ZION SOLUTIONS LLC
An EnergySolutions Company

ZION STATION RESTORATION PROJECT
FINAL STATUS SURVEY RELEASE RECORD

UNIT 2 CONTAINMENT BASEMENT
SURVEY UNITS 02100/02110

PREPARED BY / DATE:  2019-09-01
David Montt, Radiological Engineer

REVIEWED BY / DATE:  2019-09-01
Robert Massengill, Radiological Engineer

APPROVED BY / DATE:  2019-09-01
D. Wojtkowiak, C/LT Manager

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
AMCG	Average Member of the Critical Group
BcDCGL	Base Case Derived Concentration Guideline Level
BcSOF	Base Case Sum of Fractions
BFM	Basement Fill Model
C/LT	Characterization/License Termination
CP	Circular Plane
DCGL	Derived Concentration Guideline Level
DQA	Data Quality Assessment
DQO	Data Quality Objective
DRL	Depth Relaxation Length
EMC	Elevated Measurement Comparison
ECP	Exponential Circular Plane
FOV	Field-of-View
FSS	Final Status Survey
GW	Groundwater
IC	Insignificant Contributor
ISOCS	In Situ Object Counting System
HTD	Hard-to-Detect
LTP	License Termination Plan
LBGR	Lower Bound of the Gray Region
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	Minimum Detectable Concentration
NRC	Nuclear Regulatory Commission
OpDCGL	Operational Derived Concentration Guideline Level
OpSOF	Operational Sum of Fractions
QAPP	Quality Assurance Project Plan

QC	Quality Control
RE	Radiological Engineer
ROC	Radionuclides of Concern
SOF	Sum of Fractions
ORISE	Oak Ridge Institute for Science and Education
TEDE	Total Effective Dose Equivalent
TSD	Technical Support Document
UBGR	Upper Bound of the Gray Region
UCL	Upper Confidence Level
ZNPS	Zion Nuclear Power Station
ZSRP	Zion Station Restoration Project

1. EXECUTIVE SUMMARY

This Final Status Survey (FSS) Release Record for survey units 02100 and 02110, Unit 2 Containment Basement, has been generated for the Zion Station Restoration Project (ZSRP) in accordance with Zion*Solutions* procedure ZS-LT-300-001-005, *"Final Status Survey Data Reporting"* (Reference 1) and satisfies the requirements of Section 5.11 of the *"Zion Station Restoration Project License Termination Plan"* (LTP) (Reference 2). The FSS package for the Unit 2 Containment Basement includes FSS design and FSS results for the following;

- B1-02100AF Unit 2 Containment above 565 foot
- B1-02110AF Unit 2 Containment Under Vessel Area

Final Status Survey (FSS) sample plans for each of these survey units were developed in accordance with Zion*Solutions* procedure ZS-LT-300-001-001, *"Final Status Survey Package Development"* (Reference 3), the ZSRP LTP, and guidance from NUREG-1575, "*Multi-Agency Radiation Survey and Site Investigation Manual"* (MARSSIM) (Reference 4).

In accordance with ZSRP LTP Chapter 5, section 5.5.2.1.2 and Table 5-19, the Unit 2 Containment basement survey units have a MARSSIM classification of 1. Survey plans were designed based upon use of the Sign Test as the nonparametric statistical test for compliance. Both the Type I (α) and Type II (β) decision error rates were set at 0.05. The Canberra *In Situ* Object Counting System (ISOCS) was selected as the primary instrument used to perform FSS of the Containment basement survey units. As Class 1 survey units, ISOCS measurement locations were designated to ensure 100% areal coverage of all accessible structural surfaces within the survey units.

Based on a measurement Field-of-View (FOV) of 28 m^2 for each ISOCS measurement, it was determined that one hundred and fifty-five (155) ISOCS measurements were required to ensure 100% areal coverage of the Containment above the 565 foot elevation (survey unit 02100) and nineteen (19) ISOCS measurements were identified to provide 100% areal coverage of the Under Vessel area (survey unit 02110).

Modifications to the designed sample plan were required based on the location of measurement center-points. It was determined that some measurement locations were not feasible due to physical constraints and alternate measurement locations were added. After making those adjustments to the sample plan, a total of one hundred and sixty-four (164) ISOCS measurements were taken; sixty-eight (68) on the lower wall above 565 foot and ninety-six (96) on the floor (metal liner) and in the Cavity Flood Sump and the Recirculation Sump. In the Under Vessel area, additional measurements were required due to physical constraints caused by the limited space in the Incore Tunnel Area. A 3-

meter stand-off distance between the detector and the surface undergoing survey was not possible in all cases. Consequently, a total of fifty four (54) ISOCS measurements were required to ensure 100% areal coverage of the wall and floor surfaces in the Under Vessel and Incore Tunnel Area.

The final Radionuclides of Concern (ROC) for the decommissioning of Zion Nuclear Power Station (ZNPS) are Co-60, Cs-134 and Cs-137 (as well as Eu-152 and Eu-154 for Containment), which are gamma emitters and Ni-63, Sr-90 and H-3 (applicable only to Containment), which are Hard-to-Detect (HTD) radionuclides. LTP section 5.1 states that HTD concentrations will be inferred using a surrogate approach and that the maximum ratios from LTP Chapter 5, Table 5-15 will be used unless area-specific ratios as determined by actual survey data are derived.

The results for all ISOCS measurements taken in both survey units indicate that the Sum-of-Fractions (ee) for each measurement, considering the concentration of all applicable ROC, either by direct measurement or by inference, is less than one (1) when applying the respective Operational Derived Concentration Guideline Levels (OpDCGL) for the Containment Basements (Zion*Solutions* Technical Support Document (TSD) 17-004, "*Operational Derived Concentration Guideline Levels for Final Status Survey*" [Reference 5]). Therefore the null hypothesis is rejected and both of the Unit 2 Containment Basement survey units # 02100 and 02110 are acceptable for unrestricted release.

2. SURVEY UNIT DESCRIPTION

The Unit 2 Containment Basement survey units 02100 and 02110 are impacted Class 1 basement FSS units. A basement FSS unit is comprised of the combined internal wall and floor surfaces of each remaining building basement below the 588 foot elevation following demolition. The FSS of the penetrations in the Unit 2 Containment Basement is documented in the Release Record for Survey Unit 02112. The Unit 2 Containment Basement structure is located within Class 1 open land survey units 12201, 12104 and 12105.

The basic decommissioning end-state configuration for the Unit 2 Containment Building is the walls and floors below 588 foot elevation. All 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 Incore Instrument Shaft leading to and including the area under vessel (or Under Vessel area), and the structural concrete outside of the liner. The exposed metal liner was cleaned to levels below the OpDCGLs for basement structures (LTP Chapter 5, Table 5-4).

The large components inside each structure such as the Reactor Vessel, Pressurizer, Steam Generators, Reactor Coolant Pumps, primary piping and all associated systems were removed and disposed of as radioactive waste. The upper steel containment liner, the refuel cavity and all interior walls above the 588 foot elevation were also removed and disposed of as radioactive waste. The outer containment shells above the 588 foot elevation were surveyed and demolished. All waste material was packaged and sent offsite for disposal at approved disposal facilities for radioactive waste.

In accordance with the planned end-state configuration, the concrete floor of the 568 foot elevation was removed to expose the ½-inch steel liner. In this end-state configuration, FSS unit 02100 consisted of the interior side of the steel liner walls below the 588 foot elevation and the 565 foot elevation liner floor. The survey unit also contained the Cavity Flood Sump and the Recirculation Sump. The bottoms of both sumps were located at the 559 foot elevation.

Prior to remediation, the configuration of FSS unit 02110 included the concrete and embedded, ½-inch steel support rings interior to the steel liner below the 565 foot elevation of the Unit 2 Containment Building. The Under Vessel Area walls were 1 foot 11.5 inches thick, and the floor concrete was 2 foot 6 inches thick. The access tunnel had 1 foot 3 inch thick walls, floor, and roof. The embedded steel rings had supported equipment present in the Under Vessel area.

The Zion Station Restoration Project (ZSRP) performed extensive remediation of the concrete located in the Under Vessel area below the 565 foot elevation in Unit 2 Containment. Scabbling and hammering demolition techniques were used to remove at least six inches of concrete from the floor and walls located directly under the reactor vessel and at least six inches of concrete from the walls and sloped floor of the access tunnel. In some places, sufficient concrete was removed to expose the steel liner. Parts of the ½-inch steel support rings were also removed.

Also, during remediation, Pipe #P325, the Unit 2 Containment Incore Sump Drain header, which was embedded in the concrete of the tunnel walls, was completely removed and disposed of as radioactive waste. In the LTP, the Unit 2 Containment Incore Sump Drain header was to remain in the end-state however, due to the extensive amount of remediation of the concrete in the sloped tunnel, it became more cost effective to completely remove the pipe. Therefore, no dose will be assigned to the Unit 2 Containment Basement from embedded pipe 02111.

Figure 1 - Containment Layout

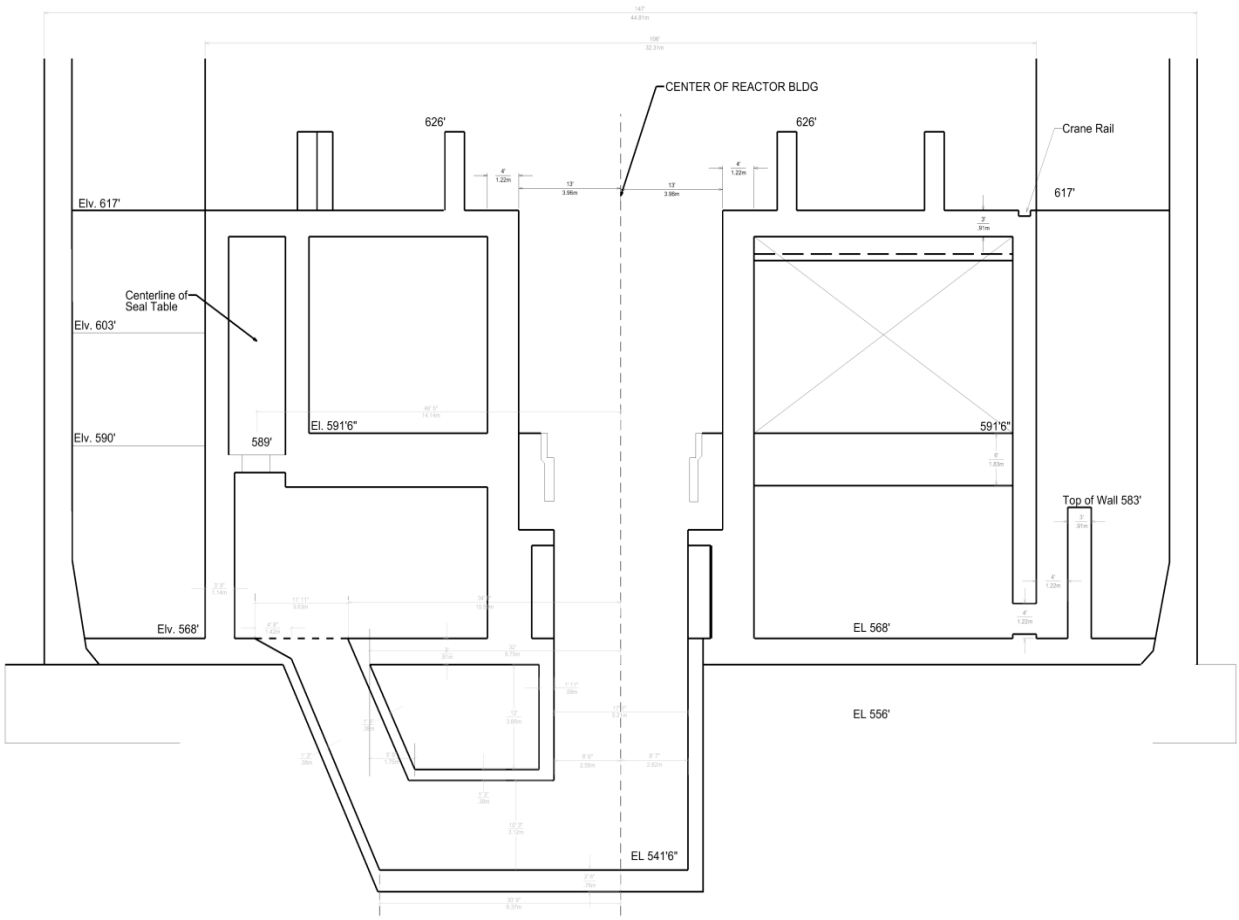

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Figure 2 - Unit 2 Containment 565 Foot Elevation

Figure 3 - Unit 2 Containment Under Vessel

Figure 4 - Unit 2 Containment Incore Tunnel

Figure 5 - Unit 2 Containment Sloped Tunnel

3. CLASSIFICATION BASIS

The Unit 2 Containment housed numerous systems containing primary coolant as well as radioactively contaminated support systems. System leakage and maintenance activities over the operating life of the reactor resulted in the radiological contamination of most of the interior surfaces of the structures. Some components, equipment, structural steel and concrete became radioactive due to neutron activation. Based on the building design basis and the operating history, all internal survey units in Unit 2 Containment Building were given an initial classification of Class 1 in accordance with the "*Zion Station Historical Site Assessment*" (HSA) (Reference 6).

Final Status Survey unit 02100 encompassed the Unit 2 Containment above the 565 foot elevation. The Unit 2 Containment structure housed the Unit 2 Reactor Vessel, Steam Generators and Pressurizer. The HSA noted several occasions of radioactive liquid spill events during plant operation.

Final Status Survey unit 02110 housed the Unit 2 Incore flux monitoring tubes and associated supports. This survey unit was the concrete structure around and beneath the reactor void space (565 foot elevation and below). It provided personnel access to the area under the reactor vessel and housed the Incore sump for collection and recovery of liquids released into the area.

The following summary of processes and incidents was obtained from the HSA:

- May 1980: Due to a valve connection error, a freeze seal was applied to a line connected to the Unit 2 refueling cavity. The freeze seal blew out, causing the spillage of ~2000 gallons of refueling cavity water into the lower portion of Unit 2 Containment (NRC IR 80-12/80-12).
- 08/24/1996 to 10/4/1996 Inspection: Discussion of unplanned spraying of ~3000 gallons of demineralized water into Unit 2 568 foot IMB (NRC IR 96-14/96-14).
- January 1997: 25-100 mR/hr General Area, 80,000 dpm/100cm^2.
- 12/28/1976 to 03/08/1977: Inspection noted flaking paint in Unit 2 Containment (NRC IR -/77-11).
- 08/14/1984: The Containment exceeded the tech spec limit of 120 degrees F. Actual level reached 120.48 degrees F (LER 2-84-020).
- 06/09/1986: Flooding was noted in the Unit 2 Tendon Tunnels from a possible water main problem. On 06/13/1986, Tendon Tunnel drains backed up, supposedly from high lake water level (Zion RP/Decon Logs).

- 06/27/1986: Unit 2 tripped due to lightning strike on one or more of the Containment lightning rods. The surge followed a path from Containment liner to ground via the electrical penetrations (LER 2-86-016 and NRC 86-13/86-12).
- 05/07/1990: During refueling, a piece of grid strap was observed falling from the assembly. All cladding appeared to remain intact (LER 2-90-006).
- 05/13/1992: Approximately 4200 gallons of RCS water was inadvertently sprayed into Containment though the 2A CS header – A GSEP was declared (NRC IR 92-10/92-10 and Zion RP/Decon Log).
- November 1996: 40-50% of concrete floor coatings in Unit 2 Containment showed extensive failure. Unqualified coatings (~1200 ft^2) were observed on various components including instrument racks, struts, filter housings, valve bodies, and piping (NRC IEN 97-24).

During the time that initial characterization was performed, all radioactive systems and components were still located inside Containment. Consequently, ambient radiation dose rates inside the Containment prohibited the direct assessment of concrete and steel structural surfaces below the 588 foot elevation by scanning or direct measurement.

On 11/09/2010, an initial characterization survey of the Incore surfaces was conducted (Survey #2980). Fourteen (14) out of twenty (20) smears collected in the area were greater than 1,000 dpm/100cm^2; the highest loose surface contamination indication was 127,000 dpm/100cm^2. The maximum dose rate recorded in the area was 35 mR/hr.

From June of 2012 through January of 2013, site characterization was performed in Unit 2 Containment. The characterization survey consisted of a series of concrete core samples taken in the 568 foot concrete floor, the 541 foot Incore Tunnel floor and Incore Tunnel walls. The locations selected for the concrete core sampling were biased toward locations where physical or observed radiological measurements indicated the presence of fixed and/or volumetric contamination of the concrete media. When possible, locations were determined based upon elevated observed contact dose rates or count rates. In addition, visual observations of floor and wall surfaces were used to identify potential locations of surface contamination, such as discoloration or standing water. The goal was to identify, to the extent possible, the locations that exhibited the highest potential of representing the worst case bounding radiological condition for concrete in each survey unit. This judgmental sampling approach also ensured there was sufficient source term in the cores to achieve the sensitivities required to determine the radionuclide distributions of gamma emitters as well as HTD radionuclides.

Sixteen (16) concrete core samples were taken on the 568 foot elevation of the Unit 2 Containment, eight inside the missile shield and eight outside of the missile shield.

Three (3) concrete core samples were obtained from each of the Incore Tunnel Under Vessel areas. Two (2) concrete core samples were taken from the 541 foot elevation floor and one was taken from the wall directly under each reactor vessel.

The results of the site characterization surveys performed from 2010 to 2013 are documented in Zion*Solutions* Technical Support Document (TSD) 14-028, *"Radiological Characterization Report"* (Reference 7) and in Chapter 2 of the LTP. A summary of the on-site gamma spectroscopy results for the analysis of the concrete cores taken from the Unit 2 Containment 568 foot elevation is presented in Table 1. A summary of the on-site gamma spectroscopy results for the analysis of the concrete cores taken from the Containment Incore Tunnel areas are presented in Table 2. A summary of the analysis of select concrete cores for the full suite of radionuclides by an off-site laboratory is presented in Table 3. The locations where the core samples were taken are illustrated in Figures 6 and 7.

For the Unit 2 568 foot elevation, the sample analysis indicated that the majority of the radionuclide source inventory resided within the first ½-inch of concrete and that Cs-137 was the dominant radionuclide. For the Unit 2 Under Vessel area, the maximum dose rate recorded was 15 mR/hr and the maximum loose surface contamination smear indicated 90,000 dpm/100cm^2, which was taken at the plate that supports the Incore tubes (Survey #2013-0046). Sample B1-02110-CJF-CCV-001 showed the majority of activity above Minimum Detectable Concentration (MDC) for Co-60, Cs-137, and Eu-152 was to a depth of 14 inches (entire core). The majority of Eu-154 source term was in the first 10 inches. Sample B1-02110-CJF-CCV-002 showed the majority of activity above MDC for Co-60, Eu-152, and Eu-154 was to a depth of 4.5 inches (entire core). The majority of Cs-137 source term was in the first ½-inch. Sample B1-02110-CJW-CCV-003 showed the majority of activity above MDC for Co-60, Cs-137, Eu-152, and Eu-154 was to a depth of 5.5 inches (entire core).

The top ½-inch puck from eight (8) of the nineteen (19) cores from Unit 2 were sent to Eberline Laboratories for gamma spectroscopy and HTD analyses for radionuclides such as H-3, C-14, Tc-99, Ni-63, Sr-90, and alpha emitters. Significant HTD radionuclides identified by the analysis of the concrete core samples included Ni-63, H-3 and Sr-90. The other radionuclides positively detected at concentrations greater than their respective MDC included; C-14, Tc-99, Pu-238, Pu-239/240, Am-241, Am-243 and Cm-243/244.

Table 1 - Unit 2 Containment 568 Foot Elevation Concrete Core Sample Analysis Summary

Location	Sample ID#	Core Depth (inches)	Co-60		Cs-137	
			Surface Activity (1) (pCi/g)	Avg. Subsurface Activity (2) (pCi/g)	Surface Activity (1) (pCi/g)	Avg. Subsurface Activity (2) (pCi/g)
"A" Loop I/S Missile Barrier	B102102-CJFCCV-001	3.0	7.56E+02	1.78E+02	1.10E+05	1.66E+04
"A" Loop I/S Missile Barrier	B102102-CJFCCV-002	6.0	9.40E+04	1.65E+03	1.75E+03	5.65E+01
"B" Loop I/S Missile Barrier	B102103-CJFCCV-001	5.5	5.64E+02	2.31E+01	4.57E+04	1.57E+03
"B" Loop I/S Missile Barrier	B102103-CJFCCV-002	4.0	1.91E+02	8.11E+00	6.39E+03	2.27E+02
"C" Loop I/S Missile Barrier	B102104-CJFCCV-001	5.5	3.55E+02	1.22E+01	1.94E+04	6.59E+02
"C" Loop I/S Missile Barrier	B102104-CJFCCV-002	1.5	1.40E+02	4.05E+00	1.45E+04	1.73E+02
"D" Loop I/S Missile Barrier	B102105-CJFCCV-001	4.5	1.11E+03	4.39E+01	2.88E+03	8.77E+01
"D" Loop I/S Missile Barrier	B102105-CJFCCV-002	4.0	1.11E+02	4.05E+00	1.25E+04	3.82E+02
"A" Loop O/S Missile Barrier	B102106-CJFCCV-001	5.0	5.59E+01	1.75E+00	8.13E+02	1.70E+01
"A" Loop O/S Missile Barrier	B102106-CJFCCV-002	1.5	2.71E+01	1.20E+01	1.40E+04	2.93E+03
"B" Loop O/S Missile Barrier	B102107-CJFCCV-001	4.5	6.61E+01	8.16E+00	4.10E+03	7.06E+00
"B" Loop O/S Missile Barrier	B102107-CJFCCV-002	1.5	3.57E+01	3.86E+00	2.09E+03	1.82E+02
"C" Loop O/S Missile Barrier	B102108-CJFCCV-001	2.0	1.30E+01	1.17E+00	2.55E+02	1.77E+01
"C" Loop O/S Missile Barrier	B102108-CJFCCV-002	2.0	1.89E+01	1.64E+00	3.97E+02	2.64E+01
"D" Loop O/S Missile Barrier	B102109-CJFCCV-001	4.0	1.13E+03	4.61E+01	6.07E+03	2.15E+02
"D" Loop O/S Missile Barrier	B102109-CJFCCV-002	2.5	8.62E+01	7.46E+00	4.65E+03	3.09E+02

(1) Represents surface activity of floor following removal of loose contamination
(2) Represents average of activity over entire depth of core sample minus the surface activity

Table 2 - Unit 2 Containment 541 Foot Elevation Concrete Core Sample Analysis Summary

Location	Sample ID#	Core Depth (inches)	Co-60		Cs-137		Eu-152		Eu-154	
			Surface Activity [1] (pCi/g)	Avg. Sub-surface Activity [2] (pCi/g)	Surface Activity [1] (pCi/g)	Avg. Sub-surface Activity [2] (pCi/g)	Surface Activity [1] (pCi/g)	Avg. Sub-surface Activity [2] (pCi/g)	Surface Activity [1] (pCi/g)	Avg. Sub-surface Activity [2] (pCi/g)
Incore Tunnel Floor	B102110-CJFCCV-001	14.0	2.35E+01	9.15E+00	6.74E+02	1.08E+01	1.14E+02	7.71E+01	8.45E+00	4.33E+00
Incore Tunnel Floor	B102110-CJFCCV-002	4.5	1.42E+01	1.37E+01	1.74E+01	9.43E-01	1.13E+02	1.22E+02	8.61E+00	7.38E+00
Incore Tunnel Wall	B102110-CJWCCV-003	5.5	1.35E+01	8.45E+00	5.01E+01	1.99E+00	7.08E+01	6.27E+01	5.12E+00	3.56E+00

(1) Represents surface activity of floor following removal of loose contamination

(2) Represents average of activity over entire depth of core sample minus the surface activity

Table 3 - Unit 2 Containment Concrete Core Samples – Eberline Laboratories Analysis

Radionuclide[1]	B102102-CJFCCV-001 (pCi/g)	B102103-CJFCCV-001 (pCi/g)	B102103-CJFCCV-002 (pCi/g)	B102105-CJFCCV-001 (pCi/g)	B102105-CJFCCV-002 (pCi/g)	B102106-CJFCCV-001 (pCi/g)	B102106-CJFCCV-002 (pCi/g)	B102107-CJFCCV-001 (pCi/g)	B102110-CJFCCV-001 (pCi/g)	B102110-CJFCCV-002 (pCi/g)
H-3	**1.27E+02**	**7.61E+01**	**5.57E+00**	**9.18E+00**	**2.06E+02**	**1.12E+01**	**5.19E+01**	**7.26E+00**	**2.41E+02**	**3.29E+01**
C-14	**2.80E+00**	**5.80E+00**	**1.17E+00**	**3.94E+00**	**1.23E+00**	**2.72E+00**	**2.51E+00**	**4.44E+00**	*9.72E-01*	**1.84E+00**
Co-60	**9.96E+02**	**6.91E+02**	**2.59E+02**	**1.09E+03**	**1.83E+02**	**8.01E+01**	**4.35E+01**	**7.57E+01**	**4.95E+01**	**2.27E+01**
Ni-63	**4.35E+03**	**1.23E+03**	**2.72E+02**	**4.85E+03**	**1.08E+02**	**9.98E+00**	**1.07E+02**	**3.11E+02**	**7.31E+01**	**4.73E+01**
Sr-90	**4.84E+00**	**1.41E+00**	**1.46E+00**	**1.76E+01**	**8.33E-01**	*4.17E-01*	**3.79E+00**	**2.08E+00**	**3.71E-01**	*3.35E-01*
Nb-94	*1.92E+01*	*1.77E+01*	*1.77E+01*	*3.50E+00*	*5.97E+00*	*1.06E+00*	*7.04E+00*	*1.25E+00*	*3.22E+00*	**2.48E+00**
Tc-99	**2.86E-01**	**2.22E+00**	*6.85E-01*	*3.97E-01*	*2.54E-01*	*2.95E-01*	**3.96E-01**	*2.80E-01*	*2.60E-01*	*2.50E-01*
Ag-108m	**6.85E+01**	*2.29E+01*	*1.88E+00*	*2.93E+00*	*7.03E+00*	*8.09E-01*	*9.72E+00*	*1.08E+00*	**4.17E+00**	**2.08E+00**
Sb-125	*2.39E+02*	*1.00E+02*	*1.00E+02*	*2.93E+00*	*5.56E+01*	*6.51E+00*	*6.41E+01*	*1.52E+01*	NA	NA
Cs-134	**6.09E+01**	*2.10E+01*	**8.27E+00**	**3.10E+00**	**8.75E+00**	**1.26E+00**	*1.12E+01*	**1.68E+01**	**1.30E+00**	*8.19E-01*
Cs-137	**2.14E+05**	**5.58E+04**	**8.45E+03**	**2.49E+03**	**2.09E+04**	**1.13E+03**	**2.66E+04**	**4.51E+03**	**1.05E+03**	**1.56E+01**
Pm-145	**1.23E+04**	**8.75E+02**	**1.08E+03**	**3.31E+01**	**2.62E+03**	**1.28E+02**	**1.12E+03**	**3.88E+02**	**4.78E+01**	**2.79E+01**
Eu-152	*3.98E+01*	*5.08E+01*	**5.08E+01**	*9.27E+00*	*1.22E+01*	*3.28E+00*	*1.11E+01*	*3.58E+00*	**3.97E+02**	**2.53E+02**
Eu-154	*2.70E+01*	*3.35E+01*	**3.35E+01**	*5.45E+00*	*9.97E+00*	*1.43E+00*	*1.21E+01*	*1.75E+00*	**2.58E+01**	**2.17E+01**
Eu-155	*7.97E+01*	*3.55E+01*	*6.12E+00*	*4.05E+00*	*2.00E+01*	*2.32E+00*	*2.39E+01*	*4.58E+00*	**7.02E+00**	**5.98E+00**
Np-237	*2.74E-02*	*2.85E-02*	*2.85E-02*	*2.96E-02*	*3.68E-02*	*3.84E-02*	*2.90E-02*	*3.17E-02*	NA	NA
Pu-238	*4.15E-02*	*3.99E-02*	*2.59E-02*	*1.64E-01*	*4.71E-02*	*2.85E-02*	*4.43E-02*	*3.67E-02*	*3.18E-02*	*2.71E-02*
Pu-239/240	*4.40E-02*	*5.00E-02*	**4.74E-02**	*1.54E-01*	*4.48E-02*	*2.86E-02*	*4.04E-02*	*2.56E-02*	*2.78E-02*	*2.36E-02*
Pu-241	*3.38E+00*	*4.01E+00*	*2.79E+00*	*6.17E+00*	*4.65E+00*	*3.45E+00*	*4.20E+00*	*3.09E+00*	*3.30E+00*	*2.70E+00*
Am-241	**2.49E-01**	**1.24E-01**	**1.27E-01**	**6.28E+00**	*5.08E-02*	*4.55E-02*	*4.48E-02*	*4.25E-02*	*4.95E-02*	*1.94E-02*
Am-243	*4.86E-02*	*3.28E-02*	*3.92E-02*	*3.80E-01*	*3.58E-02*	*7.19E-02*	*5.63E-02*	*3.94E-02*	**5.18E-02**	*3.61E-02*
Cm-243/244	**9.04E-02**	**4.54E-02**	**5.56E-02**	**1.19E-00**	*3.50E-02*	*3.98E-02*	*4.60E-02*	*3.66E-02*	*4.96E-02*	*2.86E-02*

(1) Bold values indicate concentration greater than MDC. Italicized values indicate MDC value. NA indicates "no analysis"

Figure 6 - Unit 2 Containment 568 Foot Elevation Concrete Core Sample Locations

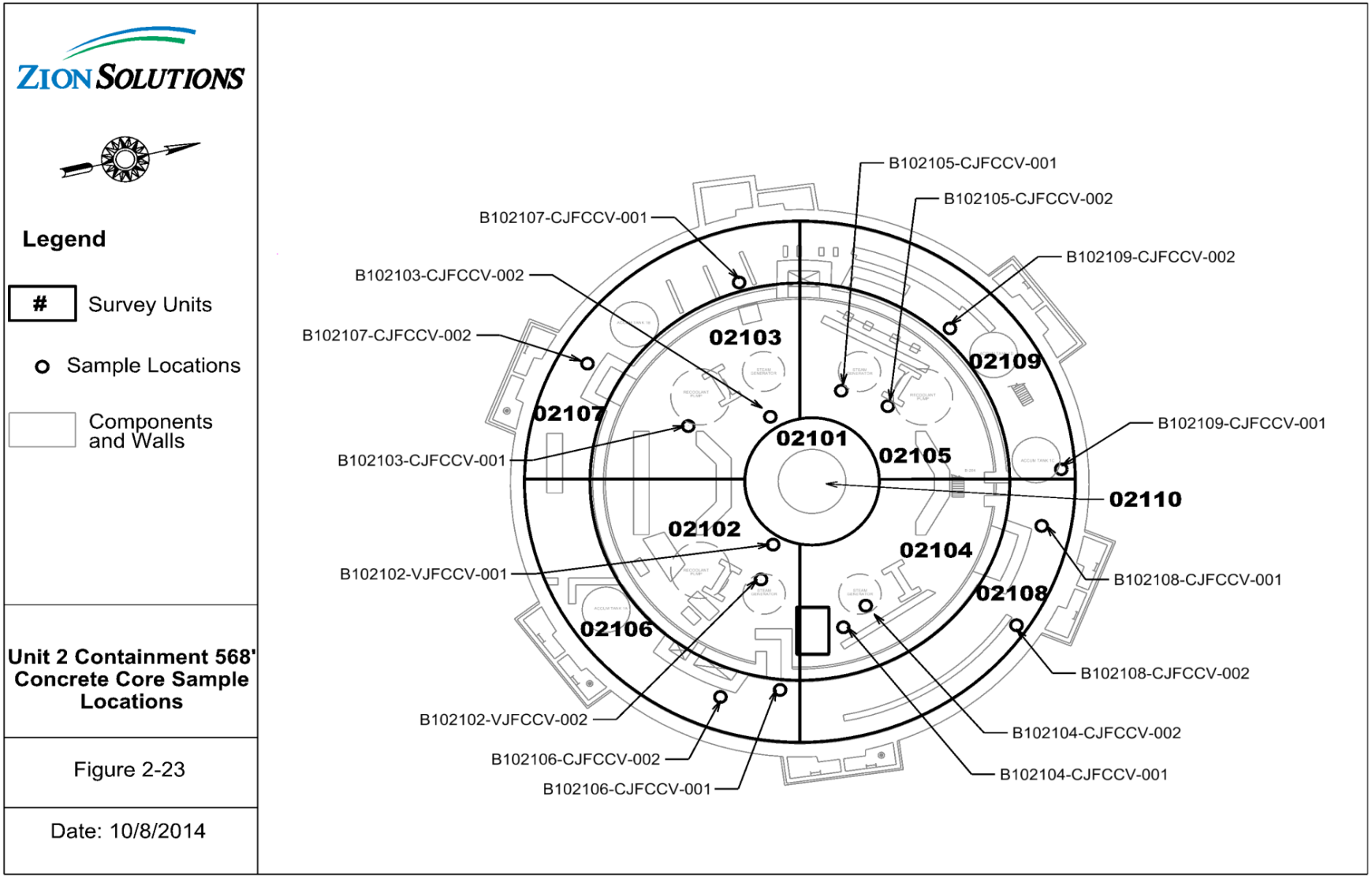
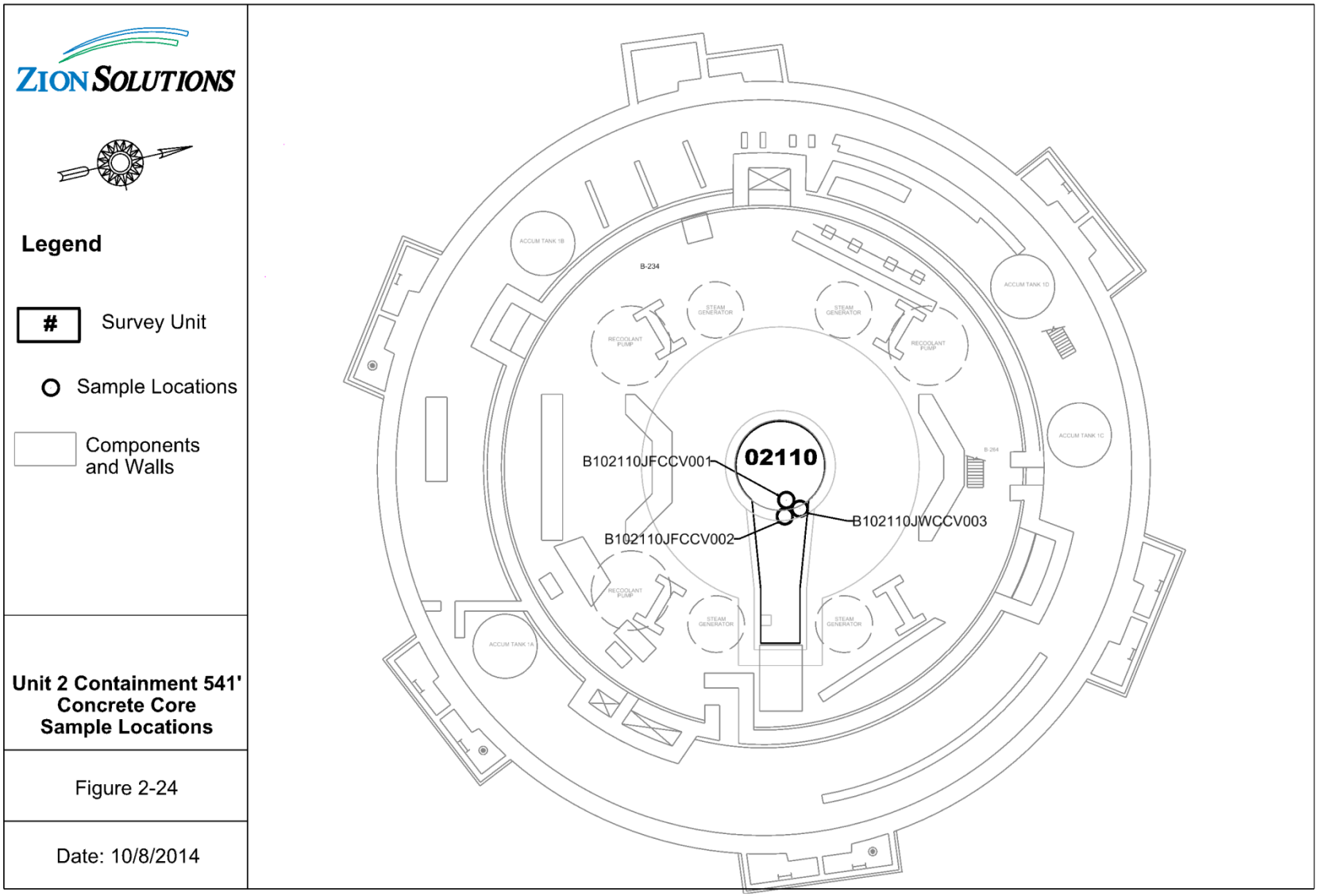


Figure 7 - Unit 2 Containment 541 Foot Elevation Concrete Core Sample Locations



On 07/20/16, the last routine surveys were conducted in Unit 2 Containment, before heavy demolition started and access was no longer possible. Survey 2016-2226, conducted in the Outer Missile Barrier (OMB) area of Unit 2, showed that all smears were less than 1,000 dpm/100cm^2 and that the maximum dose rate was 1.5 mR/hr. Survey 2016-2224, conducted in the Inner Missile Barrier (IMB) area of Unit 2, showed a maximum loose contamination level of 6,400 dpm/100cm^2 and a maximum dose rate of 5.1 mR/hr.

Following demolition and prior to attempting FSS, continuing characterization was performed on the concrete walls and floor of the Under Vessel area in Unit 2 Containment and to assess the radiological condition of the exposed steel liner above the 565 foot This work was required in accordance with LTP Chapter 5, section 5.3.4.4. The continuing characterization of the steel liner above the 565 foot elevation consisted of sufficient smear samples and beta scans of accessible surfaces to ensure that the liner was adequately decontaminated prior to FSS. This survey was performed in December 2017. The result of smear samples indicated no detectable loose surface contamination greater than 1,000 dpm/100cm^2 on exposed building surfaces above the 565 foot elevation.

