



June 5, 2020

ZS-2020-0011

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Zion Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-39 and DPR-48
NRC Docket Nos. 50-295 and 50-304

Subject: Zion Nuclear Power Station Request for Partial Site Release

References:

- 1) John R. Tappert, U.S. Nuclear Regulatory Commission, Letter to John Sauger, *ZionSolutions*, "Zion Nuclear Power Station, Units 1 and 2 – Approval of Partial Site Release for Facility Operating License Nos. DPR-39 and DPR-49 (TAC Nos. L53070 and L53071)," dated March 31, 2016
- 2) John B. Hickman, U.S. Nuclear Regulatory Commission, Letter to John Sauger, *EnergySolutions*, "Zion Nuclear Power Station, Units 1 and 2 – Issuance of Amendments 191 and 178 for the Licenses to Approve the License Termination Plan," dated September 28, 2018
- 3) Gerard van Noordennen, *ZionSolutions*, Letter to U.S. Nuclear Regulatory Commission, "Final Status Survey Final Report - Phase 1," dated November 1, 2018
- 4) Gerard van Noordennen, *ZionSolutions*, Letter to U.S. Nuclear Regulatory Commission, "Revised Final Status Survey Report- Phase 1," dated June 21, 2019
- 5) Gerard van Noordennen, *ZionSolutions*, Letter to U.S. Nuclear Regulatory Commission, "Final Status Survey Final Report - Phase 2, Part 1," dated March 11, 2019
- 6) Gerard van Noordennen, *ZionSolutions*, Letter to U.S. Nuclear Regulatory Commission, "Revised Final Status Survey Report- Phase 2," dated September 30, 2019
- 7) Gerard van Noordennen, *ZionSolutions*, Letter to U.S. Nuclear Regulatory Commission, "Final Status Survey Report- Phase 2 Part 2," dated November 25, 2019
- 8) Gerard van Noordennen, *ZionSolutions*, Letter to U.S. Nuclear Regulatory Commission, "Final Status Survey Report- Phase 3," dated December 30, 2019
- 9) Gerard van Noordennen, *ZionSolutions*, Letter to U.S. Nuclear Regulatory Commission, "Revised Final Status Survey Release Records for Four Phase 3 Survey Units," dated April 30, 2020
- 10) Gerard van Noordennen, *ZionSolutions*, Letter to U.S. Nuclear Regulatory Commission, "Final Status Survey Report- Phase 4," dated May 1, 2020

NM5501
NM55

The purpose of this letter is to provide written notification to the Nuclear Regulatory Commission (NRC) that ZionSolutions, the licensee for Zion Nuclear Power Station, Units 1 and 2, (ZNPS), intends to remove a portion of the site from the 10 CFR Part 50 Licenses, License Nos. DPR-39 and DPR-48. Specifically, ZionSolutions intends to remove an area consisting of 7 basement survey units, 116 open land survey units (including 3 below grade excavation survey units), and 5 buried pipe survey units.

The area requested to be removed from the license, approximately 112 acres, encompasses approximately 34 percent of the original site area of 331 acres. The NRC approved the partial site release of approximately 214 acres of non-impacted land from the 10 CFR Part 50 license by letter dated March 31, 2016 (Reference 1). Approximately 5 acres of the licensed site is associated with the Independent Spent Fuel Storage Facility (ISFSI); this area will be retained under the 10 CFR Part 50 license until the ISFSI is decommissioned.


As stated above, ZionSolutions intends to release the site areas outside of the ISFSI and its associated land area from the Part 50 License. In accordance with 10 CFR 50.82(a)(11), the Zion Station Restoration Project License Termination Plan, and the NRC safety evaluation dated September 28, 2018 (Reference 2), ZionSolutions has reviewed and assessed the survey units to ensure that the proposed action will have no impact on the ability of the site in aggregate to meet the 10 CFR 20, Subpart E, criteria for unrestricted release. The attachment to this letter contains a summary of the analysis that was completed to support removal of the survey areas from the 10 CFR Part 50 license. In addition, the attachment includes an analysis of the dose from groundwater and the final compliance dose.

The survey units included in the proposed release of land, for unrestricted use, are provided in Tables 1 through 5 within the attachment. The area associated with the ISFSI that will remain within the license following the proposed removal is depicted in Figure 7 within the attachment. The Final Status Survey Final Reports for Phases 1 through 4 (References 3 through 10) support the summary and conclusions described in the attachment; however, these documents are not included as part of the attachment as they were previously provided to the NRC.

ZionSolutions plans to begin undertaking activities associated with the release of the subject survey areas from the 10 CFR Part 50 license on or before September 15, 2020. Therefore, ZionSolutions requests that the NRC approve the acceptability of the release of the survey areas by August 30, 2020.

There are no regulatory commitments made in this submittal. If there are any questions regarding this submittal, please contact me at (860) 462-9707.

Respectfully,



Gerard van Noordennen
Senior Vice President Regulatory Affairs

ZionSolutions, LLC
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Attachment:

Zion Station Restoration Project, Supporting Information for the Phased Release of Land from
the 10 CFR Part 50 License

cc: John Hickman, U.S. NRC Senior Project Manager
Regional Administrator, U.S. NRC, Region III
Zion Nuclear Power Station, Units 1 and 2, License Transfer Service List (w/o attachments)

Zion Nuclear Power Station, Unit 1 and 2 License Transfer Service List

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Attachment

Zion Station Restoration Project

**Supporting Information for the Phased Release of Land
from the 10 CFR Part 50 License**

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1 BACKGROUND

The Zion Station License Termination Plan (LTP) (Reference 1) was submitted by ZionSolutions to the U.S. Nuclear Regulatory Commission (NRC) for review on December 19, 2014 for the Zion Nuclear Power Station (ZNPS). In addition, ZionSolutions also submitted an accompanying License Amendment Request (LAR), "License Amendment Request for the License Termination Plan," for Zion Nuclear Power Station, Units 1 and 2 (ZNPS or the facility). The LTP was submitted as a supplement to the ZNPS Defueled Safety Analysis Report (DSAR) (Reference 2), and was accompanied by a proposed license amendment (in the form of a license condition) that established the criteria for when changes to the LTP require prior NRC approval. On February 26, 2015, ZionSolutions submitted additional information, including site-specific decommissioning cost information.

Following initial NRC review, a Request for Additional Information (RAI) was received on December 10, 2015 (Reference 3). A response to that request was submitted on March 8, 2016 (Reference 4). Continuing regulatory review resulted in a second set of RAIs that was received on May 31, 2016 (Reference 5). On July 20, 2017, ZionSolutions submitted Revision 1 to the LTP with corresponding changes to the LAR that reflect, among other things, changes made in response to RAIs (Reference 6). Subsequently, on February 7, 2018, the ZionSolutions submitted Revision 2 to the LTP. Finally, on August 28, 2018, ZionSolutions submitted a change to the license conditions associated with the LTP. The supplements dated February 26, 2015, March 8, 2016, July 20, 2016, July 20, 2017, February 7, 2018, April 10, 2018, and August 28, 2018, provided additional information that clarified the application, did not expand the scope of the application as originally noticed, and did not change the NRC staff's original proposed no significant hazards consideration determination as published in the Federal Register on April 14, 2015, (80 FR 20020).

On September 28, 2018, the NRC issued amendments that revised the ZNPS licenses to approve the LTP (Reference 7). The amendments revised the ZNPS, Units 1 and 2 licenses to add License Condition 2.C.(17). This new license condition incorporated the NRC approved LTP and associated addendum into the ZNPS licenses and specified limits on the changes the licensee was allowed to make to the approved LTP without prior NRC review and approval. The related Safety Evaluation Report (SER) was provided with the license amendments.

In Section 5.11 of the LTP, ZionSolutions indicated that it will submit final reports to the NRC that detail the results of Final Status Surveys (FSS), in a phased approach. On August 27, 2015, ZionSolutions requested approval to remove the non-impacted survey units on the site from the Part 50 licenses in accordance with 10 CFR 50.83(b), "Release of part of a power reactor facility or site for unrestricted use" (see Figure 1) (Reference 8). The NRC staff completed their review of the proposed request and approved the release of non-impacted survey units from the license via formal correspondence on March 31, 2016 (Reference 9).

2 PURPOSE

The purpose of this report is to provide written notification to the NRC of ZionSolutions' intent to release a portion of the ZNPS site from the 10 CFR 50 license. Specifically, ZionSolutions intends to release an area consisting of seven (7) basement foundations (that are below grade and covered with three feet of clean fill), one-hundred and sixteen (116) open land survey units (including three (3) below grade excavation survey units), and five (5) buried pipe survey units. This area encompasses approximately 112 acres of the original licensed site area of 331 acres and constitutes the entire impacted area of the site. Approximately 5 acres of the current licensed site (117 acres) is associated with the Independent Spent Fuel Storage Facility (ISFSI) and will remain in the 10 CFR Part 50 license.

Section 4 of this report presents the compliance equation for the site in accordance with Section 6.17 of the LTP. Section 4 also provides a description of how dose compliance is demonstrated through the summation of the four (4) distinct source terms for the end-state (i.e., basements, soil, buried pipe, and groundwater), in order to demonstrate that the ZNPS site, as a whole, meets the 25 mrem/year release criterion as established in NRC Regulation 10 CFR 20.1402, "Radiological Criteria for Unrestricted Use."

In accordance with the ZSNP LTP, the NRC SER dated September 28, 2018, and the requirements of 10 CFR 50.82(a)(11), ZionSolutions has reviewed and assessed the subject survey units to ensure that this proposed action will have no adverse impact on the ability of the site in aggregate to meet 10 CFR Part 20, Subpart E, criteria for unrestricted release.

3 SITE INFORMATION

3.1 General Information

Zion Nuclear Power Station, owned by Exelon, was located in Zion, Illinois, on the west shore of Lake Michigan. The site is approximately 40 miles north of Chicago, Illinois, and 42 miles south of Milwaukee, Wisconsin. The owner-controlled site consisted of approximately 331 acres, and within the owner-controlled area was an approximate 87-acre, fence-enclosed nuclear facility. The plant was comprised of two (2) pressurized water reactors with supporting facilities. The primary coolant system for each unit employed a four-loop pressurized water reactor nuclear steam supply system housed in a steel-lined, reinforced concrete containment structure. Each unit employed a pressurized water reactor nuclear steam supply system.

ZNPS was previously operated by Commonwealth Edison (ComEd) until it was permanently shut down on February 13, 1998. On March 9, 1998, ComEd certified to the NRC that all fuel assemblies had been permanently removed from both reactors and placed in the Spent Fuel Pool. The NRC acknowledged the certification of permanent cessation of power

operation and permanent removal of fuel from the reactor vessels in a letter dated May 4, 1998. In 2000, the license was transferred from ComEd to Exelon. In 2010, the license was transferred to *ZionSolutions* to coordinate and execute the decommissioning of the site.

