestricted release criteria.

3.4. Radiological Impacts of Decommissioning Activities

The decommissioning activities described are and will be conducted under the provisions of the *ZionSolutions* Radiation Protection Program and Radioactive Waste Management Program. These programs are and will continue to be implemented as described in the DSAR. The *ZionSolutions* Radiation Protection Program and written site procedures are intended to provide sufficient information to demonstrate that decommissioning activities will be performed in accordance with 10 CFR 19, “*Notices, Instructions And Reports To Workers*”, 10 CFR 20, “*Standards For Protection Against Radiation*” and to maintain radiation exposures As Low As Reasonably Achievable (ALARA). The *ZionSolutions* Radioactive Waste Management Program controls the generation, characterization, processing, handling, shipping, and disposal of radioactive waste in accordance with the approved *ZionSolutions* Radiation Protection Program, Process Control Program, and written plant procedures.

The current Radiation Protection Program, Waste Management Program, and “*Radiological Effluent Monitoring and Offsite Dose Calculation Manual (ODCM)*” (Reference 3-12) will be used to protect the workers and the public during the various decontamination and decommissioning activities. These well-established programs are routinely inspected by the NRC to ensure that workers, the public, and the environment are protected during facility decommissioning activities. It is also important to note that decommissioning activities involve the same radiation protection and waste management considerations as those encountered during plant operations, maintenance and outages. As described in the PSDAR, the decommissioning will be accomplished with no significant adverse environmental impacts in that:

- No site-specific factors pertaining to the decommissioning of the ZNPS would alter the conclusions presented in NUREG-0586 (see LTP Chapter 8).
- Radiation dose to the public will be minimal.
- Decommissioning is not an imminent health or safety concern and will generally have a positive environmental impact.

Continued application of the current and future Radiation Protection and Radiological Effluent Monitoring Programs at ZNPS ensures public protection in accordance with 10 CFR 20 and 10 CFR 50, Appendix I. ODCM reports for ZNPS to date conclude that the public exposure as a result of decommissioning activities is bounded by the evaluation in NUREG-0586, which concludes the impact is minimal.

3.4.1. Control Mechanisms to Mitigate the Recontamination of Remediated Areas

Due to the scope of remaining structures and systems that will be decontaminated and dismantled, some FSS of areas may be performed in parallel with decommissioning activities. Consequently, a systematic approach will be employed to ensure that areas are adequately remediated prior to performing FSS and ongoing decommissioning activities do not impact the radiological condition of areas where compliance with the unrestricted release criteria as specified in 10 CFR 20.1402 has been demonstrated. These measures and mechanisms are described in Chapter 5, sections 5.6.3 and 5.12.

3.4.2. Occupational Exposure

Table 3-2 provides the “to go” cumulative site dose and estimates for the decommissioning of ZNPS. These estimates were developed to provide site management ALARA goals. The goals are verified by summation of actual site dose, as determined by appropriate dosimetry. ALARA estimates are a compilation of RWP estimates for the period. This information is in addition to information gathered for reporting of yearly site dose. The annual report of occupational dose meets the guidance of NRC Regulatory Guide 1.16, “*Reporting of Operating Information, Appendix A, Technical Specifications*” (Reference 3-13). The total radiation exposure impact for decommissioning and spent fuel management was originally estimated to be 1100 person-rem, with a Project Goal of 900 person-rem. Due to significant financial and management investment in ALARA measures and ALARA culture by EnergySolutions (e.g. remotely operated diamond wire saws, remote wireless dose, visual and audio monitoring), this estimate has been reduced 3

times and is currently at 425 person-rem. Table 3-2 includes dose for estimate and goal for the remaining project work of 0.622 and 0.600 person-rem respectively.

3.4.3. Exposure to the Public

Continued application of *ZionSolutions* Radiation Protection, Radioactive Waste, Radiological Effluent Technical Specification and Radiological Environmental Monitoring Programs assures public protection in accordance with 10 CFR 20 and 10 CFR 50, Appendix I.

3.4.4. Radioactive Waste Projections

The Radioactive Waste Management Program is used to control the characterization, generation, processing, handling, shipping, and disposal of radioactive waste during decommissioning. Activated and contaminated systems, structures, and components represent the largest volume of low level radioactive waste expected to be generated during decommissioning. Other forms of waste generated during decommissioning include:

- Contaminated water;
- Used disposable protective clothing;
- Expended abrasive and absorbent materials;
- Expended resins and filters;
- Contamination control materials (e.g., strippable coatings, plastic enclosures); and
- Contaminated equipment used in the decommissioning process.