Continuing characterization was performed in the Under Vessel are between November 11, 2017 and November 22, 2017. The objective of the continuing characterization survey was to assess the depth of activation in the concrete in order to guide the remediation necessary to meet OpDCGL for Containment and, to ensure the correct geometry was used for the ISOCS measurements. The survey consisted of scanning the exposed concrete surfaces and the acquisition of sixteen (16) concrete core samples with four (4) of those samples taken on the upper walls, eight (8) samples taken on the lower walls and four (4) samples taken on the floor. In addition, three (3) samples were taken from the metal in the embedded steel support ring. See Figure 8 for a graphic depiction of the sample locations.

To the extent possible, the locations selected for concrete core samples were identified by the scan measurement on the surface that exhibited the highest activity. The concrete core samples were taken through the layer of concrete from the exposed grade to the underlying steel liner where possible. Each core was segmented into ½-inch pucks, which were then analyzed by the on-site gamma spectroscopy system for gamma-emitting radionuclides. The results of the analysis of continuing characterization concrete core samples are presented in Table 4.

On November 16, 2017, the two concrete pucks (as well as one metal sample) that contained the highest gamma-emitting radionuclide activity were sent to Eberline Laboratories to be analyzed for the full suite of radionuclides from Table 5-1 from LTP Section 5.1. The results of the concrete core analyses are presented in Table 5. The ratios for H-3, Ni-63 and Sr-90, based on the two continuing characterization samples that were analyzed for HTDs are presented in Table 6.

Figure 8 - Unit 2 Containment Continuing Characterization Concrete Core Sample Locations

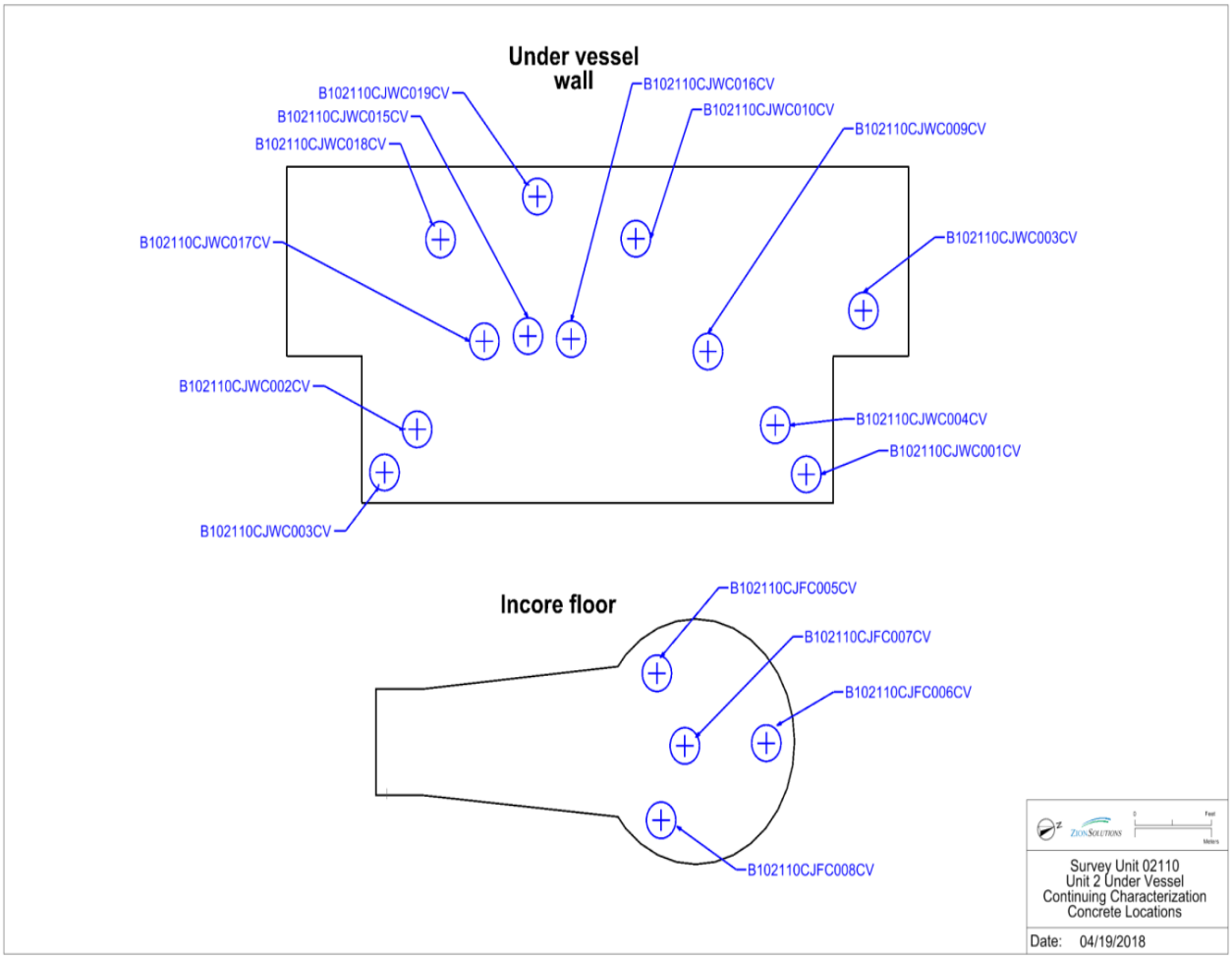


Table 4 - Unit 2 Containment Continuing Characterization Concrete Core Samples – On-Site Analysis

	B1-02110C-JWC-001-CV					B1-02110C-JWC-002-CV					B1-02110C-JWC-003-CV					B1-02110C-JWC-004-CV				
Depth	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154
(in)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
0	15.5	0.15	11900	50.8	3.84	6.14	0.314	1040	37.4	2.92	3.93	0.0292	9.76	46.2	3.66	10.4	0.0751	2060	67	4.35
0.5	14	0.321	9290	50	3.49	5.83	0.0636	754	38.5	2.62	3.39	0.119	4.24	49.1	3.54	10.3	0	1110	64.4	3.97
0.5	6.05	0.352	1150	50.6	3.65	7.92	0	96.8	11.1	0.577	3.05	0.112	0	45.4	2	6.56	0	47.7	70.2	4.28
1	6.01	1.53	879	466	2.52						3.22	0	0	45.1	2.51	6.05	0.148	28	65.8	3.69
1	8.8	0.206	334	48.7	3.44						2.67	0	0.223	51.7	2.65	5.59	0	0	71.6	4.06
1.5	9.07	0.276	363	49.5	2.96						2.5	0	0.333	54.1	2.61	5.86	0.279	0.335	69.4	3.41
1.5	5.77	0.139	49	43.5	1.6						2.59	0.0765	0	49.2	0	4.91	0.0808	0	64.2	3.61
2	5.81	0.398	38.5	45.3	3.23	8.68	0.318	73.6	9.18	2.01	2.81	0.123	0	50.1	2.55	4.72	0	0	63.8	3.25
2	3.54	0.0176	8.04	39.5	1.54	4.52	0.147	719	31	1.34	3.32	0.525	0	49.7	2.71	3.82	0.159	0.232	62.6	3.32
2.5	3.6	0	7.83	38.4	1.69	4.55	0	830	31	2.02	3.5	0.119	0	49.3	2.99	4.2	0	0	59.7	44.9
2.5	3.05	0.777	1.84	43.9	2.39	3.86	0.328	287	36.6	2.28	3.13	0	0	50.2	2.67	3.78	0	0.185	52.4	2.57
3	3.23	0.0701	1.88	44.1	2.36	3.93	0	213	35.6	1.96	3.63	0.0426	0	50.7	2.44	4.13	0.346	0	54.3	2.73
3	3.33	0.227	0.674	46.2	2.72	2.96	0.0638	83.7	32.9	0.583	3.21	0	0.445	39.6	1.84	2.95	0.0348	0.203	43.7	2.7
3.5	2.87	0.0532	0.966	43.3	2.89	3.25	0.35	86.2	32.4	0.556	3.15	0.53	0	38.1	0	2.95	0.415	0.0491	41.1	2.02
3.5	4.11	0.106	1.38	41.7	1.87	3.2	0.241	44.2	32.8	1.65	2.16	0.478	0	28.8	1.26	2.86	0.2	0	37	1.94
4	3.8	0	1.49	40.7	2.49	3.29	0.078	35.5	34.3	1.25	2.07	0.284	0.0757	27.7	0.752	3.03	0.414	0	36.9	0.974
4	4.12	0.0563	0.605	38.9	2.56	4.67	0	9.62	12.5	1.56	3.6	0.125	0	26.8	1.65	2.72	0.208	0	41.6	2.19
4.5	3.58	0.103	0.466	37.6	2.07						3.09	0.0309	0.0238	27.4	1.32	2.78	0.423	0	41.9	2.11
4.5	1.75	0	0	22.7	17						1.43	0.0707	0.166	23.4	0.84	2.11	0.122	0	34.7	1.68
5	1.58	0.0995	0.026	21.2	15.6						1.47	0.324	0.292	21.4	1.04	2	0.216	0.322	32.6	2.33
5	4.66	0	0.0403	2.47	0.0135						1.05	0	0	17.4	0.612	1.59	0.0555	0	22.1	1.27
5.5						5.78	0	7.06	10.8	0.94	0.967	0.234	0.43	17.1	0.835	1.42	0	0.018	21.9	0.825
5.5						2.15	0	22.1	24.6	0.907	0.817	0.173	0	15.2	10.4	1.38	0	0.162	16.9	0.628
6						1.82	0.0005	24.3	25.2	9.97	0.822	0	0.208	14.3	0.621	1.26	0.163	0.0985	16.5	0.929
6						2.24	0.163	18.6	31.8	0.434	0.77	0.113	0.102	10.9	0.534	1.03	0.218	0.18	14	0.858
6.5	3.68	0.0356	0.175	1.9	0.162	2.43	0	17.8	29.8	0.923	0.662	0	0	10.8	0.508	0.88	0.11	0	13.7	1.07
6.5	0.783	0.0128	0.346	12.6	8.89	2.66	0.0623	12.2	21.3	0.401	0.67	0.0145	0	11.1	0.728	0.759	0	0	12.3	0.782
7	0.948	0.18	0.326	11.9	1.33	2.87	0.11	10.3	20.4	0.616	0.82	0.196	0.249	11.4	0.152	0.732	0.0144	0	11.8	0.0476
7	0.961	0.215	0.106	11.1	0.891	1.2	0.101	3.84	15.4	0.976	0.318	0	0	7.12	0.479	0.823	0.0195	0	12.9	9.43
7.5	0.737	0.21	0.195	11.4	0.248	1.15	0	2.58	16.1	1.45	0.596	0	0	8.02	0	0.844	0	0	11.2	1.15
7.5	0.947	0.0598	0.337	10.6	0.228	1.1	0.113	0.276	13.9	0.32	0.458	0	0	7.34	5.07	0.613	0.0389	0.319	9.61	0.133
8	0.935	0.0721	0.2	11	0.235	1.22	0.0207	0.294	14.2	0.701	0.367	0	0	7.32	5.59	0.792	0.0174	0	11.2	0
8	0.558	0.0563	0.0931	7.51	0.591	0.933	0	0	11	0.176	0.532	0.0633	0	5.57	3.97	0.518	0	0.205	8.85	0.53
8.5	0.589	0	0.23	7.67	0.683	0.83	0.089	0.112	10.6	1.15	0.462	0.0183	0.111	5.56	0	0.49	0.0199	0.05	8.27	0.823
8.5	0.621	0.0474	0	6.77	0.841	0.708	0	0	9.05	2.29	0.842	0.0154	0	5.68	0.248	0.438	0	0	6.8	0.702
9	0.461	0.101	0.0546	6.49	0	0.619	0	0.105	8.14	0.292	0.657	0.0087	0.0098	5.26	0	0.542	0.0446	0.06	6.15	0.59
9	0.535	0.145	0.0766	6.47	0.321	0.75	0	0	9.27	0.0038	0.474	0.0343	0.0386	4.32	0.0064	0.325	0	0.0984	4.6	3.3
9.5	0.494	0	0.323	5.92	4.63	0.609	0.137	0	8.57	0.0394	0.619	0.276	0	4.07	0.386	0.361	0.0104	0	4.56	0.219

Table 4 (continued) - Unit 2 Containment Continuing Characterization Concrete Core Samples – On-Site Analysis

	B1-02110C-JWC-001-CV (cont)					B1-02110C-JWC-002-CV (cont)					B1-02110C-JWC-003-CV (cont)					B1-02110C-JWC-004-CV (cont)				
Depth	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154
(in)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
9.5	0.422	0.143	0.24	6.04	0.659	0.453	0	0.09	5.92	0.0264	0.285	0	0	2.95	2.31	0.303	0.0777	0	3.98	0.238
10	0.398	0.113	0.195	5.64	0.457	0.443	0	0.294	5.75	0.285	0.204	0	0	3.12	2.52	0.312	0.091	0.136	3.69	0.151
10						0.349	0	0	4.99	0.104	0.116	0	0.0771	2.29	0	0.25	0	0.11	3.11	0.327
10.5						0.444	0.0866	0.0335	4.34	1.89	0.119	0.0082	0.305	2.31	0.155	0.261	0.222	0	2.77	0
10.5	0.347	0.0504	0.217	5.03	0.492	0.263	0.0308	0.0425	3.67	0.464	0.328	0	0.229	2.3	0	0.203	0	0	2.48	1.67
11	0.376	0	0.203	4.51	0.534	0.279	0.0849	0.0433	3.5	0.203	0.286	0	0.0382	1.95	0	0.219	0.0164	0.0162	2.67	1.84
11	0.438	0.0473	0.23	3.93	0.0867	0	0.147	0	4.04	0.492	0.139	0.0502	0	1.46	0.0408	0.212	0	0	2.43	1.57
11.5	0.489	0.0355	0.0316	3.96	0.0264	0.101	0	0.0646	3.77	0.103	0.172	0.0396	0.0399	1.48	0	0.19	0	0.16	2.26	1.68
11.5	0.284	0.0514	0.127	3.63	0.321	0.305	0.0751	0.139	2.97	0.505	0.18	0.166	0.0738	1.08	0.719	0.169	0.0017	0	1.9	0
12	0.357	0.157	0.111	3.31	0.241	0.168	0.0422	0	2.76	0.438	0.157	0.0156	0.0341	1.32	0.343	0.18	0.139	0	1.92	1.32
12	0.419	0	0.302	3.57	0.706	0.252	0	0	2.14	0.739	0.0447	0	0.0924	1.05	0.77	0.273	0.0111	0	1.26	1.32
12.5	0.318	0.0182	0.122	3.35	0.416	0.251	0	0.132	2.49	0.648	0.0874	0	0.0148	0.828	0.654	0.194	0	0	1.34	0.846
12.5	0.285	0.101	0.149	2.13	0.11	0.216	0.0485	0.0772	2.29	0.0005	0.141	0.135	0	0.523	0.0316	0.149	0.0723	0	0.878	0
13	0.195	0.0564	0.227	2.29	0.0995	0.162	0	0	2.3	0.0414	0.0619	0.0151	0	0.557	0.469	0.146	0.145	0	1.13	0
13	0.34	0.22	0.155	1.42	0	0.335	0	0.0454	2.17	0.404	0.102	0	0	0.759	0.373	0.172	0.0296	0.0269	0.688	0.0005
13.5	0.334	0	0.333	1.45	0.0623	0.198	0	0.148	1.73	0.165	0.0922	0	0	0.697	0.559	0.161	0.179	0.165	0.771	0.441
13.5	0.164	0	0.252	1.37	0.922	0.1	0.0683	0	1.32	0.531	0.157	0.0345	0.0521	0.681	0.343	0.213	0.042	0	0.458	0.601
14	0.185	0.0479	0.226	0.981	0.0575	0.188	0.159	0.136	1.14	0.441	0.0846	0.0206	0.0799	0.0429	0.442	0.149	0	0.0291	0.717	0.0406
14	0.139	0.0166	0.233	1.09	0.229	0.0679	0.0091	0	0.905	0.254	0.191	0	0.0226	0.399	0.366	0.108	0	0.0815	0.45	0
14.5	0.232	0.0866	0.321	1.06	0.165	0.17	0	0	0.911	0.221	0.0090	0.0891	0	0.359	0.369	0.111	0	0	0.347	0.274
14.5	0.433	0.138	1.21	1.17	0.734	0.17	0	0	0.659	0.402	0.0371	0.0288	0.0214	0.237	0.318	0.14	0.149	0	0.0114	0.181
15	0.22	0.02	1.49	0.987	0.32	0.123	0.0241	0.0619	0.624	0.0126	0.122	0.0157	0.0124	0.141	0.111	0.0282	0.0463	0.109	0.43	0.0308
15	0.0751	0.0067	0.13	0.562	0.222	0.21	0	0	0.638	0.0153	0	0	0.0577	0.298	0.154	0.102	0	0.0059	0.112	0.196
15.5	0.118	0	0.0446	0.291	0.177	0.0613	0.0726	0.102	0.735	0.184	0.183	0.0648	0.159	0.189	0.0112	0.123	0	0	0.184	0.289
15.5	0.0561	0.0167	0.192	0.466	0.313	0.111	0.0907	0.0281	0.591	0	0.111	0	0.0183	0.197	0.196	0.126	0	0.173	0.232	0.125
16	0.0543	0.0469	0.104	0.296	0.145	0.101	0	0	0.629	0	0.0444	0.016	0	0.426	0.154	0.0616	0	0.0127	0.318	0.006
16						0.12	0.0307	0.174	0.294	0	0.0651	0.0651	0.0703	0	0.0048	0.118	0.0351	0.0444	0.214	0.129
16.5						0.148	0.159	0.0898	0.385	0	0.0992	0.0142	0	0.0984	0.096	0.226	0	0	0.0578	0.149
16.5	0.0613	0.189	0.003	0.12	0.107	0.0366	0	0	0.319	0	0.0592	0	0.0188	0.327	0	0.109	0.0444	0.163	0.101	0.234
17	0.179	0.123	0.219	0.589	0.0352	0	0	0	0.324	0	0.0971	0	0.056	0.117	0.0682	0.0628	0	0.0624	0.157	0.0389
17	0.0565	0	0.28	0.259	0.186	0.0107	0.0060	0.0083	0.0088	0						0.0557	0.0517	0.112	0.112	0.0564
17.5	0.056	0	0.323	0.617	0.0387	0	0.0155	0.0165	0.204	0						0.153	0.0894	0.0599	0.227	0.173
17.5	0.134	0.083	0.727	0.264	0.244															
18	0.145	0.102	1.07	0.0867	0.0487															
18																				

Table 4 (continued) - Unit 2 Containment Continuing Characterization Concrete Core Samples – On-Site Analysis

	B1-02110C-JFC-005-CV					B1-02110C-JWC-001-CV					B1-02110C-JFC-007-CV					B1-02110C-JFC-008-CV				
Depth	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154
(in)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
0	49	0	7730	44.1	3.41	37.5	0.0064	5200	85.9	5.41	14.20	0.0597	2000	14	1.52	7.41	0.00	306.00	40.30	6.13
0.5	35	0.505	4590	44.8	3.35	33	2.98	4320	87.3	9.16	13.50	0.694	1750	14.3	0.91	6.15	0.04	292.00	42.30	2.10
0.5	10.7	0.429	287	52.8	3.15	20.5	0.711	1140	106	7.43	21.10	0	798	43.7	3.5	4.42	0.11	121.00	55.90	3.36
1	9.48	0.508	187	54.6	3.09	21.2	0.699	1040	112	7.94	19.10	0.0051	703	44.3	2.51	4.94	0.03	88.40	57.80	3.09
1	5.49	0.0119	7.76	75	4.17	13.9	11.4	202	136	7.44	14.10	0.261	291	47.9	2.48	3.70	0.00	6.47	56.10	3.68
1.5	6.46	0.709	8.08	80.9	4.08	15.6	0.151	277	142	7.79	13.60	0.865	250	47.8	2.99	3.53	0.17	5.96	54.50	3.45
1.5	6.16	0	6.34	77.3	3.88	12.6	7.13	35.6	135	7.43	11.00	0	107	43.5	2.56	5.22	0.23	2.82	59.50	3.93
2	4.46	0	3.16	66.3	3.53	12.2	0.337	37.3	132	8.3	11.40	0.126	108	46.5	2.66	5.66	0.58	2.69	62.80	3.55
2	6.18	0.0435	6.08	76.9	3.52	10.8	0.42	50.4	201	10.1	9.46	0.0635	94.4	54.7	2.54	7.76	0.00	1.66	72.00	4.13
2.5	5.38	0.244	6.98	72.2	4.48	11.7	0.862	55.9	232	13.9	9.52	0.199	79.4	53.7	2.54	7.76	0.00	1.95	70.50	3.56
2.5	6.67	0.104	7.76	83	4.46	12	1.25	24.9	215	11.2	8.41	0.627	68.9	61.9	3.59	5.31	0.67	0.32	61.40	4.10
3	5.02	0.533	3.28	67.5	3.6	11.7	0.174	17.7	189	8.66	7.94	0.0525	56.8	62.4	2.98	4.94	0.00	0.00	66.00	3.27
3	4.26	0.197	0.213	65.9	3.56	8.31	0.305	0.592	110	5.58	7.76	0.13	16.8	51.5	2.55	6.43	0.36	0.00	65.10	3.87
3.5	3.83	0	0.403	58.7	3.53	8.51	0.0050	0.478	113	4.96	7.31	0	14.9	47.6	2.73	7.68	0.96	0.00	65.10	2.13
3.5	21.4	0.138	0.186	10.3	9.62	7.47	0.594	0	115	6.25	4.25	0.267	12.6	39.7	2.18	7.06	0.00	0.00	58.60	3.17
4	23.2	0.0711	0.243	7.7	0.475	8.41	14.6	0.675	116	4.98	4.48	0.119	11.1	42.1	1.89	6.61	0.06	0.04	57.00	2.79
4	6.39	0.63	1.93	55.8	2.95	8.57	0.225	0	111	5.61	4.46	0	25	37.5	2.24	4.16	0.09	0.00	53.90	3.44
4.5	8.56	0	1.61	65.2	3.99	8	0.194	0	105	4.62	4.33	0	19	38.4	1.9	4.32	0.00	0.05	50.60	1.89
4.5	3.79	0.232	0.172	46.6	2.14	5.7	0.123	0.321	88.1	4.01	2.61	0	8.79	29.5	1.33	3.67	0.00	0.00	42.80	2.18
5	3.59	0.118	0.0725	44.9	2.4	5.65	0.483	0	91	3.45	2.38	0.0517	9.32	28.3	1.84	3.07	0.46	0.00	43.20	2.07
5	5.04	0	0	49.2	3.05	5.63	0.216	0.735	88.4	4.45	2.05	0.449	6.55	26.9	1.34	2.25	0.02	0.54	37.00	1.96
5.5	5.15	0	0.443	49.8	2.65	5.68	0.0608	0	87.1	3.82	2.03	0.0266	6.34	28	1.38	2.12	0.00	0.00	37.20	1.12
5.5	4.46	1.1	0	42.5	2.21	5.38	0.97	0	81	3.05	1.60	0.0466	1.97	22.5	1.18	2.46	0.22	0.00	35.20	1.67
6	3.8	0	0.132	43	2.17	5.33	0.0783	0	80.6	3.05	1.41	0	1.59	19.7	0.731	2.60	0.16	0.31	35.60	1.77
6	2.34	0.155	0.198	33.1	1.48	4.92	0.114	0	76.9	3.4	1.27	0	1.16	21.6	1.15	2.09	0.01	0.00	29.30	1.66
6.5	2.39	0	0.103	31.8	1.62	4.85	0.386	0	72.5	4.21	1.41	0	1.01	21.5	0	1.96	0.00	0.19	29.10	1.14
6.5	3.33	0.349	0.176	31.2	0.864	3.17	0.28	0.778	49.4	2.41	1.25	0.0089	0.388	18.7	0.412	3.29	0.05	0.00	29.50	1.22
7	3.22	0.137	0	31.4	1.41	3.04	0.125	0.0616	49.9	2.51	1.28	0.292	0.313	17.5	0.478	3.51	0.00	0.17	29.20	0.94
7	3.3	0	0	31.1	0.876	3.07	0.0638	0	49.9	1.95	1.76	0	0.109	15.6	0.558	3.23	0.32	0.39	34.40	1.71
7.5	2.99	0	0.184	29.9	1.13	2.92	0.0725	0.177	47.7	2.47	1.64	0.122	0.0748	14.3	0.658	2.78	0.15	0.69	28.70	1.04
7.5	1.53	0.151	0.523	21	1.08	2.52	0.562	0.636	35.2	1.07	0.84	0	0.252	10.2	0.56	2.75	0.00	0.33	24.60	1.34
8	1.54	0.041	0.173	20.7	1.13	2.64	0.0423	0	34.7	1.74	0.73	0.0038	0.181	9.82	0.385	2.60	0.16	0.00	24.50	0.90
8	1.23	0	0	17.9	1.11	3.43	1.11	0.12	43.9	0.993	4.58	0.054	0.218	1.28	0.0618	1.29	0.15	0.02	18.60	0.57
8.5	1.47	0.0454	0.0448	18.8	1.37	3	0.168	0.648	42.9	1.75						1.23	0.00	0.00	18.20	1.02
8.5	0.708	0	0	13.3	0.0622	1.91	0.0348	0.124	23.1	0.917						1.52	0.25	0.02	25.60	0.80
9	0.773	0	0.0469	13.2	0.653	1.81	0.162	0.071	20	1.08	3.59	0	0.293	1.32	0.142	1.13	0.04	0.03	22.60	1.19
9	0.749	0.172	0.0161	12.4	0.34	2.22	0.0041	0.14	22.2	1.22	0.12	0.0649	0.327	0.026	0.0286	1.42	0.00	0.31	16.50	0.52
9.5	0.58	0.133	0	12.1	9.57	2.67	0.0289	0.407	24.7	1.26	0.10	0.0232	0.231	0.161	0.0393	1.87	0.09	0.00	17.50	0.63

Table 4 (continued) - Unit 2 Containment Continuing Characterization Concrete Core Samples – On-Site Analysis

	B1-02110C-JFC-005-CV (cont)					B1-02110C-JWC-001-CV (cont)					B1-02110C-JFC-007-CV (cont)					B1-02110C-JFC-008-CV (cont)				
Depth	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154
(in)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
9.5	0.401	0	0.349	9.44	6.48	1.57	0.32	0	19.5	0.377	0.10	0.0134	0.17	0	0.0757	1.74	0.19	0.09	13.90	0.49
10	0.712	0	0.284	12.8	0.435	1.54	6.61	0	18.6	1.33	0.00	0.051	0.135	0.0813	0.109	1.63	0.00	0.09	13.80	0.66
10	0.719	0	0	11.8	0.995	0.887	0.138	0	12.9	1.05	0.02	0	0.0674	0.295	0.0603	0.96	0.00	0.19	15.60	0.21
10.5	0.495	0	0.169	9.18	1.73	0.96	0.228	0	13.1	0.937	0.17	0.076	0.13	0	0.144	0.78	0.12	0.00	13.40	1.02
10.5	0.533	0.107	0	7.23	0	0.905	0.0441	0	12.4	0.549	0.10	0.095	0.0228	0.396	0.0691	0.76	0.08	0.45	12.50	0.67
11	0.618	0	0.14	7.31	0.66	0.798	0.647	0.185	11.9	0.471	0.06	0	0.103	0.352	0.0172	0.56	0.00	0.51	8.95	1.63
11	0.684	0	0.154	6.1	0.463	0.984	0.125	0.332	11.2	0.582	0.00	0	0.106	0.206	0.0587	0.55	0.00	0.50	8.26	0.05
11.5	0.791	0.0276	0.0204	6.2	0.16	0.854	0.0763	0.0302	10.5	0.148	0.08	0.0298	0.145	0.0738	0.0399	0.85	0.00	0.46	9.78	0.75
11.5	0.532	0.219	0	5.51	4.47	0.566	0.0262	0.145	7.54	0.161	0.00	0	0.0955	0.379	0.113	1.27	0.31	0.24	9.29	0.82
12	0.724	0	0.154	5.58	4.44	0.492	3.56	0.101	7.28	0.0476	0.05	0	0.1	0.144	0.0574	1.47	0.00	0.06	9.12	0.48
12	0.466	0	0.0781	4.53	0.301	0.567	2.59	0.0449	7.23	0.537	0.16	0.153	0.0954	0.276	0.141	1.02	0.15	0.07	6.84	0.14
12.5	0.255	0.13	0.186	4.33	0.23	0.618	0.0772	0	7.58	5.82	0.05	0.044	0.116	0.3	0.206	1.00	0.07	0.27	6.71	0.27
12.5	0.206	0	0.176	3.4	0.115	0.31	1.48	0.109	5.91	4.39	0.12	0	0	1.33	0.764	0.29	0.02	0.02	4.84	0.53
13	0.334	0	0.106	3.37	0.224	0.271	0.0263	0.0669	5.56	0.519	0.20	0.147	0.176	1.28	0.0963	0.26	0.01	0.32	4.74	3.47
13	0.321	0.0579	2.63	3.04	0.0289	0.247	0.0012	0.0871	4.28	0.349	0.16	0.118	0.139	1.36	1.13	0.38	0.00	0.22	5.06	0.34
13.5	0.237	0.0257	3.39	2.38	0.422	0.32	0.046	0.256	4.17	0.232	0.15	0	0.153	1.61	0.375	0.50	0.00	0.12	5.14	0.40
13.5	0.3	0.0474	2.49	2.29	0.24	0.364	0.0206	0.21	3.35	2.54	0.12	0	0.0919	0.94	0.581	0.29	0.00	0.12	3.74	0.09
14	0.396	0.111	1.34	3.18	0.0991	0.328	0.0031	0	3.24	2.37	0.14	0.0182	0.127	0.816	0.0808	0.30	0.00	0.14	3.29	2.52
14	0.244	0.0447	0.0419	2.48	0	0.211	0.0741	0.098	2.62	0.0998	0.24	0.0098	0.101	0.702	0.0257	0.24	0.00	0.16	3.52	0.73
14.5	0.246	0.0286	0.0293	2.32	1.94	0.231	0.263	0.257	2.85	0.136	0.17	0.0397	0.311	0.837	0.277	0.27	0.01	0.02	3.57	0.25
14.5	0.206	0	0	2.25	0.585	0.163	1.92	0.104	2.07	1.46	0.05	0.0167	0.182	0.603	0.293	0.42	0.05	0.00	3.41	0.28
15	0.164	0	0.094	2.14	0.723	0.132	0.149	0.0936	1.87	1.4	0.14	0.129	0.269	0.746	0.521	0.32	0.35	0.00	3.26	2.04
15	0.2	0.0060	0.0984	1.61	0.0298	0.191	0.0161	0.0651	1.69	0.411	0.10	0	2.86	0.355	0.244	0.29	0.10	0.00	2.13	1.50
15.5	0.159	0.0524	0	1.61	0.0733	0.271	0.0318	0	1.98	0.225	0.18	0	1.92	0.395	0.275	0.34	0.00	0.04	2.31	0.23
15.5	0.199	0.189	0	1.26	0.847	0.137	0.044	0.0832	1.62	0.122	0.18	0.0284	0.259	0.589	0.35	0.23	0.10	0.06	2.21	1.57
16	0.072	0	0.188	0.949	0	0.0838	0.223	0.11	1.3	0.267	0.07	0.0404	0.078	0.579	0.412	0.28	0.00	0.00	2.01	1.62
16	0.225	0.0077	0.503	0.929	0.0961	0.13	0.991	0.0857	1.09	0.529	0.00	0	0.0485	0.199	0.426	0.19	0.07	0.12	1.91	0.52
16.5	0.383	0	0.437	1.14	0.417	0.0656	0.0372	0.0452	1.17	0.781	0.00	0.19	0.0998	0.47	0.214	0.17	0.01	0.22	1.86	0.21
16.5	0.193	0	0.214	1.21	0.46	0.0709	0.0546	0.199	0.896	0.669	0.19	0.0496	0.136	1.49	1.13	0.10	0.18	0.16	1.92	0.36
17	0.173	0.0396	0.0384	0.841	0.153	0.108	0.201	0.14	0.834	0.605	0.17	0	0.302	1.55	1.23	0.25	0.07	0.24	1.77	1.24
17	0.0626	0.0787	0.193	0.731	0.573	0.117	0.288	0.432	0.318	0.222	0.26	0.102	0.0702	2.24	0.114	0.20	0.17	0.08	1.14	0.88
17.5	0	0	0.0336	0.582	0.238	0.174	0.0769	0.286	0.229	0.171	0.22	0	0.0297	2.19	0.0553	0.29	0.18	0.06	1.06	0.94
17.5	0.0966	0.037	0.165	0.448	0.213	0.0123	0.0755	0.0542	0.555	0.141	0.31	0.16	0.0324	2.65	1.82	0.09	0.14	0.02	1.17	0.86
18	0.095	0	0.0113	0.527	0.263	0.0539	0.161	0.115	0.0032	0.22	0.28	0	0.0074	2.54	0.801	0.13	0.05	0.00	1.04	0.82
18	0.0793	0.0573	0.141	0.468	0.417	0	0.0949	0.17	0.28	0.212	0.20	0.0727	0.108	2.72	0.324	0.25	0.00	0.25	1.14	0.25
18.5	0.189	0	0.127	0.255	0.227	0.0837	2.09	0.106	0.224	0.248	0.21	0	0.0137	2.88	0.2	0.22	0.08	0.18	0.97	0.00
18.5	0.145	0	0.141	0.601	0.167	0.0656	0.77	0.105	0.32	0.18	0.26	0	0.0957	3.75	2.75	0.10	0.06	0.12	0.66	0.25
19	0.104	0.0604	0.219	0.321	0.165	0.0642	0.0746	0.111	0.228	0.139	0.27	0	0	3.77	0.25	0.05	0.02	0.00	0.64	0.42

Table 4 (continued) - Unit 2 Containment Continuing Characterization Concrete Core Samples – On-Site Analysis

	B1-02110C-JWC-009-CV					B1-02110C-JWC-010-CV					B1-02110C-JWC-011-CV					B1-02110C-JWC-015-CV				
Depth	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154
(in)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
0	5.35	0.0449	0.529	55.2	3.62	161	6.4	3.2	2230	117	5.49	0.179	0.977	73.9	3.75	4.51	0.723	12.8	54.7	3.82
0.5	5.21	0.0662	0.0217	54.2	4.06	180	5.24	1.09	2540	133	5.42	0.209	0	79	2.96	4.82	0.404	10.6	64.4	49.5
0.5	5.42	0.268	0	72.4	4.38	182	3.43	0	2420	122	4.47	0.0937	0	65.2	3.79	5.38	0.649	1.93	80.8	4.08
1	5.55	0.181	0	70	4.03	176	3.44	0	2380	126	4.13	0.46	0.299	65.8	3.57	5.55	0.502	1.01	72.6	4.15
1	5.51	0.38	0.216	65.8	3.57	215	4.61	0	2780	145	5.44	0.539	0	62.9	3.14	6.47	0.115	0.258	71.1	3.8
1.5	5.29	0.122	0	64.6	3.62	214	0.274	0	2700	134	5.15	0.0536	0	63	2.74	6.95	0	0.135	68.6	3.73
1.5	5.85	0	0	63.5	3.34	240	0	0	2760	132	3.76	0.253	0.207	52.8	2.81	5.39	0	0.168	57.9	2.63
2	5.5	0.141	0	62.4	3.52	233	1.24	0	2790	130	3.72	0.355	0.743	53.6	2.24	4.71	0.708	0	56.8	2.95
2	7.03	0.0743	0.018	5.32	0.421	171	3.89	3.03	2140	102	3.56	0	0	49.4	2.39	4.22	0.289	0.336	55.5	2.51
2.5						178	0	0.943	2140	97.8	3.68	0.121	0.156	50.1	2.24	4.22	0.463	0.347	57.9	3.08
2.5						153	1.76	1.4	1920	87.6	3.37	0.0564	0.219	42.3	2.09	3.94	0.2	0	54.1	2.39
3						150	2.96	0	1910	89.2	3.24	0.0247	0	41.7	1.48	3.5	0	0	51.5	2.17
3						122	1.29	0.665	1640	77.1	2.51	0	0	40	1.74	3.34	0.324	0.0424	46.3	2.56
3.5						121	0.329	2.4	1660	73.4	2.8	0.331	0.0108	40.6	1.81	3.21	0	0.386	45.4	2.17
3.5						162	2.16	6.13	1450	64.2	1.91	0.228	0.397	31.9	1.68	2.78	0.21	0.0796	36.2	1.73
4						161	0.0742	0	1520	69.1	1.97	0.266	0.161	30.7	1.41	2.97	0	0	41.4	2.04
4						67.2	3.66	0	995	40.7	1.89	0.275	0.0442	28	1.55	4	0	0	49.5	3.01
4.5						67.5	2.03	0	995	43.6	1.79	0.11	0.341	26.9	1.37	4.25	0.0273	0	45.8	1.59
4.5						132	1.6	0.22	1310	61.6	2.34	0	0	28.8	1.34	2.03	0	0	28.4	1.66
5	5.52	0.039	0.0587	2.38	0.103	136	2	0	1360	61.7	2.25	0.301	0	27.4	1.17	1.75	0.223	0.124	29.6	1.19
5	1.35	0.0137	0	20.4	1.68	64.1	0.155	0	827	34.1	1.37	0.114	0	16.9	0.0506	1.8	0.141	0.0718	27.9	0.983
5.5	14.3	0	0.0834	21.1	0.982	60.7	0.0469	0	848	34.3	1.25	0.0609	0	17.5	0.222	1.73	0.0109	0.128	27.1	1.2
5.5	2.71	0.133	0	23.2	0.901	37.7	0.331	0	591	26	1.22	0.0835	0	18.1	0.698	1.79	0.227	0.0945	22.2	1.07
6	2.91	0.174	0.0237	24.6	1.16	37.7	0	0	582	21.7	1.21	0.227	0.0583	16.5	0	1.72	0.0595	0	21.6	0.355
6	2.3	0.306	0	24.2	1.33	62.9	0.82	0	610	26.5	1.08	0.144	0.369	18.4	0.537	2.61	0	0	19.2	0.702
6.5	1.35	0.0965	0.0527	21.5	1.28	60.6	0	1.46	606	25.5	1.26	0	0.261	17.2	0.829	2.42	0	0.206	19.2	14
6.5	1.49	0	0.0528	20.1	15.8	34.2	0.319	0	459	18	1.18	0.0418	0	17.5	0.954	1.13	0.17	0.151	16	0.766
7	2.12	0.241	0.423	23.5	0.713	37.4	0	0	463	19.6	1.19	0	0	15.2	0.776	1.12	0.0556	0.0543	16.3	0.586
7	2.05	0.23	0.0245	18.5	1.19	33.2	0.305	0	405	17.1	0.875	0	0.129	10.9	0.127	1.21	0	0	15.1	0.522
7.5	1.74	0.129	0	19	1.22	31.3	0	0	398	16.9	0.843	0	0.0198	10	0.651	1.16	0	0.256	12.3	0.621
7.5	0.962	0.194	0	17.2	1.03	23.6	1.42	0.709	306	13.1	0.552	0.0315	0.173	7.9	6.16	1.36	0.339	0.0323	10.8	0.863
8	0.957	0	0	15.9	0.597	23.4	1.17	0	301	11.2	0.521	0.0348	0	7.93	0.426	0.994	0	0.11	11.3	1.3
8	0.9	0.0304	0.0578	14.8	0.771	25.3	0	0.656	303	12.1	0.589	0.0913	0.251	7.38	0.0359	0.623	0.241	0	9.82	0.329
8.5	1.06	0	0	13.2	0.297	25.3	1.2	0.225	311	13.8	0.523	0.102	0.0755	7.11	0.222	0.713	0.46	0.259	10.6	8.26
8.5	1.07	0.0446	0	12.2	0.886	22.8	0.686	0	285	11.6	0.449	0	0.0653	6	0.605	0.485	0.0498	0.259	8.07	5.45
9	1.07	0.0601	0.083	11.2	0.0896	22	0.129	0	275	11.5	0.411	0.188	0.0516	5.12	0.422	0.472	0.0561	0.0928	7.41	5.04
9	1.06	0.0418	0.32	8.68	0.156	12.2	0	0	200	8.46	0.42	0.0509	0.164	4.42	0	0.541	0	0.107	5.86	0
9.5	0.886	0	0	8.2	0.158	12.5	0.318	0.134	196	8.17	0.304	0.0194	0	4.02	0.655	0.439	0.0243	0.0497	5.91	0.418