Decommissioning and subsequent final radiological surveys were completed in accordance with the LTP and relevant regulatory guidance. Demobilization of personnel from the site occurred from December, 2019 to February, 2020. The spent nuclear fuel stored in the Zion ISFSI will be maintained under an amended Part 50 license.

3.2 Description of Survey Units (Covered Under this Partial Site Release Request)

Presently, *ZionSolutions* intends to release an area consisting of seven (7) basement foundations, one-hundred and sixteen (116) open land survey units, and five (5) buried pipe survey units. This area encompasses approximately 112 acres (the impacted area of 117 acres minus the area of the ISFSI) of the original licensed site area of 331 acre (approximately 34%), leaving only the land area associated with the ISFSI within the Part 50 license. Buried within the impacted open land survey units are seven (7) basement foundation survey units and five (5) buried pipe survey units that were subjected to FSS separately. The boundaries of the area subject to this release request are depicted in Figures 2 through 6.

An FSS was performed on each of the one-hundred and sixteen (116) impacted open land survey units the five (5) buried pipe survey units and the seven (7) buried basements that are subject to this release request. The FSS was performed in accordance with the LTP, NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM), as well as numerous *ZionSolutions* implementing procedures.

As detailed in Section 5.11 of the LTP, an FSS Release Record was prepared for each survey unit to provide complete and unambiguous records of the as-left radiological status. Sufficient data and information are provided in each Release Record to enable an independent re-creation and evaluation at some future time of both the survey activities and the derived results.

Final Reports were written consistent with the guidance provided in NUREG-1757, Vol. 2, "Consolidated Decommissioning Guidance - Characterization, Survey, and Determination of Radiological Criteria" and MARSSIM. To facilitate the data management process, FSS Final Reports incorporate multiple survey unit Release Records.

To minimize the incorporation of redundant historical assessment and other FSS program information, and to facilitate potential phased releases from the current license, FSS Final Reports were prepared in a phased approach. Four (4) FSS Final Reports (FSSR) have previously been submitted to the NRC.

The Phase 1 FSSR was submitted to NRC for review on November 1, 2018 (Reference 10). The Phase 1 FSSR and the accompanying Release Records addressed the FSS of eight (8)

Class 3 open land survey units at Zion. Following review and comment, the revised Phase 1 FSSR was resubmitted on June 21, 2019 (Reference 11).

The Phase 2, Part 1 FSSR submitted to the NRC in March of 2019 contained the FSS units that encompassed the basement structures including the Unit 1 and Unit 2 Containments, the Spent Fuel Pool (SFP)/Transfer Canal, the Auxiliary Building, the Crib House/Forebay, the Waste Water Treatment Facility (WWTF) and the Turbine Building. On September 30, 2019, the revised Phase 2, Part 1 FSSR was submitted to the NRC (Reference 12).

The Phase 2, Part 2 FSSR and all pertinent Release Records were submitted to the NRC on November 25, 2019 (Reference 13). The Phase 2, Part 2 FSSR contained the FSS units that encompassed buried pipe.

The Phase 3 FSSR addressed forty-one (41) Class 1 open land area survey units that totaled approximately 73,546 m² in area. The Phase 3 FSSR and all pertinent Release Records were submitted to the NRC on December 30, 2019 (Reference 14).

The Phase 4 FSS Final Report was submitted to the NRC for review on May 1, 2020 (Reference 15). The report presents the FSS of sixty-seven (67) open land area survey units that total approximately 178,182 m² in area. Sixty (60) of the sixty-seven (67) open land survey units included in the Phase 4 report are classified as MARSSIM Class 1 survey units.

A listing of survey units within each of the FSS Final Report phased submittals, along with a description and classification designation for each, is provided in Tables 1 through 5. The boundaries of the survey units within the scope of this release request, broken down by phase, are depicted in Figures 2 through 6.

Table 1 – Phase 1 Survey Units

Survey Unit	Name	Class	Size (m²)
10205	Switchyard	3	54,573
10219A	Area Far South of Switchyard (A)	3	2,433
10219B	Area Far South of Switchyard (B)	3	7,516
10220C	Adjacent to South Restricted Area - Lakeshore	3	27,870
10222	North Beach Area	3	21,778
10223	Power Block Beach Area	3	12,371
10224	South Beach Area	3	14,608
10301	West Training Area	3	55,942

Table 2 – Phase 2, Part 1 Survey Units

Survey Unit ⁽¹⁾	Name	Class ⁽⁷⁾	Size (m ²)
01100 ⁽²⁾	Unit 1 Containment above 565 ft.	1	2,465
01110 ⁽²⁾	Unit 1 Containment Under Vessel Area	1	294
01111	Unit 1 Containment In-Core-Sump Drain	1	0.86
01112	Unit 1 Containment Penetrations	1	242
02100 ⁽³⁾	Unit 2 Containment above 565 ft.	1	2,465
02110 ⁽³⁾	Unit 2 Containment Under Vessel Area	1	294
02112	Unit 2 Containment Penetrations	1	242
03202	SFP/Transfer Canal	1	723
05100	Auxiliary Building 542 ft. Floor and Walls	1	7,226
05119	Auxiliary Building Embedded Floor Drains	1	294
05120	Auxiliary Building Penetrations	1	949
06100 ⁽⁴⁾	Turbine Building Basement and Steam Tunnels	3	27,135
06105A ⁽⁴⁾	Circulating Water Discharge Pipe	3	1,075
09200 ⁽⁵⁾	Unit 1 & Unit 2 Circulating Water Discharge Tunnels	3	4,868
06105B ⁽⁵⁾	Turbine Building Embedded Pipe	3	238
06107 ⁽⁵⁾	Unit 1 Turbine Building Buttress Pit	3	1,596
06108 ⁽⁵⁾	Unit 2 Turbine Building Buttress Pit	3	1,596
06201 ⁽⁵⁾	Unit 1 Turbine Building 570' Diesel Fuel Storage	1	813
06202 ⁽⁵⁾	Unit 2 Turbine Building 570' Diesel Fuel Storage	1	813
06209 ⁽⁵⁾	Unit 1 Steam Tunnel Floor Drain	3	47
06210 ⁽⁵⁾	Unit 2 Steam Tunnel Floor Drain	3	46
06211 ⁽⁵⁾	Unit 1 Tendon Tunnel Floor Drain	3	51
06212 ⁽⁵⁾	Unit 2 Tendon Tunnel Floor Drain	3	42
06213 ⁽⁵⁾	Unit 1 Steam Tunnel East Valve House	1	304
06214 ⁽⁵⁾	Unit 1 Steam Tunnel West Valve House	1	304
06215 ⁽⁵⁾	Unit 2 Steam Tunnel East Valve House	3	240

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**Table 2 (continued) – Phase 2, Part 1 Survey Units**

Survey Unit ⁽¹⁾	Name	Class ⁽⁷⁾	Size (m ²)
06216 ⁽⁵⁾	Unit 2 Steam Tunnel West Valve House	3	240
08100 ⁽⁶⁾	Crib House	3	8,435
08401 ⁽⁶⁾	Forebay	3	5,407
08102A&B ⁽⁶⁾	Unit 1 and Unit 2 Circulating Water Intake Pipes	3	4,412
09100	Waste Water Treatment Facility	1	1,124

- (1) In accordance with the LTP, there are seven (7) basement survey units (Unit 1 Containment, Unit 2 Containment, Auxiliary Building, SFP/Transfer Canal, Turbine Building, Crib House/Forebay and Waste Water Treatment Facility.) Table 2 lists the thirty-one (31) dose components that are included in these survey units for FSS.
- (2) Both dose components included in Release Record for Unit 1 Containment
- (3) Both dose components included in Release Record for Unit 2 Containment
- (4) The Release Record for the Turbine Building basement also includes the surface area of the Unit 1 and Unit 2 Steam Tunnels, the unit 1 and Unit 2 Circulating Water Discharge pipe and the Unit 1 and Unit 2 Circulating Water Discharge Tunnels
- (5) Included as an "Appendixes" to the Turbine Building basement Release Record
- (6) The Release Record for the Crib House also includes the FSS for the Forebay and the Unit 1 and Unit 2 Circulating Water Intake Pipes.
- (7) Denote Final Survey Unit Classification

Table 3 – Phase 2, Part 2 Survey Units

Survey Unit	Name	Class ⁽¹⁾	Area (ft ²)	Pipe ID
00101A	Condensate Feed Water Supply and Recirculation	3	2,455	T-103, T-105, and T-106
00101B	Primary Water	2	312	T-095 and T-102
00101F	Diesel Generator Heat Exchanger Service Water Supply and Return	3	956	AO-27, AO-28, AO-30, AO-31, TO-32, and TO-33
00101H	Service Water Supply Header	3	5,248	CO-26 and CO-29
00150A/B&C	North East Storm Drain	2	2,187	NA

- (1) Indicates classification of buried pipe interior

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**Table 4 – Phase 3 Survey Units**

Survey Unit ⁽¹⁾	Name	Size (m²)	Survey Unit ⁽¹⁾	Name	Size (m²)
10201A	NE Corner of Restricted Area - Lakeshore	1,554	10220E	SE Corner of Exclusion Area - Inland	1,976
10201B	NE Corner of Restricted Area - Lakeshore	1,427	10220F	SE Corner of Exclusion Area - Inland	1,578
10201C	NE Corner of Restricted Area - Lakeshore	1,379	10220G	SE Corner of Exclusion Area - Inland	1,674
10201D	NE Corner of Restricted Area - Lakeshore	1,472	10220J	SE Corner of Exclusion Area - Inland	2,030
10202A	IRSF/Fire Training Area	1,757	10221B	South of Protected Area - Inland	1,855
10202B	IRSF/Fire Training Area	1,711	10221E	South of Protected Area - Lakeshore	1,975
10202C	IRSF/Fire Training Area	1,696	10221F	South of Protected Area - Lakeshore	1,968
10202D	IRSF/Fire Training Area	1,680	10221G	South of Protected Area - Lakeshore	1,956
10203D	East Training Area	1,993	10221H	South of Protected Area - Lakeshore	1,994
10203E	East Training Area	1,886	12101	WWTF Sludge Drying Bed Area	2,036
10209A	Restricted Area South of Gate House	1,966	12102	WWTF Sludge Drying Bed Area	2,024
10209B	Restricted Area South of Gate House	1,977	12103	WWTF Sludge Drying Bed Area	2,034
10209D	Restricted Area South of Gate House	1,586	12112	Unit 1 PWST/SST Area West	1,693
10209E	Restricted Area South of Gate House	1,560	12113	Unit 1 PWST/SST Area West	1,658
10210A	Restricted Area South of Turbine Building	1,788	12203B	Under Service Building and Southeast Yard	1,989
10210B	Restricted Area South of Turbine Building	1,913	12203C	Under Service Building and Southeast Yard	1,955
10210C	Restricted Area South of Turbine Building	1,893	12203D	Under Service Building and Southeast Yard	1,635