Table 3-3 provides projections of waste classifications and quantities that will be generated by the decommissioning of ZNPS. These waste quantities are consistent with the waste quantities projected in the PSDAR. As *ZionSolutions* has elected to institute an approach commonly referred to as “rip & ship” verses performing significant on-site decontamination activities, the total volume of low-level radioactive waste for disposal has been estimated at approximately 6,000,000 cubic feet. Actual waste volumes and classifications may vary. The vast majority of this waste will be shipped to the licensed *EnergySolutions* radioactive waste disposal facility in Clive, Utah by gondola railcar.

3.5. References

- 3-1 Letter from *ZionSolutions* to the U.S. Nuclear Regulatory Commission, “Notification of “Amended Post-Shutdown Decommissioning Activities Report (PSDAR) for Zion Nuclear Power Station, Units 1 and 2” – March 18, 2008.
- 3-2 U.S. Nuclear Regulatory Commission NUREG-0586 “Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities”, Supplement 1, Volume 1” – November 2002
- 3-3 Zion Station, “Defueled Safety Analysis Report” (DSAR) – September 2014
- 3-4 U.S. Nuclear Regulatory Commission Docket Number 50-295, “Facility Operating License Number DPR-39 (for Unit One)”

-
- 3-5 U.S. Nuclear Regulatory Commission Docket Number 50-304, “Facility Operating License Number DPR-48 (for Unit Two)”
 - 3-6 Letter from Exelon and ZionSolutions - Application for License Transfers and Conforming Administrative License Amendments-January 25, 2008
 - 3-7 Letter from J.B. Hickman (U.S. Nuclear Regulatory Commission) to J. Christian (ZionSolutions), “Issuance of Conforming Amendments Relating to Transfer of Licenses for Zion Nuclear Power Station, Units 1 and 2” – September 2010
 - 3-8 “Zion Nuclear Power Station, Units 1 and 2 Asset Sale Agreement” – December 2007
 - 3-9 ZionSolutions Technical Support Document 17-010, Revision 1, “Final Report – Unconditional Release Surveys at the Zion Station Restoration Project”
 - 3-10 ZionSolutions Technical Support Document 10-002, Revision 1, “Technical Basis for Radiological Limits for Structure Building Open Air Demolition
 - 3-11 ZionSolutions Technical Support Document 14-016, Revision 0, “Description of Embedded Pipe, Penetrations, and Buried Pipe to Remain in Zion End State”
 - 3-12 Exelon Nuclear “Radiological Effluent Monitoring and Offsite Dose Calculation Manual (ODCM)” – January 2001
 - 3-13 U.S. Nuclear Regulatory Commission Regulatory Guide 1.16, “Reporting of Operating Information, Appendix A, Technical Specifications” – August 1975

Table 3-1 Status of Major ZNPS Systems, Structures, and Components as of December 2018

System or Component	Required for SFP	Status
Reactor Coolant System	No	Removed-Disposed
Reactor Vessel Internals	No	Removed-Disposed
Reactor Vessels	No	Removed-Disposed
Steam Generators	No	Removed-Disposed
Reactor Coolant Pumps	No	Removed-Disposed
Pressurizer	No	Removed-Disposed
Chemical & Volume Control System	No	Removed-Disposed
Safety Injection System	No	Removed-Disposed
Residual Heat Removal System	No	Removed-Disposed
Containment Spray System	No	Removed-Disposed
Component Cooling Water System	No	Removed-Disposed
Service Water System	No	Removed-Disposed
Spent Fuel Pool (SFP)	Yes	Removed-Disposed
Fuel Handling Equipment	No	Removed-Disposed
Spent Fuel Pool Cooling and Demineralizer System (SFPI systems)	Yes	Removed-Disposed
Condensate System	No	Removed-Disposed
Feedwater System	No	Removed-Disposed
Steam Generator Blowdown System	No	Removed-Disposed
Primary Makeup Water System	No	Removed-Disposed
Refueling Water Storage Tank	No	Removed-Disposed
Plant Effluent Monitoring System	No	In place
Containment Ventilation System	No	Removed-Disposed
Fuel Building Ventilation System	Yes	Removed-Disposed
Aux Building Ventilation System	No	Removed-Disposed
Auxiliary Boiler	No	Removed-Disposed