Table 4 (continued) - Unit 2 Containment Continuing Characterization Concrete Core Samples – On-Site Analysis

	B1-02110C-JWC-009-CV (cont)					B1-02110C-JWC-010-CV (cont)					B1-02110C-JWC-011-CV (cont)					B1-02110C-JWC-015-CV (cont)				
Depth	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154
(in)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
9.5	0.64	0	0	8.29	1.01	9.24	0	0.319	142	5.43	0.314	0.0114	0.0466	3.63	2.43	0.752	0	0.14	6.38	0.109
10	0.629	0.0796	0.0201	7.48	0.807	9.29	0.451	0.604	145	5.23	0.322	0.0246	0.0099	3.23	0.55	1.05	0	0	6.95	0.789
10	0.506	0.046	0.0469	6.28	0.605	11.9	0.465	0.195	138	5.27	0.263	0.0425	0.0844	3.09	0.366	0.366	0	0	4.78	0.264
10.5	0.398	0.046	0.159	5.95	0.309	12.1	0.113	0	135	5.33	0.377	0	0.0686	3.03	0.114	0.351	0.0556	0.0116	4.19	0
10.5	0.403	0.0486	0	6.01	0.483	21.2	0.245	0.314	142	5.77	0.284	0.0142	0.066	2.93	2.2	0.153	0	0.072	2.52	0.204
11	0.531	0.0339	0	5.64	0.527	21	0	0	136	6	0.267	0.0212	0	2.71	2.11	0.145	0.0193	0.0836	2.18	1.6
11	0.3	0	0.126	3.79	2.77	6.99	1.37	0	93.3	4.04	0.258	0	0.014	2.08	0.0256	0.165	0.0493	0.0244	1.96	0.0818
11.5	0.43	0	0	4.46	0.829	7.02	0.0318	0	91.7	4.31	0.303	0.168	0.0046	1.82	0.0357	0.176	0.0121	0.065	2.05	0
11.5	0.391	0.0031	0.183	3.19	0.232	7.69	0.57	0.448	81.4	3.13	0.188	0.219	0	1.3	0.938	0.15	0	0.132	1.43	0.0392
12	0.308	0.0466	0	3.33	0.0817	8.09	0	0.17	81.6	3.35	0.0838	0.0478	0	1.3	0.843	0.0847	0.0284	0	1.37	0.819
12	0.231	0.0007	0	2.82	1.78	6.18	0	0.182	65.5	2.93	0.143	0.0267	0.0245	1.23	0.167	0.139	0.0237	0.0895	1.69	0.0925
12.5	0.267	0	0.0821	2.39	0.0389	6.68	0.397	0.239	70.5	2.77	0.158	0	0.0946	1.04	0.053	0.178	0.14	0	1.67	1.18
12.5	0.22	0	0.0898	2.18	0.1	2.84	0	0.233	42.8	1.88	0.25	0.0427	0	0.987	0.385	0.172	0.0045	0	1.63	1.14
13	0.216	0.0618	0.0325	2.15	0.0901	2.6	0.0632	0	41.7	1.85	0	0.0494	0.111	1.15	0.756	0.129	0	0	1.48	1.02
13	0.322	0.072	0.214	1.75	0.415	3.09	0.245	0	33.7	2.28	0.11	0	0	0.866	0.736	0.0885	0	0.12	0.924	0.613
13.5	0.356	0.107	0.187	2	0.199	3.76	0.0655	0.0576	32.6	1.44	0.163	0.109	0.0607	0.8	0.599	0.0853	0.0594	0.0325	0.929	0.26
13.5	0.274	0	0.0219	1.98	1.35	2.22	0.0899	0	26.6	1.74	0.0999	0	0.0603	0.466	0.297	0.222	0	0.0623	0.924	0.583
14	0.297	0.0224	0	1.82	0.0822	2.11	0.167	0.241	27.3	19.9	0.141	0	0.0051	0.429	0.246	0.176	0	0.0073	0.912	0.689
14	0.0714	0	0	2.09	0.703	2.03	0.167	0.0761	21.4	0.359	0.0912	0.0484	0.0239	0.472	0.0664	0.126	0.0868	0	0.674	0.524
14.5	0.185	0.175	0	1.78	0.0132	2.16	0	0.184	19.7	0.856	0.163	0	0	0.491	0.386	0.109	0	0.0816	0.54	0.457
14.5	0.0866	0.0285	0.0463	0.842	0.186	1.24	0	0.121	17.8	14.2	0.182	0.165	0	0.374	0.546	0.171	0.013	0.101	0.286	0.363
15	0.13	0.11	0.133	1.13	0.401	1.39	0.12	0.241	18	1.2	0.0906	0.0416	0	0.467	0	0.119	0	0.0417	0.253	0.172
15	0.105	0.176	0.161	0.634	0.501	0.859	0.225	0.0592	14.1	0.785	0.142	0.118	0.146	0.358	0.187	0.11	0.0546	0	0.344	0.37
15.5	0.176	0.136	0	0.502	0.373	0.952	0	0.134	13.3	0.889	0.0918	0	0	0.215	0.0451	0.0161	0.042	0.0794	0.312	0.052
15.5	0.12	0	0.0717	0.512	0.26	0.777	0.0662	0.0123	9.51	0.464	0.0327	0	0	0.214	0.0673	0.0611	0.0202	0.0156	0.353	0.226
16	0.0545	0	0.132	0.62	0.409	0.689	0.0815	0.0517	8.69	0.771	0.119	0	0.0447	0.145	0.0079	0.0613	0	0	0.267	0.182
16	0.0583	0.0652	0.0802	0.282	0.314	0.415	0	15.6	4.35	0.349	0.0902	0	0	0.0376	0.181	0.103	0.055	0	0.336	0.163
16.5	0.145	0.0044	0.0759	0.233	0.405	0.393	0	26.8	4.67	0.329	0.106	0.0778	0	0.157	0.17	0.0879	0	0.0382	0.406	0.392
16.5	0.263	0.115	0.0556	0.601	0.433	0.591	0.19	0.46	6.98	0.507	0.0764	0.0069	0.0413	0.108	0.107	0.0822	0.0564	0.127	0.241	0.232
17	0.167	0.0597	0.169	0.288	0.534	0.608	0.0909	0.354	7.16	4.97	0.107	0	0.1	0.164	0.0525	0.0012	0.0054	0	0.281	0.191
17											0.111	0.0406	0.0927	0.164	0.0397	0.0115	0.0092	0.142	0.154	0.111
17.5											0.0855	0	0.0188	0.0871	0.0774	0	0.101	0.0785	0.0438	0.0573
17.5											0.0173	0.129	0.0661	0.0549	0.257					
18											0.106	0.0732	0.0228	0.203	0.134					
18											0.135	0	0.0502	0.246	0.163					
18.5											0.074	0.0604	0.148	0.121	0.081					
18.5											0	0.163	0.0398	0	0.0317					
19											0.0119	0	0.0186	0.14	0.037					

Table 4 (continued) - Unit 2 Containment Continuing Characterization Concrete Core Samples – On-Site Analysis

	B1-02110C-JWC-016-CV					B1-02110C-JWC-017-CV					B1-02110C-JWC-018-CV					B1-02110C-JWC-019-CV				
Depth	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154
(in)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
0	4.71	0.199	22.4	64.1	3.54	6.33	0	0.203	59	3.01	181	1.14	0	2120	121	77.8	0.942	0	1220	55.7
0.5	4.56	0.0594	12.1	62.9	4.45	6.76	0.394	0	64.6	3.67	202	0.681	4.28	2300	132	83.1	1.12	0	1300	62.4
0.5	5.07	0.258	0	66.4	3.65	5.63	0.0844	0	72.4	3.34	239	8.55	0	2510	135	92.8	0	0	1110	57.6
1	4.74	0.531	0	68.4	2.7	6.1	0.0585	0	74.9	3.87	270	0.526	0	2680	156	96.7	4.83	0	1100	49.2
1	4.28	0.339	0	61.3	3.47	5.31	0.334	0.199	66.9	3.46	296	4.14	0	2720	139	90.5	0.588	0	1620	76.2
1.5	4.47	0.19	0.0504	62.4	3.46	5.41	0.201	0	71.7	3.21	281	2.77	0	2660	126	85.9	1.13	0	1640	75.5
1.5	3.93	0.162	0	53.8	2.5	4.65	0.232	0.22	64.2	3.45	147	0.987	0	2420	118	67.2	1.94	0.536	795	37.3
2	3.56	0.0544	0.0004	52.6	3.24	4.27	0	0	62.7	2.57	142	1.33	0	2330	121	62	0	0.181	809	37
2	3.88	0	0.259	45	2.32	4.54	0.627	0	53.7	3.37	158	35	0	2240	107	44.7	1.24	0	678	28.9
2.5	3.08	0.263	0.119	41.5	1.78	4.47	0.401	0	56.7	3.07	159	0.553	0	2210	104	45.7	0.385	0.397	652	29.3
2.5	7.28	0.596	0	44.3	1.97	5.66	0	0	61.2	2.69	118	3.54	0.698	2280	112	43.9	0.245	0	514	23.8
3	6.55	0.15	0	40.7	2.36	5.62	0.603	0	60.3	2.5	116	3.93	0	2310	111	48.9	0.452	0.216	540	25.8
3	2.63	0.0176	0	40.8	1.82	2.79	0.122	0.198	39.8	1.99	127	0.81	2.13	1950	84.7	44.6	0.149	0	591	22.1
3.5	2.87	0.336	0	41.5	1.78	2.43	0.207	0	36.7	1.56	127	4.02	0	1940	89.5	44.2	0	0	592	25.1
3.5	3.27	0.29	0.0808	49.1	2.6	2.8	0.066	0.192	36.8	1.89	174	0.596	0	1820	84.1	37.1	0.131	0.334	409	16.9
4	3.42	0.0905	0.217	48.1	2.12	2.93	0	0.305	37.4	1.59	173	0	0.149	1820	87	41.7	0.65	0.607	436	18.1
4	2.2	0.09	0.0037	32.5	1.62	2.98	0.0487	0.0271	32.4	1.95	149	1.55	0	1610	71.7	32.9	0.273	0.59	328	13.9
4.5	2.25	0.107	0	32.9	1.78	2.67	0.261	0.328	29.6	0.802	142	1.5	0	1560	70.6	31.3	0.0813	0	320	14.5
4.5	4.67	0.154	0.0018	32.9	1.76	2.16	0	0.14	25.8	1.28	97.6	1.51	4.17	1270	53.3	31.7	0	0.511	299	13
5	4.04	0.26	0.0412	32.2	1.19	2.37	0.193	0.177	27	1.04	92.7	1.85	0.67	1210	59.2	31.5	0.109	0	301	14.5
5	1.66	0.256	0.0291	25.9	1.31	2.04	0.168	0.0344	20.2	0.717	78	0	0	1190	49.6	16.2	0.766	0	255	11.8
5.5	1.95	0.0858	0	25.3	1.43	1.77	0.0399	0.39	20.3	0.851	80	4.06	0	1190	57	17.2	0	0	249	10.7
5.5	1.85	0	0.169	21.2	0.969	1.37	0.0457	0	20.2	0.976	61.7	2.35	0	876	41.1	14.7	0.32	1.16	193	7.95
6	1.65	0	0	21.2	0.587	1	0.129	0	18.4	0.884	67.5	1.2	0	876	39.2	14	0	0.653	185	8.22
6	1.85	0.0383	0.233	22.1	1.27	0.866	0.0847	0	15.1	0.463	53.9	3.87	0.309	708	32.5	13.4	0.117	1.06	162	7.64
6.5	1.73	0	0.129	22.5	0.833	0.914	0.0582	0	14.4	0.138	58.6	1.12	0.754	719	30.4	12.9	0	0	159	5.75
6.5	1.6	0	0	18.7	0.783	1.12	0	0	13.9	0.607	82.3	0	0	647	27.2	8.73	0.297	0	119	5.19
7	1.5	0.56	0	18	0.842	1.22	0.0458	0	13.1	0.499	78.8	1.82	0	623	29.4	8.67	0.228	0	120	5.5
7	1.28	0.0998	0.15	13.3	0.985	0.554	0	0.0617	8.84	0.245	40.2	2.39	0	489	21.1	9.51	0.625	0.33	121	4.94
7.5	1.16	0	0.0077	13.4	0.565	0.675	0	0.0448	9.24	0.476	39.2	0	0.192	481	21.4	9.09	0.836	0	116	5.28
7.5	0.693	0.0423	0	11.5	0.663	1.08	0.0819	0.0987	9.14	0.0638	25.5	0.0165	0	356	15.3	5.83	0.039	0	87.6	3.8
8	0.661	0.0557	0.211	11.4	0.509	1.06	0.0998	0.0796	9.04	0.586	25.5	0.82	0	344	14.9	5.75	0.21	0.23	85.6	3.33
8	0.746	0.0567	0.223	9.42	0.349	0.995	0.232	0.202	7.07	0.913	20.6	1.04	0	339	15.2	7.57	0.12	0.195	78.8	3.02
8.5	0.852	0	0	8.77	0.938	0.831	0	0.0095	6.79	0.384	10.9	1.15	1.64	326	12.2	8.29	0	0	78.6	3.22
8.5	0.469	0.229	0	6.66	0.0523	0.323	0	0	5.25	1.4	13.9	0.0513	0	236	9.97	4.98	0	0	57.7	1.59
9	0.43	0.0319	0	7.48	0.292	0.417	0	0.0084	4.88	0.354	13.9	0	0.545	234	10.3	3.97	0.136	0.0244	53.4	3.45
9	0.645	0.174	0	6.88	0.639	0.216	0.0658	0.0672	4.11	0.215	14	0.212	0.159	213	8.58	3.06	0	0	45.1	1.34
9.5	0.609	0.226	0.123	6.45	0.491	0.256	0.0438	0.0647	3.98	0.0822	13.6	0.511	0	198	8.25	3.34	0	0	41.6	1.55

Table 4 (continued) - Unit 2 Containment Continuing Characterization Concrete Core Samples – On-Site Analysis

	B1-02110C-JWC-016-CV (cont)					B1-02110C-JWC-017-CV (cont)					B1-02110C-JWC-018-CV (cont)					B1-02110C-JWC-019-CV (cont)				
Depth	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154	Co-60	Cs-134	Cs-137	Eu-152	Eu-154
(in)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
9.5	0.258	0.187	0.0287	4.81	3.53	0.446	0.0374	0	3.64	0	12.5	0	0.211	200	8.52	3.41	0.273	0.102	37.1	1.75
10	0.398	0	0	5.36	0.248	0.344	0	0	3.67	0.216	12.4	0.363	1.2	199	7.95	3.29	0.421	0	36.5	1.73
10	0.41	0	0.135	4.47	1.23	0.377	0	0.186	2.57	2.06	10.7	0.66	0.293	136	5.68	2.73	0.0325	0.0837	33.5	1.4
10.5	0.331	0.0064	0	4.46	0.127	0.351	0	0.139	2.62	0.211	10.9	0	0.0209	133	4.89	2.99	0.0714	0.106	33.4	1.73
10.5	0.389	0	0.0372	4.02	0.38	0.178	0	0	2.06	0.719	10.7	0.156	0	124	5.46	1.99	0	0	28.4	1.05
11	0.298	0	0.0911	3.7	1.19	0.195	0	0	2.09	0	10.1	0.309	0	122	3.88	2.62	0	0.308	29.1	1.01
11	0.427	0.0757	0.207	2.77	0.709	0.231	0.0763	0.0675	1.96	0.412	10.8	0.156	0	106	3.81	3.16	0.147	0	23.1	1.15
11.5	0.129	0.0618	0.0008	2.3	1.74	0.252	0.0143	0	2.03	0.151	9.17	0.122	0	102	4	2.75	0.232	0	21.4	1.07
11.5	0.12	0	0	1.93	1.53	0.147	0.042	0.0731	1.61	1.52	4.32	0.847	0	75.7	2.54	1.16	0.304	0.0878	16.7	0.706
12	0.143	0	0.0019	1.87	1.41	0.115	0.026	0.0601	1.45	0.988	3.63	0.147	0	75.4	3.28	1.31	0.146	0	16.2	0.78
12	0.167	0.0014	0	2.02	0.132	0.248	0	0	1.07	0.721	3.84	0.313	0.263	57.9	2.51	1.15	0.148	0	15.6	0.964
12.5	0.301	0.0051	0	1.96	0.218	0.154	0.0334	0	1.34	0.0131	4.21	2.73	0.0973	60.1	2.34	1.22	0.214	0	14.5	0.558
12.5	0.132	0	0.0485	1.38	0.905	0.0931	0.0025	0.023	0.841	0.667	2.97	0.169	0	44.1	2.39	0.693	0	0.0080	9.21	0.638
13	0.0999	0	0.108	1.24	0.434	0.126	0	0	0.737	0	2.51	0.142	0.332	44.3	2.34	0.544	0	0	9.01	7.27
13	0.21	0	0	1.08	0.0666	0	0.185	0.0021	1.09	0.486	4.65	0.185	0	52.4	2.22	0.499	0	0.0231	8.15	5.34
13.5	0.11	0	0	1.15	0.785	0.14	0.381	0.0061	0.529	0.408	4.09	3.35	0	46.8	1.16	0.645	0.0924	0	7.26	0.438
13.5	0.123	0.0166	0.0253	0.718	0.477	0.129	0	0.0435	0.571	0.328	0.636	0.104	0	9.84	0.811	0.521	0.0731	0	5.9	0.125
14	0.144	0.0859	0	0.844	0.463	0.108	0	0	0.602	0.449	0.773	1.82	0	11.1	8.64	0.397	0	0.147	5.5	0.231
14	0.181	0.0107	0.0040	0.675	0.105	0.0014	0	0.028	0.472	0.3	1.48	0.407	0	32.4	24.3	0.323	0.0573	0	2.53	0
14.5	0.157	0.0532	0.244	0.78	0.0364	0.0873	0.0432	0	0.425	0.409	1.54	0.181	0.247	33.4	0.623	0.288	0.0359	0.0224	2.36	0.463
14.5	0.0888	0	0.0702	0.494	0.546	0.124	0	0.0436	0.32	0.278	1.43	0.89	0.257	21.4	13.8	0.372	0.062	0.0030	5.11	0.0769
15	0.286	0.0924	0	0.392	0.582	0.092	0	0	0.382	0.345	1.29	0.374	0.311	19.4	0.563	0.353	0.0448	0.169	4.35	0.275
15	0.132	0	0.0638	0.556	0	0.0873	0.11	0	0.314	0.236	1.92	0.0896	0.245	14.7	0.96	0.177	0.0845	0.043	3.15	0.344
15.5	0.096	0	0	0.444	0.286	0.0675	0	0	0.242	0.206	2.37	0.156	0.226	14.2	0.894	0.209	0	0.0191	2.99	1.87
15.5	0.146	0.0662	0	0.317	0.281	0.133	0.0678	0	0.15	0.1	1.68					0.33	0.0704	0.122	2.35	0.165
16	0.116	0	0.0648	0.429	0.327	0.115	0	0.112	0.126	0.0472	1.6					0.12	0	0.0554	2.18	0.424
16	0.0905	0	0	0.253	0.265	0.0595	0.19	0.0165	0.0701	0.284						0.201	0	0.0188	1.51	0.0695
16.5	0.0772	0	0.106	0.307	0.247	0.0367	0	0.0538	0.289	0.224						0.214	0.0679	0.128	1.67	0.515
16.5	0.0208	0	0	0.172	0.0109	0.0356	0.0102	0.018	0.0129	0.01						0.149	0.154	0.379	1.22	0.169
17	0.129	0.184	0.136	0.0131	0.189											0.0813	0	0.878	1.09	0.833
17	0.0487	0	0.0379	0.0556	0.176											0.149	0	19	0.663	0.64
17.5	0.113	0.135	0.13	0.0313	0.128											0.166	0.344	29.8	0.793	0.311
17.5	0.108	0.0717	0	0.14	0.0037															
18	0.113	0.0058	0.0127	0.0611	0.146	0.0217	0	0	0.0345	0.0222										
18	0.135	0.0126	0.121	0.0675	0.0443	0.105	0	0	0.171	0.127										
18.5	0.107	0.0536	0.0606	0.27	0.0227	0.0428	0.0192	0.0394	0	0.089										
18.5	0.105	0.0516	0	0.0393	0	0.0604	0.0278	0	0.0514	0.077										
19	0.128	0.0832	0.0223	0.0503	0.248	0.126	0	0.0616	0.139	0.0523										

Table 5 - Unit 2 Containment Continuing Characterization Concrete Core Samples – Eberline Laboratory Analysis

Nuclide	B102110-CJWC-001CV				B102110-CJFC-005CV			
	Result (pCi/g)	Uncertainty (pCi/g)	MDA (pCi/g)	>MDA	Result (pCi/g)	Uncertainty (pCi/g)	MDA (pCi/g)	>MDA
H-3	6.99E+01	1.25E+01	1.84E+01	Yes	5.72E+01	1.44E+01	2.22E+01	Yes
C-14	3.19E+00	2.68E+00	4.47E+00	No	1.01E+01	2.55E+00	4.02E+00	Yes
Fe-55	4.05E+00	6.61E+00	1.00E+01	No	2.26E+00	6.03E+00	9.12E+00	No
Ni-59	2.53E+01	8.21E+01	1.34E+02	No	1.53E+00	3.43E+01	5.50E+01	No
Co-60	2.65E+00	5.07E-01	1.31E-01	Yes	7.49E+01	5.47E+00	2.23E+00	Yes
Ni-63	1.15E+04	5.08E+01	8.49E+00	Yes	5.60E+02	7.38E+00	3.45E+00	Yes
Sr-90	1.74E+02	3.55E+00	8.13E-01	Yes	9.38E+00	9.07E-01	8.03E-01	Yes
Nb-94	0.00E+00	5.04E-01	6.65E-01	No	8.75E-01	1.23E+00	3.12E+00	No
Tc-99	1.61E+00	7.55E-01	1.24E+00	Yes	1.59E+00	7.45E-01	1.22E+00	Yes
Ag-108m	3.37E-01	4.36E-01	8.09E-01	No	1.49E+00	2.50E+00	3.47E+00	No
Sb-125	0.00E+00	1.30E+01	1.85E+01	No	3.89E+00	3.09E+01	3.83E+01	No
Cs-134	0.00E+00	2.60E+00	8.52E-01	No	0.00E+00	4.38E+00	3.18E+00	No
Cs-137	1.68E+03	2.96E+02	6.66E+00	Yes	1.04E+04	1.72E+03	2.28E+01	Yes
Pm-147	2.32E+00	8.88E-01	1.43E+00	Yes	1.49E+01	1.26E+00	1.65E+00	Yes
Eu-152	9.24E+00	2.33E+00	1.17E+00	Yes	8.14E+01	9.68E+00	6.67E+00	Yes
Eu-154	3.90E-01	4.42E-01	1.40E+00	No	2.25E+00	3.17E+00	5.55E+00	No
Eu-155	0.00E+00	5.15E+00	5.32E+00	No	1.09E+01	8.21E+00	1.36E+01	No
Np-237	4.64E-03	3.00E-02	8.17E-02	No	4.15E-02	5.35E-02	7.45E-02	No
Pu-238	0.00E+00	4.28E-02	1.46E-01	No	3.59E-02	8.23E-02	1.60E-01	No
Pu-239/240	3.39E-02	6.59E-02	1.23E-01	No	6.30E-02	8.03E-02	1.20E-01	No
Pu-241	0.00E+00	5.66E+00	9.77E+00	No	0.00E+00	5.77E+00	1.00E+01	No
Am-241	0.00E+00	3.46E-02	1.14E-01	No	4.33E-02	7.09E-02	1.24E-01	No
Am-243	8.44E-02	8.72E-02	1.10E-01	No	3.40E-02	5.77E-02	9.79E-02	No
Cm-243/244	1.53E-02	4.53E-02	9.86E-02	No	1.04E-01	8.30E-02	7.49E-02	Yes

Table 6 - HTD Ratios Based on Continuing Characterization Concrete Core Samples

Sample ID	H-3 to Cs-137	Ni-63 to Co-60	Sr-90 to Cs-137
B102110-CJWC-001CV	0.0416	4,339	0.1036
B102110-CJFC-005CV	0.0055	7.4770	0.0009

The maximum ratios from LTP Table 5-15 were exceeded by the Ni-63/Co-60 ratio of 4,339 and Sr-90/Cs-137 ratio of 0.1036. LTP section 5.2.11 states, "The maximum ratios will be used in the surrogate calculations during FSS unless area specific ratios are determined by continuing characterization. Note that the 95% UCL is conservatively based in the standard deviation of the individual values as opposed to the standard deviation of the mean. Any future continuing characterization or FSS data that contains positive results for H-3, Ni-63 and Sr-90 will be reviewed. In these cases, the area specific ratios as determined by actual survey data will be used in lieu of the maximum ratios presented in Table 5-15. The area-specific ratios used and the survey data serving as the basis for the ratios will be documented in the release record for the survey unit." Due to the fact that unreasonably high concentrations of Ni-63 and Sr-90 would be inferred using the ratios from the continuing characterization samples, an additional set of concrete core samples were acquired "post-remediation" to represent as "end-state" condition of the concrete following the removal of the source term. Concrete core samples taken during implementation of the 1st set of continuing characterization concrete core samples were determined to be not relevant due to the continuing remediation of concrete surfaces in the Under Vessel and Incore Areas after the concrete cores were collected. Additional concrete core samples were taken post-remediation and as part of the FSS for the Under Vessel Area to validate radionuclide ratios.

The secondary objective of the continuing characterization concrete core samples were to assess the depth of activation in the concrete in order to ensure the correct geometry was used for the ISOCS measurements. Based on the assessment of the analytical results of ROC concentrations at depth as presented in Table 4, an exponential circular plane geometry with a 17.8 cm depth of contamination and a depth relaxation length (DRL) of 8.6 cm was chosen as the default template.

LTP section 5.1 states, "…concrete cores will be collected during FSS to confirm the HTD to surrogate radionuclide ratios used for the surrogate calculation. Only HTD radionuclides included as ROC (H-3, Ni-63, Sr-90, for Containment and Ni-63 and Sr-90 for all other structures and soils) will be analyzed in the FSS confirmatory samples. Concrete cores will be collected from the Auxiliary Building basement, Spent Fuel Pool (SFP)/Transfer Canal, and the Under-Vessel areas in Containment where concrete will

remain. The number of cores collected and analyzed for ROC HTD will be ten percent (10%) of the FSS ISOCS measurements. The concrete core locations will be selected from the floor and lower walls in the survey unit to alleviate safety concerns from working at heights and to focus on the areas expected to contain the majority of residual radioactivity."

The survey design for the Under Vessel concrete as specified in LTP Table 5-19, required a minimum of 19 ISOCS measurements and consequently, two additional concrete core samples were collected to meet the requirements of LTP section 5.1. As a consequence of the results of the concrete core samples taken during continuing characterization, an additional 19 concrete cores were taken from the post-remediated concrete walls and floors. These concrete core samples represented the as-left condition of the Under Vessel concrete at the time FSS was performed. The concrete surfaces that were represented by the continuing characterization concrete samples were remediated twice and the actual concrete that was sampled (original concrete surface to a depth of ½ inch) had been removed and disposed of as radioactive waste. At least a foot of concrete was removed from the Under Vessel floor and up to 6 inches of concrete removed from the walls. A 6-inch concrete core was obtained at the center of the FOV of every ISOCS measurement acquired in the Under Vessel region (for a total of nine) and adjacent to the location of the continuing characterization cores. The pucks representing the existing post-remediation grade of the concrete to a depth of ½ inch for the 19 selected locations were sent to Eberline Laboratories for analysis results for Sr-90, H-3, Ni-63 and gamma spectroscopy. The results are presented in Attachment 7 of this Release Record.

Containment turnover also included the continuing characterization survey of the exposed steel liner above the 565 foot elevation. The objective of the survey was to assess the radiological condition of the exposed steel liner above the 565 foot elevation after the contaminated concrete has been removed. The liner was subjected to sufficient smear samples and beta scans of the accessible surfaces to demonstrate that the liner was adequately decontaminated prior to FSS. Locations for taking samples and/or measurements were biased toward locations with high potential for the presence of loose or fixed contamination. All swipe samples taken showed loose surface contamination results that were less than 1,000 dpm/100cm^2.

During the removal of the concrete from the floor above the 565 foot elevation, several instances occurred where the steel liner was punctured by the ram-hoe used to break apart the concrete. During these occurrences, work was stopped and the area was surveyed for loose surface contamination. In all cases, swipe samples taken of the puncture locations showed loose surface contamination of less than 1,000 dpm/100cm^2. No conditions were encountered that indicated any potential cross-contamination of media outside of the liner.

A patch was welded over each puncture location to prevent any future potential cross-contamination.

A Radiological Engineer (RE) performed a visual inspection and walk-down of the Unit 2 Containment Basement survey units 02100 and 02110 on January 9, 2018 as part of the initial turnover for performing FSS. The purpose of the walk-down was to assess the physical condition of the survey units, evaluate access points and travel paths and identify potentially hazardous conditions. A final classification assessment was performed in accordance with procedure ZS-LT-300-001-002, "*Survey Unit Classification*" (Reference 8) as part of the survey design for FSS.

Based upon completion of the Survey Unit Classification Basis for final classification, which included a review of the historical information, the results of the Characterization Survey data and, completion of a final Survey Unit Classification Worksheet, the correct final classification of survey units 02100 and 02110 were determined to be Class 1.

4. DATA QUALITY OBJECTIVES (DQO)

Final Status Survey planning and design hinges on coherence with the Data Quality Objective (DQO) process to ensure, through compliance with explicitly defined inputs and boundaries, that the primary objective of the survey is satisfied. The DQO process is described in the ZSRP LTP in accordance with MARSSIM. The appropriate design for a given survey is developed using the DQO process as outlined in Appendix D of MARSSIM.

The DQO process incorporated hypothesis testing and probabilistic sampling distributions to control decision errors during data analysis. Hypothesis testing is a process based on the scientific method that compares a baseline condition to an alternate condition. The baseline condition is technically known as the null hypothesis. Hypothesis testing rests on the premise that the null hypothesis is true and that sufficient evidence must be provided for rejection. In designing the survey plan, the underlying assumption, or null hypothesis was that residual activity in the survey unit exceeded the release criteria. Rejection of the null hypothesis would indicate that residual activity within the survey unit does not exceed the release criteria. Therefore, the survey unit would satisfy the primary objective of the FSS sample plan.

The primary objective of the FSS sample plan was to demonstrate that the level of residual radioactivity in survey units 02100 and 02110 did not exceed the release criteria specified in the LTP and that the potential dose from residual radioactivity was As Low As Reasonably Achievable (ALARA).

Zion*Solutions* TSD 11-001, *"Technical Support Document for Potential Radionuclides of Concern During the Decommissioning of the Zion Station"* (Reference 9) established the

basis for an initial suite of potential ROC for the decommissioning of the Zion Nuclear Power Station (ZNPS). LTP Chapter 2 provides detailed characterization data that described contamination levels in the Containment basement at the time site characterization was performed. The survey data for this basement was based on core samples obtained at biased locations with elevated contact dose rates and/or evidence of leaks/spills and analyzed for the presence of plant-derived radionuclides.

Zion*Solutions* TSD 14-019, *"Radionuclides of Concern for Soil and Basement Fill Model Source Terms"* (Reference 10) evaluated the results of the concrete core analysis data from the Containments and Auxiliary Building and refined the initial suite of radionuclides to potential ROC by evaluating the dose significance of each radionuclide.

LTP Chapter 6, section 6.5.2 discusses the process used to derive the ROC for the decommissioning of ZNPS, including the elimination of insignificant dose contributors (IC) from the initial suite. Table 7 presents the ROC for the Containment Basement structural surfaces and the normalized fractions based on the radionuclide mixture.

Table 7 - Dose Significant Radionuclides and Mixture

Radionuclide	% of Total Activity (normalized)(1)
H-3	0.08%
Co-60	4.72%
Ni-63	26.50%
Sr-90	0.05%
Cs-134	0.01%
Cs-137	68.17%
Eu-152	0.44%
Eu-154	0.06%

(1) Based on maximum percent of total activity from Table 20 of TSD 14-019, normalized to one for the dose significant radionuclides.

A fundamental precursor to survey design is to establish a relationship between the release criteria and some measurable quantity. This is done through the development of Derived Concentration Guideline Levels (DCGL). The DCGLs represent average levels of radioactivity above background levels and are presented in terms of surface or mass activity concentrations. Chapter 6 of the LTP describes in detail the modeling used to develop the DCGLs for structures.

The end-state basements are comprised of steel and/or concrete structures that will be covered by at least three feet of clean soil and physically altered to a condition where it

would not realistically allow the remaining structures, if excavated, to be occupied. The exposure pathways in the Basement Fill Model (BFM) are associated with residual radioactivity in floors and walls that is released through leaching into water contained in the interstitial spaces of the fill material. The BFM assumes that the inventory of residual radioactivity in a given building is released either instantly or over time by diffusion, depending on whether the activity is surficial or volumetric, respectively. The activity released into the fill water will adsorb onto the clean fill, as a function of the radionuclide-specific distribution coefficients, resulting in equilibrium concentrations between the fill and the water. Consequently, the only potential exposure pathways after backfill, assuming the 'as-left' geometry, are associated with the residual radioactivity in the water contained in the fill.

The final outputs of the BFM are the Basement DCGLs, in units of pCi/m^2, which are calculated using the BFM Groundwater (GW) and BFM Drilling Spoils Dose Factors (LTP Chapter 6, Tables 6-24 and 6-25). DCGLs are calculated separately for the GW and Drilling Spoils scenarios and for the summation of both scenarios. The summation DCGL is designated as the (Base Case DCGL) BcDCGL and is used during FSS to demonstrate compliance (analogous to the $DCGL_W$ as defined in MARSSIM). The BcDCGLs are radionuclide-specific concentrations that represent the 10 CFR 20.1402 dose criterion of 25 mrem/yr and are calculated for each ROC and each backfilled basement.

When applied to structures, the DCGLs are expressed in units of activity per unit of area (pCi/m^2). The unity rule is applied when there is more than one ROC. The measurement results for each singular ROC present in the mixture are compared against their respective DCGL to derive a dose fraction.

The BcDCGLs for the unrestricted release of the Containment basement survey units are provided in Table 8. The IC dose percentage of 10% was used to adjust the Containment basement DCGLs to account for the dose from the eliminated IC radionuclides.

Each radionuclide-specific 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/yr to an Average Member of the Critical Group (AMCG). To ensure that the summation of dose from each source term is 25 mrem/yr or less after all FSS is completed, the BcDCGLs are reduced based on an expected, or *a priori*, fraction of the 25 mrem/yr dose limit from each source term. The reduced DCGLs, or Operational DCGLs can be related to the BcDCGLs as an expected fraction of dose based on an *a priori* assessment of what the expected dose should be based on the results of site characterization, process knowledge and the extent of planned remediation. The OpDCGL is then used as the DCGL for the FSS design of the survey unit (calculation of surrogate DCGLs, investigations levels, etc.). Details of the

OpDCGLs derived for each dose component and the basis for the applied *a priori* dose fractions are provided in TSD 17-004.

Table 8 - Base Case DCGLs for Containment ($BcDCGL_B$) from LTP Chapter 5, Table 5-3

Radionuclide	Base Case DCGL (pCi/m^2)
H-3	2.38E+08
Co-60	1.57E+08
Ni-63	4.02E+09
Sr-90	1.43E+06
Cs-134	3.01E+07
Cs-137	3.94E+07
Eu-152	3.66E+08
Eu-154	3.19E+08

The OpDCGLs for the unrestricted release of the Containment basement survey units 02100 and 02110 are provided in Table 9.

Table 9 - Operational DCGLs ($OpDCGL_B$) for Containment from LTP Chapter 5, Table 5-4

Radionuclide	Operational DCGL (pCi/m^2) Above 565 foot	Operational DCGL (pCi/m^2) Under Vessel
H-3	3.25E+07	2.37E+08
Co-60	2.15E+07	1.56E+08
Ni-63	5.50E+08	4.00E+09
Sr-90	1.96E+05	1.42E+06
Cs-134	4.12E+06	2.99E+07
Cs-137	5.39E+06	3.92E+07
Eu-152	5.00E+07	3.64E+08
Eu-154	4.36E+07	3.17E+08

As part of the DQOs applied to laboratory processes, analysis results were reported as actual calculated results. The actual recorded value was used as the recorded FSS result for measurement and/or sample values that are less than MDC. Negative values were recorded as "zero". For radionuclides less than MDC, the value representing the highest

abundance was selected. Results were not reported as less than MDC. Sample report summaries included unique sample identification, analytical method, radionuclide, result, uncertainty, laboratory data qualifiers, units, and the observed MDC.