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**Table 4 (continued) – Phase 3 Survey Units**

Survey Unit ⁽¹⁾	Name	Size (m ²)	Survey Unit ⁽¹⁾	Name	Size (m ²)
10211A	SE Corner of Restricted Area (Lakeshore)	1,536	12204A	Crib House Area	1,943
10211B	SE Corner of Restricted Area (Lakeshore)	1,663	12204B	Crib House Area	1,971
10220B	SE Corner of Exclusion Area - Inland	1,696	12204C	Crib House Area	1,994
10220D	SE Corner of Exclusion Area - Inland	1,475			

(1) All survey units listed had a final classification of Class 1 in accordance with MARSSIM section 4.4 prior to performing FSS

Table 5 – Phase 4 Survey Units

Survey Unit	Name	Class	Size (m ²)	Survey Unit	Name	Class	Size (m ²)
10203A	East Training Area	1	1,999	10214E	Construction Parking Area	1	1,989
10203B	East Training Area	1	1,977	10214F	Construction Parking Area	1	1,661
10203C	East Training Area	1	1,871	10220A	SE Corner of Exclusion Area – Lakeshore	1	2,025
10203F	East Training Area	1	1,888	10220H	SE Corner of Exclusion Area – Lakeshore	1	2,088
10204A	North Gate Area	1	2,231	10220I	SE Corner of Exclusion Area – Lakeshore	1	2,060
10204B	North Gate Area	1	1,549	10221A	South of Protected Area - Inland	1	1,976
10204C	North Gate Area	1	1,547	10221C	South of Protected Area - Inland	1	1,959
10204D	North Gate Area	1	1,545	10221D	South of Protected Area - Inland	1	1,697
10206A	Station Construction Area	1	2,844	12104	North Half of Unit 2 Containment	1	1,940
10206B	Station Construction Area	1	1,837	12105	South Half of Unit 2 Containment	1	1,938
10206C	Station Construction Area	1	1,833	12106	North Half of Fuel & Auxiliary Buildings	1	1,936

Table 5 (continued) – Phase 4 Survey Units

Survey Unit	Name	Class	Size (m ²)	Survey Unit	Name	Class	Size (m ²)
10206D	Station Construction Area	1	1,829	12107	South Half of Fuel & Auxiliary Buildings	1	1,934
10206E	Station Construction Area	1	1,825	12108	North Half of Unit 1 Containment	1	1,933
10207A	North Warehouse Area	1	2,675	12109	South Half of Unit 1 Containment	1	1,931
10207B	North Warehouse Area	1	1,736	12110	Yard Between Unit 1 Containment and Turbine	1	1,740
10207C	North Warehouse Area	1	1,735	12111	South Yard Area Northeast of Gate House	1	1,964
10207D	North Warehouse Area	1	1,733	12201A	North Protected Area Yard	1	1,992
10207E	North Warehouse Area	1	1,731	12201B	North Protected Area Yard	1	1,995
10208A	South Warehouse Area	1	2,460	12201C	North Protected Area Yard	1	1,968
10208B	South Warehouse Area	1	1,835	12201D	North Protected Area Yard	1	1,842
10208C	South Warehouse Area	1	1,868	12201E	North Protected Area Yard	1	1,902
10208D	South Warehouse Area	1	1,827	12202A	Gate House and Southwest Yard	1	1,998
10209C	Restricted Area South of Gate House	1	1,970	12202B	Gate House and Southwest Yard	1	1,999
10212A	NE Corner of Exclusion Area - Lakeshore	2	9,550	12202C	Gate House and Southwest Yard	1	1,894
10212B	VCC Construction Area	3	16,154	12202D	Gate House and Southwest Yard	1	1,663
10212C	NE Corner of Exclusion Area - Lakeshore	1	1,744	12202E	Gate House and Southwest Yard	1	1,845
10212D	NE Corner of Exclusion Area - Lakeshore	1	1,490	12202F	Gate House and Southwest Yard	1	1,858
10213A	NE Corner of Exclusion Area	2	5,730	12203A	Under Service Building and Southeast Yard	1	1,988
10213B	NE Corner of Exclusion Area	1	1,994	12205A	Area Under the Turbine Building	1	1,809

Table 5 (continued) – Phase 4 Survey Units

Survey Unit	Name	Class	Size (m ²)	Survey Unit	Name	Class	Size (m ²)
10213C	NE Corner of Exclusion Area	1	1,934	12205B	Area Under the Turbine Building	1	1,814
10214A	Construction Parking Area	2	8,542	12205C	Area Under the Turbine Building	1	1,818
10214B	Construction Parking Area	2	7,372	12205D	Area Under the Turbine Building	1	1,821
10214C	Construction Parking Area	2	7,579	12205E	Area Under the Turbine Building	1	1,825
10214D	Construction Parking Area	2	8,946				

4 DOSE SUMMATION AND COMPLIANCE

Each radionuclide-specific Base Case Derived Concentration Guideline Level (BcDCGL) is equivalent to the level of residual radioactivity (above background levels) that could, when considered independently, result in a Total Effective Dose Equivalent (TEDE) of 25 mrem year to the Average Member of the Critical Group (AMCG). Compliance is demonstrated through the summation of the dose from each of the Radionuclides of Concern (ROCs) in each of the four media (i.e., basement concrete, soil, buried pipe and existing groundwater). Dose summation for compliance is discussed in further detail in the LTP, Section 6.17.

4.1 Compliance Dose

The results of the FSS performed in each FSS unit was reviewed to determine the maximum dose from each of the four source terms using the mean Base Case Sum of Fractions (BcSOF) of FSS systematic results plus the dose from any identified elevated areas. The compliance dose must be less than 25 mrem/year. The dose contribution from each ROC is accounted for using the BcSOF to ensure that the total dose from all ROC does not exceed the dose criterion.

4.1.1 Structures (BcSOF_{BASEMENT})

The term for each basement includes the dose contributions from wall and floor surfaces within the basement, the dose contribution from embedded pipe within the basement, the dose contribution from penetrations within the basement and the dose contribution from concrete fill in the basement when clean concrete debris was used as fill. Each (structural surfaces, embedded pipe and penetrations) were surveyed separately during FSS. The dose from clean concrete fill was predetermined based on a maximum allowable MDC of 5,000 dpm/100cm² and the resultant dose values were documented in LTP Chapter 5, Table 5-21.

The remaining below grade basement structures that were subjected to FSS at ZNPS were the Unit 1 and Unit 2 Containments, Turbine Building, Auxiliary Building, Spent Fuel Pool (SFP)/Transfer Canal, Forebay, Crib House, and the Waste Water Treatment Facility (WWTF). The Phase 2, Part 1 FSSR submitted to the NRC on September 30, 2019, documents the FSS performed on these structures prior to backfill and coverage by a minimum of three feet of clean fill.

After the FSS of all dose components in a given basement was complete and all dose component survey units passed the Sign Test, the mean BcSOF for each dose component was calculated using Equations 5-5 or 5-6 as applicable from LTP Chapter 5, Section 5.5.4.

Basement surface area adjustments (i.e., increases) were applied to the DCGL calculation for certain basements to ensure that the DCGLs accounted for the contribution of residual radioactivity from basements/structures that cannot, on their own, support a water supply well but, were hydraulically connected to a basement that could support a well. The area-weighted BcSOF for basements that have dose contributions from multiple surface survey units were calculated in accordance with Equation 1 below, which was reproduced from Equation 5-8 from LTP Section 5.5.6.1. In accordance with LTP Section 5.5.6.1, this adjustment was made to the mean BcSOF for both Containments, the Auxiliary Building, the SFP/Transfer Canal and the Turbine Building FSS unit. For the areas specified in Footnote 1 of LTP Table 5-2, the $SOF_{Bi,B}$ to be used in Equation 1 is based on the mean of the judgmental samples/measurements.

Equation 1

$$SOF_{B,B} = \sum_{i=1}^n \frac{SA_{SUi,B}}{SA_{Adjust,B}} * SOF_{Bi,B}$$

where:

$SOF_{B,B}$	=	total surface SOF including all surface survey units in basement (B)
$SA_{SUi,B}$	=	surface area of survey unit (i) in basement (B)
$SA_{Adjust,B}$	=	adjusted surface area for DCGL calculation (LTP Table 5-23) for basement (B)
$SOF_{Bi,B}$	=	SOF _B for survey unit (i) in basement (B)

The area-weighted and adjusted mean BcSOF for each of the basement structures at ZNPS were documented in the individual Release Record for each basement as well as the Phase 2, Part 1 FSSR and are reproduced below in Table 6.

Table 6 – Area-Weighted Mean BcSOF for Basement Structures

Basement	Mean BcSOF _B
Unit 1 Containment	0.222
Unit 2 Containment	0.122
Auxiliary Building	0.078
SFP/Transfer Canal	0.033
Turbine Building	0.068
Crib House/Forebay	0.006
WWTF	0.013

Once the surface area adjustments are complete, the result becomes the mean of FSS non-parametric results (plus the dose from any identified elevated areas) for backfilled basements or the variable $BcSOF_B$ in Equation 2 (reproduced from LTP Equation 5-7) below:

Equation 2

$$BcSOF_{BASEMENT} = BcSOF_B + BcSOF_{EP} + BcSOF_{PN} + BcSOF_{CF}$$

where:

$BcSOF_{BASEMENT}$ = BcSOF (mean of FSS systematic results plus the dose from any identified elevated areas) for backfilled basements

$BcSOF_B$ = BcSOF for structural survey unit(s) within the basement (mean of FSS systematic results plus the dose from any identified elevated areas)

$BcSOF_{EP}$ = BcSOF for embedded pipe survey unit(s) within the basement (mean of FSS systematic results plus the dose from any identified elevated areas)

$BcSOF_{PN}$ = BcSOF for penetration survey unit(s) within the basement (mean of FSS systematic results plus the dose from any identified elevated areas)

$BcSOF_{CF}$ = BcSOF for clean concrete fill (if applicable) based on maximum MDC during Unrestricted Release Survey (URS)

Table 7 presents the mean BcSOF values for surfaces, penetrations, embedded pipe and clean fill and the derived value for $BcSOF_{BASEMENT}$ for each. The maximum

$BcSOF_{BASEMENT}$ was for the Unit 1 Containment at 0.444 (which equates to a dose of 11.105 mrem/year). This value will be used for the variable “Max $BcSOF_{BASEMENT}$ ” in the compliance equation (Equation 3).