Table 3-1 (continued)

System or Component	Required for SFP	Status
Instrument and Service Air System	No	Removed-Disposed
Gaseous Radioactive Waste System	No	Removed-Disposed
Solid Radioactive Waste System	No	Removed-Disposed
Liquid Radioactive Waste System	No	Removed-Disposed
Makeup Water Systems	Yes	Removed-Disposed
Radiation Monitoring System	Yes	Removed-Disposed
Process Sampling System	No	Removed-Disposed
Fire Protection System	Yes	Removed-Disposed
Electrical Systems	Yes	Removed-Disposed
Containment Building	No	Domes/basements in place
Auxiliary Building	No	Basement in place
Fuel Handling Building	Yes	Basement in place
Turbine Building	No	Basement in place
Service Buildings	No	Removed-Disposed

Table 3-2 Radiation Exposure Projections for Decommissioning After 1/1/2018

Activity	Exposure (person-rem)
Remaining Activities	
Walkdowns/ Tours/ Security	0.040
RP routine Activities	0.030
Misc. D&D Work Activities	0.045
NRC Activities	0.005
Sluicing/ WWTF/ Resin and HIC activities	0.010
Asbestos Removal Activities	0.005
ISFSI Activities	0.025
Waste Operations Activities	0.150
FSS Activities	0.095
Electrical Activities	0.005
Decon of equipment/components/material activities	0.020
Per/OAD of Aux/FHB/CTMT's/Steam Tunnels/Valve Houses	0.190
Visitor Activities	0.002
TOTAL Estimate/Goal (remaing after 01/01/18)	0.622/0.600
Zion Project Radiation Exposure (thru 12/31/17)	421 person-rem (vs original estimate of 1100 person-rem) and current estimate of 425 person-rem.

Table 3-3 Projected Waste Quantities

WASTE TYPE	WASTE CLASS	WASTE WEIGHT (lbs.)	PACKING DENSITY (lbs./cubic feet)	WASTE VOLUME (cubic feet)
Bulk Concrete	A	307,164,310	84.00	3,642,803
Soils	A	98,865,000	89	1,112,358
Metal Debris	A	67,426,312	47-66	1,020,230
Large Components	A	18,200,000	68 – 388	69,700
HazMat (containerized)	A	1,450,000	59	24,700
Highly Radioactive	B or C	305,000	80	3,800
Very Highly Radioactive	>C	71,600	112	640
Clean Concrete (on-site fill)	-	345,900,000	71	4,870,000
Clean Asbestos	-	1,008,000	8.3	121,400
Clean Debris (local landfill)	-	28,000,000	100	280,000
Clean Scrap Metal (recycler)	-	44,570,000	129	346,000
Totals	-	912,960,222		11,491,631

Table 3-4 General Project Milestones

Date	Milestone
Q3/2014	Unit 2 Reactor Internals Segmentation Complete
Q4/2014	Unit 1 Reactor Internals Segmentation Complete
Q4/2014	License Termination Plan Submittal to NRC
Q1/2015	Complete Transfer of Spent Nuclear Fuel to ISFSI
Q1/2015	Cold and Dark Complete (Electrical)
Q2/2015	Complete Demolition of Crib House
Q2/2015	Unit 2 Reactor Vessel Segmentation Complete
Q3/2015	Complete Demolition of Service Building (East/West)
Q4/2015	Complete Demolition of Turbine Building
Q4/2015	Unit 1 Reactor Vessel Segmentation Complete
Q4/2016	Complete Interior Dismantlement of Auxiliary Building
Q1/2017	Complete Interior Dismantlement of Unit 2 Containment
Q4/2017	Complete Interior Dismantlement of Unit 1 Containment
Q4/2018	Complete All Major Demolition
Q4/2018	Complete FSS and Site Restoration
Q4/2018	Complete Zion Station Restoration Project

Note; Circumstances can change during decommissioning. If *ZionSolutions* determines that the decommissioning cannot be completed as outlined in this schedule, *ZionSolutions* will provide an updated schedule to the NRC.