Instrument DQOs included a verification of the ability of the survey instrument to detect the radiation(s) of interest relative to the OpDCGL. Response checks were required prior to issuance and after use. Control and accountability of ISOCS units was required to assure data quality.

In accordance with the LTP, for laboratory analysis, MDCs less than 10% of the OpDCGL were preferable while MDCs up to 50% of the OpDCGL were acceptable. The maximum acceptable MDC for measurements obtained using field instruments was 50 percent of the applicable OpDCGL.

5. SURVEY DESIGN

Guidance for preparing FSS plans was provided in procedure ZS-LT-300-001-001. The FSS plan uses an integrated sample design that combines direct measurements (by ISOCS) and sampling (concrete cores).

The Canberra ISOCS was selected as the instrument of choice to perform FSS of basement surfaces because its measurements will provide results that can be used directly to determine total activity with depth in concrete, and, the surface area covered by a single ISOCS measurement is large (a nominal FOV of 10-30 m^2) which essentially eliminates the need for scan surveys. In addition, after an ISOCS measurement is collected, it can be tested against a variety of geometry assumptions to address uncertainty in the source term geometry if necessary.

The source term geometry for ISOCS efficiency calibration, i.e., concentration depth profile and areal distribution of the residual radioactivity in structures, is required to generate efficiency curves (i.e., efficiency as a function of energy) for the ISOCS gamma spectroscopy measurements. The concrete cores obtained during characterization, continuing characterization and FSS provided the requisite information regarding the distribution of activity with depth for the Under Vessel concrete. The source term geometry for the Containment above the 565 foot elevation is ½-inch plate steel with no concrete. The basis for the chosen ISOCS efficiency calibrations for the FSS of the Under Vessel concrete and the steel liner above the 565 foot elevation are documented in Zion*Solutions* TSD 14-022, *"Use of In-Situ Gamma Spectroscopy for Final Status Survey of End State Structures"* (Reference 11). For the FSS of the steel liner above the 565 foot elevation, a "circular plane" geometry with a ½ inch "depth of contamination" was selected as the default template. For the concrete in the Unit 2 Under Vessel area, an "exponential circular plane" geometry with a 17.8 cm depth of contamination and a DRL

of 8.6 cm was chosen as the default template. The basis for the selection of this geometry was the result of concrete core samples taken during continuing characterization which were analyzed for ROC concentration at depth in concrete.

In section 5.5.2.2 of the LTP, the number of ISOCS measurements required in each FSS unit was calculated as the quotient of the ISOCS FOV divided into the surface area required for areal coverage. Table 10, which is reproduced from LTP Table 5-18, presents the FSS units for the Unit 2 Containment, the classification based on contamination potential, the surface area to be surveyed and the minimum number of ISOCS measurements based on a measurement FOV of 28 m^2.

Table 10 - Number of ISOCS Measurements per FSS Unit based on Areal Coverage

FSS Unit	Classification	Area (m^2)	Minimum Areal Coverage (% of Area)	Minimum # of ISOCS Measurements (FOV-28 m^2)
Unit 2 Containment Basement above 565 foot elevation	Class 1	2,465	100%	88
Unit 2 CTMT Under-Vessel Area	Class 1	294	100%	11

To ensure that the number of ISOCS measurements based on the necessary areal coverage in a basement surface FSS unit was sufficient to satisfy a statistically based sample design, a calculation was performed and documented in LTP section 5.5.2.2 to determine sample size using the standard method as presented in MARSSIM. If the sample size based on the statistical design required more ISOCS measurements than the number of ISOCS measurement required by the areal coverage, then the number of ISOCS measurements was adjusted to meet the larger sample size.

Following MARSSIM guidance, the Type I and Type II decision errors were set at 0.05. The Upper Bound of the Gray Region (UBGR) was set at the $OpDCGL_B$. The Lower Bound of the Gray Region (LBGR) was set at the expected fraction of 50% of the $OpDCGL_B$. For the FSS unit in Unit 2 Containment above the 565 foot elevation, the entire concrete source term above the 565 foot elevation was removed. Consequently, the results of the concrete core samples taken above the 565 foot elevation in Unit 2 Containment were not representative of the conditions at the time of FSS. As reasonable value for sigma (σ) could not be determined based on existing survey data, a coefficient of variation of 30% was used in accordance with the guidance in MARSSIM, section 5.5.2.2. For the Class 1 survey unit in the Containment Under-Vessel area, the standard deviation of the cores collected during characterization were used for sigma (σ).

The relative shift (Δ/σ) was calculated as discussed in LTP section 5.6.4.1.6. The relative shift (Δ/σ) was greater than three for the FSS unit above the 565 foot elevation. Consequently, a value of three was used as the adjusted relative shift (Δ/σ). The relative shift (Δ/σ) for the Under Vessel area was two. From Table 5-5 of MARSSIM, the required number of measurements (N) for use with the Sign Test, using a value of 0.05 for the Type I and Type II decision errors, is 14 measurements for a Δ/σ value of three and 15 for a Δ/σ value of 2. Consequently, the number of ISOCS measurements in the Under Vessel FSS unit was adjusted to meet the larger sample size.

As previously noted, the required areal coverage for a Class 1 basement survey unit was 100%. The LTP required that sufficient measurements be taken in a Class 1 FSS unit to ensure that 100% of the surface area was surveyed (ISOCS FOV overlapped to ensure that there were no un-surveyed corners and gaps). In cases where the physical configuration or measurement geometry makes the acquisition of a 28 m^2 FOV difficult or prohibitive, then the FOV for the ISOCS measurement was reduced provided that the adjusted number of samples remained constant and the minimum areal coverage represented by the FSS unit classification was achieved. To ensure that were no unsurveyed corners and gaps, the number of measurements that were taken in both Unit 2 Containment Class 1 FSS units were adjusted by overlaying the center-point of the 28 m^2 FOV for the ISOCS measurement on a 4m x 4m (16 m^2) grid system. Table 11, which is reproduced from LTP Table 5-19, presents the Unit 2 Containment FSS units and the adjusted number of ISOCS measurements that will be taken in each survey unit.

Table 11 - Adjusted Minimum Number of ISOCS Measurements per FSS Unit

FSS Unit	Classification	Required Areal Coverage (m^2)	Adjusted # of ISOCS Measurements (FOV-28 m^2)	Adjusted Areal Coverage (m^2)	Adjusted Areal Coverage (% of Area)
Unit 2 CTMT above 565 foot elevation	Class 1	2,465	155(1)	2,465	100%
Unit 2 CTMT Under Vessel Area	Class 1	294	19(1)	294	100%

(1) Adjusted to ensure number of measurements that will be taken in Class 1 FSS units will ensure 100% areal coverage, including overlap to ensure that there are no un-surveyed corners and gaps (FOV based on a 4m x 4m grid system).

When the survey grids were established on the 565 foot elevation and in the Under Vessel area, obstacles and physical constraints were encountered that prompted further adjustments to the number of samples and the FOV. Some measurements were not feasible and other measurement locations were added. After adjustments to the survey design, a total of one hundred and sixty four (164) ISOCS measurements were taken above the 565 foot elevation in Unit 2 Containment; sixty eight (68) on the lower wall and

ninety six (96) on the floor (metal liner) and in the Cavity Flood Sump and the Recirculation Sump.

Nineteen (19) ISOCS measurements were originally planned for the Under Vessel area (FSS unit 02110), based on a stand-off distance of 3-meters for the ISOCS detector. Additional measurements were required due to constraints caused by the limited space in the Incore Tunnel Area, which increased the total number of ISOCS measurements necessary to achieve 100% areal coverage to fifty four (54) ISOCS measurements.

The DQO process determined that H-3, Co-60, Ni-63, Sr-90, Cs-134, Cs-137, Eu-152 and Eu-154 would be the ROC in FSS Units 02100 and 02110. During FSS, concentrations for HTD ROC H-3, Ni-63 and Sr-90 were to be inferred using a surrogate approach. Cs-137 is the principle surrogate radionuclide for H-3 and Sr-90 and Co-60 is the principle surrogate radionuclide for Ni-63. The mean, maximum and 95% Upper Confidence Level (UCL) of the surrogate ratios for concrete core samples taken in the Containment Buildings were calculated in TSD 14-019 and are presented in LTP Table 5-15 and Table 12 below. The maximum ratios were to be used to infer HTD concentrations during FSS unless area specific ratios were determined.

Table 12 - Surrogate Ratios for Containment

Ratios	Containments		
	Mean	Max	95%UCL
H-3/Cs-137	0.208	1.760	0.961
Ni-63/Co-60	30	442	193
Sr-90/Cs-137	0.002	0.021	0.010

For the FSS of survey units 02100 and 02110, the surrogate OpDCGLs for Co-60 and Cs-137 were computed based on the maximum ratios from Table 12.

The equation for calculating a surrogate DCGL is as follows:

Equation 1

$$Surrogate_{DCGL} = \frac{1}{\left[\left(\frac{1}{DCGL_{Sur}}\right) + \left(\frac{R_2}{DCGL_2}\right) + \left(\frac{R_3}{DCGL_3}\right) + \cdots \left(\frac{R_n}{DCGL_n}\right)\right]}$$

Where: $DCGL_{Sur}$ = Surrogate radionuclide DCGL

$DCGL_{2,3\ldots n}$ = DCGL for radionuclides to be represented by the surrogate

R_n = Ratio of concentration (or nuclide mixture fraction) of radionuclide "n" to surrogate radionuclide

Using the OpDCGLs for Unit 2 Containment above the 565 foot elevation presented in Table 9 and the maximum ratios from Table 12, the following surrogate calculations were performed for FSS unit 02100;

Equation 2

$$Surrogate_{DCGL\,(Cs-137)} = \frac{1}{\left[\left(\frac{1}{5.39E+06_{(Cs-137)}}\right)+\left(\frac{0.021}{1.96E+05_{(Sr-90)}}\right)+\left(\frac{1.760}{3.25E+07_{(H-3)}}\right)\right]} = 2.88E+06\ pCi/m2$$

The surrogate OpDCGL that was used for Cs-137 in FSS unit 02100 for direct comparison of sample results to demonstrate compliance is 2.88E+06 pCi/m^2.

Equation 3

$$Surrogate_{DCGL\,(Co-60)} = \frac{1}{\left[\left(\frac{1}{2.15E+07_{(Co-60)}}\right)+\left(\frac{442}{5.50E+08_{(Ni-63)}}\right)\right]} = 1.18E+06\ pCi/m2$$

The surrogate OpDCGL that was used for Co-60 in FSS unit 02100 for direct comparison of sample results to demonstrate compliance is 1.18E+06 pCi/m^2.

Using the OpDCGLs for Unit 2 Containment Under Vessel area presented in Table 9 and the maximum ratios from Table 12, the following surrogate calculations were performed for FSS unit 02110;

Equation 4

$$Surrogate_{DCGL\,(Cs-137)} = \frac{1}{\left[\left(\frac{1}{3.92E+07_{(Cs-137)}}\right)+\left(\frac{0.021}{1.42E+06_{(Sr-90)}}\right)+\left(\frac{1.760}{2.37E+08_{(H-3)}}\right)\right]} = 2.10E+07\ pCi/m2$$

The surrogate OpDCGL that was used for Cs-137 in FSS unit 02110 for direct comparison of sample results to demonstrate compliance is 2.10E+07 pCi/m^2.

Equation 5

$$Surrogate_{DCGL\,(Co-60)} = \frac{1}{\left[\left(\frac{1}{1.56E+08_{(Co-60)}}\right)+\left(\frac{442}{4.00E+09_{(Ni-63)}}\right)\right]} = 8.55E+06\ pCi/m2$$

The surrogate Operational DCGL that was used for Co-60 in FSS unit 02110 for direct comparison of sample results to demonstrate compliance is 8.55E+06 pCi/m^2.

Previous sections of this report have discussed the commitment from LTP section 5.1 to acquire concrete core samples at 10% of the locations where an ISOCS measurement was collected with the locations selected at random. Only HTD radionuclides included as ROC (H-3, Ni-63, Sr-90, for Containment) were analyzed in the FSS confirmatory

samples. For FSS unit 02100 which pertains to Unit 2 Containment above the 565 foot elevation, no concrete media remains. Consequently, no confirmatory concrete core samples were required as part of the FSS survey design. For FSS unit 02110 which pertains to Unit 2 Containment Under Vessel area, the survey design required a minimum of fifty-four (54) ISOCS measurements and consequently, five (5) additional concrete core samples were necessary to meet the requirements of LTP section 5.1.

As previously discussed, in response to the results of the continuing characterization concrete core samples, it was acknowledged that the concrete surfaces that were represented by the continuing characterization concrete samples were remediated twice and the actual concrete that was sampled (original concrete surface to a depth of ½ inch) had been removed and disposed of as radioactive waste. At least a foot of concrete was removed from the Under Vessel floor and up to 6 inches of concrete removed from the walls. Consequently, an additional 19 concrete core samples were taken on March 7, 2018 as FSS confirmatory samples. The additional 19 concrete cores represented the "as-left" condition of the Under Vessel concrete following concrete remediation.

A 6-inch concrete core sample was acquired at each of the 19 selected locations. If a concrete core was previously obtained at the same location (continuing characterization), then the second core (B group) was obtained directly adjacent. In addition, a concrete core was obtained at the center of the FOV of every ISOCS measurement acquired in the Under Vessel region (for a total of nine). The pucks representing the existing post-remediation grade of the concrete to a depth of ½ inch for the 19 selected locations (see Figure 9) were sent to Eberline Laboratories for analysis results for Sr-90, H-3, Ni-63 and gamma spectroscopy.

The analysis results for the nineteen (19) concrete core pucks taken post remediation were received from Eberline on March 29, 2018 and the results are presented in Table 13. Each sample or ½-inch puck represents the concrete from the existing grade to a depth of ½-inch. Each of the 1st ½-inch concrete pucks from each of the 19 concrete core samples were analyzed for all ROC, including the HTD ROC of H-3, Ni-63 and Sr-90. In accordance with LTP section 5.1, only samples with positive results (detectable concentrations greater than MDC) were assessed for HTD ratios.

Figure 9 - Unit 2 Containment FSS Confirmatory Concrete Core Sample Locations

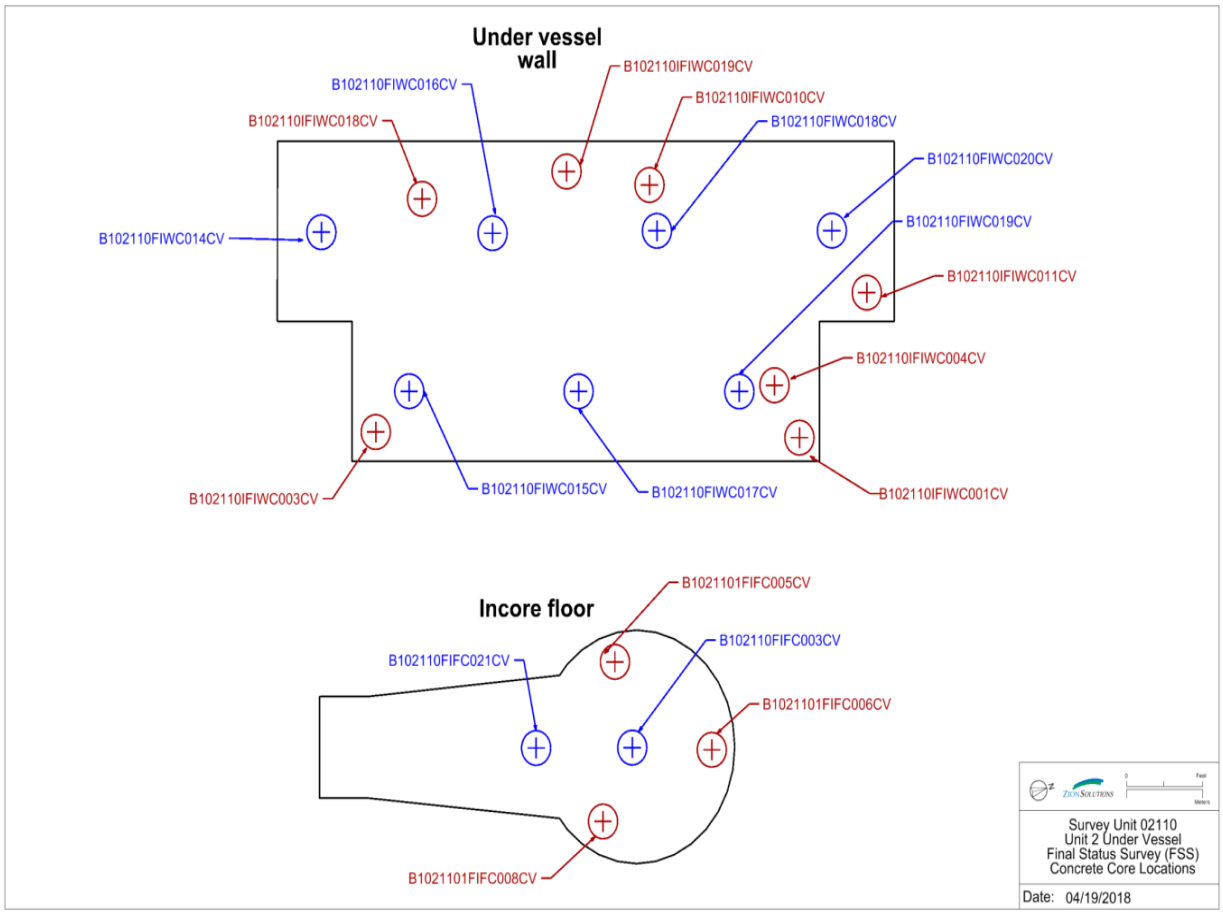


Table 13 - FSS Confirmation Concrete Core Sample Analysis – Grade to 0.5 Inch Depth

Sample ID	Nuclide	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC	Ratios
B1-02110IF-IWC-001-CV	H-3	8.33E+01	1.63E+01	2.33E+01	Y	H-3/Cs-137 = 33.59
	Co-60	1.51E+01	1.09E+00	8.04E-01	Y	
	Ni-63	3.36E+00	5.32E+00	8.98E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	4.72E-01	3.75E-01	6.09E-01	N	
	Cs-134	-4.15E-01	4.87E-01	6.74E-01	N	Sr-90/Cs-137 = N/A (Sr-90 not positively detected)
	Cs-137	2.48E+00	9.07E-01	1.32E+00	Y	
	Eu-152	1.55E+02	6.36E+00	3.34E+00	Y	
	Eu-154	6.87E+00	1.44E+00	2.55E+00	Y	
B1-02110IF-IWC-003-CV	H-3	1.13E+02	1.48E+01	1.92E+01	Y	H-3/Cs-137 = 3.01
	Co-60	4.85E+00	4.77E-01	4.42E-01	Y	
	Ni-63	2.83E+01	5.29E+00	8.02E+00	Y	Ni-63/Co-60 = 5.84
	Sr-90	5.50E-01	4.14E-01	6.72E-01	N	
	Cs-134	-1.91E-02	2.59E-01	4.88E-01	N	Sr-90/Cs-137 = N/A (Sr-90 not positively detected)
	Cs-137	3.74E+01	5.90E+00	8.62E-01	Y	
	Eu-152	1.05E+02	5.49E+00	2.06E+00	Y	
	Eu-154	3.88E+00	9.23E-01	1.68E+00	Y	
B1-02110IF-IWC-004-CV	H-3	1.20E+02	1.77E+01	2.37E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	1.13E+01	9.06E-01	7.32E-01	Y	
	Ni-63	1.62E+01	4.90E+00	7.78E+00	Y	Ni-63/Co-60 = 1.43
	Sr-90	6.88E-01	5.02E-01	8.15E-01	N	
	Cs-134	2.02E-01	3.35E-01	7.52E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	1.58E-01	6.44E-01	9.48E-01	N	
	Eu-152	1.69E+02	7.04E+00	3.25E+00	Y	
	Eu-154	5.51E+00	1.38E+00	2.52E+00	Y	

Table 13 (continued) - FSS Confirmation Concrete Core Sample Analysis – Grade to 0.5 Inch Depth

Sample ID	Nuclide	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC	Ratios
B1-02110F-IFC-003-CV	H-3	1.69E+02	2.04E+01	2.59E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	5.47E+00	5.99E-01	5.99E-01	Y	
	Ni-63	3.11E+00	5.53E+00	9.36E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	2.09E-01	5.09E-01	8.86E-01	N	
	Cs-134	3.86E-03	2.12E-01	5.84E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	2.95E-02	5.64E-01	7.66E-01	N	
	Eu-152	9.32E+01	3.89E+00	2.30E+00	Y	
	Eu-154	3.39E+00	1.03E+00	1.17E+00	Y	
B1-02110F-IFC-021-CV	H-3	1.29E+02	1.88E+01	2.52E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	4.49E+00	5.00E-01	5.34E-01	Y	
	Ni-63	4.27E+00	5.09E+00	8.56E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	6.83E-01	4.51E-01	7.18E-01	N	
	Cs-134	-7.35E-01	4.42E-01	5.46E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	-3.20E-01	4.36E-01	6.07E-01	N	
	Eu-152	1.02E+02	5.51E+00	2.09E+00	Y	
	Eu-154	2.95E+00	9.60E-01	1.80E+00	Y	
B1-02110F-IWC-015-CV	H-3	1.22E+02	1.62E+01	2.11E+01	Y	H-3/Cs-137 = 109.63
	Co-60	1.15E+01	8.09E-01	6.84E-01	Y	
	Ni-63	6.91E+00	5.00E+00	8.31E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	4.50E-01	4.42E-01	7.35E-01	N	
	Cs-134	-1.50E-01	3.73E-01	5.31E-01	N	Sr-90/Cs-137 = N/A (Sr-90 not positively detected)
	Cs-137	1.11E+00	4.67E-01	1.10E+00	Y	
	Eu-152	1.31E+02	5.86E+00	2.33E+00	Y	
	Eu-154	6.82E+00	1.12E+00	2.02E+00	Y	

Table 13 (continued) - FSS Confirmation Concrete Core Sample Analysis – Grade to 0.5 Inch Depth

Sample ID	Nuclide	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC	Ratios
B1-02110F-IWC-017-CV	H-3	1.21E+02	1.52E+01	1.95E+01	Y	H-3/Cs-137 = 55.95
	Co-60	7.60E+00	6.76E-01	6.62E-01	Y	
	Ni-63	-8.12E-01	5.68E+00	9.76E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	5.13E-01	4.98E-01	8.27E-01	N	
	Cs-134	7.41E-02	2.31E-01	6.40E-01	N	Sr-90/Cs-137 = N/A (Sr-90 not positively detected)
	Cs-137	2.17E+00	8.04E-01	1.14E+00	Y	
	Eu-152	1.58E+02	5.56E+00	3.06E+00	Y	
	Eu-154	5.91E+00	1.24E+00	2.26E+00	Y	
B1-02110F-IWC-019-CV	H-3	3.86E+02	2.19E+01	2.02E+01	Y	H-3/Cs-137 = 57.27
	Co-60	8.89E+00	7.44E-01	6.22E-01	Y	
	Ni-63	9.28E+00	5.64E+00	9.30E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	9.00E-01	4.96E-01	7.74E-01	Y	
	Cs-134	1.04E-02	1.63E-01	6.10E-01	N	Sr-90/Cs-137 = 0.13
	Cs-137	6.75E+00	1.35E+00	1.25E+00	Y	
	Eu-152	1.53E+02	7.84E+00	2.24E+00	Y	
	Eu-154	7.05E+00	1.32E+00	2.39E+00	Y	
B1-02110F-IWC-020-CV	H-3	2.28E+02	2.33E+01	2.80E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	7.92E+00	5.99E-01	3.68E-01	Y	
	Ni-63	1.51E+01	5.52E+00	8.88E+00	Y	Ni-63/Co-60 = 1.91
	Sr-90	5.64E-01	4.16E-01	6.72E-01	N	
	Cs-134	-4.01E-02	3.21E-01	4.64E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	4.31E-01	4.08E-01	6.08E-01	N	
	Eu-152	1.06E+02	3.83E+00	2.11E+00	Y	
	Eu-154	2.91E+00	8.12E-01	1.47E+00	Y	

Table 13 (continued) - FSS Confirmation Concrete Core Sample Analysis – Grade to 0.5 Inch Depth

Sample ID	Nuclide	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC	Ratios
B1-02110F-IWC-014-CV	H-3	1.52E+02	1.94E+01	2.50E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	8.07E+00	6.91E-01	7.22E-01	Y	
	Ni-63	5.61E+00	4.76E+00	7.94E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	3.55E-01	4.39E-01	7.41E-01	N	
	Cs-134	-2.36E-01	4.21E-01	5.93E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	5.93E-01	4.66E-01	7.55E-01	N	
	Eu-152	1.29E+02	5.40E+00	3.03E+00	Y	
	Eu-154	3.62E+00	1.03E+00	1.89E+00	Y	
B1-02110F-IWC-018-CV	H-3	1.52E+02	1.82E+01	2.31E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	7.87E+00	7.54E-01	6.54E-01	Y	
	Ni-63	3.75E+00	5.94E+00	1.00E+01	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	4.56E-01	4.55E-01	7.57E-01	N	
	Cs-134	-2.17E-01	4.41E-01	6.24E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	1.17E-01	6.66E-01	9.04E-01	N	
	Eu-152	1.10E+02	4.36E+00	3.38E+00	Y	
	Eu-154	2.89E+00	1.26E+00	2.18E+00	Y	
B1-02110F-IWC-016-CV	H-3	1.06E+02	1.53E+01	2.05E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	3.95E+00	4.32E-01	2.63E-01	Y	
	Ni-63	0.00E+00	5.57E+00	9.54E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	5.59E-01	5.06E-01	8.35E-01	N	
	Cs-134	1.04E-01	2.63E-01	5.06E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	4.06E-01	4.60E-01	6.95E-01	N	
	Eu-152	8.22E+01	3.27E+00	2.28E+00	Y	
	Eu-154	2.28E+00	8.68E-01	1.66E+00	Y	

Table 13 (continued) - FSS Confirmation Concrete Core Sample Analysis – Grade to 0.5 Inch Depth

Sample ID	Nuclide	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC	Ratios
B1-02110IF-IWC-019-CV	H-3	2.46E+02	2.14E+01	2.42E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	8.42E+00	7.26E-01	4.79E-01	Y	
	Ni-63	3.69E+00	5.27E+00	8.88E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	1.77E-01	4.90E-01	8.54E-01	N	
	Cs-134	-4.16E-01	4.66E-01	6.38E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	6.83E-01	6.30E-01	1.03E+00	N	
	Eu-152	1.45E+02	7.66E+00	2.57E+00	Y	
	Eu-154	2.96E+00	1.17E+00	2.06E+00	Y	
B1-02110IF-IFC-005-CV	H-3	9.30E+01	6.31E+00	7.25E+00	Y	H-3/Cs-137 = 23.12
	Co-60	7.40E+00	7.64E-01	4.07E-01	Y	
	Ni-63	4.36E+00	4.49E+00	7.53E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	8.51E-01	4.07E-01	6.10E-01	Y	
	Cs-134	-1.50E-02	4.49E-01	8.63E-01	N	Sr-90/Cs-137 = 0.21
	Cs-137	4.02E+00	1.02E+00	1.17E+00	Y	
	Eu-152	1.54E+02	8.50E+00	2.83E+00	Y	
	Eu-154	5.56E+00	1.63E+00	3.10E+00	Y	
B1-02110IF-IFC-006-CV	H-3	2.04E+02	1.21E+01	1.32E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	1.74E+01	1.30E+00	8.79E-01	Y	
	Ni-63	4.94E+00	4.47E+00	7.47E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	5.76E-01	4.50E-01	7.32E-01	N	
	Cs-134	-3.18E-01	7.02E-01	1.00E+00	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	-2.16E-02	8.65E-01	1.26E+00	N	
	Eu-152	2.36E+02	8.46E+00	4.41E+00	Y	
	Eu-154	8.68E+00	1.82E+00	3.37E+00	Y	

Table 13 (continued) - FSS Confirmation Concrete Core Sample Analysis – Grade to 0.5 Inch Depth

Sample ID	Nuclide	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC	Ratios
B1-02110IF-IFC-008-CV	H-3	2.64E+01	9.04E+00	1.43E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	2.32E+00	4.53E-01	3.77E-01	Y	
	Ni-63	5.99E+00	4.59E+00	7.63E+00	N	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	8.11E-01	4.91E-01	7.80E-01	Y	
	Cs-134	1.27E-01	2.15E-01	5.26E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	-6.01E-01	5.17E-01	6.30E-01	N	
	Eu-152	4.80E+01	2.42E+00	2.48E+00	Y	
	Eu-154	8.13E-01	8.90E-01	1.65E+00	N	
B1-02110IF-IWC-010-CV	H-3	5.01E+01	9.74E+00	1.46E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	9.17E+00	9.70E-01	6.78E-01	Y	
	Ni-63	4.94E+01	6.24E+00	8.89E+00	Y	Ni-63/Co-60 = 5.39
	Sr-90	3.23E-01	5.36E-01	9.20E-01	N	
	Cs-134	1.04E-01	3.24E-01	9.28E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	8.54E-01	8.59E-01	1.43E+00	N	
	Eu-152	1.64E+02	6.91E+00	3.96E+00	Y	
	Eu-154	4.92E+00	1.64E+00	3.21E+00	Y	
B1-02110IF-IWC-011-CV	H-3	3.16E+00	7.44E+00	1.27E+01	N	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	6.31E-02	1.96E-01	3.08E-01	N	
	Ni-63	1.01E+01	5.12E+00	8.38E+00	Y	Ni-63/Co-60 = N/A (Ni-63 not positively detected)
	Sr-90	4.96E-01	6.11E-01	1.03E+00	N	
	Cs-134	-4.12E-03	6.81E-02	2.79E-01	N	Sr-90/Cs-137 = N/A (Cs-137/Sr-90 not positively detected)
	Cs-137	-3.59E-02	1.56E-01	2.32E-01	N	
	Eu-152	3.64E+00	4.34E-01	8.63E-01	Y	
	Eu-154	-3.80E-02	2.11E-01	5.58E-01	N	

Table 13 (continued) - FSS Confirmation Concrete Core Sample Analysis – Grade to 0.5 Inch Depth

Sample ID	Nuclide	Result (pCi/g)	Uncertainty (pCi/g)	MDC (pCi/g)	>MDC	Ratios
B1-02110IF-IWC-018-CV	H-3	1.65E+02	1.26E+01	1.52E+01	Y	H-3/Cs-137 = N/A (Cs-137 not positively detected)
	Co-60	1.34E+01	9.82E-01	1.02E+00	Y	
	Ni-63	1.32E+01	5.71E+00	9.28E+00	Y	Ni-63/Co-60 = 0.98
	Sr-90	1.61E+00	6.17E-01	9.09E-01	Y	
	Cs-134	-1.39E-02	3.37E-01	7.68E-01	N	Sr-90/Cs-137 = N/A (Cs-137 not positively detected)
	Cs-137	4.94E-02	6.40E-01	9.34E-01	N	
	Eu-152	2.23E+02	7.75E+00	4.54E+00	Y	
	Eu-154	7.20E+00	1.47E+00	2.62E+00	Y	

Table 14 - FSS Confirmation Concrete Core Sample Analysis – Concentrations at Depth

B1-02110IF-IWC-003-CV

Depth	H-3 (pCi/g)	Co-60 (pCi/g)	Ni-63 (pCi/g)	Sr-90 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)
Surface to 0.5 inch	1.13E+02	4.85E+00	2.83E+01	5.50E-01	-1.91E-02	3.74E+01	1.05E+02	3.88E+00
0.5 to 1 inch	1.48E+01	5.83E+00	1.48E+01	3.32E-01	6.40E-03	1.85E+01	1.20E+02	3.91E+00
1 to 1.5 inch	1.17E+01	5.44E+00	1.17E+01	7.35E-01	5.91E-02	2.27E+00	1.17E+02	4.81E+00
1.5 to 2 inch	1.21E+00	1.49E+01	1.21E+00	3.85E-01	8.86E-02	-7.21E-02	2.01E+01	4.18E-01
2 to 2.5 inch	2.10E-01	3.12E+00	2.10E-01	3.23E-01	-1.77E-01	9.10E-02	5.42E+01	2.49E+00
2.5 to 3 inch	2.46E+01	2.95E+00	2.46E+01	5.49E-01	7.12E-02	-2.66E-01	5.74E+01	1.68E+00
3 to 3.5 inch	2.20E+00	1.65E+00	2.20E+00	4.51E-01	-1.26E+00	-4.89E-01	3.95E+01	3.24E+00
3.5 to 4 inch	9.53E-01	4.30E+00	9.53E-01	4.98E-02	6.66E-03	-2.22E-02	1.35E+01	6.10E-01
4 to 4.5 inch	1.23E+00	1.24E+00	1.23E+00	1.57E-01	1.67E-02	2.07E-01	2.70E+01	-6.97E-03
4.5 to 5 inch	1.27E+00	1.49E+00	1.27E+00	4.25E-01	-4.74E-01	-9.51E-02	2.21E+01	2.33E+00
5 to 5.5 inch	7.04E-01	6.68E-01	7.04E-01	2.56E-01	3.90E-02	-3.46E-03	2.09E+01	5.88E-01

B1-02110F-IWC-014-CV

Depth	H-3 (pCi/g)	Co-60 (pCi/g)	Ni-63 (pCi/g)	Sr-90 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)
Surface to 0.5 inch	1.52E+02	8.07E+00	5.61E+00	3.55E-01	-2.36E-01	5.93E-01	1.29E+02	3.62E+00
0.5 to 1 inch	5.12E+01	4.64E+00	3.34E+00	3.11E-01	4.53E-02	1.72E-01	8.23E+01	2.67E+00
1 to 1.5 inch	4.16E+01	5.65E+00	-4.55E-01	1.60E+00	1.79E-01	4.41E-02	8.14E+01	2.64E+00
1.5 to 2 inch	2.10E+01	4.50E+00	-9.45E-01	9.81E-01	2.26E-01	-1.51E-01	1.27E+02	4.06E+00
2 to 2.5 inch	1.05E+01	3.83E+00	1.73E+00	2.55E-01	2.11E-02	-2.18E-01	5.28E+01	1.55E+00
2.5 to 3 inch	1.37E+01	1.70E+00	1.52E+00	1.57E-01	1.79E-01	2.31E-01	3.48E+01	1.75E-01
3 to 3.5 inch	1.65E+01	1.16E+00	-1.01E+00	4.42E-01	-5.31E-02	4.69E-02	2.57E+01	9.10E-01
3.5 to 4 inch	4.54E+01	1.61E+00	-1.37E+00	1.05E+00	-1.13E-03	5.18E-03	2.64E+01	5.25E-01
4 to 4.5 inch	3.10E+01	1.38E+00	-9.19E-01	3.79E-01	-2.55E-02	1.18E-01	2.36E+01	4.67E-01
4.5 to 5 inch	4.05E+01	1.04E+00	1.12E+00	-2.97E-02	2.20E-02	1.34E-02	2.02E+01	9.21E-01
5 to 5.5 inch	3.16E+01	1.17E+00	-2.09E+00	1.09E+00	-5.97E-01	3.04E-01	1.82E+01	4.27E-01
5.5 to 6 inch	2.91E+01	7.26E-01	-2.88E+00	6.88E-01	-8.13E-02	8.10E-02	1.76E+01	-1.64E-02

Table 14 (continued) - FSS Confirmation Concrete Core Sample Analysis – Concentrations at Depth

B1-02110F-IWC-015-CV

Depth	H-3 (pCi/g)	Co-60 (pCi/g)	Ni-63 (pCi/g)	Sr-90 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)
Surface to 0.5 inch	1.22E+02	1.15E+01	6.91E+00	4.50E-01	-1.50E-01	1.11E+00	1.31E+02	6.82E+00
0.5 to 1 inch	5.36E+01	7.92E+00	0.00E+00	6.06E-01	1.25E-01	-1.11E-01	1.55E+02	8.19E+00
1 to 1.5 inch	1.15E+02	7.81E+00	4.61E-01	8.23E-01	-5.70E-02	8.07E-02	1.42E+02	3.75E+00
1.5 to 2 inch	1.30E+02	7.80E+00	-1.85E-01	4.89E-01	-1.79E-02	3.96E-01	1.49E+02	7.04E+00
2 to 2.5 inch	1.39E+02	6.32E+00	-5.44E-01	3.35E-01	-4.34E-01	-2.06E-01	1.29E+02	4.67E+00
2.5 to 3 inch	1.23E+02	9.62E+00	3.60E-01	7.49E-01	1.65E-01	-3.14E-01	1.09E+02	4.32E+00
3 to 3.5 inch	1.05E+02	5.37E+00	8.46E-01	6.09E-01	9.23E-02	3.08E-01	9.54E+01	2.72E+00
3.5 to 4 inch	9.97E+01	1.14E+01	1.84E+00	4.70E-01	1.19E-01	-4.06E-02	1.01E+02	5.14E+00
4 to 4.5 inch	7.70E+01	5.09E+00	1.18E+00	-4.41E-01	6.46E-02	1.67E-02	7.37E+01	2.52E+00
4.5 to 5 inch	7.76E+01	3.77E+00	2.54E+00	2.29E-01	1.44E-02	2.41E-01	6.60E+01	1.86E+00
5 to 5.5 inch	5.78E+01	5.49E+00	1.57E+00	4.52E-01	1.12E-01	2.84E-01	8.37E+01	2.50E+00

B1-02110F-IWC-016-CV

Depth	H-3 (pCi/g)	Co-60 (pCi/g)	Ni-63 (pCi/g)	Sr-90 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)
Surface to 0.5 inch	1.06E+02	3.95E+00	0.00E+00	5.59E-01	1.04E-01	4.06E-01	8.22E+01	2.28E+00
0.5 to 1 inch	1.72E+02	4.17E+00	2.25E+00	6.63E-01	-2.76E-01	-1.74E-01	7.08E+01	2.52E+00
1 to 1.5 inch	1.41E+02	2.49E+00	1.59E+00	4.15E-02	-2.01E-02	-1.02E-01	4.12E+01	1.77E+00
1.5 to 2 inch	1.14E+02	2.26E+00	1.41E+00	-7.12E-02	-8.33E-02	9.99E-02	4.49E+01	1.06E+00
2 to 2.5 inch	1.03E+02	2.23E+00	-2.95E-01	6.52E-01	-5.81E-02	6.67E-03	4.87E+01	1.30E+00
2.5 to 3 inch	8.10E+01	2.98E+00	1.65E-01	4.51E-01	-2.23E-01	-2.06E-01	3.64E+01	1.37E+00
3 to 3.5 inch	6.25E+01	1.42E+00	3.14E-01	3.24E-01	-6.03E-02	-5.34E-02	3.28E+01	7.25E-01
3.5 to 4 inch	6.10E+01	1.84E+00	1.09E+00	1.14E-01	-3.45E-02	4.33E-03	3.01E+01	9.56E-01
4 to 4.5 inch	5.06E+01	1.71E+00	9.50E-01	2.97E-01	-6.53E-02	4.78E-01	2.71E+01	6.05E-01
4.5 to 5 inch	4.05E+01	9.95E-01	1.66E-01	2.06E-01	4.17E-02	1.91E-01	1.77E+01	3.69E-01
5 to 5.5 inch	3.08E+01	1.08E+00	8.72E-02	2.21E-01	-5.68E-01	1.03E-01	1.51E+01	3.09E-01
5.5 to 6 inch	3.05E+01	6.01E-01	8.11E-02	9.41E-01	-4.50E-03	8.64E-02	9.46E+00	1.77E-01

Table 14 (continued) - FSS Confirmation Concrete Core Sample Analysis – Concentrations at Depth

B1-02110F-IWC-017-CV

Depth	H-3 (pCi/g)	Co-60 (pCi/g)	Ni-63 (pCi/g)	Sr-90 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)
Surface to 0.5 inch	1.21E+02	7.60E+00	-8.12E-01	5.13E-01	7.41E-02	2.17E+00	1.58E+02	5.91E+00
0.5 to 1 inch	6.67E+01	5.74E+00	7.70E-01	4.94E-01	2.25E-02	-1.11E-01	1.13E+02	4.04E+00
1 to 1.5 inch	7.70E+01	6.41E+00	2.09E+00	6.79E-01	1.95E-02	-2.83E-01	1.17E+02	4.95E+00
1.5 to 2 inch	6.47E+01	7.35E+00	7.29E-02	4.96E-02	3.18E-01	3.46E-01	1.60E+02	6.98E+00
2 to 2.5 inch	5.89E+01	5.96E+00	5.95E-01	3.77E-01	-8.67E-02	1.56E-01	1.04E+02	3.93E+00
2.5 to 3 inch	5.13E+01	6.64E+00	-7.10E-02	6.17E-01	6.95E-01	-2.04E-01	1.09E+02	2.73E+00
3 to 3.5 inch	7.75E+01	5.90E+00	6.50E-01	3.17E-01	-1.09E-01	-2.28E-01	1.15E+02	3.93E+00
3.5 to 4 inch	8.58E+01	4.96E+00	1.25E+00	1.24E-01	-2.00E-01	4.84E-01	7.75E+01	3.33E+00
4 to 4.5 inch	8.39E+01	2.49E+00	-3.20E-01	2.63E-01	-3.00E-01	1.09E-01	5.75E+01	1.34E+00

In accordance with the process described in LTP section 5.1, the HTD to surrogate ratio was derived for concrete cores with positive results for both the HTD ROC and the corresponding surrogate (Cs-137 or Co-60). The HTD ratios from the analysis of the 1st ½-inch of the nineteen (19) FSS confirmatory concrete cores are presented in Table 15.