Table 7 – Mean $BcSOF$ Values for Surfaces, Penetrations, Embedded Pipe and Clean Fill

BASEMENT	Structures $BcSOF_B$	Embedded Pipe $BcSOF_{EP}$	Penetrations $BcSOF_{PN}$	Clean Fill $BcSOF_{CF}$	$BcSOF_{BASEMENT}$	Dose (mrem/yr)
Unit 1 Containment	0.222	0.049	0.102	0.071	0.444	11.105
Unit 2 Containment	0.122	0.000	0.010	0.071	0.203	5.071
Auxiliary Building	0.078	0.007	0.044	0.040	0.169	4.218
SFP/Transfer Canal	0.033	0.000	0.000	0.006	0.039	0.979
Turbine Building	0.068	0.001	0.002	0.063	0.134	3.340
Crib House/Forebay	0.006	0.000	0.000	0.063	0.069	1.723
WWTF	0.013	0.000	0.000	0.256	0.269	6.725

4.1.2 Buried Pipe ($BcSOF_{BURIED PIPE}$)

The second variable in the compliance equation is dose from remaining buried pipe. The Phase 2, Part 2 FSSR was submitted to the NRC on November 25, 2019. The report addressed the FSS of the five (5) buried piping systems remaining in the end-state after decommissioning activities were completed. Specifically, the report included the FSS results for the following buried pipe:

- Condensate Feed Water Supply and Recirculation (survey unit 00101A),
- Primary Water Supply (survey unit 00101B),
- Diesel Generator Heat Exchanger Service Water Supply and Return (survey unit 00101F),
- Service Water Supply Header (survey unit 00101H), and
- North East Storm Drain (survey units 00150A, B & C).

Table 8 presents the mean $BcSOF$ values from the FSS of these five (5) buried piping systems. The maximum mean $BcSOF$ for the FSS of the five (5) buried pipe systems was for the Primary Water Supply pipe at 0.227 (which equates to a dose of 5.673 mrem/year). This value will be used for the variable “Max $BcSOF_{BURIED PIPE}$ ” in the compliance equation (Equation 3).

Table 8 – Mean BcSOF Values for Buried Pipe

Description	Mean BcSOF	Dose (mrem/yr.)
Condensate Feed Water Supply and Recirculation	0.082	2.052
Primary Water Supply Header	0.227	5.674
Diesel Generator Service Water Supply and Return Pipe	0.037	0.922
Service Water Supply Header	0.033	0.814
North Yard Drain Pipe	0.027	0.683

4.1.3 Soil (BcSOF_{soil})

The third variable in the compliance equation is dose from soil. There are one-hundred and sixteen (116) open land survey units at ZNPS. The Phase 1 FSSR was resubmitted to the NRC on July 21, 2019, and again on March 03, 2020. These reports address the FSS performed on eight (8) Class 3 open land survey units that totaled approximately 197,101 m² in area. The Phase 3 FSSR addressed the FSS of forty-one (41) Class 1 open land area survey units that totaled approximately 73,546 m² in area. It was submitted to the NRC on December 30, 2019. The report addressed the FSS of sixty (60) Class 1 open land survey units, six (6) Class 2 open land survey units and one (1) Class 3 open land survey unit, which makes up the balance of the impacted open land area at ZSNP.

Table 9 presents the mean BcSOF values from the FSS of the one-hundred and sixteen (116) open land survey units at ZNPS. The maximum mean BcSOF for the FSS of open land survey units was for survey unit 12203A at 0.040 (which equates to a dose of 0.994 mrem/year). This value will be used for the variable “Max BcSOF_{soil}” in the compliance equation (Equation 3).

Table 9 – Mean BcSOF Values for Soils

Survey Unit	Description	Mean BcSOF	Dose (mrem/yr)	Survey Unit	Description	Mean BcSOF	Dose (mrem/yr)
10201A	NE Restricted Area - Lakeshore	0.012	0.299	10220A	SE Exclusion Area - Lakeshore	0.014	0.348
10201B	NE Restricted Area - Lakeshore	0.012	0.303	10220B	SE Exclusion Area - Inland	0.012	0.302
10201C	NE Restricted Area - Lakeshore	0.012	0.288	10220C	South Restricted Area (Lakeshore)	0.015	0.377
10201D	NE Restricted Area - Lakeshore	0.015	0.385	10220D	SE Exclusion Area - Inland	0.007	0.173
10202A	IRSF/Fire Training Area	0.014	0.354	10220E	SE Exclusion Area - Inland	0.008	0.196

Table 9 (continued) – Mean BcSOF Values for Soils

Survey Unit	Description	Mean BcSOF	Dose (mrem/yr)	Survey Unit	Description	Mean BcSOF	Dose (mrem/yr)
10202B	IRSF/Fire Training Area	0.012	0.292	10220F	SE Exclusion Area - Inland	0.009	0.233
10202C	IRSF/Fire Training Area	0.013	0.319	10220G	SE Exclusion Area - Inland	0.011	0.270
10202D	IRSF/Fire Training Area	0.014	0.348	10220H	SE Exclusion Area - Lakeshore	0.012	0.307
10203A	East Training Area	0.010	0.244	10220I	SE Exclusion Area - Lakeshore	0.010	0.244
10203B	East Training Area	0.013	0.321	10220J	SE Exclusion Area - Inland	0.012	0.289
10203C	East Training Area	0.010	0.238	10221A	South of Protected Area - Inland	0.015	0.379
10203D	East Training Area	0.011	0.263	10221B	South of Protected Area - Inland	0.010	0.245
10203E	East Training Area	0.013	0.323	10221C	South of Protected Area - Inland	0.017	0.427
10203F	East Training Area	0.007	0.244	10221D	South of Protected Area - Inland	0.011	0.286
10204A	North Gate Area	0.011	0.321	10221E	South of Protected Area - Lakeshore	0.014	0.353
10204B	North Gate Area	0.009	0.238	10221F	South of Protected Area - Lakeshore	0.013	0.331
10204C	North Gate Area	0.014	0.181	10221G	South of Protected Area - Lakeshore	0.009	0.233
10204D	North Gate Area	0.011	0.283	10221H	South of Protected Area - Lakeshore	0.007	0.163
10205	Switchyard	0.004	0.102	10222	North Beach Area	0.012	0.294
10206A	Station Construction Area	0.016	0.392	10223	Power Block Beach Area	0.003	0.075
10206B	Station Construction Area	0.012	0.309	10224	South Beach Area	0.005	0.112
10206C	Station Construction Area	0.015	0.370	12101	WWTF Sludge Drying Bed Area	0.014	0.355
10206D	Station Construction Area	0.018	0.440	12102	WWTF Sludge Drying Bed Area	0.013	0.330
10206E	Station Construction Area	0.007	0.180	12103	WWTF Sludge Drying Bed Area	0.011	0.271
10207A	North Warehouse Area	0.035	0.869	12104	North Half of Unit 2 Containment	0.009	0.215
10207B	North Warehouse Area	0.010	0.243	12105	South Half of Unit 2 Containment	0.009	0.216

Table 9 (continued) – Mean BcSOF Values for Soils

Survey Unit	Description	Mean BcSOF	Dose (mrem/yr)	Survey Unit	Description	Mean BcSOF	Dose (mrem/yr)
10207C	North Warehouse Area	0.018	0.441	12106	North Half of Fuel & Aux Buildings	0.008	0.198
10207D	North Warehouse Area	0.013	0.333	12107	South Half of Fuel & Aux Buildings	0.010	0.246
10207E	North Warehouse Area	0.011	0.282	12108	North Half of Unit 1 Containment	0.007	0.17
10208A	South Warehouse Area	0.012	0.297	12109	South Half of Unit 1 Containment	0.009	0.236
10208B	South Warehouse Area	0.012	0.300	12110	Yard Between Unit 1 CTMT & Turbine	0.014	0.34
10208C	South Warehouse Area	0.012	0.291	12111	South Yard Area NE of Gate House	0.008	0.197
10208D	South Warehouse Area	0.011	0.272	12112	Unit 1 PWST/SST Area West	0.018	0.449
10209A	South of Gate House	0.011	0.264	12113	Unit 1 PWST/SST Area West	0.012	0.297
10209B	South of Gate House	0.012	0.304	12201A	North Protected Area Yard	0.009	0.223
10209C	South of Gate House	0.015	0.382	12201B	North Protected Area Yard	0.008	0.19
10209D	South of Gate House	0.022	0.544	12201C	North Protected Area Yard	0.011	0.268
10209E	South of Gate House	0.013	0.318	12201D	North Protected Area Yard	0.016	0.392
10210A	South of Turbine Building	0.014	0.361	12201E	North Protected Area Yard	0.011	0.264
10210B	South of Turbine Building	0.015	0.365	12202A	Gate House and Southwest Yard	0.008	0.206
10210C	South of Turbine Building	0.012	0.287	12202B	Gate House and Southwest Yard	0.008	0.202
10211A	SE Restricted Area (Lakeshore)	0.008	0.189	12202C	Gate House and Southwest Yard	0.010	0.248
10211B	SE Restricted Area (Lakeshore)	0.013	0.321	12202D	Gate House and Southwest Yard	0.010	0.252
10212A	NE Exclusion Area - Lakeshore	0.012	0.304	12202E	Gate House and Southwest Yard	0.006	0.156
10212B	VCC Construction Area	0.010	0.250	12202F	Gate House and Southwest Yard	0.010	0.248
10212C	NE Exclusion Area - Lakeshore	0.015	0.382	12203A	Under Service Building & SE Yard	0.040	0.994
10212D	NE Exclusion Area - Lakeshore	0.021	0.526	12203B	Under Service Building & SE Yard	0.014	0.352

Table 9 (continued) – Mean BcSOF Values for Soils

Survey Unit	Description	Mean BcSOF	Dose (mrem/yr)	Survey Unit	Description	Mean BcSOF	Dose (mrem/yr)
10213A	NE Corner of Exclusion Area	0.021	0.519	12203C	Under Service Building & SE Yard	0.011	0.268
10213B	NE Corner of Exclusion Area	0.039	0.968	12203D	Under Service Building & SE Yard	0.014	0.354
10213C	NE Corner of Exclusion Area	0.025	0.616	12204A	Crib House Area	0.009	0.229
10214A	Construction Parking Area	0.009	0.230	12204B	Crib House Area	0.013	0.335
10214B	Construction Parking Area	0.010	0.243	12204C	Crib House Area	0.015	0.383
10214C	Construction Parking Area	0.009	0.227	12205A	Area Under the Turbine Building	0.005	0.135
10214D	Construction Parking Area	0.009	0.232	12205B	Area Under the Turbine Building	0.006	0.15
10214E	Construction Parking Area	0.008	0.195	12205C	Area Under the Turbine Building	0.009	0.22
10214F	Construction Parking Area	0.011	0.278	12205D	Area Under the Turbine Building	0.008	0.199
10219A	Area Far South of Switchyard	0.009	0.235	12205E	Area Under the Turbine Building	0.008	0.211
10219B	Area Far South of Switchyard	0.021	0.525	10301	West Training Area	0.011	0.263

4.1.4 Groundwater (BcSOF_{GROUNDWATER})

The fourth and last variable in the compliance equation is dose from groundwater. The monitoring program and results are described in the ZionSolutions TSD 14-003, Conestoga Rovers & Associates (CRA) Report, "Zion Hydrogeologic Investigation Report" (Reference 16). The historical groundwater monitoring results are summarized in LTP Section 2.3.6.5.