Table 15 - FSS Confirmation Concrete Core Sample Analysis Surrogate Ratios

Ratios	Containment		
	Mean	Max	95%UCL
H-3/Cs-137	47.10	109.63	96.54
Ni-63/Co-60	3.11	5.84	5.75
Sr-90/Cs-137	0.17	0.21	0.21

A review of the post-remediation concrete core data indicates that almost all of the ratios for H-3/Cs-137 exceeded 1.76 and all the positive results for Sr-90/Cs-137 exceeded 0.021, both representing the maximum ratios from LTP section 5.2.11, Table 5-15. A review of the pre-remediation results (Table 4) and the post remediation results (Table 13 and Table 14) clearly showed that the cause could be attributed to the fact that the majority of the less soluble source term activity for Cs-137 was contained with the near surface concrete that was remediated and removed (within a minimum of 6 inches) while the more soluble ROC (H-3 and Sr-90), while present in lesser concentrations than present in the pre-remediated concrete, had become the dominant radionuclide in the relationship with Cs-137. Due to the significant reduction in the concentrations of the gamma-emitting ROC (many at MDC), the H-3 and Sr-90 concentrations were not well correlated with Cs-137 and the use of a ratio with Cs-137 to infer a concentration for the HTD was no longer defensible.

LTP Chapter 5, section 5.1 states. “Survey unit-specific surrogate ratios, in lieu of the maximum ratios from section 5.2.11 Table 5-15, may be used for compliance if sufficient radiological data exists to demonstrate that a different ratio is representative for the given survey unit. In these cases, the survey unit-specific radiological data and the derived surrogate ratios will be submitted to the Nuclear Regulatory Commission (NRC) for approval. If approved, then the survey unit-specific ratios used and the survey data serving as the basis for the surrogate ratios will be documented in the release record for the survey unit. Accordingly, ZSRP submitted a document to the NRC titled “Request for Regulatory Approval for Area Specific Hard to Detect (HTD) Approach for the Zion Nuclear Station Unit 1 Containment Undervessel Area” on April 10, 2018 While this document was specific to Unit 1 Containment, the situation and the proposed solution were applicable to both Unit 1 and Unit 2 Containments. In this document, ZSRP presented evidence that the use of surrogate ratios to infer concentrations of HTD ROC in the Under Vessel concrete was no longer defensible. ZSRP proposed an alternate approach to use the actual measured concentration of each HTD ROC to derive HTD

concentrations for demonstrating compliance in the end-state concrete.

In the document, ZSRP stated that a sufficient number (19) of post-remediation concrete core samples were taken on the Under Vessel concrete to demonstrate compliance based on actual analysis results. As previously stated, of the nineteen (19) samples taken, nine (9) were taken directly at the center-point of the FOV of the ISOCS FSS measurement. The other ten (10) were taken adjacent to continuing characterization concrete core locations that were selected based on elevated scan results (i.e. biased to areas exhibiting highest activity).

To ensure that the measured values were limiting, the following calculations were performed to assess the dose consequence of the inventory of each HTD in the Under Vessel concrete if present at the measured concentration. The measurements and dimensions presented in Table 16 (which were taken from Zion*Solutions* TSD 13-005, "*Unit 1 & 2 Reactor Building Estimated End State Concrete and Liner Volumes and Surfaces Areas*" [Reference 12]) were used to quantify the volume of concrete in the Unit 2 Containment Under Vessel area.

Table 16 - Unit 2 Containment Under Vessel Concrete Area, Volume and Dimensions

Section	Length (in)	Width (in)	Thickness (in)	Surface Area (ft^2)	Volume (ft^3)	Number	Total Surface Area (ft^2)	Total Volume (ft^3)
Sloped Tunnel Floor	320	90	15	200	250	1	200	250
Sloped Tunnel Ceiling	168	90	15	105	131	1	105	131
Sloped Tunnel Walls	319.9	94	15	209	344	2	418	688
Tunnel Ceiling	196	90	15	123	153	1	123	153
Sump Area Floor	87	90	30	70	128	1	70	128
Sump Area Walls	87	123	15	74	127	2	149	254
Fan Shaped Floor	179.5	126	30	157	393	1	157	393
Fan Shaped Walls	157	123	15	134	229	2	268	458
Under Vessel Floor	N/A	102.5	30	229	573	1	229	573
Under Vessel Walls	348	102.5	23.5	1443	3150	1	1443	3150
							3161 ft^2 294 m^2	6178 ft^3 175 m^3 1.75E+08 cm^3

For the assessment, the concrete thickness was reduced by 20% to account for the volume of concrete removed during remediation. The concentrations in units of pCi/g were multiplied by the affected mass of concrete in units of grams resulting in the actual inventory of each measured HTD ROC in units of mCi. The dose consequence was derived using the dose factors from LTP Chapter 6, Tables 6-19 and 6-20. The dose bounding calculations for each HTD ROC based on the measured concentrations of each HTD ROC from the 1st ½-inch puck from each of the nineteen (19) FSS confirmatory concrete core samples are presented in Table 17.

Table 17 - Unit 2 Containment Under Vessel Concrete HTD Inventory and Dose Based on FSS Confirmatory Core Samples

Sample ID	Description of Location	Nuclide	Result (pCi/g)	Concrete Thickness (cm)	Representative Area (cm2)	Concrete Volume (cm3)	Concrete Mass (g)	Activity (mCi)	Dose (mrem/yr)
B1-02110IF-IWC-001-CV	Lower Under Vessel wall adj to tunnel	H-3	8.33E+01	47.752	9.57E+04	4.57E+06	1.07E+07	0.8950	0.03
B1-02110IF-IWC-003-CV	Lower Under Vessel wall adj to tunnel	H-3	1.13E+02	47.752	9.57E+04	4.57E+06	1.07E+07	1.2109	0.04
B1-02110IF-IWC-004-CV	Lower Under Vessel wall adj to tunnel	H-3	1.20E+02	47.752	9.57E+04	4.57E+06	1.07E+07	1.2924	0.04
B1-02110F-IFC-003-CV	Under Vessel Floor center-point	H-3	1.69E+02	60.96	4.26E+04	2.60E+06	6.10E+06	1.0288	0.03
B1-02110F-IFC-021-CV	Under Vessel Floor @ tunnel	H-3	1.29E+02	60.96	4.26E+04	2.60E+06	6.10E+06	0.7843	0.02
B1-02110F-IWC-015-CV	Under Vessel Floor north	H-3	1.22E+02	47.752	9.57E+04	4.57E+06	1.07E+07	1.3061	0.04
B1-02110F-IWC-017-CV	Upper Under Vessel east	H-3	1.21E+02	47.752	9.57E+04	4.57E+06	1.07E+07	1.3035	0.04
B1-02110F-IWC-019-CV	Lower Under Vessel wall adj to tunnel	H-3	3.86E+02	47.752	9.57E+04	4.57E+06	1.07E+07	4.1494	0.13
B1-02110F-IWC-020-CV	Mid Under Vessel wall east	H-3	2.28E+02	47.752	9.57E+04	4.57E+06	1.07E+07	2.4446	0.07
B1-02110F-IWC-014-CV	Mid Under Vessel wall west	H-3	1.52E+02	47.752	9.57E+04	4.57E+06	1.07E+07	1.6327	0.05
B1-02110F-IWC-018-CV	Upper Under Vessel west	H-3	1.52E+02	47.752	9.57E+04	4.57E+06	1.07E+07	1.6280	0.05
B1-02110F-IWC-016-CV	Upper Under Vessel east	H-3	1.06E+02	47.752	9.57E+04	4.57E+06	1.07E+07	1.1378	0.03
B1-02110IF-IWC-019-CV	Upper Under Vessel east	H-3	2.46E+02	47.752	9.57E+04	4.57E+06	1.07E+07	2.6404	0.08
B1-02110IF-IFC-005-CV	Under Vessel Floor west wall	H-3	9.30E+01	60.96	4.26E+04	2.60E+06	6.10E+06	0.5672	0.02
B1-02110IF-IFC-006-CV	Under Vessel Floor north wall	H-3	2.04E+02	60.96	4.26E+04	2.60E+06	6.10E+06	1.2461	0.04
B1-02110IF-IFC-008-CV	Under Vessel Floor east wall	H-3	2.64E+01	60.96	4.26E+04	2.60E+06	6.10E+06	0.1609	0.00
B1-02110IF-IWC-010-CV	Upper undervessel east	H-3	5.01E+01	47.752	9.57E+04	4.57E+06	1.07E+07	0.5381	0.02
B1-02110IF-IWC-011-CV	Mid undervessel wall adj to tunnel	H-3	3.16E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0339	0.00
B1-02110IF-IWC-018-CV	Mid undervessel wall adj to tunnel	H-3	1.65E+02	47.752	9.57E+04	4.57E+06	1.07E+07	1.7745	0.05
Avg. of Tunnel Adj Cores (1)	Tunnel	H-3	1.43E+02	47.752	1.39E+06	6.62E+07	1.56E+08	22.2313	0.67

Constants

Concrete Density	=	2.35	g/cm^3
H-3 Dose Factor (2)	=	3.02E-02	mrem/yr per mCi
Conversion Factor	=	1.00E-09	mCi/pCi

Total H-3 Activity Inventory in Under Vessel Concrete 48.01 mCi

Total Dose from H-3 Inventory in Concrete 1.45 mrem/yr

Notes

(1) No concrete cores were taken in the Tunnel. Result for H-3 concentration in Tunnel is the average of the concrete cores taken closest to and adjacent to the Tunnel opening. These cores included 001, 003, 004, 011, 018, 019 and 021

(2) The Dose Factor for H-3 is the sum of the Dose Factor for Groundwater from LTP Chapter 6, Table 6-19 and the Dose Factor for Drilling Spoils from LTP Chapter 6, Table 6-20. The value was then adjusted by dividing by 0.9 to account for the Insignificant Contributor (IC) Dose Adjustment Factor

Table 17 (continued) - Unit 2 Containment Under Vessel Concrete HTD Inventory and Dose Based on FSS Confirmatory Core Samples

Sample ID	Description of Location	Nuclide	Result (pCi/g)	Concrete Thickness (cm)	Representative Area (cm2)	Concrete Volume (cm3)	Concrete Mass (g)	Activity (mCi)	Dose (mrem/yr)
B1-02110IF-IWC-001-CV	Lower Under Vessel wall adj to tunnel	Ni-63	3.36E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0361	0.0001
B1-02110IF-IWC-003-CV	Lower Under Vessel wall adj to tunnel	Ni-63	2.83E+01	47.752	9.57E+04	4.57E+06	1.07E+07	0.3044	0.0005
B1-02110IF-IWC-004-CV	Lower Under Vessel wall adj to tunnel	Ni-63	1.62E+01	47.752	9.57E+04	4.57E+06	1.07E+07	0.1737	0.0003
B1-02110F-IFC-003-CV	Under Vessel Floor center-point	Ni-63	3.11E+00	60.96	4.26E+04	2.60E+06	6.10E+06	0.0190	0.0000
B1-02110F-IFC-021-CV	Under Vessel Floor @ tunnel	Ni-63	4.27E+00	60.96	4.26E+04	2.60E+06	6.10E+06	0.0261	0.0000
B1-02110F-IWC-015-CV	Under Vessel Floor north	Ni-63	6.91E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0742	0.0001
B1-02110F-IWC-017-CV	Upper Under Vessel east	Ni-63	0.00E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0000	0.0000
B1-02110F-IWC-019-CV	Lower Under Vessel wall adj to tunnel	Ni-63	9.28E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0997	0.0002
B1-02110F-IWC-020-CV	Mid Under Vessel wall east	Ni-63	1.51E+01	47.752	9.57E+04	4.57E+06	1.07E+07	0.1625	0.0003
B1-02110F-IWC-014-CV	Mid Under Vessel wall west	Ni-63	5.61E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0603	0.0001
B1-02110F-IWC-018-CV	Upper Under Vessel west	Ni-63	3.75E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0403	0.0001
B1-02110F-IWC-016-CV	Upper Under Vessel east	Ni-63	0.00E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0000	0.0000
B1-02110IF-IWC-019-CV	Upper Under Vessel east	Ni-63	3.69E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0396	0.0001
B1-02110IF-IFC-005-CV	Under Vessel Floor west wall	Ni-63	4.36E+00	60.96	4.26E+04	2.60E+06	6.10E+06	0.0266	0.0000
B1-02110IF-IFC-006-CV	Under Vessel Floor north wall	Ni-63	4.94E+00	60.96	4.26E+04	2.60E+06	6.10E+06	0.0301	0.0001
B1-02110IF-IFC-008-CV	Under Vessel Floor east wall	Ni-63	5.99E+00	60.96	4.26E+04	2.60E+06	6.10E+06	0.0365	0.0001
B1-02110IF-IWC-010-CV	Upper Under Vessel east	Ni-63	4.94E+01	47.752	9.57E+04	4.57E+06	1.07E+07	0.5306	0.0009
B1-02110IF-IWC-011-CV	Mid Under Vessel wall adj to tunnel	Ni-63	1.01E+01	47.752	9.57E+04	4.57E+06	1.07E+07	0.1087	0.0002
B1-02110IF-IWC-018-CV	Mid Under Vessel wall adj to tunnel	Ni-63	1.32E+01	47.752	9.57E+04	4.57E+06	1.07E+07	0.1417	0.0003
Avg. of Tunnel Adj Cores (1)	Tunnel	Ni-63	1.21E+01	47.752	1.39E+06	6.62E+07	1.56E+08	1.8843	0.0034

Constants

Concrete Density	=	2.35	g/cm^3
Ni-63 Dose Factor (2)	=	1.79E-03	mrem/yr per mCi
Conversion Factor	=	1.00E-09	mCi/pCi

Total Ni-63 Activity Inventory in Under Vessel Concrete	3.7943	mCi
Total Dose from Ni-63 Inventory in Concrete	0.0068	mrem/yr

Notes

(1) No concrete cores were taken in the Tunnel. Result for Ni-63 concentration in Tunnel is the average of the concrete cores taken closest to and adjacent to the Tunnel opening. These cores included 001, 003, 004, 011, 018, 019 and 021

(2) The Dose Factor for Ni-63 is the sum of the Dose Factor for Groundwater from LTP Chapter 6, Table 6-19 and the Dose Factor for Drilling Spoils from LTP Chapter 6, Table 6-20. The value was then adjusted by dividing by 0.9 to account for the Insignificant Contributor Dose Adjustment Factor

Table 17 (continued) - Unit 2 Containment Under Vessel Concrete HTD Inventory and Dose Based on FSS Confirmatory Core Samples

Sample ID	Description of Location	Nuclide	Result (pCi/g)	Concrete Thickness (cm)	Representative Area (cm2)	Concrete Volume (cm3)	Concrete Mass (g)	Activity (mCi)	Dose (mrem/yr)
B1-02110IF-IWC-001-CV	Lower Under Vessel wall adj to tunnel	Sr-90	4.72E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0051	0.0254
B1-02110IF-IWC-003-CV	Lower Under Vessel wall adj to tunnel	Sr-90	5.50E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0059	0.0296
B1-02110IF-IWC-004-CV	Lower Under Vessel wall adj to tunnel	Sr-90	6.88E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0074	0.0370
B1-02110F-IFC-003-CV	Under Vessel Floor center-point	Sr-90	2.09E-01	60.96	4.26E+04	2.60E+06	6.10E+06	0.0013	0.0064
B1-02110F-IFC-021-CV	Under Vessel Floor @ tunnel	Sr-90	6.83E-01	60.96	4.26E+04	2.60E+06	6.10E+06	0.0042	0.0209
B1-02110F-IWC-015-CV	Under Vessel Floor north	Sr-90	4.50E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0048	0.0242
B1-02110F-IWC-017-CV	Upper Under Vessel east	Sr-90	5.13E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0055	0.0276
B1-02110F-IWC-019-CV	Lower Under Vessel wall adj to tunnel	Sr-90	9.00E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0097	0.0484
B1-02110F-IWC-020-CV	Mid Under Vessel wall east	Sr-90	5.64E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0061	0.0304
B1-02110F-IWC-014-CV	Mid Under Vessel wall west	Sr-90	3.55E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0038	0.0191
B1-02110F-IWC-018-CV	Upper Under Vessel west	Sr-90	4.56E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0049	0.0245
B1-02110F-IWC-016-CV	Upper Under Vessel east	Sr-90	5.59E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0060	0.0301
B1-02110IF-IWC-019-CV	Upper Under Vessel east	Sr-90	1.77E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0019	0.0095
B1-02110IF-IFC-005-CV	Under Vessel Floor west wall	Sr-90	8.51E-01	60.96	4.26E+04	2.60E+06	6.10E+06	0.0052	0.0260
B1-02110IF-IFC-006-CV	Under Vessel Floor north wall	Sr-90	5.76E-01	60.96	4.26E+04	2.60E+06	6.10E+06	0.0035	0.0176
B1-02110IF-IFC-008-CV	Under Vessel Floor east wall	Sr-90	8.11E-01	60.96	4.26E+04	2.60E+06	6.10E+06	0.0049	0.0248
B1-02110IF-IWC-010-CV	Upper Under Vessel east	Sr-90	3.23E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0035	0.0174
B1-02110IF-IWC-011-CV	Mid Under Vessel wall adj to tunnel	Sr-90	4.96E-01	47.752	9.57E+04	4.57E+06	1.07E+07	0.0053	0.0267
B1-02110IF-IWC-018-CV	Mid Under Vessel wall adj to tunnel	Sr-90	1.61E+00	47.752	9.57E+04	4.57E+06	1.07E+07	0.0173	0.0866
Avg. of Tunnel Adj Cores [1]	Tunnel	Sr-90	7.71E-01	47.752	1.39E+06	6.62E+07	1.56E+08	0.1200	0.6015

Constants

Concrete Density	=	2.35	g/cm^3
Sr-90 Dose Factor [2]	=	5.01E+00	mrem/yr per mCi
Conversion Factor	=	1.00E-09	mCi/pCi

Total Sr-90 Activity Inventory in Under Vessel Concrete	0.2262	mCi
Total Dose from Sr-90 Inventory in Concrete	1.1338	mrem/yr

Notes

(1) No concrete cores were taken in the Tunnel. Result for Sr-90 concentration in Tunnel is the average of the concrete cores taken closest to and adjacent to the Tunnel opening. These cores included 001, 003, 004, 011, 018, 019 and 021

(2) The Dose Factor for Sr-90 is the sum of the Dose Factor for Groundwater from LTP Chapter 6, Table 6-19 and the Dose Factor for Drilling Spoils from LTP Chapter 6, Table 6-20. The value was then adjusted by dividing by 0.9 to account for the Insignificant Contributor Dose Adjustment Factor

Table 13 presents the measured concentrations of each HTD ROC in units of pCi/g from grade to a depth of ½-inch for each of the nineteen (19) sample locations. In Table 14, five (5) of the 19 concrete core samples are further analyzed at depths greater than the 1st ½-inch. In the April 10th document, it was proposed to convert the measured concentrations of each HTD ROC from units of pCi/g to units of pCi/m^2, assuming a depth of ½-inch (1.27 cm) and a concrete density of 2.35 g/cm^3. The concentration for each HTD ROC could then be directly compared against its respective OpDCGL to derive an Operational Sum of Fractions (OpSOF) for each. Table 18 shows the results of converting positively identified measured concentrations of H-3, Ni-63 and Sr-90 from the concrete core samples to units of pCi/m^2 and then converting to SOF.

Table 18 - Unit 2 Containment Under Vessel FSS Confirmatory Core Samples Measured HTD Concentrations and SOF

Sample ID	H-3 (pCi/m^2)	H-3 OpSOF	Ni-63 (pCi/m^2)	Ni-63 OpSOF	Sr-90 (pCi/m^2)	Sr-90 OpSOF
B1-02110IF-IWC-001-CV	2.49E+06	0.010				
B1-02110IF-IWC-003-CV	3.37E+06	0.014	8.46E+05	0.000		
B1-02110IF-IWC-004-CV	3.59E+06	0.015	4.83E+05	0.000		
B1-02110F-IFC-003-CV	5.03E+06	0.021				
B1-02110F-IFC-021-CV	3.84E+06	0.016				
B1-02110F-IWC-015-CV	3.63E+06	0.015				
B1-02110F-IWC-017-CV	3.62E+06	0.015				
B1-02110F-IWC-019-CV	1.15E+07	0.049			2.69E+04	0.019
B1-02110F-IWC-020-CV	6.79E+06	0.029	4.52E+05	0.000		
B1-02110F-IWC-014-CV	4.54E+06	0.019				
B1-02110F-IWC-018-CV	4.52E+06	0.019				
B1-02110F-IWC-016-CV	3.16E+06	0.013				
B1-02110IF-IWC-019-CV	7.34E+06	0.031				
B1-02110IF-IFC-005-CV	2.77E+06	0.012			2.54E+04	0.018
B1-02110IF-IFC-006-CV	6.10E+06	0.026				
B1-02110IF-IFC-008-CV	7.87E+05	0.003			2.42E+04	0.017
B1-02110IF-IWC-010-CV	1.50E+06	0.006	1.47E+06	0.000		
B1-02110IF-IWC-011-CV			3.02E+05	0.000		
B1-02110IF-IWC-018-CV	4.93E+06	0.021	3.94E+05	0.000	4.80E+04	0.034
	Samples =	18	Samples =	6	Samples =	4
	Mean =	0.019	Mean =	0.019	Mean =	0.022
	Max =	0.049	Max =	0.049	Max =	0.034
	Min =	0.003	Min =	0.003	Min =	0.017
	SD =	0.010	SD =	0.010	SD =	0.008
	95%URL =	0.034	95%URL =	0.034	95%URL =	0.032
					Max Operational SOF (OpSOF) from HTDs=	0.083
					95%UCL OpSOF from HTDs=	0.066

To demonstrate compliance with the unrestricted release criteria in FSS unit 02100 and FSS unit 02110, the Sign Test was selected as the non-parametric statistical test. The use of the Sign Test did not require the selection or use of a background reference area, which simplified survey design and implementation.

It was proposed to sum the maximum SOF for each HTD ROC to derive a SOF that represented the "worst-case" dose consequence from the presence of HTD ROC. While the depth of contamination for the HTD ROC is greater than ½ inch, use of the maximum concentration compensated for the additional source term at depth. ZSRP also conservatively proposed using the maximum SOF as opposed to the mean or 95%UCL SOF to account for any additional, unspecified variability.

The summation of the maximum SOF resulted in a value of 0.083 which equates to a dose of 2.071 mrem/yr. This value corresponds closely with the calculated dose from total inventory of 2.591 mrem/yr from Table 17 (1.45 mrem/yr from H-3 plus 0.007 mrem/yr from Ni-63 plus 1.114 mrem/yr from Sr-90). It was then proposed to add this "worst-case" SOF to each of the measured OpSOF for the gamma emitting ROC. The combined OpSOF (including the addition of the maximum SOF for HTD) for each measurement would then be used as the sum value for the Sign Test. Passing the Sign Test with the combined OpSOF would then demonstrate that the mean activity for each ROC was less than the $OpDCGL_B$ at a Type 1 decision error of 0.05. The mean measured concentration for each HTD ROC would then be compared to their respective Base Case DCGLs to calculate dose in mrem/yr.

The Elevated Measurement Comparison (EMC) did not apply to this survey unit. At ZSRP, EMC only applies to soils as all other media (structural surfaces, embedded pipe, buried pipe and penetrations) will be remediated to their applicable BcDCGL.

A Prospective Power Curve was generated using MARSSIM 2000, a software package developed for implementation of MARSSIM. The result showed adequate power for the survey design.

For this Class 1 basement structure survey unit, the "Investigation Levels" for ISOCS measurement results are those levels specified in LTP Chapter 5, Table 5-25 and are reproduced below in Table 19.

Table 19 - Investigation Levels

Classification	Direct Measurement
Class 1	>Operational DCGL

Table 20 provides a synopsis of the survey designs for FSS unit 02100 and FSS unit 02110.

Table 20 - Synopsis of Survey Design

FEATURE	DESIGN CRITERIA		BASIS
Survey Unit Surface Areas	Under Vessel	294 m^2	LTP Ch. 5, Table 5-19
	Above 565 foot	2,465 m^2	
Number of ISOCS Measurements	Under Vessel	19(1)	LTP Ch. 5, Table 5-19
	Above 565 foot	155(1)	
Survey Design	• UBGR = SOF of 1 • LBGR = SOF of 0.01 • Type I error = 0.05 • Type II error = 0.05 • $\Delta/\sigma = 3$ (adjusted) (above 565 foot) • $\Delta/\sigma = 2$ (Under Vessel) • MARSSIM Table 5.5		LTP Chapter 5, Sec. 5.5.2.2
Grid Spacing	100% Areal Coverage (Planned for 28 m^2 FOV)		LTP Chapter 5, Sec. 5.5.2.2
DCGLs	See Tables 3 and 4 above		LTP Chapter 5, Tables 5-3 and 5-4
Investigation Level	>Operational DCGL		LTP Chapter 5, Table 5-25
Quality Control (QC)	5 % Replicate ISOCS Measurements		LTP Chapter 5, Sec. 5.9.3.1

(1) The number of ISOCS measurements designated in the survey designs is greater than the minimum number required for these survey units per Chapter 5 of the LTP, Table 5-19. Fifty four (54) measurements were required to achieve 100% coverage of the Under Vessel. One hundred and sixty four (164) measurements were required for 100% coverage of the 565 foot

6. SURVEY IMPLEMENTATION

For FSS unit 02100 and FSS unit 02110, compliance with the unrestricted release criteria was demonstrated through a combination of direct measurements using the ISOCS and the analysis of concrete core samples obtained from the Under Vessel area.

"Field Logs" (ZS-LT-300-001-001 Attachment 14) were used to document field activities and other information pertaining to the performance of the FSS. Daily briefings were conducted to discuss the expectations for job performance and to review safety aspects of the job.

Zion*Solutions* TSD 14-022 provided the initial justification for the selection of reasonably conservative geometries for efficiency calibrations for the ISOCS based on the physical conditions of the remediated surface and the anticipated depth and distribution of activity. All ISOCS measurements were acquired using approved geometries. Various stand-off distances were utilized due to space constraints in the Incore Tunnel area. Graphics

containing the details of those geometries are attached to this Release Record. The number and locations of the ISOCS shots were adjusted to ensure 100% coverage of the surfaces of the steel liner above the 565 foot elevation, the Under Vessel and Incore Tunnel area.

Between 2014 and 2017, decommissioning activities involved the removal of all radioactive systems and components from the interior of the Unit 2 Containment, including major components such as the Reactor Vessel, the Steam Generators, the Pressurizer, the Reactor Coolant Pumps as well as all contaminated primary and secondary pipe. In 2017, all contaminated concrete was removed from the interior of the Containment above the 565 foot elevation, leaving only the exposed ½-inch steel liner and several penetrations.

Initial remediation of the Under Vessel concrete was performed between November 27, 2017 and December 21, 2017. Remediation techniques included the scabbling and hammering of the concrete surface using hydraulic hoe-rams. Concrete debris was then removed through load-out of waste skids. Approximately 2 to 4 inches of concrete was removed from the walls and floor directly below where the Reactor Vessel was located and approximately 1 to 2 inches of concrete was removed from the walls and floor of the sloped tunnel.

Both the interior above the 565 foot elevation and the Under Vessel area of Unit 2 Containment were initially turned over to the Characterization/License Termination (C/LT) Group on December 22, 2017 anticipating that the remediation performed was sufficient to meet the unrestricted release criteria.

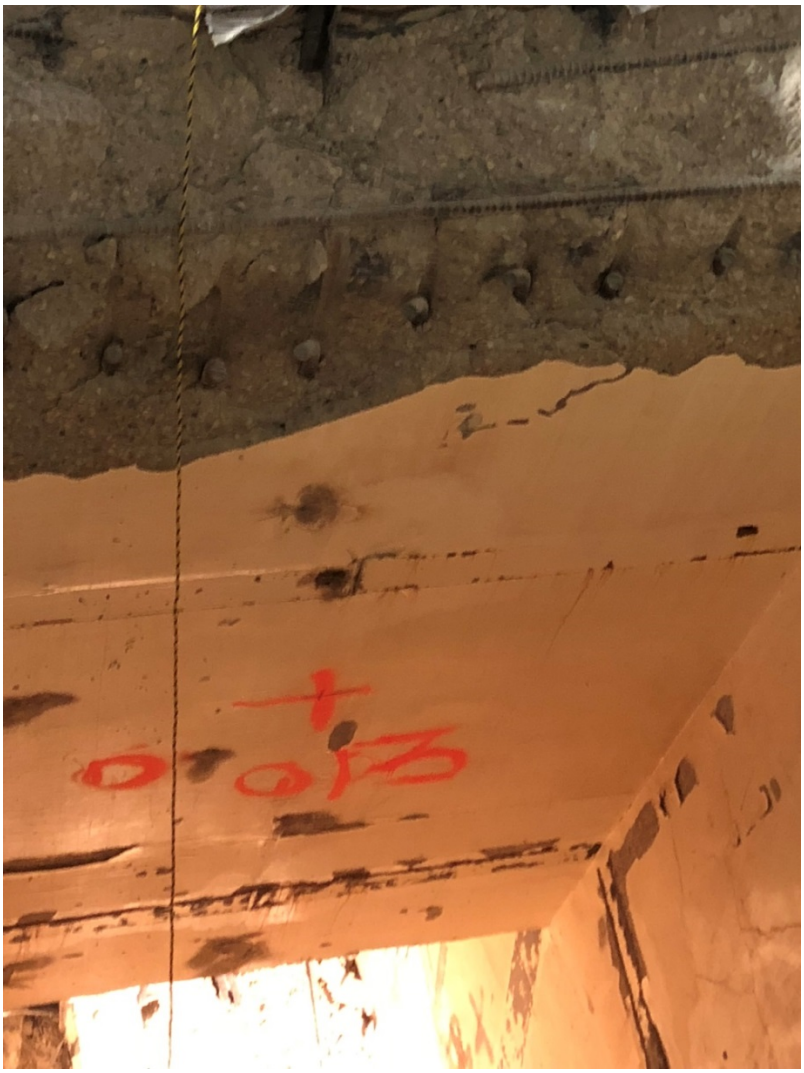
On January 12, 2018, the C/LT group attempted to perform FSS. FSS failed due to several ISOCS measurements exceeding a SOF of one. The area was rejected and turned back over for additional remediation on January 13, 2018.

Between January 13, 2018 and January 28, 2018, an additional 4 inches of concrete was removed from the floor of the Under Vessel area and from the floor of the sloped tunnel.

On January 29, 2018, C/LT took turnover of the Unit 2 Containment Under Vessel area for the second time. Additional ISOCS measurements indicated contaminated concrete around the Incore sump that exceeded the OpDCGL for Cs-137. Again, the area was rejected and turned back over for additional remediation on February 2, 2018.

On February 3, 2018, the decommissioning contractor re-commenced remediation of Under Vessel concrete. Emphasis was placed on removing concrete around sump and concrete at the seams of the floor and lower wall where scans indicate elevated gamma activity.

Figure 10 - Unit 2 Under Vessel Incore Tunnel Remediation



On February 12, 2018, C/LT took turnover of the Unit 2 Containment Under Vessel area for the third time. ISOCS measurements continued to indicate contaminated concrete around the Incore sump and along the seams in the floor that exceeded the OpDCGL for Cs-137. Again, the area was rejected and turned back over for additional remediation on February 15, 2018.

On February 15, 2018, remediation re-commenced of the Under Vessel concrete. Project management provided direction to remove another 6 to 12 inches of concrete from the floor and walls and to remove all concrete down to the liner in the sloped tunnel area at the locations that failed FSS.

Remediation was completed on April 5, 2018. The area was cleaned and turned over to the C/LT group for FSS. A walkdown and turnover survey was satisfactorily performed in

both FSS units in accordance with the Isolation and Control requirements of procedure ZS-LT-300-001-003, "*Isolation and Control for Final Status Survey*" (Reference 13). The turnover surveys consisted of surveys for loose surface contamination as well as the acquisition of several ISOCS measurements in areas that had previously failed FSS. All smear results were less than 1,000 dpm/100 cm^2 and all ISOCS measurements indicated a SOF of less than one for all ROC. The Unit 2 Containment was deemed acceptable for turnover and FSS commenced in the Under Vessel area on April 6, 2018.

The ISOCS detector was positioned horizontal or vertical to the surface at the center-point of each selected measurement location. In most cases, the exposed face of the detector was positioned at a distance of 3 meters from the surface with the 90- degree collimation shield installed; this orientation corresponded to a nominal FOV of 28 m^2. The detector to source distance was reduced even further to accommodate physical constraints or encountered obstructions. In this case, the FOV was reduced and the number of measurements increased to ensure 100% areal coverage was achieved.

The measured activity for each gamma-emitting ROC (and any other gamma-emitting radionuclide that was positively detected by ISOCS) was recorded (in units of pCi/m^2). Background was not subtracted from any measurement. A OpSOF calculation was performed for each measurement by dividing the reported concentration of each ROC by the OpDCGL for each ROC to derive an individual ROC fraction. The individual ROC fractions were then summed to provide a total OpSOF value for the measurement.

Nine (9) replicate measurements were taken with the ISOCS above the 565 foot elevation and three (3) replicate measurements were taken with the ISOCS in the Under Vessel area. Above the 565 foot elevation, the locations selected for taking replicate measurements were at locations 045, 050, 060, 100, 115, 119, 139, 150 and 165. In the Under Vessel area, the locations selected for taking replicate measurements were at locations 016, 017 and 051. These locations were randomly selected using the Microsoft® Excel RANDBETWEEN function. The number of replicate measurements satisfies the requirement that a minimum of 5% percent of the number of measurements that will be used for non-parametric statistical testing be selected for additional QC evaluation.

7. SURVEY RESULTS

The SOF or "unity rule" is applied to the data used for the survey planning, data evaluation and statistical tests for basement surfaces since multiple radionuclide-specific measurements were performed and the concentrations inferred based on known relationships. The application of the unity rule served to normalize the data to allow for an accurate comparison of the various data measurements to the release criteria. When the unity rule is applied, the $DCGL_w$ (used for the nonparametric statistical test) becomes

one (1). The $BcDCGL_B$ are directly analogous to the $DCGL_W$ as defined in MARSSIM. The use and application of the unity rule was performed in accordance with section 4.3.3 of MARSSIM.

As described in LTP Chapter 5, section 5.10.3.2, the Sign Test was used to evaluate the measured residual radioactivity against the dose criterion. The SOF for each measurement was used as the sum value for the Sign Test. The Sign Test then demonstrated that the mean activity for each ROC was less than the $OpDCGL_B$ at a Type I decision error of 0.05.

For building surfaces, areas of elevated activity were defined as any area identified by measurement/sample (systematic or judgmental) that exceeded the OpDCGL but was less than the BcDCGL. Any area that exceeded the BcDCGL would have required remediation. The OpSOF for a systematic or a judgmental measurement/sample(s) can exceed one without remediation as long as the survey unit passes the Sign Test and, the mean OpSOF for the survey unit does not exceed one. Once the survey data set passes the Sign Test (using OpDCGLs), then the mean radionuclide activity (pCi/m^2) for each ROC from systematic measurements along with any identified elevated areas from systematic and judgmental measurements can be used with the BcDCGLs to perform a mean (Base Case Sum of Fractions Basement) $BcSOF_B$ calculation. The dose from residual radioactivity assigned to the FSS unit is the mean $BcSOF_B$ multiplied by 25 mrem/yr.

Unit 2 Containment above the 565 foot Elevation

Direct measurement locations were denoted on the steel liner above the 565 foot elevation by marking an approximate 4 meter by 4 meter grid pattern using a random start point that was overlaid over the exposed surface, providing sufficient overlap between locations to ensure 100% areal coverage. See Figures 12 and 13 for a depiction of all measurement locations.

The systematic sample population consisted of one hundred and sixty four (164) direct measurements that were acquired using the ISOCS. A summary of the results of the 164 ISOCS measurements taken for non-parametric statistical testing results is provided in Table 21. The concentrations for H-3, Ni-63 and Sr-90 were inferred based on the maximum ratios as specified in LTP Chapter 5, Table 5-15. The complete ISOCS gamma spectroscopy reports are presented in Attachment 6. The basic statistics for the systematic measurements are summarized in Table 22.

Figure 11 - ISOCS Measurements of Unit 2 Containment Above 565 foot Elevation

Figure 12 - Unit 2 Containment Above 565 foot Elevation FSS Floor Measurement Locations

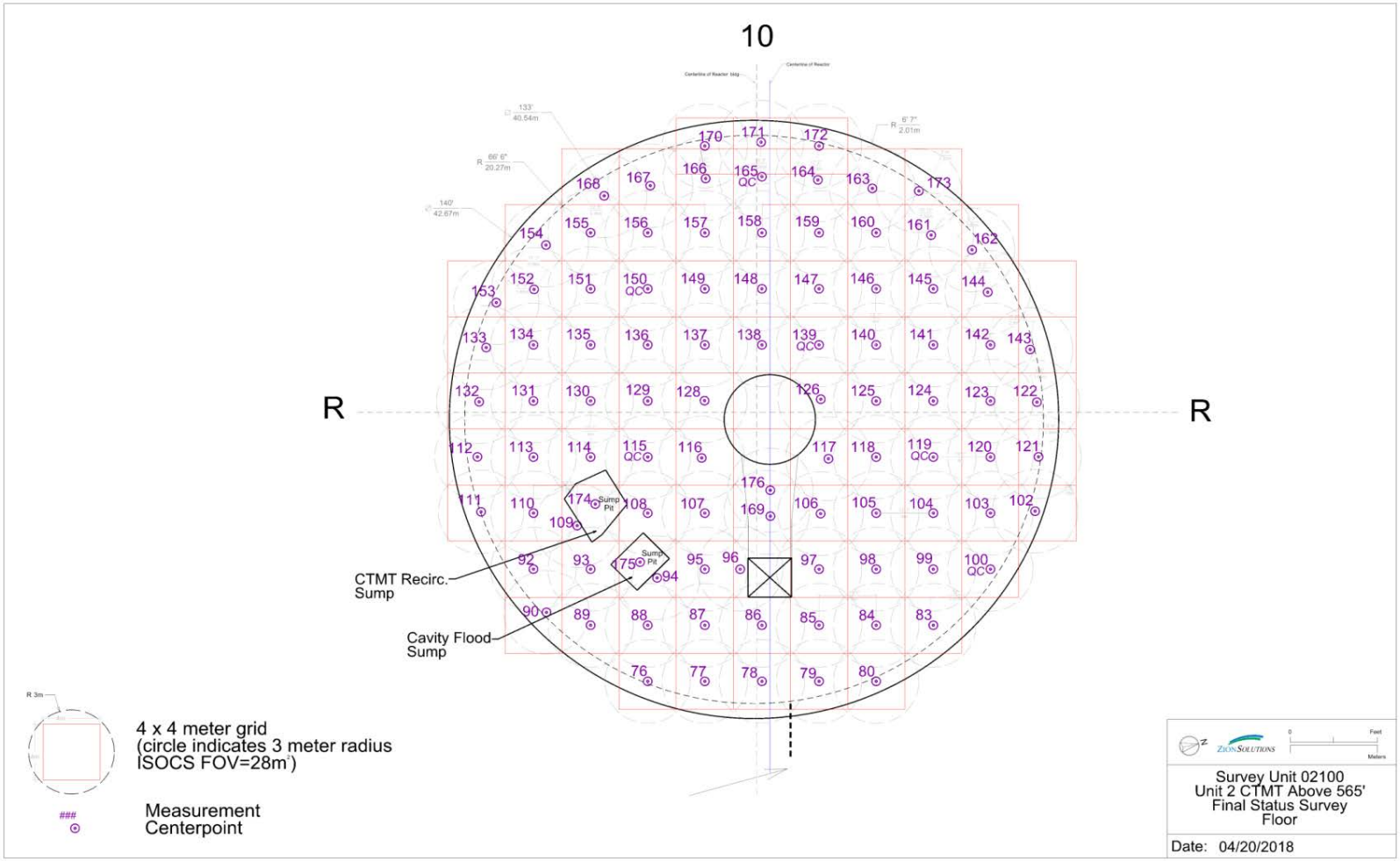


Figure 13 - Unit 2 Containment Above 565 foot Elevation FSS Wall Measurement Locations

Table 21- Unit 2 Containment Above 565 foot Elevation - Measured Concentrations of ROC for FSS

Measurement ID	H-3[(2)] (pCi/m^2)	Co-60[(1)] (pCi/m^2)	Ni-63[(2)] (pCi/m^2)	Sr-90[(2)] (pCi/m^2)	Cs-134 (pCi/m^2)	Cs-137[(1)] (pCi/m^2)	Eu-152 (pCi/m^2)	Eu-154 (pCi/m^2)	OpSOF
B1-02100DF-SWM-001-GD	6.35E+04	3.65E+04	1.62E+07	7.58E+02	2.17E+03	3.61E+04	0.00E+00	2.76E+04	0.045
B1-02100DF-SWM-002-GD	3.51E+04	7.75E+04	3.43E+07	4.19E+02	0.00E+00	2.00E+04	5.73E+04	2.75E+04	0.075
B1-02100DF-SWM-003-GD	4.68E+04	3.86E+04	1.71E+07	5.58E+02	7.99E+03	2.66E+04	2.40E+04	8.61E+03	0.045
B1-02100DF-SWM-004-GD	6.54E+04	4.66E+04	2.06E+07	7.81E+02	0.00E+00	3.72E+04	1.89E+04	7.79E+02	0.053
B1-02100DF-SWM-005-GD	1.29E+05	2.92E+04	1.29E+07	1.53E+03	2.64E+04	7.31E+04	3.37E+04	1.89E+04	0.058
B1-02100DF-SWM-006-GD	7.33E+04	2.72E+04	1.20E+07	8.75E+02	7.25E+03	4.17E+04	4.61E+03	8.65E+03	0.040
B1-02100DF-SWM-007-GD	3.54E+04	2.44E+04	1.08E+07	4.23E+02	0.00E+00	2.01E+04	4.47E+04	3.09E+04	0.029
B1-02100DF-SWM-008-GD	6.58E+04	3.22E+04	1.42E+07	7.85E+02	5.15E+03	3.74E+04	2.67E+04	0.00E+00	0.042
B1-02100DF-SWM-009-GD	5.83E+04	2.78E+04	1.23E+07	6.96E+02	0.00E+00	3.32E+04	2.11E+04	2.57E+04	0.036
B1-02100DF-SWM-010-GD	3.92E+04	2.89E+04	1.28E+07	4.67E+02	1.89E+04	2.23E+04	2.30E+04	0.00E+00	0.037
B1-02100DF-SWM-011-GD	9.02E+04	2.46E+04	1.09E+07	1.08E+03	4.88E+03	5.12E+04	8.28E+04	9.68E+03	0.042
B1-02100DF-SWM-012-GD	1.11E+05	2.84E+04	1.25E+07	1.33E+03	2.19E+04	6.33E+04	2.40E+04	8.04E+02	0.052
B1-02100DF-SWM-013-GD	1.04E+05	3.99E+04	1.76E+07	1.24E+03	3.20E+03	5.89E+04	2.13E+04	7.15E+03	0.056
B1-02100DF-SWM-014-GD	6.34E+04	2.88E+04	1.27E+07	7.57E+02	1.02E+04	3.60E+04	6.68E+03	1.45E+04	0.040
B1-02100DF-SWM-015-GD	1.04E+05	6.39E+04	2.83E+07	1.24E+03	9.43E+03	5.90E+04	2.32E+03	2.77E+04	0.078
B1-02100DF-SWM-016-GD	1.22E+05	4.02E+04	1.78E+07	1.45E+03	0.00E+00	6.93E+04	5.58E+04	3.56E+03	0.059
B1-02100DF-SWM-017-GD	1.83E+05	4.30E+04	1.90E+07	2.18E+03	2.62E+03	1.04E+05	5.73E+04	9.19E+03	0.075
B1-02100DF-SWM-018-GD	3.63E+05	9.22E+04	4.08E+07	4.34E+03	2.36E+03	2.07E+05	2.45E+03	1.42E+04	0.151
B1-02100DF-SWM-019-GD	6.62E+05	2.36E+05	1.04E+08	7.90E+03	0.00E+00	3.76E+05	5.00E+04	4.64E+03	0.332
B1-02100DF-SWM-020-GD	3.44E+05	3.21E+04	1.42E+07	4.11E+03	1.46E+04	1.96E+05	1.49E+04	0.00E+00	0.099
B1-02100DF-SWM-021-GD	3.40E+05	3.62E+04	1.60E+07	4.05E+03	1.08E+04	1.93E+05	8.38E+03	0.00E+00	0.100
B1-02100AF-SWM-022-GD	8.78E+04	1.76E+04	7.80E+06	1.05E+03	4.42E+03	4.99E+04	3.81E+04	1.23E+04	0.034
B1-02100DF-SWM-023-GD	8.64E+04	1.49E+03	6.59E+05	1.03E+03	0.00E+00	4.91E+04	1.34E+04	1.49E+04	0.019
B1-02100DF-SWM-024-GD	2.08E+05	2.00E+04	8.84E+06	2.49E+03	0.00E+00	1.18E+05	6.55E+04	3.90E+04	0.060
B1-02100DF-SWM-025-GD	1.83E+05	2.74E+04	1.21E+07	2.18E+03	2.11E+04	1.04E+05	4.25E+04	2.39E+04	0.066
B1-02100DF-SWM-026-GD	1.84E+05	3.38E+04	1.50E+07	2.20E+03	4.99E+03	1.05E+05	2.31E+04	3.67E+04	0.068
B1-02100DF-SWM-027-GD	7.87E+04	2.62E+04	1.16E+07	9.39E+02	8.00E+03	4.47E+04	0.00E+00	2.07E+04	0.040
B1-01200DF-SWM-028-GD	9.18E+04	3.29E+04	1.46E+07	1.10E+03	3.24E+04	5.22E+04	2.33E+04	1.20E+04	0.055
B1-02100DF-SWM-029-GD	1.84E+05	3.97E+04	1.75E+07	2.20E+03	7.21E+03	1.05E+05	1.99E+04	9.37E+03	0.072
B1-02100DF-SWM-030-GD	1.58E+05	3.83E+04	1.69E+07	1.88E+03	0.00E+00	8.95E+04	4.98E+04	0.00E+00	0.065
B1-02100DF-SWM-031-GD	6.57E+04	3.02E+04	1.33E+07	7.84E+02	8.59E+03	3.73E+04	3.87E+04	8.38E+03	0.042
B1-02100DF-SWM-032-GD	1.57E+05	3.00E+04	1.32E+07	1.88E+03	7.46E+03	8.94E+04	1.51E+04	6.12E+04	0.060

Table 21 (continued) - Unit 2 Containment Above 565 foot Elevation - Measured Concentrations of ROC for FSS

Measurement ID	H-3[2] (pCi/m^2)	Co-60[1] (pCi/m^2)	Ni-63[2] (pCi/m^2)	Sr-90[2] (pCi/m^2)	Cs-134 (pCi/m^2)	Cs-137[1] (pCi/m^2)	Eu-152 (pCi/m^2)	Eu-154 (pCi/m^2)	OpSOF
B1-02100DF-SWM-033-GD	1.23E+05	3.51E+04	1.55E+07	1.46E+03	1.46E+03	6.97E+04	3.76E+04	4.67E+03	0.055
B1-02100DF-SWM-034-GD	7.59E+04	2.55E+04	1.13E+07	9.05E+02	0.00E+00	4.31E+04	2.99E+04	6.30E+03	0.037
B1-02100DF-SWM-035-GD	3.55E+04	2.86E+04	1.26E+07	4.24E+02	1.87E+04	2.02E+04	7.19E+04	0.00E+00	0.037
B1-02100DF-SWM-036-GD	1.53E+05	4.32E+04	1.91E+07	1.82E+03	9.30E+03	8.68E+04	0.00E+00	1.54E+04	0.069
B1-02100DF-SWM-037-GD	8.33E+04	2.97E+04	1.31E+07	9.93E+02	7.65E+03	4.73E+04	1.81E+04	1.29E+04	0.044
B1-02100DF-SWM-038-GD	3.28E+04	2.29E+04	1.01E+07	3.92E+02	1.48E+04	1.86E+04	5.73E+04	1.85E+04	0.031
B1-02100DF-SWM-039-GD	5.44E+04	3.94E+04	1.74E+07	6.49E+02	0.00E+00	3.09E+04	0.00E+00	4.02E+04	0.045
B1-02100DF-SWM-040-GD	9.18E+04	4.51E+04	2.00E+07	1.10E+03	7.51E+03	5.22E+04	4.97E+04	1.72E+04	0.060
B1-02100DF-SWM-041-GD	9.63E+04	7.02E+04	3.10E+07	1.15E+03	1.00E+04	5.47E+04	1.76E+04	3.69E+04	0.082
B1-02100DF-SWM-042-GD	1.16E+05	4.13E+04	1.83E+07	1.39E+03	0.00E+00	6.62E+04	2.52E+04	0.00E+00	0.059
B1-02100DF-SWM-043-GD	8.80E+04	3.47E+04	1.54E+07	1.05E+03	1.59E+04	5.00E+04	5.13E+04	2.30E+04	0.052
B1-02100DF-SWM-044-GD	5.57E+04	3.45E+04	1.52E+07	6.64E+02	8.04E+03	3.16E+04	5.90E+04	1.74E+04	0.044
B1-02100DF-SWM-045-GD	2.95E+04	2.23E+04	9.84E+06	3.52E+02	8.02E+03	1.67E+04	5.43E+03	2.18E+04	0.027
B1-02100DF-SWM-046-GD	6.60E+04	2.33E+04	1.03E+07	7.87E+02	2.06E+04	3.75E+04	4.83E+04	2.47E+04	0.039
B1-02100DF-SWM-047-GD	4.88E+04	2.55E+04	1.13E+07	5.82E+02	0.00E+00	2.77E+04	8.28E+04	6.33E+04	0.034
B1-02100DF-SWM-048-GD	3.51E+04	3.75E+04	1.66E+07	4.19E+02	2.98E+03	1.99E+04	2.20E+04	2.07E+04	0.040
B1-02100DF-SWM-049-GD	5.51E+04	3.09E+04	1.36E+07	6.57E+02	1.22E+03	3.13E+04	4.01E+04	1.45E+04	0.039
B1-02100DF-SWM-050-GD	3.48E+04	1.54E+04	6.80E+06	4.15E+02	1.67E+04	1.97E+04	0.00E+00	8.38E+02	0.024
B1-02100DF-SWM-051-GD	5.39E+04	5.51E+04	2.44E+07	6.43E+02	4.45E+03	3.06E+04	1.86E+04	0.00E+00	0.059
B1-02100DF-SWM-052-GD	5.39E+04	3.33E+04	1.47E+07	6.43E+02	9.03E+03	3.06E+04	1.63E+04	8.37E+03	0.042
B1-02100DF-SWM-053-GD	3.13E+04	3.31E+04	1.46E+07	3.73E+02	0.00E+00	1.78E+04	2.02E+04	1.16E+04	0.035
B1-02100DF-SWM-054-GD	4.43E+04	3.14E+04	1.39E+07	5.28E+02	3.08E+03	2.52E+04	1.33E+04	1.89E+04	0.037
B1-02100DF-SWM-055-GD	6.77E+04	3.62E+04	1.60E+07	8.08E+02	2.03E+04	3.85E+04	6.77E+03	1.20E+04	0.049
B1-02100DF-SWM-056-GD	5.17E+04	4.32E+04	1.91E+07	6.17E+02	0.00E+00	2.94E+04	4.09E+04	4.30E+04	0.049
B1-02100DF-SWM-057-GD	8.06E+04	4.05E+04	1.79E+07	9.62E+02	8.83E+03	4.58E+04	1.09E+04	2.23E+04	0.053
B1-02100DF-SWM-058-GD	5.26E+04	3.48E+04	1.54E+07	6.28E+02	0.00E+00	2.99E+04	1.40E+04	0.00E+00	0.040
B1-02100DF-SWM-059-GD	6.57E+04	3.94E+04	1.74E+07	7.84E+02	7.94E+02	3.74E+04	1.86E+04	1.59E+04	0.047
B1-02100DF-SWM-060-GD	7.05E+04	4.32E+04	1.91E+07	8.41E+02	3.67E+02	4.01E+04	1.37E+04	6.71E+03	0.051
B1-02100DF-SWM-061-GD	5.60E+04	5.57E+04	2.46E+07	6.68E+02	0.00E+00	3.18E+04	1.68E+03	2.53E+04	0.059
B1-02100DF-SWM-062-GD	6.30E+04	3.66E+04	1.62E+07	7.51E+02	0.00E+00	3.58E+04	1.68E+04	7.63E+03	0.044
B1-02100DF-SWM-063-GD	4.34E+04	5.57E+04	2.46E+07	5.18E+02	4.77E+03	2.47E+04	8.52E+04	8.33E+03	0.059

Table 21 (continued) - Unit 2 Containment Above 565 foot Elevation - Measured Concentrations of ROC for FSS

Measurement ID	H-3[(2)] (pCi/m^2)	Co-60[(1)] (pCi/m^2)	Ni-63[(2)] (pCi/m^2)	Sr-90[(2)] (pCi/m^2)	Cs-134 (pCi/m^2)	Cs-137[(1)] (pCi/m^2)	Eu-152 (pCi/m^2)	Eu-154 (pCi/m^2)	OpSOF
B1-02100DF-SWM-064-GD	7.74E+04	1.02E+05	4.50E+07	9.24E+02	1.54E+04	4.40E+04	2.09E+03	1.01E+04	0.106
B1-02100DF-SWM-065-GD	2.26E+04	7.67E+04	3.39E+07	2.69E+02	0.00E+00	1.28E+04	4.49E+04	7.21E+03	0.071
B1-02100DF-SWM-066-GD	4.22E+04	2.90E+04	1.28E+07	5.03E+02	4.40E+03	2.40E+04	2.68E+04	8.63E+03	0.035
B1-02100DF-SWM-067-GD	4.43E+04	5.57E+04	2.46E+07	5.28E+02	2.40E+03	2.52E+04	4.45E+04	1.37E+03	0.058
B1-02100DF-SWM-068-GD	3.06E+04	8.89E+04	3.93E+07	3.65E+02	2.91E+02	1.74E+04	2.01E+04	8.65E+03	0.082
B1-02100DF-SFM-076-GD	1.15E+05	3.87E+04	1.71E+07	1.37E+03	0.00E+00	6.51E+04	1.17E+04	0.00E+00	0.056
B1-02100DF-SFM-077-GD	5.55E+04	4.00E+04	1.77E+07	6.62E+02	9.77E+03	3.15E+04	3.47E+04	2.05E+04	0.049
B1-02100DF-SFM-078-GD	5.71E+04	2.48E+04	1.10E+07	6.81E+02	0.00E+00	3.24E+04	1.57E+04	1.22E+04	0.033
B1-02100DF-SFM-079-GD	4.54E+04	1.77E+04	7.84E+06	5.42E+02	1.89E+03	2.58E+04	1.36E+04	5.98E+03	0.025
B1-02100DF-SFM-080-GD	6.97E+04	4.48E+04	1.98E+07	8.32E+02	5.13E+03	3.96E+04	5.95E+04	2.75E+04	0.055
B1-02110AF-SWM-083-GD	1.36E+05	2.72E+04	1.20E+07	1.62E+03	8.49E+03	7.71E+04	3.71E+04	1.62E+04	0.053
B1-02100DF-SFM-084-GD	3.27E+04	2.29E+04	1.01E+07	3.90E+02	0.00E+00	1.86E+04	6.38E+04	4.10E+03	0.027
B1-02100AF-SFM-085-GD	7.80E+04	1.81E+04	7.98E+06	9.31E+02	3.04E+03	4.43E+04	5.73E+04	1.65E+04	0.033
B1-02100DF-SFM-086-GD	2.23E+05	2.17E+04	9.59E+06	2.66E+03	5.20E+03	1.27E+05	8.58E+03	1.23E+04	0.064
B1-02100DF-SFM-087-GD	4.36E+04	2.64E+04	1.17E+07	5.20E+02	7.14E+03	2.48E+04	3.09E+04	1.15E+04	0.034
B1-02100DF-SFM-088-GD	4.83E+04	2.02E+04	8.91E+06	5.76E+02	1.45E+04	2.74E+04	2.79E+04	0.00E+00	0.031
B1-02100DF-SFM-089-GD	6.68E+04	2.85E+04	1.26E+07	7.97E+02	1.06E+04	3.79E+04	1.72E+04	4.52E+04	0.041
B1-02100DF-SFM-090-GD	1.28E+05	3.22E+04	1.42E+07	1.52E+03	2.59E+03	7.25E+04	1.69E+04	2.30E+04	0.054
B1-02100DF-SFM-092-GD	9.06E+04	3.19E+04	1.41E+07	1.08E+03	5.13E+03	5.15E+04	4.46E+04	4.90E+04	0.048
B1-02100DF-SFM-093-GD	5.01E+04	2.55E+04	1.13E+07	5.97E+02	3.39E+03	2.84E+04	1.86E+04	6.65E+04	0.034
B1-02100DF-SFM-094-GD	8.41E+04	1.99E+04	8.81E+06	1.00E+03	5.18E+03	4.78E+04	6.82E+04	2.36E+04	0.037
B1-02100DF-SFM-095-GD	6.80E+04	2.12E+04	9.37E+06	8.11E+02	5.41E+03	3.86E+04	1.12E+05	4.44E+04	0.036
B1-02100DF-SFM-096-GD	1.50E+05	2.29E+04	1.01E+07	1.79E+03	2.12E+04	8.54E+04	1.85E+04	0.00E+00	0.055
B1-02100DF-SFM-097-GD	5.41E+04	1.97E+04	8.69E+06	6.46E+02	9.77E+03	3.07E+04	1.05E+05	1.73E+03	0.032
B1-02100DF-SFM-098-GD	3.82E+04	1.90E+04	8.42E+06	4.56E+02	1.41E+04	2.17E+04	5.33E+04	6.19E+03	0.028
B1-02100DF-SFM-099-GD	4.19E+04	1.85E+04	8.17E+06	5.00E+02	0.00E+00	2.38E+04	1.15E+05	1.78E+04	0.027
B1-02100DF-SFM-100-GD	6.41E+04	3.68E+04	1.63E+07	7.65E+02	1.71E+04	3.64E+04	2.77E+04	1.46E+04	0.049
B1-02100DF-SFM-102-GD	3.77E+04	2.74E+04	1.21E+07	4.50E+02	1.14E+04	2.14E+04	3.45E+04	1.75E+04	0.035
B1-02100DF-SFM-103-GD	4.56E+04	1.76E+04	7.79E+06	5.45E+02	5.54E+03	2.59E+04	3.59E+04	1.27E+04	0.026
B1-02100DF-SFM-104-GD	1.84E+05	1.00E+04	4.43E+06	2.19E+03	1.27E+04	1.04E+05	8.45E+03	1.30E+04	0.048
B1-02100DF-SFM-105-GD	6.34E+04	2.27E+04	1.00E+07	7.56E+02	1.69E+04	3.60E+04	2.22E+04	3.14E+04	0.037
B1-02100DF-SFM-106-GD	4.29E+04	3.28E+04	1.45E+07	5.12E+02	2.75E+04	2.44E+04	1.67E+04	1.98E+04	0.044

Table 21 (continued) - Unit 2 Containment Above 565 foot Elevation - Measured Concentrations of ROC for FSS

Measurement ID	H-3[(2)] (pCi/m^2)	Co-60[(1)] (pCi/m^2)	Ni-63[(2)] (pCi/m^2)	Sr-90[(2)] (pCi/m^2)	Cs-134 (pCi/m^2)	Cs-137[(1)] (pCi/m^2)	Eu-152 (pCi/m^2)	Eu-154 (pCi/m^2)	OpSOF
B1-02100DF-SFM-107-GD	6.72E+04	2.68E+04	1.18E+07	8.02E+02	0.00E+00	3.82E+04	9.25E+04	0.00E+00	0.038
B1-02100DF-SFM-108-GD	7.95E+04	3.25E+04	1.44E+07	9.49E+02	0.00E+00	4.52E+04	2.27E+04	1.92E+04	0.044
B1-02100DF-SFM-109-GD	8.42E+04	2.13E+04	9.43E+06	1.01E+03	1.07E+04	4.79E+04	3.25E+04	5.44E+03	0.038
B1-02100DF-SFM-110-GD	6.23E+04	2.52E+04	1.11E+07	7.43E+02	1.82E+04	3.54E+04	2.03E+04	5.09E+04	0.040
B1-02100DF-SFM-111-GD	1.68E+05	4.78E+04	2.11E+07	2.01E+03	4.68E+03	9.56E+04	4.13E+03	7.88E+03	0.075
B1-02100DF-SFM-112-GD	1.47E+05	5.55E+04	2.46E+07	1.76E+03	8.36E+04	8.36E+04	6.26E+04	4.44E+04	0.099
B1-02100DF-SFM-113-GD	4.25E+04	2.17E+04	9.57E+06	5.07E+02	9.99E+03	2.41E+04	4.76E+03	1.88E+04	0.030
B1-02100DF-SFM-114-GD	6.95E+04	2.76E+04	1.22E+07	8.30E+02	1.04E+04	3.95E+04	5.94E+04	8.41E+03	0.041
B1-02100DF-SFM-115-GD	7.23E+04	3.29E+04	1.45E+07	8.63E+02	4.88E+03	4.11E+04	9.35E+03	3.29E+03	0.044
B1-02100DF-SFM-116-GD	2.18E+05	1.19E+05	5.28E+07	2.61E+03	8.96E+03	1.24E+05	6.60E+05	3.62E+05	0.168
B1-02100DF-SFM-117-GD	6.21E+05	4.88E+05	2.16E+08	7.41E+03	7.44E+04	3.53E+05	2.67E+06	1.89E+05	0.613
B1-02100DF-SFM-118-GD	4.02E+04	2.74E+04	1.21E+07	4.80E+02	1.28E+04	2.29E+04	4.04E+04	1.32E+04	0.035
B1-02100DF-SFM-119-GD	4.96E+04	2.76E+04	1.22E+07	5.91E+02	7.75E+03	2.82E+04	8.60E+04	2.87E+04	0.038
B1-02100DF-SFM-120-GD	3.15E+04	2.73E+04	1.21E+07	3.76E+02	1.64E+04	1.79E+04	2.92E+04	4.78E+04	0.035
B1-02100DF-SFM-121-GD	7.32E+04	2.46E+04	1.09E+07	8.74E+02	1.80E+04	4.16E+04	5.52E+04	3.30E+04	0.042
B1-02100DF-SFM-122-GD	6.81E+04	2.68E+04	1.19E+07	8.12E+02	0.00E+00	3.87E+04	2.33E+04	1.44E+04	0.037
B1-02100DF-SFM-123-GD	4.59E+04	1.76E+04	7.78E+06	5.47E+02	1.70E+03	2.61E+04	9.04E+03	3.07E+04	0.025
B1-02100DF-SFM-124-GD	3.43E+04	1.76E+04	7.78E+06	4.10E+02	0.00E+00	1.95E+04	1.61E+04	2.80E+04	0.023
B1-02100DF-SFM-125-GD	4.25E+04	2.98E+04	1.32E+07	5.07E+02	0.00E+00	2.41E+04	5.06E+04	4.01E+04	0.036
B1-02100DF-SFM-126-GD	9.33E+05	8.23E+05	3.64E+08	1.11E+04	1.49E+04	5.30E+05	4.70E+06	1.82E+05	0.985
B1-02100DF-SFM-128-GD	3.44E+05	2.23E+05	9.85E+07	4.10E+03	1.63E+04	1.95E+05	1.29E+06	4.79E+04	0.288
B1-02100DF-SFM-129-GD	7.75E+04	2.40E+04	1.06E+07	9.25E+02	2.26E+03	4.40E+04	1.04E+04	1.05E+04	0.037
B1-02100DF-SFM-130-GD	5.27E+04	2.66E+04	1.18E+07	6.29E+02	1.09E+04	3.00E+04	9.23E+04	1.06E+04	0.038
B1-02100DF-SFM-131-GD	5.20E+04	1.35E+004	5.97E+06	6.21E+02	2.38E+03	2.96E+04	1.78E+04	6.86E+03	0.023
B1-02100DF-SFM-132-GD	2.67E+05	3.99E+4	1.76E+07	3.18E+03	1.85E+04	1.52E+05	7.10E+02	1.99E+04	0.091
B1-02100DF-SFM-133-GD	4.77E+05	3.68E+04	1.62E+07	5.69E+03	9.44E+03	2.71E+05	1.62E+04	2.24E+04	0.128
B1-02100DF-SFM-134-GD	2.68E+04	1.57E+04	6.92E+06	3.19E+02	2.66E+03	1.52E+04	1.58E+04	5.14E+04	0.021
B1-02100DF-SFM-135-GD	7.18E+04	3.63E+04	1.60E+07	8.56E+02	1.01E+03	4.08E+04	1.01E+04	1.31E+04	0.046
B1-02100DF-SFM-136-GD	5.30E+04	2.45E+04	1.08E+07	6.33E+02	1.31E+04	3.01E+04	4.52E+04	2.37E+04	0.036
B1-02100DF-SFM-137-GD	6.88E+04	3.28E+04	1.45E+07	8.21E+02	1.16E+04	3.91E+04	8.45E+04	5.75E+04	0.047
B1-02100DF-SFM-138-GD	3.66E+05	1.12E+05	4.94E+07	4.37E+03	7.73E+03	2.08E+05	5.93E+05	3.58E+05	0.189
B1-02100DF-SFM-139-GD	1.62E+05	8.10E+04	3.58E+07	1.93E+03	1.11E+04	9.20E+04	3.78E+05	2.06E+05	0.116

Table 21 (continued) - Unit 2 Containment Above 565 foot Elevation - Measured Concentrations of ROC for FSS

Measurement ID	H-3[(2)] (pCi/m^2)	Co-60[(1)] (pCi/m^2)	Ni-63[(2)] (pCi/m^2)	Sr-90[(2)] (pCi/m^2)	Cs-134 (pCi/m^2)	Cs-137[(1)] (pCi/m^2)	Eu-152 (pCi/m^2)	Eu-154 (pCi/m^2)	OpSOF
B1-02100DF-SFM-140-GD	5.32E+04	2.08E+04	9.18E+06	6.34E+02	5.19E+03	3.02E+04	3.16E+04	2.37E+04	0.031
B1-02100DF-SFM-141-GD	3.99E+04	1.61E+04	7.12E+06	4.76E+02	1.89E+04	2.27E+04	9.55E+04	1.86E+04	0.028
B1-02100DF-SFM-142-GD	3.76E+04	1.03E+04	4.57E+06	4.49E+02	4.56E+03	2.14E+04	1.05E+04	0.00E+00	0.018
B1-02100DF-SFM-143-GD	4.24E+04	2.88E+04	1.27E+07	5.06E+02	2.07E+04	2.41E+04	4.55E+04	2.32E+04	0.039
B1-02100DF-SFM-144-GD	5.05E+04	2.16E+04	9.53E+06	6.03E+02	1.18E+04	2.87E+04	2.10E+04	7.79E+03	0.032
B1-02100DF-SFM-145-GD	4.95E+04	1.16E+04	5.13E+06	5.90E+02	1.34E+04	2.81E+04	1.19E+03	1.12E+04	0.023
B1-02100DF-SFM-146-GD	4.24E+04	2.35E+04	1.04E+07	5.05E+02	1.01E+04	2.41E+04	5.72E+04	4.02E+04	0.033
B1-02100DF-SFM-147-GD	6.62E+04	2.14E+04	9.46E+06	7.90E+02	7.10E+03	3.76E+04	2.79E+04	1.74E+04	0.034
B1-02100DF-SFM-148-GD	1.03E+05	2.16E+04	9.53E+06	1.23E+03	0.00E+00	5.87E+04	7.69E+04	2.06E+04	0.041
B1-02100DF-SFM-149-GD	7.56E+04	1.53E+04	6.78E+06	9.02E+02	5.08E+03	4.29E+04	2.37E+04	1.71E+04	0.030
B1-02100DF-SFM-150-GD	8.21E+04	2.21E+04	9.78E+06	9.80E+02	1.02E+04	4.67E+04	6.36E+04	3.32E+04	0.040
B1-02100DF-SFM-151-GD	5.41E+04	1.61E+04	7.09E+06	6.45E+02	1.20E+04	3.07E+04	3.58E+04	2.73E+04	0.029
B1-02100DF-SFM-152-GD	1.49E+05	1.97E+04	8.70E+06	1.78E+03	2.40E+03	8.46E+04	0.00E+00	2.28E+03	0.047
B1-02100DF-SFM-153-GD	3.40E+05	3.45E+04	1.52E+07	4.06E+03	0.00E+00	1.93E+05	5.29E+04	2.36E+04	0.098
B1-02100DF-SFM-154-GD	9.79E+04	3.42E+04	1.51E+07	1.17E+03	0.00E+00	5.56E+04	0.00E+00	1.72E+04	0.049
B1-02100DF-SFM-155-GD	5.18E+04	1.92E+04	8.48E+06	6.18E+02	1.32E+04	2.94E+04	6.69E+04	2.08E+04	0.032
B1-02100DF-SFM-156-GD	5.87E+04	2.49E+04	1.10E+07	7.01E+02	2.63E+03	3.34E+04	8.32E+03	1.70E+03	0.034
B1-02100DF-SFM-157-GD	8.92E+04	2.28E+04	1.01E+07	1.06E+03	3.27E+03	5.07E+04	2.40E+03	0.00E+00	0.038
B1-02100DF-SFM-158-GD	3.18E+04	1.71E+04	7.55E+06	3.79E+02	4.05E+03	1.81E+04	3.22E+03	1.80E+04	0.022
B1-02100DF-SFM-159-GD	5.26E+04	3.00E+04	1.33E+07	6.27E+02	1.38E+04	2.99E+04	1.57E+04	1.77E+04	0.040
B1-02100DF-SFM-160-GD	3.73E+04	1.95E+04	8.62E+06	4.45E+02	3.44E+03	2.12E+04	1.64E+04	7.03E+03	0.025
B1-02100DF-SFM-161-GD	5.21E+04	2.58E+04	1.14E+07	6.22E+02	2.03E+04	2.96E+04	3.79E+04	3.43E+04	0.039
B1-02100DF-SFM-162-GD	8.56E+04	2.71E+04	1.20E+07	1.02E+03	5.42E+03	4.86E+04	3.74E+02	1.41E+04	0.042
B1-02100DF-SFM-163-GD	9.05E+04	2.91E+04	1.28E+07	1.08E+03	1.60E+04	5.14E+04	7.56E+04	4.37E+03	0.048
B1-02100DF-SFM-164-GD	4.82E+04	1.69E+04	7.45E+06	5.75E+02	0.00E+00	2.74E+04	0.00E+00	1.18E+03	0.024
B1-02100DF-SFM-165-GD	4.49E+04	1.57E+04	6.93E+06	5.36E+02	1.97E+04	2.55E+04	7.99E+03	6.75E+03	0.027
B1-02100DF-SFM-166-GD	6.80E+04	2.38E+04	1.05E+07	8.12E+02	0.00E+00	3.87E+04	3.47E+04	1.94E+04	0.035
B1-02100DF-SFM-167-GD	7.48E+04	2.39E+04	1.06E+07	8.92E+02	0.00E+00	4.25E+04	4.80E+03	2.33E+04	0.036
B1-02100DF-SFM-168-GD	1.40E+05	4.42E+04	1.95E+07	1.66E+03	0.00E+00	7.93E+04	3.29E+04	1.58E+04	0.066
B1-02100DF-SFM-169-GD	7.65E+04	5.80E+04	2.56E+07	9.13E+02	3.02E+03	4.35E+04	1.92E+05	1.94E+04	0.069
B1-02100DF-SFM-170-GD	1.34E+05	3.21E+04	1.42E+07	1.60E+03	5.12E+03	7.62E+04	3.10E+04	2.08E+03	0.056

Table 21 (continued) - Unit 2 Containment Above 565 foot Elevation - Measured Concentrations of ROC for FSS

Measurement ID	H-3[(2)] (pCi/m^2)	Co-60[(1)] (pCi/m^2)	Ni-63[(2)] (pCi/m^2)	Sr-90[(2)] (pCi/m^2)	Cs-134 (pCi/m^2)	Cs-137[(1)] (pCi/m^2)	Eu-152 (pCi/m^2)	Eu-154 (pCi/m^2)	OpSOF
B1-02100DF-SFM-171-GD	1.72E+05	4.30E+04	1.90E+07	2.05E+03	1.79E+03	9.75E+04	3.10E+04	3.51E+04	0.072
B1-02100DF-SFM-172-GD	1.48E+05	3.40E+04	1.50E+07	1.77E+03	2.23E+04	8.42E+04	4.21E+04	2.11E+04	0.065
B1-02100DF-SFM-173-GD	8.50E+04	5.04E+04	2.23E+07	1.01E+03	5.53E+03	4.83E+04	2.33E+04	3.03E+04	0.062
B1-02100DF-SFM-174-GD	2.80E+05	1.62E+05	7.15E+07	3.34E+03	9.69E+02	1.59E+05	6.66E+04	1.19E+04	0.195
B1-02100DF-SFM-175-GD	2.15E+05	4.09E+04	1.81E+07	2.56E+03	2.67E+03	1.22E+05	5.63E+04	6.54E+04	0.080
B1-02100DF-SFM-176-GD	3.25E+05	1.86E+05	8.21E+07	3.88E+03	1.72E+04	1.85E+05	7.54E+05	4.79E+05	0.252

(1) The surrogate OpDCGL for Cs-137 (inferring both H-3 and Sr-90 at the maximum ratios from LTP Table 5-15) is 2.88E+06 pCi/m2 (Equation 2) and the surrogate OpDCGL for Co-60 (inferring Ni-63 at the maximum ratio from LTP Table 5-15) is 1.18E+06 pCi/m2 (Equation 3). No ISOCS measurement result for Cs-137 or Co-60 exceeded its respective surrogate OpDCGL value.