No significant groundwater contamination had been identified by groundwater monitoring prior to the commencement of decommissioning activities and was not expected to be present at the time of license termination. The LTP specified that if groundwater contamination was identified during decommissioning, then the dose would be calculated using the BFM Groundwater Exposure Factors from LTP Section 6.6.5, Table 6-18, which is reproduced below as Table 10. The BFM Groundwater Exposure Factors presented are fully applicable to any groundwater contamination, regardless of the location.

Table 10 – Groundwater Exposure Factors for BFM Model

Radionuclide	GW Exposure Factor (mrem/y per pCi/L)
Co-60	2.50E-02
Cs-134	8.75E-02
Cs-137	6.94E-02
Eu-152	3.62E-03
Eu-154	5.26E-03
H-3	4.43E-05
Ni-63	9.78E-04
Sr-90	1.09E-01

In May of 2006, tritium (H-3) was positively detected in one well at a maximum observed concentration of 586 pCi/L. Also, in May of 2006, Sr-90 was positively detected in a well up-gradient from the groundwater flow direction and that should not have been impacted by ZNPS activities. As the observed Sr-90 concentrations were barely above the MDC of the analysis, and the results within the range of uncertainty, the results were classified as false positive.

From 2006 until 2020, ZSRP has monitored eleven (11) wells on a quarterly basis in accordance with the Zion Radiological Groundwater Protection Program (RGPP). All samples were analyzed for tritium, gamma radionuclides, gross-alpha and beta (suspended and dissolved), hard-to-detects, and Sr-90. Gamma-radionuclides and HTD radionuclides (including Fe-55, Ni-63 and Sr-90) were not positively detected in any groundwater monitoring sample taken from any of the eleven (11) wells since May of 2006. In addition, from 2006 until the 1st quarter of 2018 and from the 1st quarter of 2019 until the present, tritium was not positively detected at a concentration greater than the MDC of 200 pCi/L. However, during the 1st and 3rd quarter of 2018 into the 1st quarter of 2019, samples taken from well MW-ZN-08S indicated positive tritium at concentrations exceeding the MDC of the analysis. The positive tritium results ranged from 200 to 416 pCi/L. It was postulated that the source of the tritium was slightly contaminated concrete that was placed on the ground in the vicinity of the well prior to loadout and disposal as waste. There are no other indications of positively detected plant-derived radionuclides being detected in any well sample since.

To determine the mean BcSOF from groundwater, ZSRP will conservatively use the maximum observed positively detected tritium concentration of 586 pCi/L as representative of any potential residual tritium radioactivity in groundwater. As no other radionuclides were positively detected in groundwater since the units were placed into SAFSTOR in 1988, only tritium will be included for the assessment of compliance dose. The tritium concentration of 586 pCi/L was multiplied by the BFM Groundwater Exposure Factor for tritium of $4.43\text{E-}05$ mrem/y per pCi/L to determine a dose of 0.026 mrem/year. A fraction of allowable dose was then calculated by dividing the extrapolated dose by 25 mrem/year. The dose fraction for all positively detected ROC were then summed to derive the variable "BcSOF_{GW}". The dose fraction of 0.001 (which equates to a dose of 0.026 mrem/year) is the value used for the variable "Max BcSOF_{GROUNDWATER}" in the compliance equation (Equation 3).

4.2 Demonstrating Compliance with Dose Criteria

The compliance dose was calculated using Equation 6-11 in the LTP after FSS was completed in all survey units. The equation is replicated below as Equation 3 to this report.

Equation 3

$$\text{Compliance Dose} = (\text{Max BcSOF}_{\text{BASEMENT}} + \text{Max BcSOF}_{\text{SOIL}} + \text{Max BcSOF}_{\text{BURIED PIPE}} + \text{Max SOF}_{\text{GROUNDWATER}}) \times 25 \text{ mrem/year}$$

where:

Compliance Dose	=	must be less than or equal to 25 mrem/year,
Max BcSOF _{BASEMENT}	=	Maximum Base Case Sum-of-Fraction (BcSOF) (mean of FSS systematic results plus the dose from any identified elevated areas) for backfilled basements (including surface, embedded pipe, penetrations and fill [if required]),
Max BcSOF _{SOIL}	=	Maximum BcSOF (mean of FSS systematic results plus the dose from any identified elevated areas) for open land survey units,
Max BcSOF _{BURIED PIPE}	=	Maximum BcSOF (mean of FSS systematic results plus the dose from any identified elevated areas) from buried piping survey units,
Max SOF _{GROUNDWATER}	=	Maximum SOF from existing groundwater

Using the values for each of the variables, this equation can also be expressed as:

Equation 4

$$(0.444 + 0.040 + 0.227 + 0.001) \times 25 \text{ mrem/yr} = 17.806 \text{ mrem/year TEDE}$$

4.3 Final Dose Summation

The dose summation for compliance was determined in accordance with LTP Section 6.17. The total dose applied to the ZNPS site is 17.806 mrem/year, which meets the unrestricted release criteria established in 10CFR20.1402. The FSS results provided in this report, combined with the FSS results documented in the five (5) FSSRs that were previously submitted (Phase 1, Phase 2 Part 1, Phase 2 Part 2, Phase 3 and Phase 4) clearly demonstrate that any residual radioactive material remaining on the Zion site results in a dose to the AMCG that does not exceed 25 mrem/year and that the residual radioactivity has been reduced to levels that are ALARA.

5 IMPACT OF RELEASE OF THE AREAS

With the exception of decommissioning activities at the ISFSI to be undertaken when all spent fuel has been removed, all decommissioning and dismantlement activities have been completed at the ZNPS site. Thus, no additional activities are required in these subject survey units for ZionSolutions to release them.

5.1 Potential for Cross-Contamination from Subsequent Activities

Prior to implementing FSS, survey units were isolated and controlled in accordance with the LTP, Section 5.6.3. This included posting of the survey units as well as notifications to site personnel. Prior permission to enter and work in these areas was required to be obtained from FSS personnel. During decommissioning, control measures were placed on the release of material from Radiologically Controlled Areas (RCA) which decreased the probability that the survey units would be impacted from decommissioning activities. These control measures included contamination containment, dust control, storm water runoff measures, building demolition controls, and additional evaluations and radiological surveys of materials leaving the RCA.

The LTP, Section 5.12, describes periodic surveillances/re-surveys to confirm that no radioactive material had been introduced into the survey units that would potentially invalidate the results of the FSS or the final configuration of the survey unit. These isolation and control measures occurring prior to, during, and following FSS, have been implemented in these subject survey units through approved procedures. These procedures were in effect at the time of turnover to the Characterization/License Termination (C/LT) Group and remained in effect throughout site final survey activities and until the risk of recontamination from decommissioning activities was alleviated.

The requirements for decommissioning activities, as well as the additional protections afforded from FSS isolation and control measures, provide strong assurance that the potential for cross-contamination of the subject survey units is minimal. In addition, the site has carried out an erosion control program (Storm Water Pollution Prevention Plan) (Reference 17) to reduce the potential for soil erosion into adjacent land areas and surface water bodies.

The spent fuel at the ISFSI is stored in the NAC MAGNASTOR spent fuel cask storage system. The main components of the system are the transportable storage canister (TSC), the vertical concrete cask (VCC), and the MAGNASTOR transfer cask (MTC). The canisters were placed in VCCs for shielding and physical protection and set on the ZNPS ISFSI pad. The NAC MAGNASTOR System is a sealed and leak-tight spent fuel storage system and consists of sixty-five dry cask storage canisters including four Greater-Than-Class C (GTCC) waste canisters. In addition, in-process inspections and tests were performed during fabrication and sealing of the canisters. Consequently, there is no release of radioactive material during normal conditions of storage. The structural analysis of the canister for off-normal and accident conditions of storage shows that the canister is not breached in any of the evaluated events. Consequently, there is no release of radioactive material during off-normal and accident conditions of storage that could impact the survey units proposed for release. The ISFSI facility is managed and monitored in accordance with NRC Regulations 10 CFR Part 72, which includes radiological monitoring.

5.2 Impact of Releasing the Subject Survey Units on Part 50 License Basis

The license basis for the ZNPS includes the maintenance of certain programs to fulfill regulatory requirements and functional responsibilities. Throughout decommissioning, these programs have been modified as necessary and terminated when the applicable concern is no longer relevant. These program changes are implemented using the change processes specified for each type of program. The methodology for releasing land requires a review and assessment of the impact on license programs for the site lands remaining within the domain of the Part 50 license. The NRC accepted this approach included in the LTP via License Amendment. The impact of releasing the subject survey units from the Part 50 license on each of the licensing programs is described below. With this submittal, ZionSolutions is not requesting NRC approval of any potential changes described herein.

5.2.1 Technical Specifications

The Zion Defueled Technical Specifications are not impacted by the release of the subject survey units, as a size and description of the site are not included in the Technical Specifications. The survey and release are consistent with the LTP and associated License Condition.

The NAC MAGNASTOR Technical Specifications, associated with allowable surface contamination on the cask after loading, were based upon limiting the dose at the Controlled Area Boundary (CAB) due to a total mechanistic release of the surface contamination. The closest CAB distance is the southern site boundary at 772 feet. As stated in Section 10.3 of the ISFSI 10 CFR 72.212 Report (Reference 18), an occupancy dose at 772 feet from the ISFSI, to the nearest real individual, is based on direct exposure of 11.8 mrem/year (long-term camper on the camp site closest to the ISFSI at the Illinois Beach State Park). The partial site release will not affect the basis for this Technical Specification, as the assumed residual plant area dose from all exposure pathways meets the radiological dose criteria from all exposure pathways as specified in 10 CFR 20.1402. In the assessment of direct exposure, a very conservative assumption of combining the projected boundary dose from the ISFSI and the maximum residual plant area dose from direct exposure to soil (0.994 mrem/year), the result (12.794 mrem/year) confirms that the Technical Specification basis will continue to be maintained after partial site release has been implemented.

The ComEd switchyard is within the *ZionSolutions* controlled area. Access to the switchyard by ComEd workers is controlled and verifiable. Personnel entering this area are treated as members of the public in the Controlled Area; therefore, a dose limit of 100 mrem/hour under 10 CFR 20.1301 is applicable. Using a bounding occupancy of 2,088 hours/year, the annual dose for work in the switchyard is anticipated to be 37.6 mrem/year. This dose is well within the limit of 100 mrem/year.

5.2.2 Final Safety Analysis Report (FSAR) and Environmental Report

The Decommissioning Final Safety Analysis Report will require minor edits to Section 2 to describe the reduced site area resulting from the removal of the subject area from the Part 50 License.

During preparation of the LTP, the impacts on information provided in the "Final Environmental Statement related to operation of Zion Nuclear Power Station Units 1 and 2" (Reference 19) and NUREG-0586, Supplement 1, Volume 1, "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities" (Reference 20) were evaluated. The information contained within the LTP was determined to be consistent or bounded by the information in the Environmental Report and the Environmental Impact Statement. The process of partial site release was included in the LTP, and this partial site release is being proposed consistent with the process in the LTP. Thus, the Environmental Report, Environmental Impact Statement and conclusions in Section 8 of the LTP concerning NUREG-0586 are not impacted by partial site release.

5.2.3 ISFSI Emergency Plan

As the former nuclear plant has been dismantled and decommissioned, the Emergency Plan for the site has been revised to address the ISFSI only. The ISFSI Emergency Plan describes the location of the ISFSI, the radiologically controlled and protected areas, and the CAB. None of these locations/areas will be affected by the proposed partial site release. Although portions of the CAB are included in the area proposed for partial site release, ZionSolutions will continue to maintain control of this area.

5.2.4 Security Plan

The Security Plan will not be affected by the release of the proposed areas from the Part 50 license.

5.2.5 Off-Site Dose Calculation Manual

Gaseous, liquid, and solid radioactive waste systems associated with the operation of the ZNPS have been removed and disposed of. Site decommissioning activities have been concluded for the site (except those required in the future for the ISFSI), and discharges of radioactive material (gaseous or liquid) are no longer made. In addition, the ISFSI casks are considered to be leak tight under normal and various postulated accident conditions, and thus are not a source of effluent.

Accordingly, the Off-Site Dose Calculation Manual (ODCM) (Reference 21) has been revised to address only the ISFSI. Monitoring in accordance with the ODCM continues and will not be impacted by the proposed partial site release. Thus, the ODCM will not be affected by the release of the proposed areas.

5.2.6 Environmental Monitoring Program

Gaseous, liquid, and solid radioactive waste systems associated with the operation of the ZNPS have been removed and disposed of. Site decommissioning activities have been concluded for the site (except those required in the future for the ISFSI), and discharges of radioactive material (gaseous or liquid) are no longer made. In addition, the ISFSI casks are considered to be leak tight under normal and various postulated accident conditions, and thus are not a source of effluent.

ZNPS received a 'No Further Remediation Letter' from the Illinois Environmental Protection Agency on November 7, 2017 (Reference 22). The letter verified that ZionSolutions had demonstrated that the remediation objectives were completed in accordance with the site's Remedial Action Plan, and 35 Illinois Administrative Code Part 740.

Accordingly, the Environmental Monitoring Program has been revised to address monitoring associated with the ISFSI only. The Environmental Monitoring Program will not be affected by the release of the proposed areas.

5.2.7 Groundwater Monitoring Program

The Groundwater Monitoring Program is intended to integrate all aspects of groundwater characterization, monitoring and remediation required to support unrestricted release of the ZNPS site. All monitoring and supply wells on site have been abandoned with concurrence of the NRC. The Groundwater Monitoring Program is no longer required for the purposes of the Part 50 license.

5.2.8 Fire Protection Program

The ISFSI Fire Protection Program will not be affected by the release of the subject survey areas from the Part 50 license.

5.2.9 Training Program

The training program for the ISFSI structures, systems and components that are important to safety will not be affected by the release of the subject areas from the Part 50 license.

5.2.10 Post-Shutdown Decommissioning Activities Report

The PSDAR does not contain a description of the site in detail, therefore, changes are not required.

5.2.11 License Termination Plan

The requested release is consistent with the information in the LTP concerning FSS and partial site release. A minor revision will be made to the LTP to revise the area of the site still under the Part 50 license after this request is approved by the NRC.

5.2.12 Compliance with 10 CFR 100 Siting Criteria

The release of the subject property has been reviewed with respect to the siting criteria in 10 CFR 100 and it has been determined that the requirements of 10 CFR 100 are either not impacted (e.g., 10 CFR 100.11, Determination of Exclusion Area, Low Population Zone, and Population Center Distance, or 10 CFR 100, Appendix A, Seismic and Geologic Siting Criteria) or are not applicable (e.g., 10 CFR 100, Subpart B, Evaluation Factors for Stationary Power Reactor Site Application on or after January 10, 1997). The reactor vessel has been defueled and removed from the site for disposal. The spent fuel has been relocated into the licensed ISFSI area.

5.3 Consideration of Interaction between the Proposed Partial Site Release and the Previously Released Site and between the Proposed Partial Site Release and Remaining Licensed Site

Appendix L to NUREG 1757, Volume 2, provides guidance for the licensee to identify and analyze the potential interaction between the proposed site release and any other on-site sources. That guidance has been integrated into this partial site release request.

The following sections describe effects of interaction between the proposed site release and previously released site and interaction between the proposed site release and the remaining licensed site.

5.3.1 Effects on the Proposed Site Release from Previous Land Release

On August 27, 2015, *ZionSolutions* submitted a request (ADAMS Accession No. ML15243A029) to release the non-impacted portion of the Zion site from the 10 CFR 50 license in accordance with 10 CFR 50.83, Release of Part of a Power Reactor Facility or Site for Unrestricted Use, and 10 CFR 100, Reactor Site Criteria. A report was generated for the request that addressed the release of 214 of the 331 acres that comprised the Zion site. That report contains a summary of the final assessment performed as well as a summary of the characterization surveys performed of these non-impacted open-land survey units. *ZionSolutions* reviewed and assessed the subject property to ensure that the radiological condition of these land areas will have no adverse impact on the ability of the site, in aggregate, to meet the 10 CFR 20, Subpart E, Radiological Criteria for License Termination. The eleven (11) survey units incorporated within the report were classified as non-impacted, and as such, no statistical tests, scan measurements, static measurements, or elevated measurement comparisons were required. The release of the non-impacted areas from the license(s) was approved by the NRC on March 31, 2016.

These previously released areas were classified as non-impacted and as such, the release criteria were “no detectable plant-related radioactivity above background.” Any migration of material from the previously released areas to the proposed release area (although very unlikely) would have radionuclide concentrations which are well below the Operational DCGLs used in the areas of the proposed release. Therefore, the previous land release will not have an adverse effect on the areas of the proposed release.

5.3.2 Dose Effects on ISFSI Land (i.e., land that will remain under jurisdiction of the Part 50 license)

The Zion ISFSI is located within the site boundary of the existing Zion site. The CAB for an ISFSI, as defined in 10 CFR 72.3, is the area immediately surrounding an ISFSI for which the Licensee exercises authority regulating its use and within which ISFSI operations are performed. The ISFSI CAB will encompass some of the land being requested by this

submittal for release from jurisdiction of the Part 50 license. However, this area will continue to be under the authority and control of ZionSolutions until the licenses are transferred back to Exelon in accordance with the Asset Sales Agreement.

As stated previously, certain land around the ISFSI is not the subject of the proposed site release and will remain in the Zion Part 50 license. A radiological evaluation was performed for the ISFSI in accordance with 10 CFR 72.212 (b)(2)(i)(C) to establish that the requirements of 10 CFR 72.104 have been met. These requirements specify that the annual dose equivalent to any individual who is located beyond the CAB, from normal operation or any anticipated occurrences at the ISFSI, would not exceed 25 mrem to the whole body, 75 mrem to the thyroid and 25 mrem to any other critical organ as a result of exposure to:

- (1) planned discharges or radioactive materials,
- (2) direct radiation from the ISFSI, and
- (3) any other radiation from uranium fuel cycle operations within the region.

The spent fuel at the ISFSI is stored in the NAC MAGNASTOR System. The NAC MAGNASTOR System is a sealed and leak-tight spent fuel storage system. In addition, in-process inspections and tests were performed during fabrication and sealing of the canisters. Consequently, there is no release of radioactive material during normal conditions of storage. The structural analysis of the canister for off-normal and accident conditions of storage shows that the canister is not breached in any of the evaluated events. Consequently, there is no release of radioactive material during off-normal and accident conditions of storage that could impact the survey units proposed for release.

The NAC MAGNASTOR Technical Specifications, associated with allowable surface contamination on the cask after loading, were based upon limiting the dose at the Controlled Area Boundary (CAB) due to a total mechanistic release of the surface contamination. The closest CAB distance is the southern site boundary at 772 feet. As stated in Section 10.3 of the ISFSI 10 CFR 72.212 Report (Reference 23), an occupancy dose at 772 feet from the ISFSI, to the nearest real individual, is based on direct exposure of 11.8 mrem/year (long-term camper on the camp site closest to the ISFSI at the Illinois Beach State Park). The partial site release will not affect the basis for this Technical Specification, as the assumed residual plant area dose from all exposure pathways meets the radiological dose criteria from all exposure pathways as specified in 10 CFR 20.1402. In the assessment of direct exposure, a very conservative assumption of combining the projected boundary dose from the ISFSI and the maximum residual plant area dose from direct exposure to soil (0.994 mrem/year), the result (12.794 mrem/year) confirms that the Technical Specification basis will continue to be maintained after partial site release has been implemented.

The ComEd switchyard is within the *ZionSolutions* controlled area. Access to the switchyard by ComEd workers is controlled and verifiable. Personnel entering this area are treated as members of the public in the Controlled Area; therefore, a dose limit of 100 mrem/hour under 10 CFR 20.1301 is applicable. Using a bounding occupancy of 2,088 hours/year, the annual dose for work in the switchyard is anticipated to be 37.6 mrem/year. This dose is well within the limit of 100 mrem/year.

Doses associated with the uranium fuel cycle operations at Zion no longer exist, and the areas to be released meet the criteria for unrestricted release in 10 CFR 20.1402. Thus, the limit of 25 mrem/year stipulated in 10 CFR 72.104 and 40 CFR 190, is satisfied.

5.3.3 Dose Effect on the Proposed Site Release from the Remaining Decommissioning Activities at the Remaining Zion Site

Decommissioning activities have been completed at Zion. Only activities associated with maintenance and operation of the ISFSI are being conducted. As previously discussed, the casks stored in the ISFSI are sealed and leak-tight such that there is no release of radioactive materials in normal, off-normal or accident conditions.

Also discussed previously, the dose to a member of the public outside the CAB of the ISFSI will be less than the 25 mrem/year dose as stipulated in 10 CFR 72.104.

5.4 Additional Areas to be Addressed to Support the Release of the Subject Survey Units

ZionSolutions will maintain the following records through license termination: (1) a map of the site identifying the facility and site as defined in the original license; (2) a record of the Phase 1, Phase 2-Part 1, Phase 2-Part 2, Phase 3, and Phase 4 survey units released under this action; and (3) documentation of the radiological conditions of the land released under this action.

5.5 Site Release Criteria

The site release criteria for the Zion site correspond to the 10 CFR 20.1402 criteria for unrestricted use. The residual radioactivity, including that from groundwater sources, that is distinguishable from background, must not cause the TEDE to an AMCG to exceed 25 mrem/year. The residual radioactivity must also be reduced to levels that are As Low As Reasonably Achievable (ALARA).