(2) The concentrations for H-3, Ni-63 and Sr-90 were inferred based on the maximum ratios as specified in LTP Chapter 5, Table 5-15

Table 22 - Unit 2 Containment Above 565 foot Elevation – Statistical Quantities - Systematic Measurement Population

Individual Measurement Metrics

Total Number of Systematic Measurements	=	164
Number of Quality Control Measurements	=	9
Number of Judgmental/Investigational Measurements	=	0
Total Number of Measurements	=	173
Mean Systematic Measurement OpSOF	=	0.063
Max Individual Systematic Measurement OpSOF	=	0.985
Number of Systematic Measurements with OpSOF >1	=	0

Statistical Quantities - Systematic Measurement Population

ROC	MEAN (pCi/m^2)	MEDIAN (pCi/m^2)	MAX (pCi/m^2)	MIN (pCi/m^2)	ST. DEV. (pCi/m^2)	BcDCGL (pCi/m^2)	Avg BcSOF per ROC	Avg Dose per ROC (mrem/yr)
H-3	1.07E+05	6.80E+04	9.33E+05	2.26E+04	1.18E+05	2.38E+08	0.000	0.011
Co-60	4.49E+04	2.92E+04	8.23E+05	1.49E+03	7.74E+04	1.57E+08	0.000	0.007
Ni-63	1.99E+07	1.29E+07	3.64E+08	6.59E+05	3.42E+07	4.02E+09	0.005	0.123
Sr-90	1.28E+03	8.11E+02	1.11E+04	2.69E+02	1.41E+03	1.43E+06	0.001	0.022
Cs-134	8.34E+03	5.30E+03	8.36E+04	0.00E+00	1.06E+04	3.01E+07	0.000	0.007
Cs-137	6.08E+04	3.86E+04	5.30E+05	1.28E+04	6.71E+04	3.94E+07	0.002	0.039
Eu-152	9.91E+04	2.68E+04	4.70E+06	0.00E+00	4.36E+05	3.66E+08	0.000	0.007
Eu-154	2.82E+04	1.64E+04	4.79E+05	0.00E+00	5.84E+04	3.19E+08	0.000	0.002

BASE CASE SOF (BcSOF) ASSIGNED TO SURVEY UNIT (SYSTEMATIC AVG.) = 0.009

DOSE ASSIGNED TO SURVEY UNIT (SYSTEMATIC AVG.) = 0.219 mrem/yr.

The analytical results of all measurements taken above the 565 foot elevation were less than a SOF of one.

Unit 2 Containment Under Vessel Area

Direct measurement locations were denoted on the remaining concrete and/or on the exposed steel liner in the Unit 2 Containment Under Vessel area by marking an approximate 4 meter by 4 meter grid pattern using a random start point that was overlaid over the exposed surface, providing sufficient overlap between locations to ensure 100% areal coverage. See Figure 15 for a depiction of all measurement locations.

The systematic sample population consisted of fifty-four (54) direct measurements that were acquired using the ISOCS. A summary of the results of the 54 ISOCS measurements taken for non-parametric statistical testing results is provided in Table 23.

Concentrations of HTD ROC were not inferred. However, The surrogate OpDCGL for Cs-137 (inferring both H-3 and Sr-90 at the maximum ratios from LTP Table 5-15) equaled 2.10E+07 pCi/m^2 (Equation 4) and the surrogate OpDCGL for Co-60 (inferring Ni-63 at the maximum ratio from LTP Table 5-15) equaled 8.55E+06 pCi/m^2 (Equation 5). No ISOCS measurement result for Cs-137 or Co-60 exceeded its respective surrogate OpDCGL value.

As stated in the April 10, 2018 letter to the NRC, ZSRP presented evidence that the use of surrogate ratios to infer concentrations of HTD ROC in the Under Vessel concrete was no longer defensible. Demonstrating compliance based on dose consequence from the actual measured concentrations for HTD ROC was a more reasonable approach as the spatial distribution of the concrete cores is representative and due to the extensive remediation and removal of source term, particularly Cs-137, the ratios used to infer H-3 and Sr-90 using the Cs-137 as a surrogate were no longer consistent or reasonably correlated. ZSRP proposed an area-specific alternate approach to use the actual measured concentration of each HTD ROC to derive HTD concentrations for demonstrating compliance in the end-state concrete. This is allowed under LTP Chapter 5, section 5.2.11 which states, "…the area specific ratios as determined by actual survey data will be used in lieu of the maximum ratios presented in Table 5-15. The area-specific ratios used and the survey data serving as the basis for the ratios will be documented in the release record for the survey unit."

The maximum SOF derived for each measured HTD ROC was summed to provide a SOF that represented the "worst-case" dose consequence from the presence of HTD ROC at the measured concentrations in the concrete core samples. Use of the maximum concentration compensated for the additional source term at depth and accounted for any additional, unspecified variability. The summation of the maximum SOF resulted in a value of 0.083. This value was then added to each of the measured OpSOF for the gamma-emitting ROC.

The combined OpSOF (including the addition of the maximum SOF for HTD) for each measurement was then used as the sum value for the Sign Test. The mean measured concentration for each ROC was then compared to their respective BcDCGLs to calculate dose in mrem/yr.

The complete ISOCS gamma spectroscopy reports are presented in Attachment 6. A summary of the results of the 54 ISOCS measurements taken for non-parametric statistical testing results is provided in Table 23. The basic statistics for the systematic measurements are summarized in Table 24.

On May 21, 2018, the NRC commenced a confirmatory survey of the Unit 2 Containment basement FSS unit through Oak Ridge Institute for Science and Education (ORISE). The confirmatory survey consisted of several ISOCS measurements and additional concrete core samples. Upon review of the results, the NRC had questions pertaining to measured activity for H-3 in certain concrete core samples extrapolated over a 6-inch depth verses a ½-inch depth and the potential to exceed the BcDCGL in that scenario. For Unit 2, the concrete core of concern was Zion location 03.

To address the NRCs concerns, ZSRP agreed to remove a minimum of 1 to 4 inches of additional concrete from around the location of this core. For Unit 2 Containment, the area was designated as ISOCS location 15 (inclusive of the 1 ORISE sample). See Figure 16 for a depiction of the ORISE concrete core sample locations.

ZSRP commenced removal of the additional concrete commencing on 07/02/18. Due to the location of where the concrete was physically located, it was more effective to remove all the concrete exposing the steel liner in and around the upper circular wall. Consequently, the concrete was completely removed down to the steel liner in ISOCS location #s 014, 018 and 020. In area #15, only ½-inch to 2-inches of concrete remained. During the execution of this evolution, ZSRP controlled the spread of concrete dust, wiped down adjacent areas after concrete removal and performed an extensive post-work contamination survey. All survey results indicted no detectable loose surface contamination.

Figure 14 - Unit 2 Under Vessel Concrete H-3 Concrete Remediation Area

Following the completion of this evolution, it was agreed to acquire and analyze two concrete core samples from each of the ISOCS zones that were remediated. As no concrete remained in location #s 014, 018 and 020, no concrete core samples were acquired in these locations. In location #15, two concrete core samples were acquired on 07/17/18 under NRC observation. The results are presented in Table 25. Upon completion of the sampling, the NRC provided concurrence to backfill the Unit 2 Containment.

Figure 15 - Unit 2 Containment Under Vessel FSS Measurement Locations

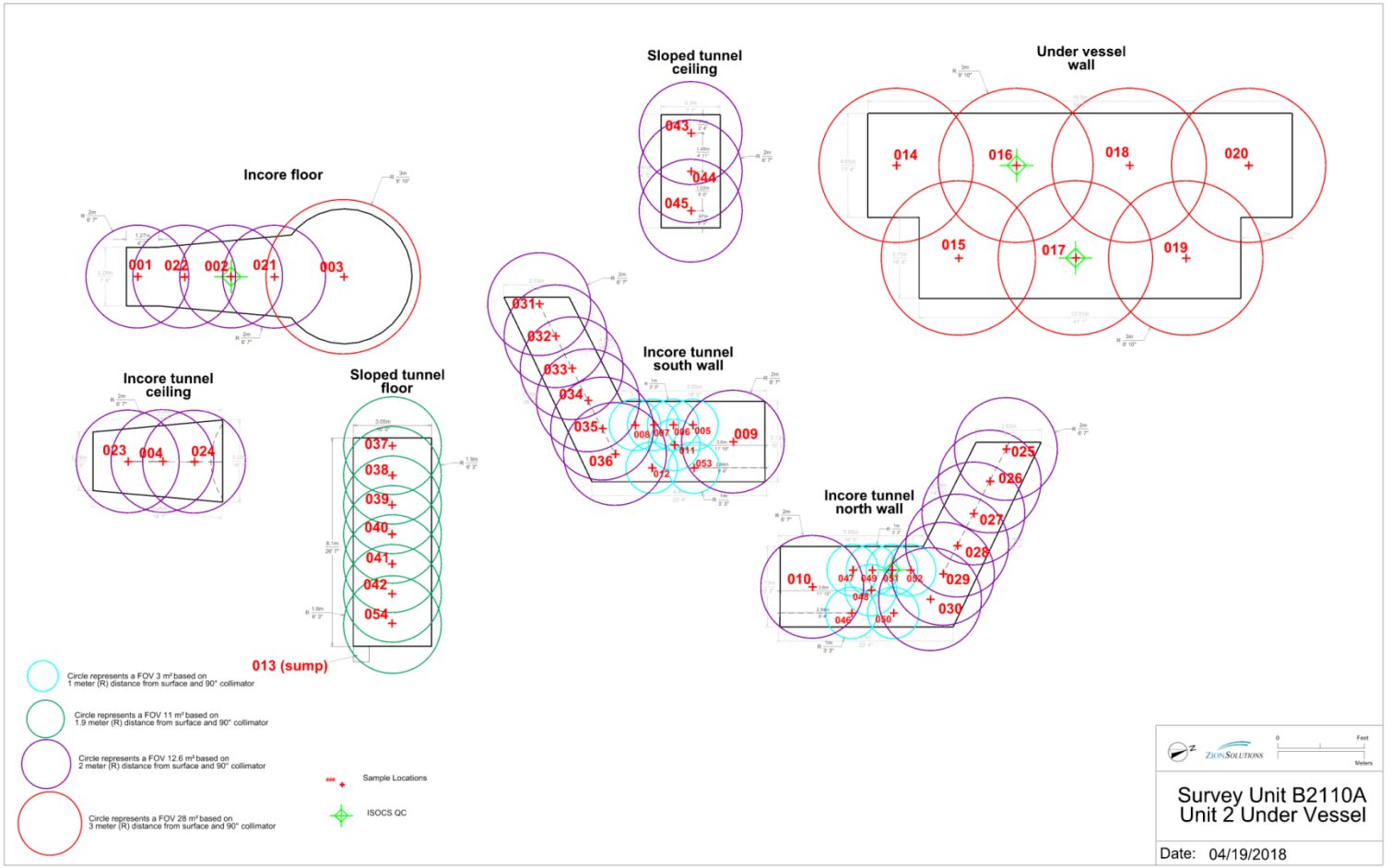


Table 23 - Unit 2 Containment Under Vessel Area - Measured Concentrations of ROC for FSS

Measurement ID	Co-60[(2)] (pCi/m^2)	Cs-134 (pCi/m^2)	Cs-137[(2)] (pCi/m^2)	Eu-152 (pCi/m^2)	Eu-154 (pCi/m^2)	OpSOF[(1)]
B1-02110DF-SFC-001-GD	1.03E+05	3.03E+04	4.18E+06	2.03E+05	1.77E+05	0.192
B1-02110DF-SFC-002-GD	3.16E+05	5.47E+04	2.26E+06	1.34E+06	1.23E+06	0.152
B1-02110DF-SFC-003-GD	4.60E+06	1.67E+05	1.11E+07	1.90E+07	7.82E+05	0.457
B1-02110DF-SCC-004-GD	6.90E+05	6.93E+04	1.68E+05	3.68E+06	2.18E+05	0.105
B1-02110DF-SWC-005-GD	1.00E+06	6.23E+04	2.03E+05	4.39E+06	2.55E+05	0.109
B1-02110DF-SWC-006-GD	6.14E+05	6.80E+04	2.30E+05	3.39E+06	2.13E+05	0.105
B1-02110DF-SWC-007-GD	5.28E+05	0.00E+00	2.61E+05	2.10E+06	9.56E+04	0.099
B1-02110DF-SWC-008-GD	3.29E+05	2.09E+04	6.79E+05	1.66E+06	1.05E+05	0.108
B1-02110DF-SWC-009-GD	1.67E+06	1.92E+05	1.91E+06	8.75E+06	4.08E+05	0.174
B1-02110DF-SWC-010-GD	1.66E+06	1.20E+04	2.33E+06	9.32E+06	5.27E+05	0.181
B1-02110DF-SWC-011-GD	4.74E+05	1.25E+05	8.27E+05	2.12E+06	1.30E+06	0.121
B1-02110DF-SWC-012-GD	2.45E+05	2.70E+04	2.17E+06	8.30E+05	6.03E+05	0.145
B1-02110DF-SFC-013-GD	2.58E+04	0.00E+00	2.15E+06	5.39E+03	3.08E+04	0.138
B1-02110DF-SWC-014-GD	3.47E+06	0.00E+00	1.71E+06	2.97E+07	1.17E+06	0.234
B1-02110DF-SWC-015-GD	3.32E+06	5.06E+04	8.28E+06	2.10E+07	1.09E+06	0.378
B1-02110DF-SWC-016-GD	2.88E+06	1.40E+05	8.43E+05	2.50E+07	9.92E+05	0.199
B1-02110DF-SWC-017-GD	4.37E+06	2.97E+04	4.14E+06	2.33E+07	1.23E+06	0.285
B1-02110DF-SWC-018-GD	4.48E+06	5.70E+04	2.71E+06	3.71E+07	1.39E+06	0.289
B1-02110DF-SWC-019-GD	3.40E+06	3.60E+04	4.48E+06	2.13E+07	1.06E+06	0.282
B1-02110DF-SWC-020-GD	4.00E+06	8.72E+04	4.29E+06	3.30E+07	1.48E+06	0.316
B1-02110DF-SFC-021-GD	1.24E+06	9.50E+03	2.59E+06	6.83E+06	4.18E+05	0.177
B1-02110DF-SFC-022-GD	2.09E+05	2.46E+04	5.29E+06	6.24E+05	4.48E+05	0.223
B1-02110DF-SCC-023-GD	3.60E+05	2.74E+04	2.35E+05	1.84E+06	6.28E+04	0.097
B1-02110DF-SCC-024-GD	1.08E+06	1.11E+04	2.24E+05	6.71E+06	2.91E+05	0.115

Table 23 (continued) - Unit 2 Containment Under Vessel Area - Measured Concentrations of ROC for FSS

Measurement ID	Co-60[2] (pCi/m^2)	Cs-134 (pCi/m^2)	Cs-137[2] (pCi/m^2)	Eu-152 (pCi/m^2)	Eu-154 (pCi/m^2)	OpSOF[1]
B1-02110DF-SWC-025-GD	2.22E+04	8.79E+03	7.09E+04	5.25E+04	1.21E+04	0.085
B1-02110DF-SWM-026-GD	2.07E+04	2.44E+04	2.04E+05	0.00E+00	2.16E+04	0.089
B1-02110DF-SWM-027-GD	1.39E+04	1.66E+04	1.48E+05	4.05E+04	2.76E+04	0.087
B1-02110DF-SWM-028-GD	9.48E+03	3.25E+04	9.30E+04	5.23E+04	0.00E+00	0.087
B1-02110DF-SWM-029-GD	2.86E+04	1.07E+04	2.04E+05	9.16E+04	2.27E+04	0.089
B1-02110DF-SWM-030-GD	4.96E+04	6.37E+03	1.07E+06	1.35E+05	1.21E+04	0.111
B1-02110DF-SWM-031-GD	2.15E+04	0.00E+00	9.28E+04	1.81E+04	2.00E+04	0.085
B1-02110DF-SWM-032-GD	6.27E+03	1.80E+03	5.34E+05	3.53E+04	5.19E+04	0.097
B1-02110DF-SWM-033-GD	1.68E+04	7.88E+03	6.35E+05	3.07E+04	0.00E+00	0.100
B1-02110DF-SWM-034-GD	2.68E+04	7.29E+03	4.20E+05	4.76E+04	2.73E+04	0.094
B1-02110DF-SWM-035-GD	4.54E+04	0.00E+00	1.11E+06	1.64E+02	6.74E+03	0.111
B1-02110DF-SWM-036-GD	6.45E+04	4.74E+03	3.60E+06	1.82E+05	7.10E+03	0.176
B1-02110DF-SFM-037-GD	1.89E+04	1.99E+03	3.40E+04	2.93E+04	3.52E+03	0.084
B1-02110DF-SFM-038-GD	1.02E+04	1.27E+04	2.00E+04	1.68E+04	6.28E+03	0.084
B1-02110DF-SFM-039-GD	1.82E+03	6.90E+03	2.63E+04	4.56E+04	1.53E+04	0.084
B1-021100DF-SFM-040-GD	8.35E+03	6.21E+03	2.25E+04	0.00E+00	1.26E+04	0.084
B1-02110DF-SFM-041-GD	2.11E+04	1.18E+04	3.14E+04	0.00E+00	2.75E+04	0.084
B1-02110DF-SFM-042-GD	1.42E+04	8.59E+03	9.25E+04	5.70E+03	2.37E+04	0.086
B1-02110DF-SCC-043-GD	8.73E+04	1.29E+04	4.12E+06	0.00E+00	1.40E+05	0.189
B1-02110DF-SCC-044-GD	1.03E+05	4.25E+03	4.52E+06	1.20E+05	1.53E+05	0.200
B1-02110DF-SCC-045-GD	2.06E+05	4.90E+04	4.11E+06	7.99E+05	7.61E+04	0.083
B1-02110DF-SWC-046-GD	4.72E+05	0.00E+00	7.90E+05	2.30E+06	6.94E+04	0.113
B1-02110DF-SWC-047-GD	1.01E+06	1.06E+04	5.89E+05	5.05E+06	2.47E+05	0.119
B1-02110DF-SWC-048-GD	5.68E+05	1.35E+05	1.28E+06	2.81E+06	1.05E+05	0.132
B1-02110DF-SWC-049-GD	6.12E+05	8.42E+04	4.75E+05	3.74E+06	1.86E+05	0.113

Table 23 (continued) - Unit 2 Containment Under Vessel Area - Measured Concentrations of ROC for FSS

Measurement ID	Co-60[(2)] (pCi/m^2)	Cs-134 (pCi/m^2)	Cs-137[(2)] (pCi/m^2)	Eu-152 (pCi/m^2)	Eu-154 (pCi/m^2)	OpSOF[(1)]
B1-02110DF-SWC-050-GD	2.70E+05	1.08E+04	3.09E+06	1.05E+06	6.00E+05	0.168
B1-02110DF-SWC-051-GD	5.45E+05	1.64E+04	2.44E+05	2.41E+06	1.34E+05	0.100
B1-02110DF-SWC-052-GD	3.05E+05	6.86E+03	3.27E+05	1.83E+06	9.76E+05	0.101
B1-02110DF-SWC-053-GD	4.51E+05	4.58E+04	7.07E+05	2.04E+06	1.09E+05	0.111
B1-02110DF-SFM-054-GD	1.62E+04	9.44E+03	2.64E+05	6.21E+04	1.91E+03	0.090

Note (1) OpSOF increased by a value of 0.083 to account for the presence of HTD ROC

(2) The surrogate OpDCGL for Cs-137 (inferring both H-3 and Sr-90 at the maximum ratios from LTP Table 5-15) is 2.10E+07 pCi/m^2 (Equation 4) and the surrogate OpDCGL for Co-60 (inferring Ni-63 at the maximum ratio from LTP Table 5-15) is 8.55E+06 pCi/m^2 (Equation 5). No ISOCS measurement result for Cs-137 or Co-60 exceeded its respective surrogate OpDCGL value.

Table 24 - Unit 2 Containment Under Vessel Area – Statistical Quantities - Systematic Measurement Population

Individual Measurement Metrics

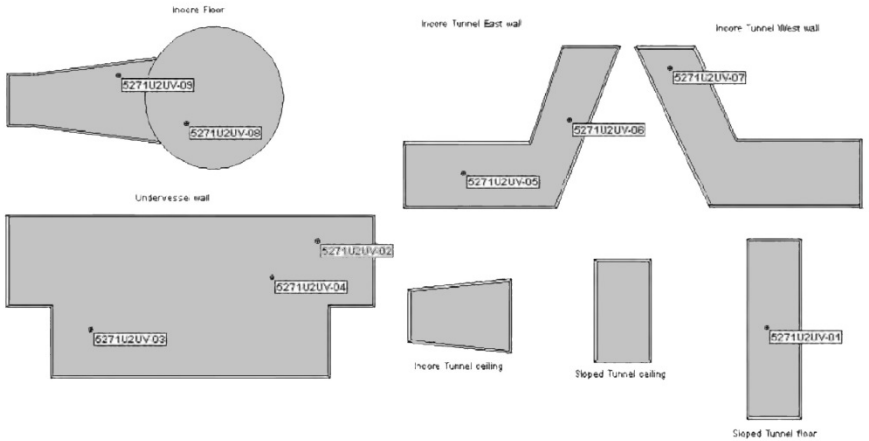
Total Number of Systematic Measurements	=	54
Number of Quality Control Measurements	=	3
Number of Judgmental/Investigational Measurements	=	0
Total Number of Measurements	=	57
Mean Systematic Gamma Measurement OpSOF	=	0.147
Max Individual Systematic Gamma Measurement OpSOF	=	0.457
Number of Systematic Measurements with OpSOF >1	=	0
Max OpSOF from HTD ROC	=	0.083

Statistical Quantities - Systematic Measurement Population

ROC	MEAN (pCi/m^2)	MEDIAN (pCi/m^2)	MAX (pCi/m^2)	MIN (pCi/m^2)	ST. DEV. (pCi/m^2)	BcDCGL (pCi/m^2)	Avg SOF per ROC	Avg Dose per ROC (mrem/yr)
H-3	4.42E+06	3.73E+06	1.15E+07	7.87E+05	2.44E+06	2.38E+08	0.019	0.464
Co-60	8.54E+05	2.87E+05	4.60E+06	1.82E+03	1.33E+06	1.57E+08	0.005	0.136
Ni-63	6.58E+05	4.67E+05	1.47E+06	3.02E+05	4.41E+05	4.02E+09	0.000	0.004
Sr-90	3.11E+04	2.61E+04	4.80E+04	2.42E+04	1.13E+04	1.43E+06	0.022	0.544
Cs-134	3.43E+04	1.28E+04	1.92E+05	0.00E+00	4.45E+04	3.01E+07	0.001	0.029
Cs-137	1.71E+06	6.93E+05	1.11E+07	2.00E+04	2.23E+06	3.94E+07	0.043	1.084
Eu-152	5.30E+06	1.20E+06	3.71E+07	0.00E+00	9.36E+06	3.66E+08	0.014	0.362
Eu-154	3.46E+05	1.21E+05	1.48E+06	0.00E+00	4.48E+05	3.19E+08	0.001	0.027

BASE CASE SOF (BcSOF) ASSIGNED TO SURVEY UNIT (SYSTEMATIC AVG.) = 0.106
DOSE ASSIGNED TO SURVEY UNIT (SYSTEMATIC AVG.) = 2.650 mrem/yr.

Figure 16 - Unit 2 Containment Under Vessel ORISE FSS Confirmatory Locations



Unit 2 Undervessel Area Measurement Locations

ID	H-3 Concentration (pCi/g)
U2UV-9	105.6 ± 7.2
U2UV-3	750 ± 39
U2UV-5	165 ± 10
U2UV-4	560 ± 30
U2UV-2	150.8 ± 9.3
U2UV-8	426 ± 23

Table 25 - Unit 2 Containment Under Vessel Area – Post H-3 Concrete Removal Concrete Core Results

B1-02110A-IRW-C001-CV

Depth	H-3 (pCi/g)	Co-60 (pCi/g)	Ni-63 (pCi/g)	Sr-90 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)
Surface to 0.5 inch	8.05E+01	5.90E+00	1.37E+00	6.97E-02	-9.87E-03	8.98E-01	9.35E+01	4.07E+00
0.5 to 1 inch	1.15E+02	5.53E+00	2.36E+00	4.04E-01	1.19E-01	4.87E-01	9.42E+01	3.85E+00
1 to 1.5 inch	1.18E+02	4.27E+00	1.95E+00	1.90E-01	8.79E-02	6.41E-02	8.05E+01	2.99E+00
1.5 to 2 inch	9.03E+01	6.92E+00	7.06E-01	2.81E-01	-4.93E-02	1.19E-02	1.16E+02	4.30E+00
2 to 2.5 inch	6.70E+01	4.92E+00	8.72E-01	2.16E-01	-2.02E-02	4.99E-01	1.02E+02	4.09E+00
2.5 to 3 inch	6.51E+01	3.01E+00	1.29E+00	-4.75E-02	-1.34E-02	-2.05E-01	5.24E+01	1.90E+00
3 to 3.5 inch	6.10E+01	2.27E+00	7.75E-01	3.68E-01	-1.20E-02	-2.39E-01	4.07E+01	1.80E+00
3.5 to 4 inch	5.65E+01	2.38E+00	1.52E+00	7.73E-02	2.34E-01	-1.24E-01	7.27E+01	2.12E+00
4 to 4.5 inch	4.55E+01	1.94E+00	1.88E+00	2.24E-01	8.85E-02	2.24E-01	3.06E+01	1.80E+00
4.5 to 5 inch	3.91E+01	1.95E+00	5.16E-01	3.49E-01	-5.07E-01	-7.41E-02	2.79E+01	1.50E+00

B1-02110A-IRW-C002-CV

Depth	H-3 (pCi/g)	Co-60 (pCi/g)	Ni-63 (pCi/g)	Sr-90 (pCi/g)	Cs-134 (pCi/g)	Cs-137 (pCi/g)	Eu-152 (pCi/g)	Eu-154 (pCi/g)
Surface to 0.5 inch	1.48E+02	5.13E+00	8.35E+00	5.25E-01	-4.18E-02	3.73E-01	1.10E+02	4.12E+00
0.5 to 1 inch	1.49E+02	6.02E+00	5.59E+00	4.21E-01	-9.09E-02	-3.66E-01	1.32E+02	5.31E+00
1 to 1.5 inch	1.42E+02	6.19E+00	6.95E+00	4.70E-01	-3.00E-01	-1.74E-01	1.17E+02	4.25E+00
1.5 to 2 inch	1.11E+02	6.41E+00	4.80E+00	2.95E-01	1.07E-01	1.16E-01	1.30E+02	3.61E+00
2 to 2.5 inch	1.35E+02	3.86E+00	3.57E+00	4.53E-01	-5.41E-02	4.85E-02	8.13E+01	3.30E+00
2.5 to 3 inch	4.24E+01	3.27E+00	2.32E+00	6.35E-02	-9.21E-03	2.15E-01	6.49E+01	2.49E+00
3 to 3.5 inch	1.12E+02	3.12E+00	2.76E+00	1.95E-01	-4.18E-01	-9.44E-02	5.50E+01	2.07E+00
3.5 to 4 inch	7.57E+01	2.91E+00	1.85E+00	-1.28E-01	7.89E-02	-1.02E-01	8.20E+01	2.27E+00
4 to 4.5 inch	7.38E+01	2.31E+00	1.94E+00	-1.60E-01	1.01E-02	-1.25E-01	4.05E+01	1.61E+00
4.5 to 5 inch	6.46E+01	1.38E+00	1.50E+00	1.48E-01	-9.81E-03	-7.11E-02	2.97E+01	1.23E+00
5 to 5.5 inch	4.51E+01	1.20E+00	2.33E+00	-2.12E-01	-2.28E-02	4.20E-01	2.99E+01	4.56E-01

8. QUALITY CONTROL

The implementation of required QC measures included the collection of three (3) additional ISOCS measurements in the Under Vessel area (survey unit 02110) and nine (9) additional ISOCS measurements in the 565 foot elevation (survey unit 02100) for "replicate measurement" analysis. The complete ISOCS gamma spectroscopy reports for the replicate measurements are presented in Attachment 6. All replicate ISOCS measurements met the required acceptance criteria. The completed Replicate Sample Assessment Forms are included in Attachment 4 of this Release Record.

9. INVESTIGATIONS AND RESULTS

The Unit 2 Containment Building was initially turned over to C/LT for performance of FSS on January 9, 2018. A walkdown by C/LT and the decommissioning contractor was conducted on that date. Following completion of the initial turnover surveys, the Unit 2 Containment was deemed to be ready for FSS. As previously stated in the Survey Implementation section of this Release Record, the C/LT group attempted to perform FSS on January 12, 2018. Several ISOCS measurement on the floor of the Under Vessel area indicated a SOF greater than one (1) when compared against the Base Case DCGLs. The elevated area was bounded and an investigation was initiated on January 12, 2018. The investigation concluded that further remediation was required in the Under Vessel area and a recommendation was made to remove approximately four (4) inches of concrete from the floor and walls of the Under Vessel and Incore Tunnel area. Remediation commenced on January 13, 2018.

Following remediation, C/LT was notified by the decommissioning contractor on January 28, 2018 that the Unit 2 Containment Building was again ready for FSS. On January 29, 2018, investigational ISOCS measurements indicated contaminated concrete at concentrations exceeding the Base Case DCGL. A second investigation was initiated on January 30, 2018 for FSS failure. Following the investigation, further remediation was recommended. On February 3, 2018, the decommissioning contractor re-commenced remediation of Under Vessel concrete.

On February 12, 2018, C/LT took turnover of the Unit 2 Containment Under Vessel area for the third time. As part of the turnover survey, investigative ISOCS shots were performed at the locations where elevated measurements were identified previously in the Under Vessel area. The results of several shots indicated SOF results greater than one (1). The area was rejected and turned back over for additional remediation on February 15, 2018.

The C/LT Manager was notified by the decommissioning contractor on February 22, 2018 that the Unit 2 Containment Building was again ready for FSS. Investigational ISOCS

measurements were taken at Under Vessel locations #007 and #012 on February 24, 2018. Again, measurement results indicated a SOF greater than one at those locations and so the Unit 2 Containment Building was not acceptable for turnover. The area was rejected and turned back over for additional remediation on February 25, 2018.

Remediation was completed on April 5, 2018. The area was cleaned and turned over to the C/LT group for FSS. A walkdown and turnover survey was satisfactorily performed in both FSS units. Following the successful completion of the turnover surveys, the radiological conditions were deemed acceptable and the area was posted for FSS isolation and control.

10. REMEDIATION AND RESULTS

As noted in Section 9 above, repeated cycles of extensive remediation and re-survey were required in the Under Vessel area prior to performance of FSS. Following remediation, FSS was conducted successfully and met all acceptance criteria for release of the survey units.

Chapter 4 of the ZSRP LTP states that remediation beyond that required to meet the release criteria is unnecessary and that the remaining residual radioactivity in structures was ALARA.

11. CHANGES FROM THE FINAL STATUS SURVEY PLAN

In accordance with the LTP, compliance with the unrestricted release criteria is demonstrated though a series of static measurements taken with an ISOCS. LTP section 5.5.2.2, Table 5-19 lists the Unit 2 Containment Under Vessel area as a Class 1 basement structure survey unit with a total surface area of 294 m^2 and the Unit 2 Containment above the 565 foot elevation as a Class 1 basement structure survey unit with a total surface area of 2,465 m^2. The FSS design specified to demonstrate compliance required a minimum of 155 static ISOCS measurements above the 565 foot elevation, 19 static ISOCS measurements in the Under Vessel area and areal coverage of 100% in both survey units.

One hundred and sixty four (164) static ISOCS measurements and fifty-four (54) static ISOCS measurements were taken in the Unit 2 Containment above the 565 foot elevation and the Under Vessel structural survey units respectively to ensure that 100% of the surface area was surveyed (the ISOCS FOV was overlapped to ensure that there were no un-surveyed corners and/or gaps). No judgmental measurements were taken. Replicate measurements were taken at nine (9) locations above the 565 foot elevation and three (3) locations in the Under Vessel area that were selected at random (LTP section 5.9.3.1). In addition, a concrete core was required to be taken at 10% of the locations selected for an FSS ISOCS measurement (LTP section 5.1) which would require the acquisition of a

minimum of six (6) FSS confirmatory concrete cores in the Under Vessel area. All concrete was removed above the 565 foot elevation. Consequently, no concrete core samples were acquired.

The LTP assumes that HTD concentrations will be inferred. Section 5.2.11 of the LTP states, "During FSS, HTD concentrations will be inferred using a surrogate approach. Cs-137 is the principle surrogate radionuclide for H-3 and Sr-90 and Co-60 is the principle surrogate radionuclide for Ni-63." The maximum ratios used to infer HTD concentrations during compliance are presented in Table 5-15 from LTP section 5.2.11.

As previously stated, a concrete core was required to be taken at 10% of the locations selected for an FSS ISOCS measurement in the Unit 2 Containment Under Vessel area (LTP section 5.1) for a minimum of 6 concrete cores to be taken as part of the FSS. The purpose of the core samples was to ensure that the ratios used to infer the HTD concentrations remained valid. During the remediation process, it was acknowledged that the concrete surfaces that were represented by the continuing characterization concrete samples were remediated twice and the actual concrete that was sampled (original concrete surface to a depth of ½ inch) had been removed and disposed of as radioactive waste. At least a foot of concrete was removed from the Under Vessel floor and up to 6 inches of concrete removed from the walls.

Due to the amount of remediation that occurred on the Under Vessel concrete, ZSRP took an additional 19 concrete cores that represented the "as-left" condition of the Under Vessel concrete following concrete remediation. A review of the analysis of the post-remediation concrete core data indicated that almost all of the ratios to Cs-137 for H-3 exceeded 1.76 and all the positive results for Sr-90 exceeded 0.021, which are the maximum ratios from LTP section 5.2.11, Table 5-15. A review of the results clearly show that the cause can be attributed to the fact that the majority of the less soluble source term activity for Cs-137 was contained with the near surface concrete that was remediated and removed (within a minimum of 6 inches) while the more soluble ROC (H-3 and Sr-90), while present in lesser concentrations than present in the pre-remediated concrete, have become the dominant radionuclide in the relationship with Cs-137. Due to the significant reduction in the concentrations of the gamma-emitting ROC (many at MDC), the H-3 and Sr-90 concentrations are not well correlated with Cs-137 and the use of a ratio with Cs-137 to infer a concentration for the HTD was no longer defensible.

On April 10, 2018, ZSRP submitted a proposal to the NRC for an alternate approach to use the actual HTD concentrations from the 19 end-state cores to demonstrate compliance as opposed to surrogate ratios. ZSRP proposed to use measured concentrations of each HTD ROC in units of pCi/g for each of the nineteen (19) locations and, assuming a depth of ½ inch (1.27 cm) and a concrete density of 2.35 g/cm^3, converting the concentrations to

units of pCi/m^2. While it was acknowledged that the depth of contamination for the HTD ROC was greater than ½ inch, it was also proposed to use the maximum concentration to conservatively compensate for the additional source term at depth. The concentration is then divided by its respective OpDCGL to derive an OpSOF.

For the FSS of the Unit 2 Containment Under Vessel concrete, the maximum measured concentrations of H-3, Ni-63 and Sr-90 in the 19 concrete core samples were used to extrapolate a "worst-case" OpSOF of 0.083 from the presence of HTD ROC. As before, a SOF was calculated for each of the 54 ISOCS measurements taken Under Vessel however, only the gamma results were included. Instead of inferring concentrations for the HTD SOF using a surrogate, the maximum measured SOF of 0.083 for HTD ROC was added to the OpSOF for the gamma results. Of the 54 measurements taken, no measurement exceeded a SOF of one. The OpSOF (including the addition of the maximum SOF of 0.083 from HTD) for each measurement was used as the sum value for the Sign Test. Passing the Sign Test demonstrates that the mean activity for each ROC is less than the $OpDCGL_B$ at a Type I decision error of 0.05. The sample data passed the Sign Test. The null hypothesis was rejected. Compliance with the dose-based unrestricted release criteria was again demonstrated in accordance with the process presented in the LTP as well as the proposed approach for accounting for the presence of HTD ROC.

The actual measured concentrations for HTD ROC were used in conjunction with the 54 ISOCS measurements taken on the Under Vessel concrete in Unit 2 Containment to demonstrate compliance. It should also be noted that the surrogate OpDCGL for Cs-137 (inferring both H-3 and Sr-90 at the maximum ratios from LTP Table 5-15) equaled 2.10E+07 pCi/m^2 (Equation 4) and the surrogate OpDCGL for Co-60 (inferring Ni-63 at the maximum ratio from LTP Table 5-15) equaled 8.55E+06 pCi/m2 (Equation 5). No ISOCS measurement result for Cs-137 or Co-60 exceeded its respective surrogate OpDCGL value.

Demonstrating compliance based on dose consequence from the actual measured concentrations for HTD ROC is a reasonable approach as the spatial distribution of the concrete cores is representative and, due to the extensive remediation and removal of source term, particularly Cs-137, the ratios used to infer H-3 and Sr-90 using the Cs-137 as a surrogate are no longer consistent or reasonably correlated.

There were no addendums to the FSS plan, however, there were changes to the ISOCS survey plans as noted earlier in this Release Record. Those changes were required due to constraints on placement of ISOCS detectors that were not obvious when the FSS plan was first written. The changes in ISOCS measurement locations were made to ensure 100% areal coverage of the survey units.

In the 565 foot elevation, the floor and lower walls were gridded using available plant drawings. In practice, some of the identified ISOCS measurement locations were not usable, and some additional locations were required. Adjustments were made to ensure 100% coverage of the surface of the survey unit.

Corrected drawings for both survey units, showing final locations of all ISOCS measurements are included in Attachment 1 of this Release Record.

12. DATA QUALITY ASSESSMENT (DQA)

The DQO sample design and data were reviewed in accordance with Zion*Solutions* procedure ZS-LT-300-001-004, *"Final Status Survey Data Assessment"* (Reference 14) for completeness and consistency. Documentation was complete and legible. Surveys and the collection of measurements were consistent with the DQOs and were sufficient to ensure that the survey unit was properly designated as Class 1. The survey design had adequate power as indicated by the Retrospective Power Curve (see Attachment 5).

The analytical results of all ISOCS measurements were less than a SOF of one. Although MARSSIM states that the Sign Test need not be performed in the instance that no measurements surpass the DCGL, the test was conducted to demonstrate coherence to the statistical principles of the DQO process. The Sign Test (Attachment 3) was performed on the data and compared to the original assumptions of the DQOs. The evaluation of the Sign Test results clearly demonstrates that the survey unit passes the unrestricted release criteria, thus, the null hypothesis is rejected.