The results of the final compliance dose have been calculated using Equation 1 and using the maximum BcSOF for the four dose components. As shown in Equation 4, the final dose summation is 17.806 mrem/year which meets the release criterion as established in 10 CFR 20.1402.

The ALARA criteria for soils, as specified in Chapter 4 of the LTP, were achieved.

5.6 Final Status Survey

The ZNPS LTP, Chapter 5, states that the FSS Plan encompasses the radiological assessment of all affected basement structures, buried pipe, and land areas for the purpose of quantifying the concentrations of any residual activity that exists following all decontamination activities. FSS were performed and reports submitted for the subject survey units, as indicated in Tables 1 through 5.

As described in Section 3.2, the reports consisted of a survey unit Release Record prepared for each survey unit, and several final reports which are compilations of numerous survey units which were submitted to the NRC in a phased approach. Final Reports were written consistent with the guidance provided in NUREG-1757, Vol. 2, MARSSIM, and the LTP.

These reports concluded that the radiological surveys were conducted in a manner consistent with the LTP and that the survey units passed the FSS. The final reports indicated that:

- each survey unit addressed in the FSSRs have met the Data Quality Objectives (DQOs) of the FSS sample plans,
- all identified ROC were used for statistical testing to determine the adequacy of the survey unit for FSS,
- the sample data in each survey unit passed the Sign test,
- a Retrospective Power Curve showed that adequate power was achieved in each survey unit, and
- the allowable dose for each survey unit have been met.

5.7 Conclusion

The release of the subject survey units is part of ZionSolutions' overall effort to achieve unrestricted release of the site in accordance with the criteria in Subpart E of 10 CFR 20. This action is also consistent with the approach described in Chapter 5 of the LTP, and is consistent with the approach endorsed by the NRC in their SER that supported approval of the ZNPS LTP.

In addition, 10 CFR 50.82(a)(11) establishes the criteria to be used by the NRC for terminating the license of a power reactor facility that has an approved LTP. These criteria include: (1) dismantlement has been performed in accordance with the approved LTP, and (2) the final radiation survey and associated documentation demonstrate that the facility and site have met the criteria for decommissioning in 10 CFR 20, Subpart E. All decommissioning and dismantlement activities have been completed in the subject survey units, which supports the process of license termination by demonstrating that this portion of the site can be released from the Part 50 license. The FSS have confirmed that the residual radioactivity in each of the survey units meets the criteria established in the LTP. Thus, the action of the release of the

subject survey units supports the overall goal of unrestricted release of the site in accordance with NRC regulations.

6 REFERENCES

1. Zion Nuclear Power Station License Termination Plan, Revision 0, dated December 19, 2014
2. ZS-2014-0290, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "Submittal of Defueled Safety Analysis Report, Revision 8," dated October 1, 2014
3. ZS 2015-0171, U.S. Nuclear Regulatory Commission Letter to *ZionSolutions*, "Request for Additional Information Related to the License Termination Plan for Zion Nuclear Power Station, Units 1 and 2," dated December 10, 2015.
4. ZS 2016-0022, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "License Termination Plan Request for Additional Information," dated March 08, 2016.
5. ZS 2016-0070, U.S. Nuclear Regulatory Commission Letter to *ZionSolutions*, "Request for Additional Information Related to the License Termination Plan for Zion Nuclear Power Station, Units 1 and 2," dated May 31, 2016.
6. ZS 2017-0084, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "License Termination Plan Request for Additional Information," dated July 20, 2017.
7. U.S. Nuclear Regulatory Commission Letter to *ZionSolutions*, "Zion Nuclear Power Station, Units 1 and 2 - Issuance of Amendments 191 and 178 for the Licenses to Approve the License Termination Plan," dated September 28, 2018.
8. ZS 2015-0134, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "Zion Station Request for Partial Site Release," dated August 27, 2015.
9. U.S. Nuclear Regulatory Commission Letter to *ZionSolutions*, "Zion Nuclear Power Station, Units 1 and 2 – Approval of Partial Site Release for Facility Operating License Nos. DPR-39 and DPR-49," dated March 31, 2016.
10. ZS-2018-0093, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "Final Status Survey Final Report – Phase 1," dated November 01, 2018.
11. ZS-2019-0043, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "Revised Final Status Survey Final Report – Phase 1," dated June 21, 2019.
12. ZS-2019-0090, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "Revised Final Status Survey Final Report – Phase 2," dated September 30, 2019.
13. ZS-2019-0101, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "Final Status Survey Final Report – Phase 2, Part 2," dated November 25, 2019.

Attachment to ZS-2020-0011

Supporting Information for the Phased Release of Land
from the 10 CFR Part 50 License



14. ZS-2019-0114, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "Final Status Survey Final Report – Phase 3," dated December 30, 2019.
15. ZS-2020-001, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, Final Status Survey Final Report – Phase 4," dated May 1, 2020.
16. *ZionSolutions* TSD 14-003, Conestoga Rovers & Associates (CRA) Report, "Zion Hydrogeologic Investigation Report."
17. "Storm Water Pollution Prevention Plan for Construction Activities Associated with the Zion Nuclear Power Station Decommissioning Project", Revision 0
18. *ZionSolutions* Technical Support Document (TSD) 19-001, "ISFSI Controlled Area Dose Evaluation," Revision 0.
19. Commonwealth Edison Company, "Final Environmental Statement Related to Operation of Zion Nuclear Power Station Units 1 and 2" – May 1971, Supplement 1 – November 1971, Supplement II – December 1971, Supplement III – February 1972, Supplement IV – April 1972, Supplement V – May 1972.
20. U.S. Nuclear Regulatory Commission NUREG-0586, "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities", Supplement 1, Volume 1" – November 2002.
21. ZS-2019-0036, *ZionSolutions* Letter to U.S. Nuclear Regulatory Commission, "Radioactive Effluent Release Report, Radioactive Effluent Control Program Report, Offsite Dose Calculation Manual and Process Control Program for 2018," dated April 22, 2019.
22. Illinois Environmental Protection Agency, "Letter Pertaining to Adequacy of Environmental Remediation - No Further Remediation", dated November 07, 2017.
23. ISFSI 10 CFR 72.212 Report.

Figure 1 – Non-Impacted Areas of the Zion Site



Figure 2 – Phase 1 Survey Unit Locations

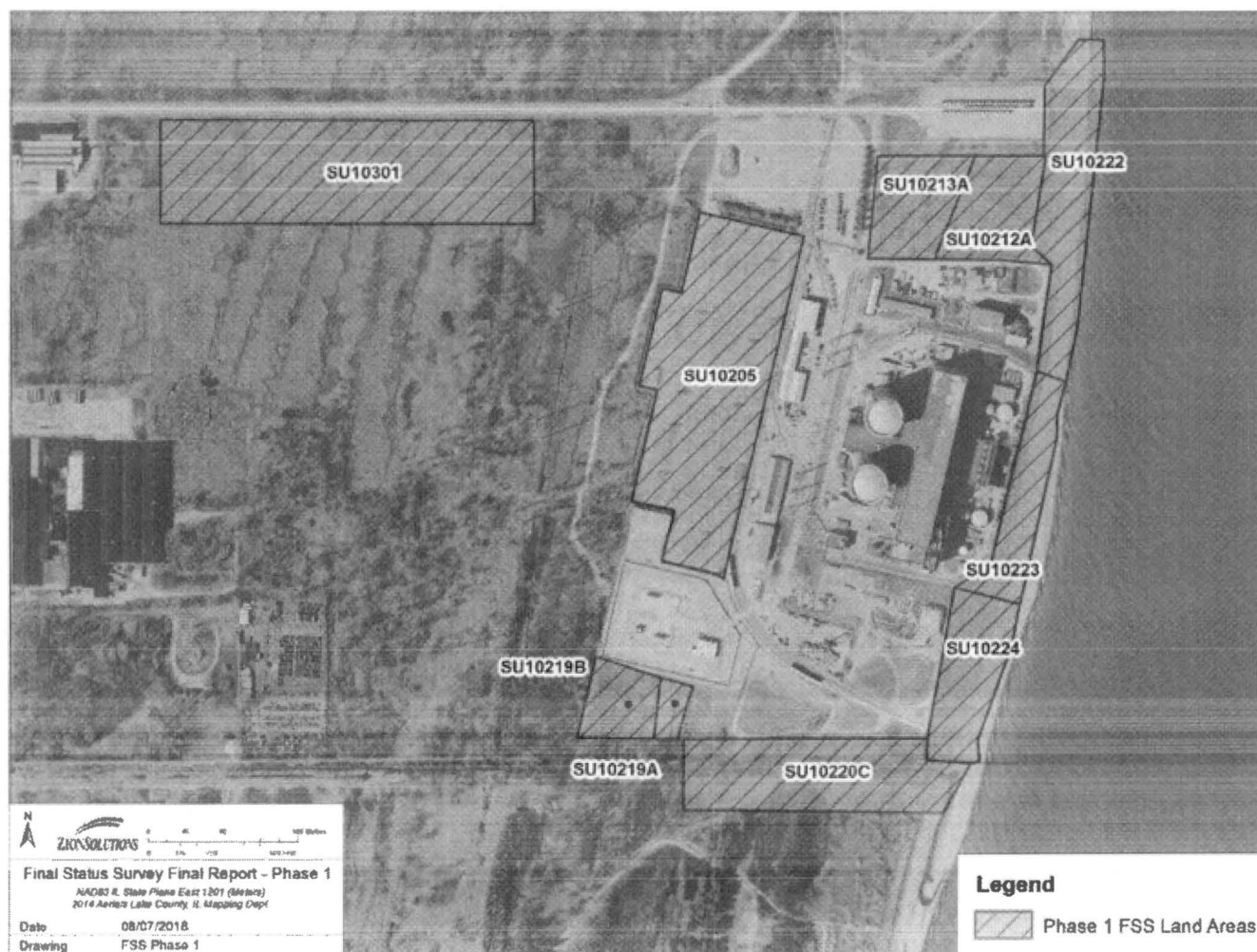


Figure 3 – Phase 2-Part 1 Survey Unit Locations

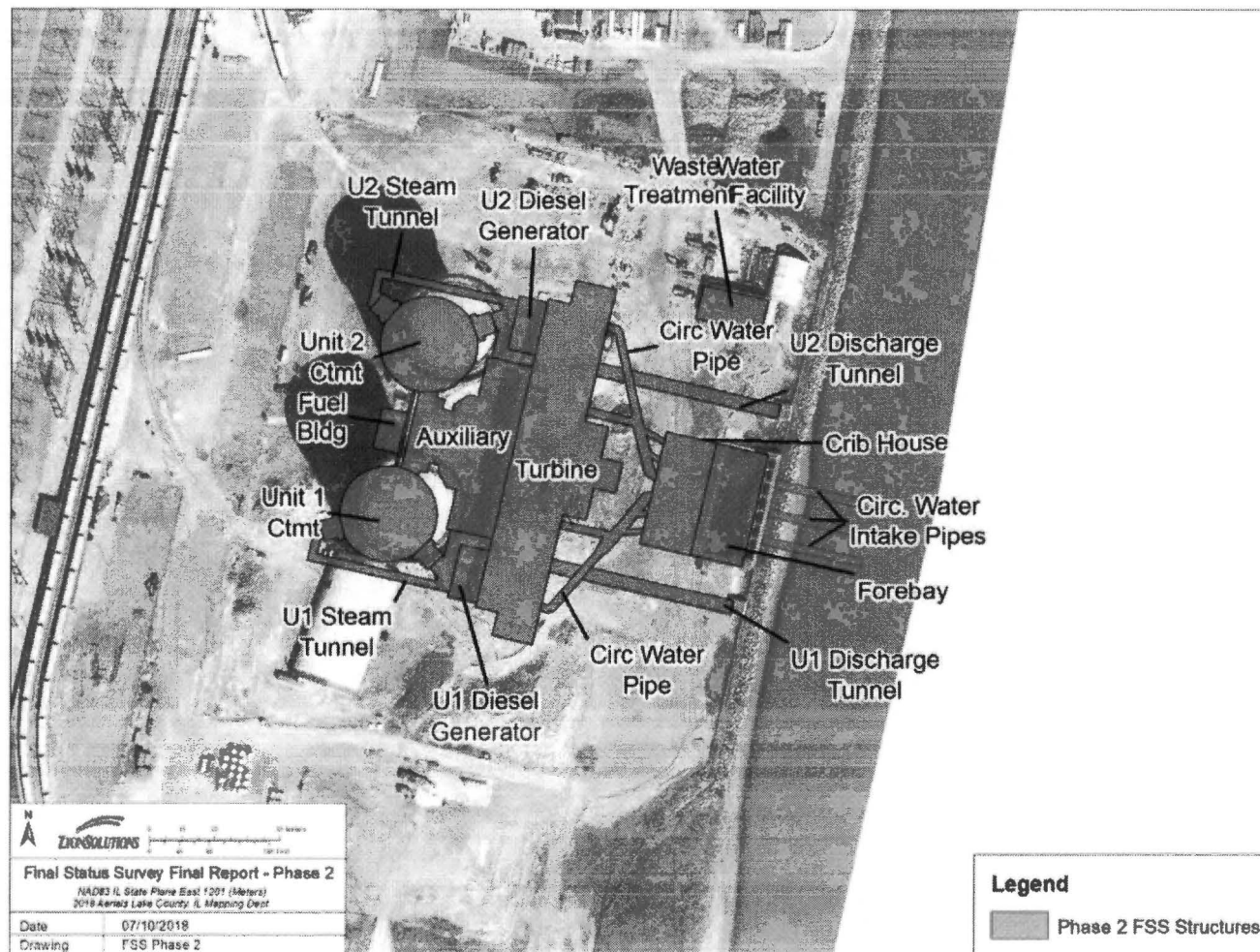


Figure 4 – Phase 2-Part 2 Survey Unit Locations

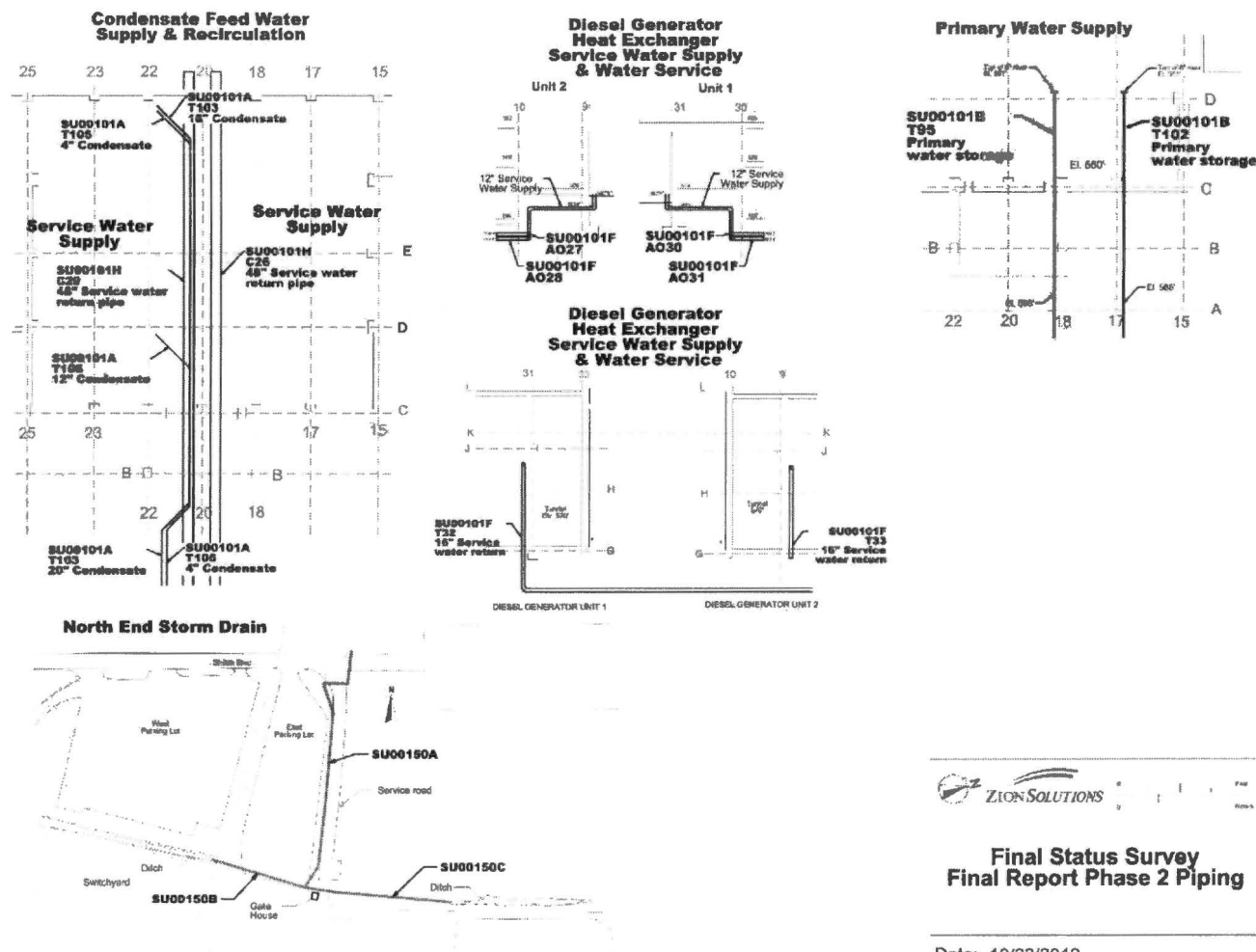


Figure 5 – Phase 3 Survey Unit Locations

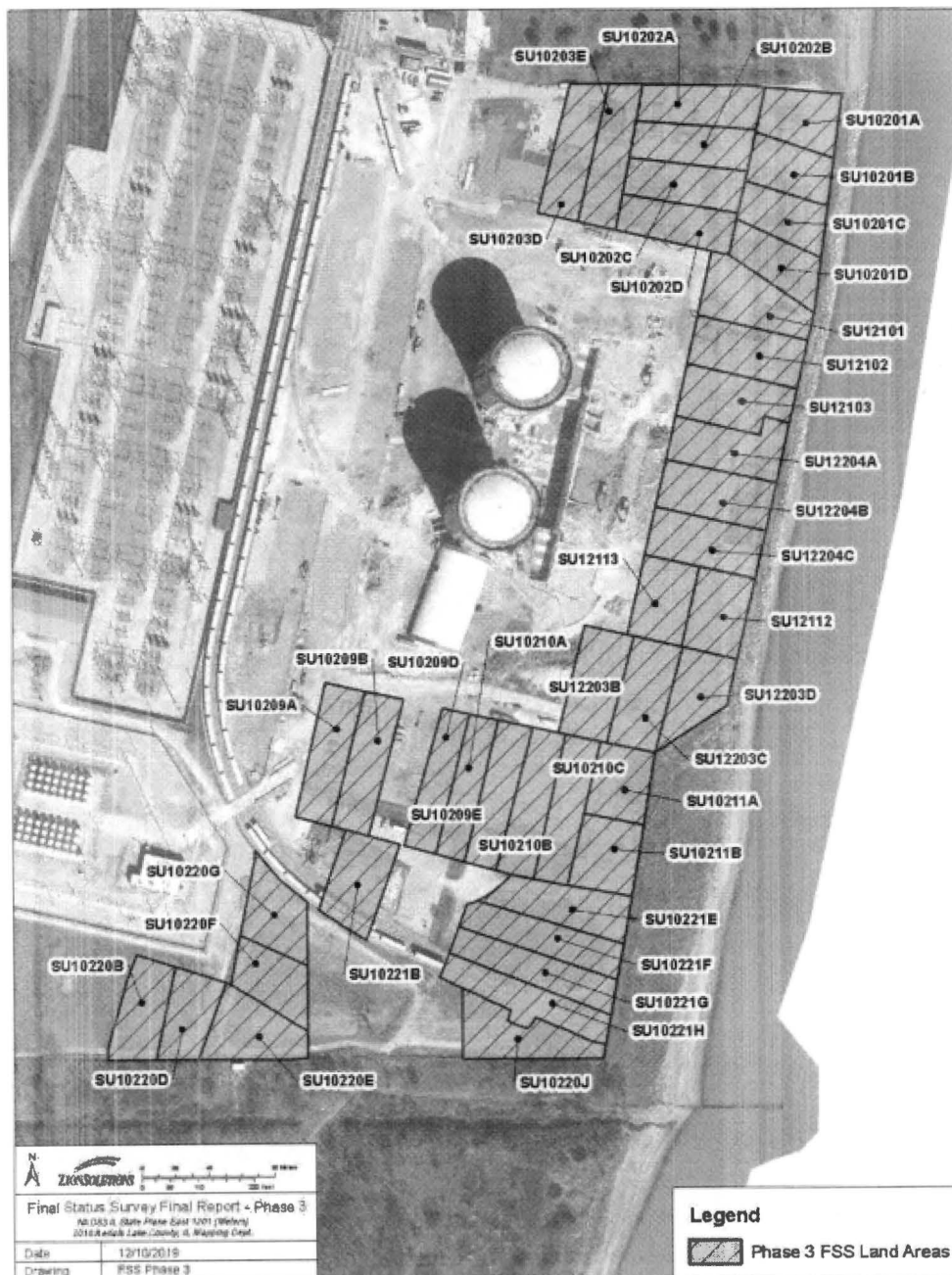


Figure 7 – ISFSI Boundary