The preliminary data review consisted of calculating basic statistical quantities (e.g., mean, median, standard deviation). All data was considered valid including negative values, zeros, values reported below the MDC, and values with uncertainties that exceeded two standard deviations. The mean and median values for each ROC were well below the respective OpDCGLs. Also, the retrospective power curve shows that a sufficient number of samples were collected to achieve the desired power. Therefore, the survey unit meets the unrestricted release criteria with adequate power as required by the DQOs.

The data for Co-60 and Cs-137 is represented graphically through a frequency plot and a quantile plot. All graphical representations are provided in Attachment 5.

13. ANOMALIES

No anomalies were observed during the performance or analyses of the survey.

14. COMPLIANCE EQUATION

There are four distinct source terms for the end-state at Zion: backfilled basements, soil, buried piping and groundwater. Demonstrating compliance with the dose criterion

requires the summation of dose from the four source terms (see Equation 6-11 from LTP Chapter 6, section 6-17).

The final compliance dose will be calculated using LTP Equation 6-11 after FSS has been completed in all survey units. The results of the FSS performed for each FSS unit will be reviewed to determine the maximum dose from each of the four source terms (e.g., basement, soil, buried pipe and existing groundwater if applicable) using the mean BcSOF of FSS systematic results plus the dose from any identified elevated areas. The compliance dose must be less than 25 mrem/yr. 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.

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) are surveyed separately during FSS. The dose from clean concrete fill is predetermined in accordance with LTP Chapter 5, Table 5-16, which is conservatively based on a maximum allowable MDC of 5,000 dpm/100cm^2. The dose from fill assigned to the Unit 2 Containment basement is 1.775 mrem/yr, which equates to a SOF of 0.071.

After the FSS of all dose components in a given basement is complete and all dose component survey units pass the Sign Test, the BcSOF for each dose component is calculated using Equations 5-5 or 5-6 as applicable from LTP Chapter 5, section 5.5.4. For both the Unit 2 Containment FSS unit above the 565 foot elevation and the Unit 2 Containment FSS unit in the Under Vessel area, there were no elevated area identified by the compliance survey (elevated areas are defined as areas exceeding the OpDCGL but less than the BcDCGL). The mean BcSOF for the Unit 2 Containment above the 565 foot elevation is 0.009, which equates to a dose of 0.219 mrem/yr, and the mean BcSOF for the Unit 2 Containment Under Vessel area is 0.106, which equates to a dose of 2.650 mrem/yr. As the DCGLs for both FSS units in Unit 2 Containment were derived on an area-weighted basis, the total mean BcSOF for Unit 2 Containment is a summation of the mean BcSOF for the area above the 565 foot elevation and the mean BcSOF for the area Under Vessel area, which equates to a total BcSOF for the Unit 2 Containment structure of 0.115 or a dose of 2.875 mrem/yr.

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. In

accordance with LTP section 5.5.6.1, this adjustment must be made to the Containment structural BcSOF due to its hydraulic conductivity with the SFP/Transfer Canal FSS unit. Equation 5-8 from LTP Chapter 5, section 5.5.6.1 was used to sum the residual activity in the Unit 2 Containment structure and the SFP/Transfer Canal structure on an area-weighted basis. The mean BcSOF for the SFP/Transfer Canal is 0.039. The derivation of this value is documented in the Release Record for the SFP/Transfer Canal structure. LTP Chapter 5, section 5.5.6.1, Table 5-23 states that the total area for the Unit 2 Containment plus the area of the SFP/Transfer Canal is 3,482 m^2 and the stand-alone area of the SFP/Transfer Canal is 723 m^2. The result is provided in Equation 7.

Equation 7

$$\left\{\left(\frac{723}{3482}\right)(0.039)\right\} = 0.008$$

The SOF of 0.008 is added to the mean BcSOF for the Unit 2 Containment to derive the adjusted BcSOF of 0.123 for the Unit 2 Containment basement structure. This equates to a dose of 3.075 mrem/yr. The adjusted BcSOF for the Unit 2 Containment structure is then used in the following equation to calculate $BcSOF_{BASEMENT}$ for the Unit 2 Containment.

Equation 8

$$SOF_{BASEMENT} = SOF_B + SOF_{EP} + SOF_{PN} + SOF_{CF}$$

where:

$SOF_{BASEMENT}$	=	SOF (mean of FSS systematic results plus the dose from any identified elevated areas) for backfilled basements
SOF_B	=	SOF for structural survey unit(s) within the basement (mean of FSS systematic results plus the dose from any identified elevated areas)
SOF_{EP}	=	SOF for embedded pipe survey unit(s) within the basement (mean of FSS systematic results plus the dose from any identified elevated areas)
SOF_{PN}	=	SOF for penetration survey unit(s) within the basement (mean of FSS systematic results plus the dose from any identified elevated areas)
SOF_{CF}	=	SOF for clean concrete fill (if applicable) based on maximum MDC during unrestricted release survey

The variable for $BcSOF_{PN}$ for the Unit 2 Containment penetrations is 0.008. The derivation of this value is documented in the Release Record for the Unit 2 Containment penetrations.

The value for embedded pipe in the Unit 2 Containment is from the Unit 2 Tendon Tunnel 547 foot Embedded Floor Drain Pipe. From the Release Record for the Unit 2 Tendon Tunnel Floor Drain Pipe, the $BcSOF_{EP}$ value is 0.000. As previously stated in section 2 of this record, the Unit 2 Containment Incore Sump Drain was completely removed and disposed of as radioactive waste during decommissioning. Therefore, no dose will be assigned to the Unit 2 Containment Basement from embedded pipe 02111.

The $BcSOF_{BASEMENT}$ value for the Unit 2 Containment is then derived as follows;

Equation 9

$$BcSOF_{BASEMENT} = 0.123 + 0.008 + 0.000 + 0.071 = 0.202$$

The $BcSOF_{BASEMENT}$ for the Unit 2 Containment basement is 0.202. This SOF equates to a dose of 5.062 mrem/yr TEDE to an AMCG from residual radioactivity in the Unit 2 Containment basement.

15. CONCLUSION

Survey Units 02100 and 02110 have met the DQOs of the FSS plan. The ALARA criteria as specified in Chapter 4 of the LTP were achieved. The EMC is not applicable to structural surfaces and remediation was successfully implemented.

All identified ROC were used for statistical testing to determine the adequacy of the survey unit for FSS. Evaluation of the data shows that none of the ROC concentration values exceed the Operational DCGL or any investigational levels; therefore, in accordance with the LTP Section 5.10, the survey units meet the release criterion.

The sample data passed the Sign Test. The null hypothesis was rejected. The Retrospective Power Curve showed that adequate power was achieved. The survey units are properly classified as Class 1.

The total mean BcSOF for the Unit 2 Containment basement structure is 0.123, which is the sum of mean BcSOF from survey unit above 565 foot elevation plus the mean SOF from the Under Vessel area and adjusted to account for residual radioactivity in the SFP/Transfer Canal on an area-weighted basis. The total dose contribution from the Unit 2 Containment basement structure, including dose from penetrations, embedded pipe and fill is 5.062 mrem/yr TEDE ($BcSOF_{BASEMENT}$ = 0.202).

Survey Units 02100 and 02110 are acceptable for unrestricted release.

16. REFERENCES

1. Zion*Solutions* procedure ZS-LT-300-001-005, "Final Status Survey Data Reporting"
2. "Zion Station Restoration Project License Termination Plan"
3. Zion*Solutions* procedure ZS-LT-300-001-001, "Final Status Survey Package Development"
4. NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual"
5. Zion*Solutions* TSD 17-004, "Operational Derived Concentration Guideline Levels for Final Status Survey"
6. "Zion Station Historical Site Assessment"
7. Zion*Solutions* TSD 14-028, "Radiological Characterization Report"
8. Zion*Solutions* procedure ZS-LT-300-001-002, "Survey Unit Classification"
9. Zion*Solutions* TSD 11-001, "Technical Support Document for Potential Radionuclides of Concern During the Decommissioning of the Zion Station"
10. Zion*Solutions* TSD 14-019, "Radionuclides of Concern for Soil and Basement Fill Model Source Terms"
11. Zion*Solutions* TSD 14-022, "Use of In-Situ Gamma Spectroscopy for Final Status Survey of End State Structures"
12. Zion*Solutions* TSD 13-005, "Unit 1 & 2 Reactor Building End State Concrete and Liner Volumes and Surfaces Areas"
13. Zion*Solutions* procedure ZS-LT-300-001-003, "Isolation and Control for Final Status Survey"
14. Zion*Solutions* procedure ZS-LT-300-001-004, "Final Status Survey Data Assessment"

17. ATTACHMENTS

Attachment 1 - Additional Figures and Maps

Attachment 2 - ISOCS Geometry

Attachment 3 - Sign Test

Attachment 4 - QC Measurement Assessments

Attachment 5 - Graphical Presentations

Attachment 6 - ISOCS Analytical Reports

Attachment 7 - Eberline Reports

ATTACHMENT 1
ADDITIONAL FIGURES AND MAPS

Figure 1 - Under Vessel ISOCS Grid Locations – Under Vessel Wall

04/19/2018

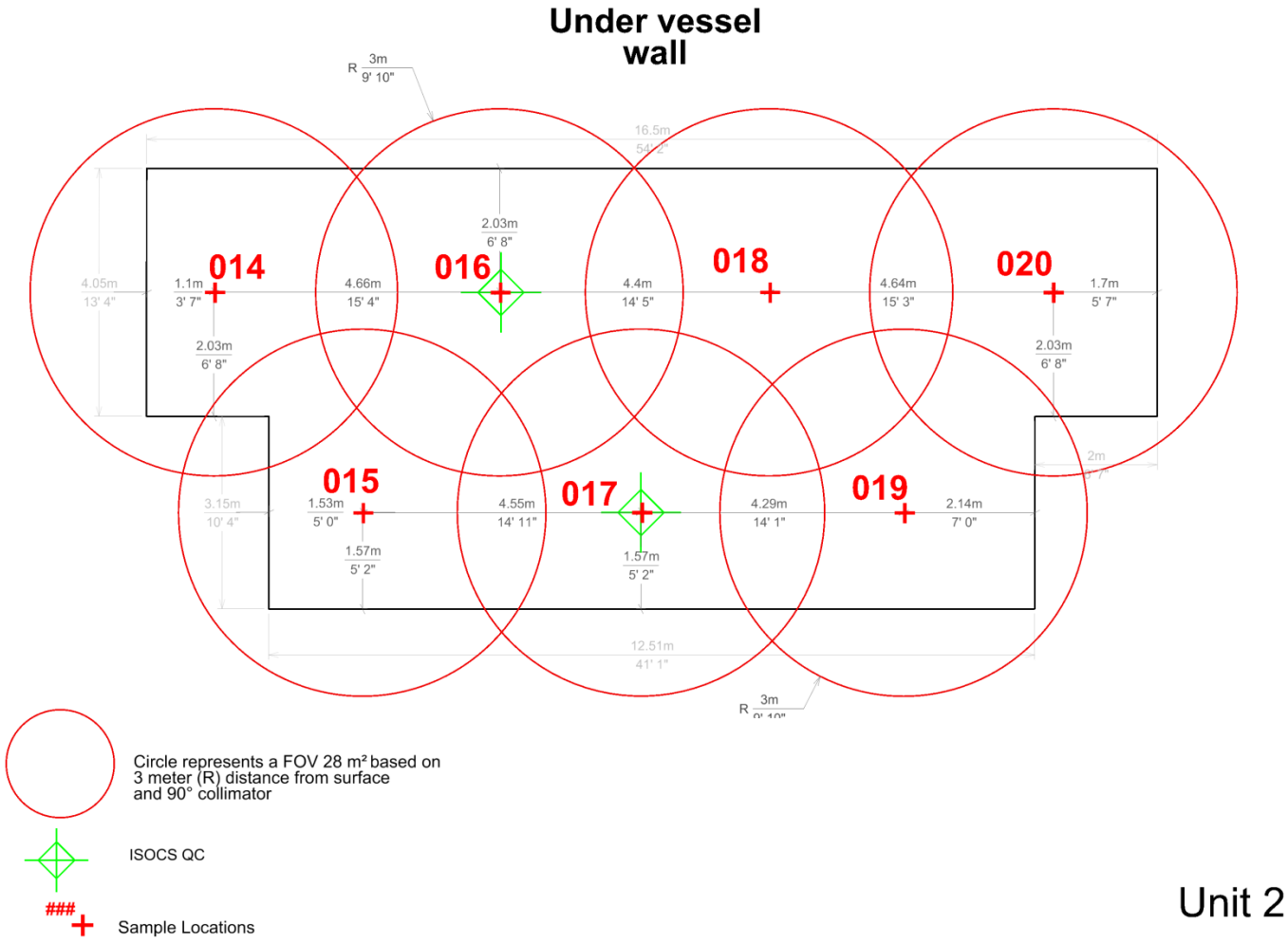


Figure 2 - Under Vessel ISOCS Grid Locations – Incore Floor

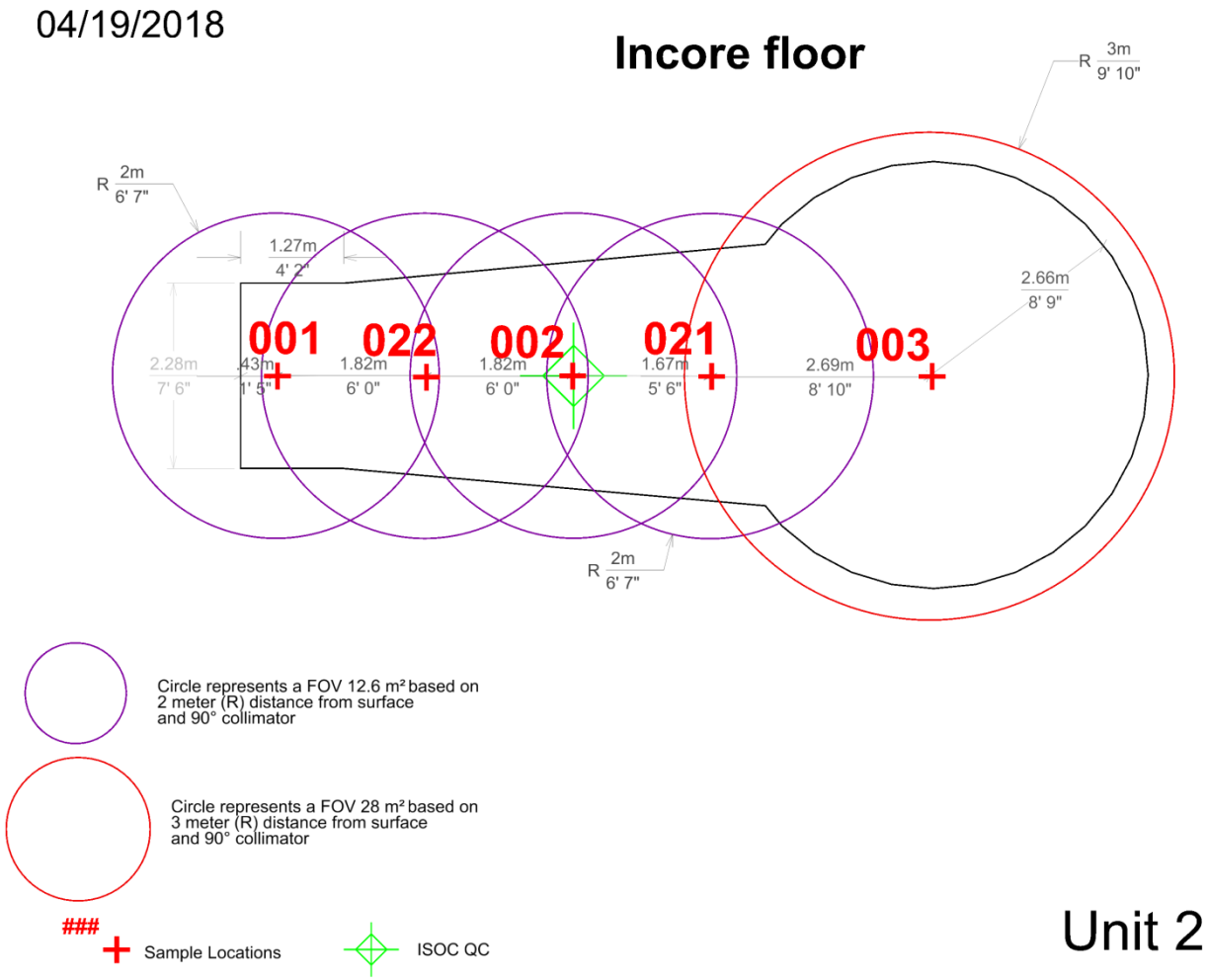


Figure 3 - Under Vessel ISOCS Grid Locations – Incore Tunnel Ceiling

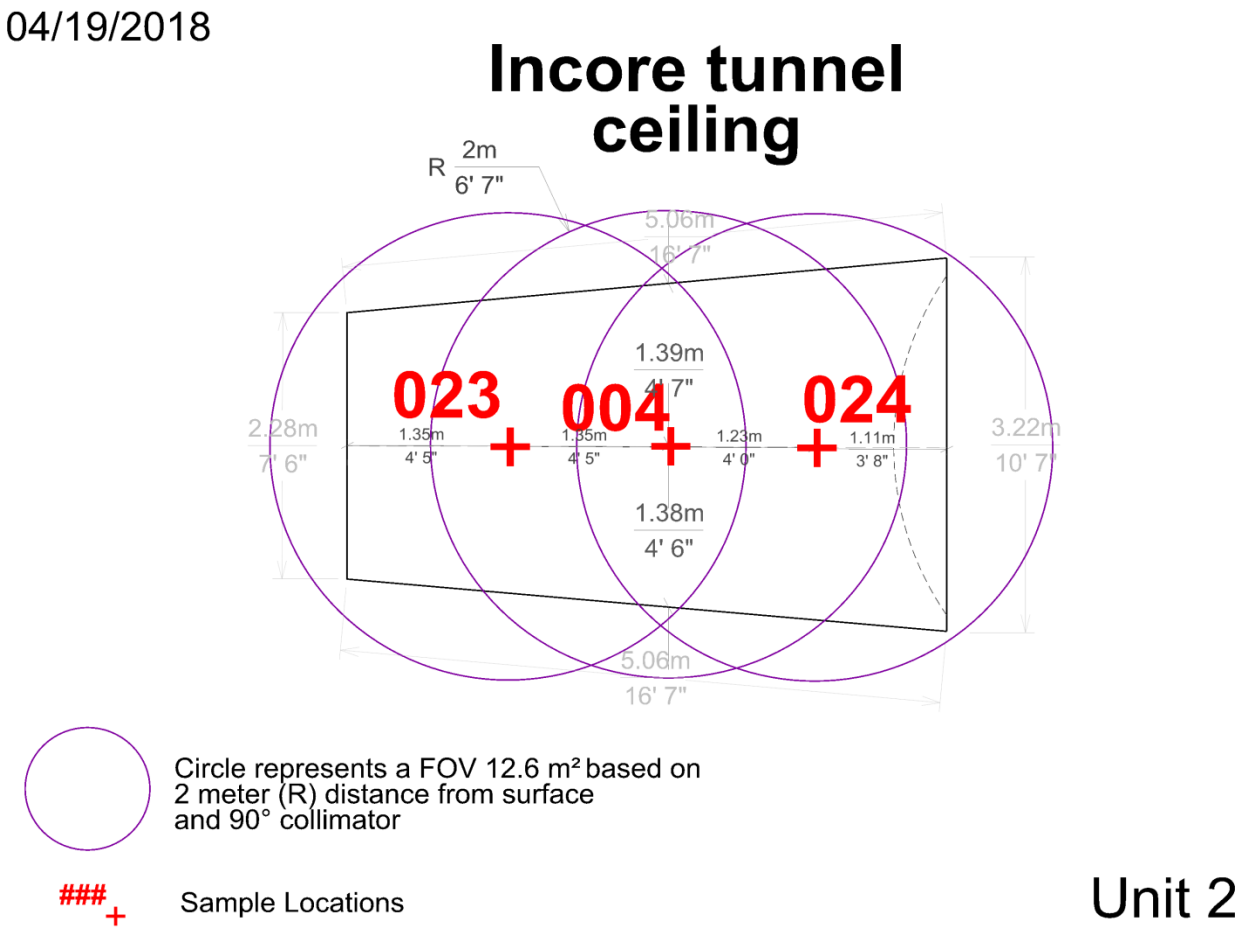


Figure 4 - Under Vessel ISOCS Grid Locations – Incore Tunnel North Wall

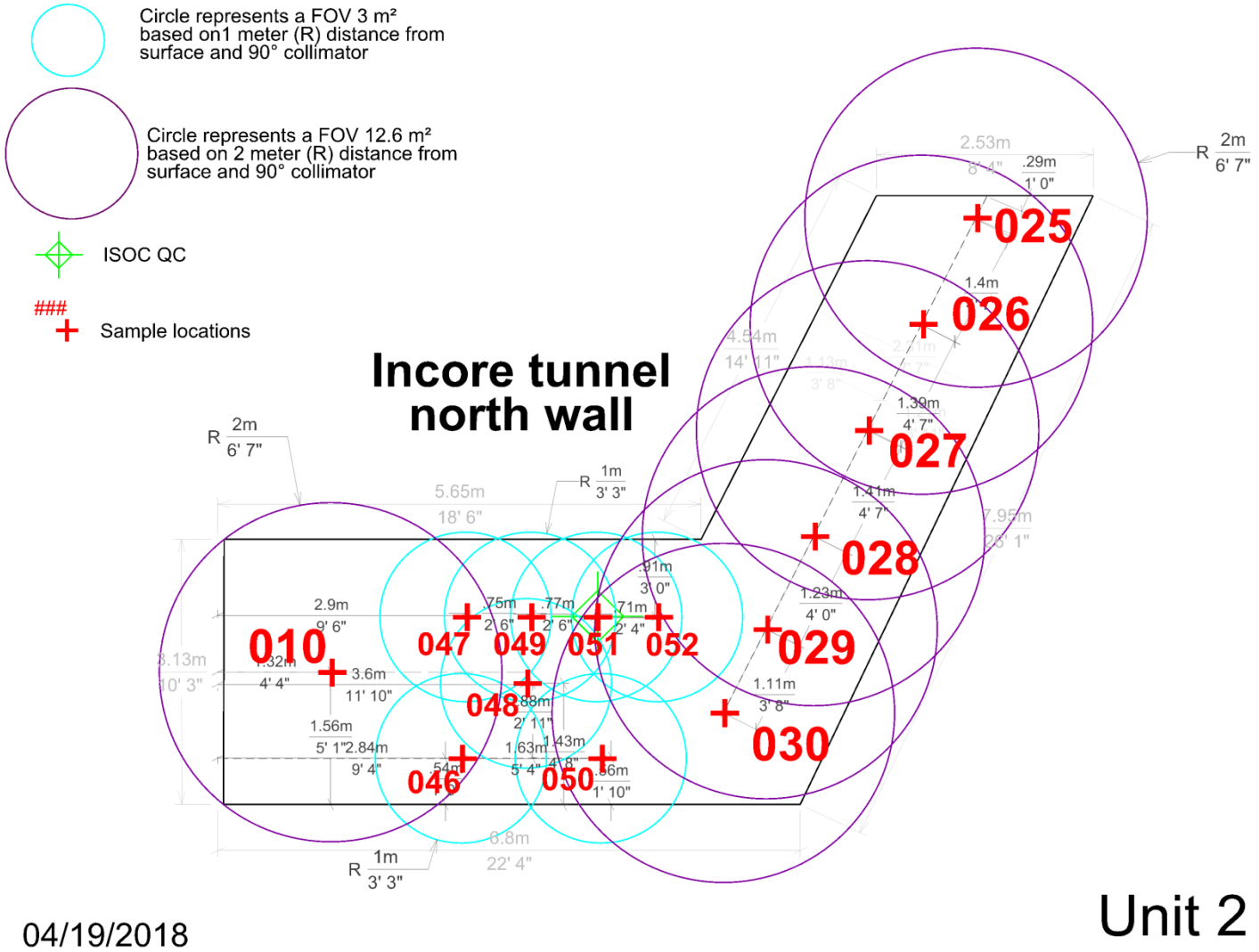


Figure 5 - Under Vessel ISOCS Grid Locations – Incore Tunnel South Wall

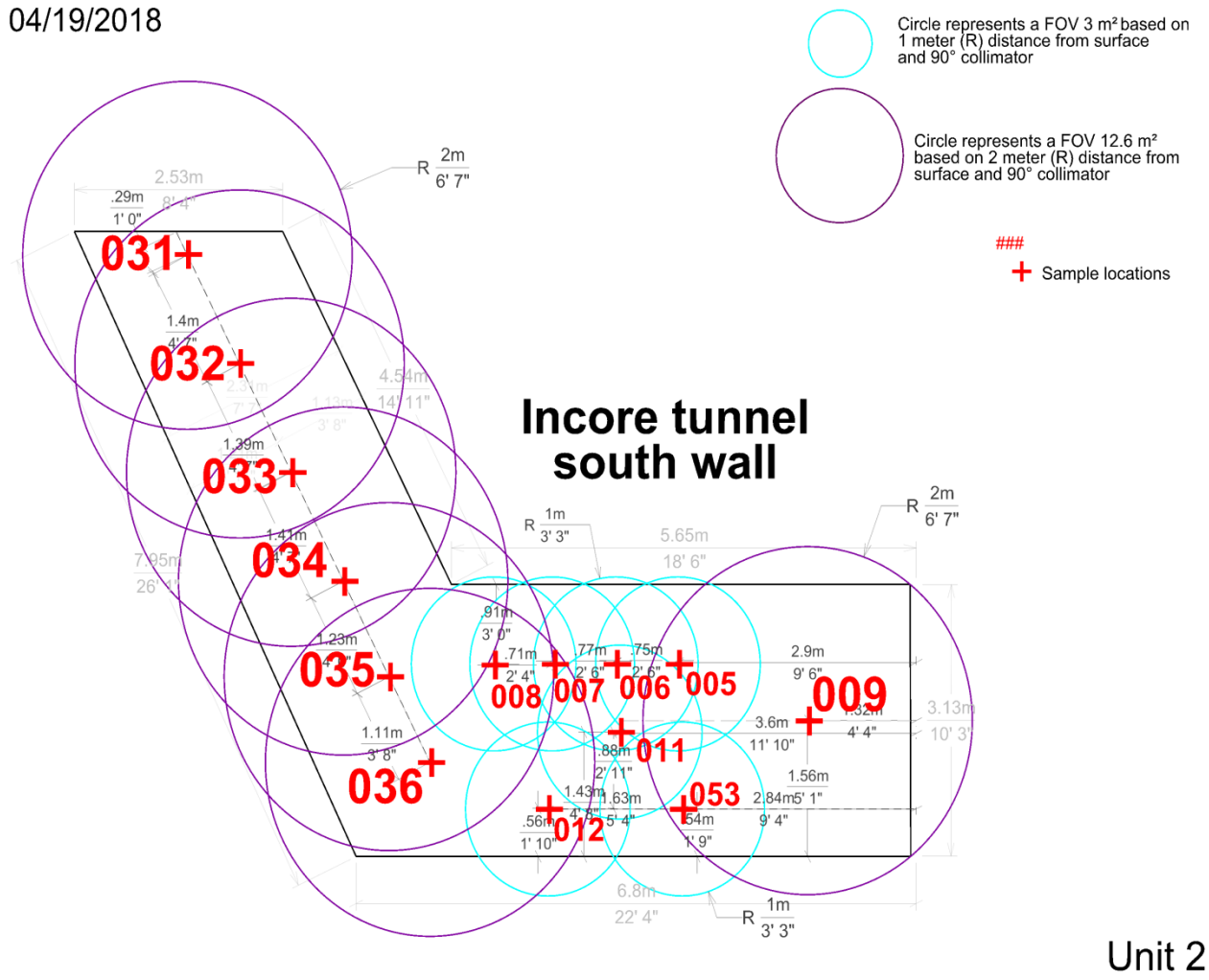


Figure 6 - Under Vessel ISOCS Grid Locations – Sloped Tunnel Floor

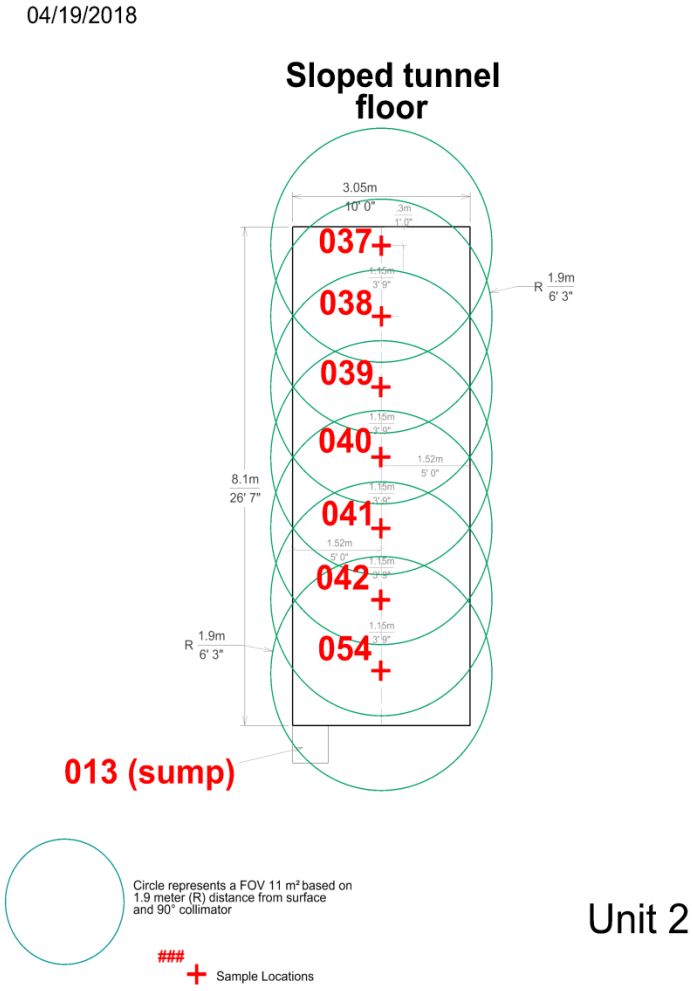
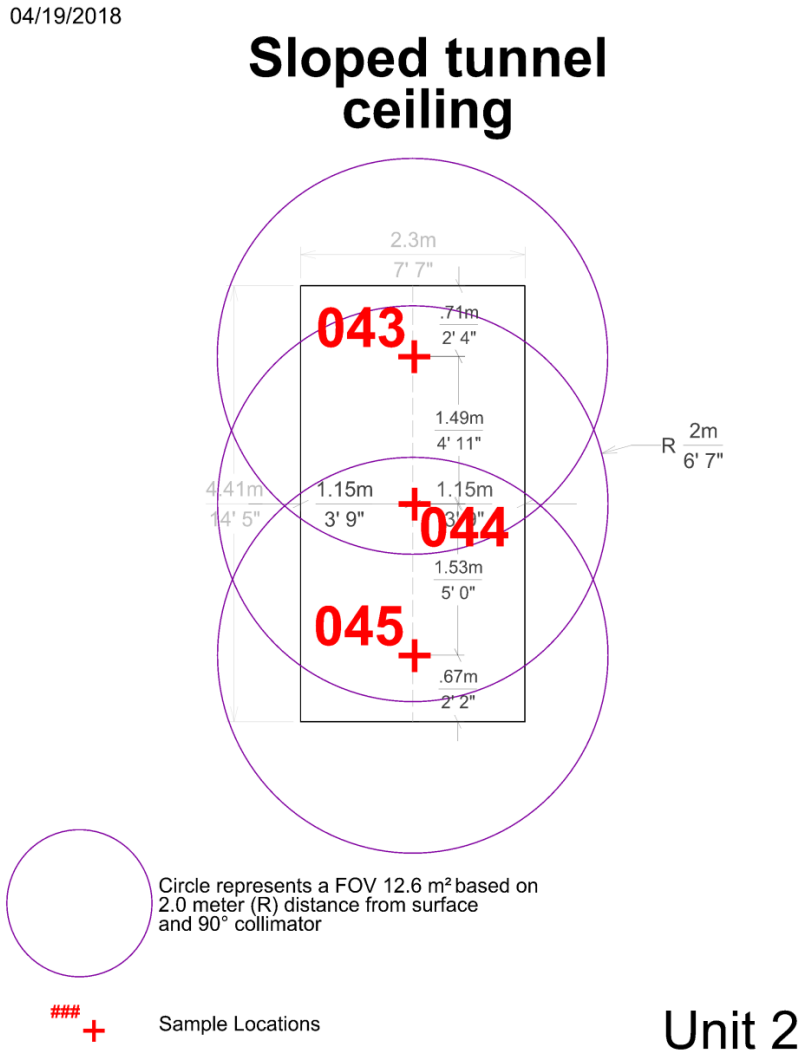


Figure 7 - Under Vessel ISOCS Grid Locations – Sloped Tunnel Ceiling



ATTACHMENT 2
ISOCS Geometry

TSD 14-022, "Use of In-Situ Gamma Spectroscopy for Source Term Survey of End State Structures"

The efficiency calibration methods and results for the use of in-situ gamma spectroscopy (ISOCS) to perform FSS of the ZSRP end state structure basements is presented in ZionSolutions TSD 14-022, *"Use of In-Situ Gamma Spectroscopy for Source Term Survey of End State Structures"*. The following is relevant information pertaining to ISOCS geometry for FSS of the Containment basements that is reproduced from the TSD.

For survey planning purposes and the assessments provided in the TSD, the assumed configuration of the ISOCS system during FSS is a three meter distance from the surface to be measured with a 90 degree, 50 mm lead collimator. This results in a 28.3 m^2 FOV. The source term geometry, concentration depth profile and areal distribution of the residual radioactivity in structures are required to generate efficiency curves (i.e., efficiency as a function of energy). The concrete cores obtained during characterization, continuing characterization and FSS confirmatory phase provide the necessary information regarding the distribution of activity with depth for each structure. The areal distribution is assumed to be uniform for the efficiency calibration.

Containment Above 565 foot Elevation ISOCS Geometries For Final Status Surveys

Section 3.7 of TSD 14-022 acknowledges the decommissioning approach for the Containment basements above the 565 foot elevation to remove all concrete inside the liners in both Containments. The source term geometry for the containment basements above the 565 ft/ elevation will be a thin layer of surface contamination on the remaining exposed steel liner. The geometry used on the Containment steel liner walls and floors will be a circular plane (CP) geometry with a thin source thickness. A source thickness of 0.153 cm provides a bounding and conservative depth of contamination for the liner model.

Containment Liner 0.153 cm Circular Plane - Minimum Detectable Concentrations

Page 1 of
Geometry Composer Report

CANBERRA

Date: Monday, May 11, 2015 - 14:43:52
Description: CP Containment 0.152 cm Steel
Comment: 90 degree 50 mm collimator 3.0 m Source to Detector
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\CIRCULAR_PLANE\CP Containmnet 0.153 Steel 051115.geo
Software: ISOCS
Template: CIRCULAR_PLANE, Version: (default)
Detector: 5456
Collimator: 50mm-90d new (newISOCS 50mm side 90deg collimation [large hole collimator])
Environment: Temperature = 22 °C, Pressure = 760 mm Hg, Relative Humidity = 30%
Integration: Convergence = 1.00%, MDRPN = 2^4 (16), CRPN = 2^4 (16)

Dimensions (cm)

No.	Description	d.1	d.2	d.3	d.4	d.5	d.6	Material	Density	Rel. Conc.
1	Side Walls	0	600					none		
2	Layer 1	0.153						csteel	7.9	1.00
3	Layer 2	0.182						csteel	7.9	
4	Layer 3	0						<none>		
5	Layer 4	0						<none>		
6	Layer 5	0						<none>		
7	Layer 6	0						<none>		
8	Layer 7	0						<none>		
9	Layer 8	0						<none>		
10	Layer 9	0						<none>		
11	Layer 10	0						<none>		
12	Absorber1									
13	Absorber2									
14	Source-Detector	300	0	0	0	0				

List of energies for efficiency curve generation

59.5 88.0 122.1 165.9 238.6 351.9 583.2 661.6
1173.2 1332.5 1460.7 2000.0

****
***** G A M M A S P E C T R U M A N A L Y S I S ***
****

Filename: C:\GENIE2K\CAMFILES\10216-012 7-31-13.CNF

Report Generated On : 5/14/2015 10:14:45 AM

Sample Title : CP_Containment_0.153_Steel
Sample Description :
Sample Identification :
Sample Type : Steel
Sample Geometry :

Peak Locate Threshold : 3.00
Peak Locate Range (in channels) : 50 - 8192
Peak Area Range (in channels) : 50 - 8192
Identification Energy Tolerance : 1.000 keV

Sample Size : 1.000E+000 M^2

Sample Taken On :
Acquisition Started : 7/31/2013 @ 12:36:59 PM

Live Time : 900.0 seconds
Real Time : 902.5 seconds

Dead Time : 0.28 %

Energy Calibration Used Done On : 5/13/2013
Efficiency Calibration Used Done On : 5/11/2015
Efficiency ID : U1CT_.153_051115

****
***** P E A K A N A L Y S I S R E P O R T **
****

Detector Name: 5452
Sample Title: CP_Containment_0.153_Steel
Peak Analysis Performed on: 5/14/2015 @ 10:14:44 AM
Peak Analysis From Channel: 50
Peak Analysis To Channel: 8192

Peak No.	ROI		Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
	start	end						
1	336	345	340.40	84.83	1.14	3.61E+01	40.33	1.64E+02
2	946	961	954.82	238.59	1.15	8.72E+01	32.59	5.88E+01
3	2327	2336	2331.97	583.12	0.53	1.90E+01	16.02	2.00E+01
4	2639	2654	2644.80	661.36	0.86	4.23E+01	17.98	1.27E+01
5	5830	5852	5841.95	1460.50	1.21	2.08E+02	31.75	1.15E+01

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 2.000 sigma

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T ***
****

Sample Title: CP_Containment_0.153_Steel
Nuclide Library Used: C:\GENIE2K\CAMFILES\Zion_LiB.NLB
.....IDENTIFIED NUCLIDES.....

Nuclide Name	ID Confidence	Energy (keV)	Yield (%)	Activity (pCi/m2)	Activity Uncertainty

K-40	0.985	1460.81*	10.67	8.89E+05	1.55E+05
Cs-137	0.986	661.65*	85.12	1.50E+04	6.63E+03
Tl-208	0.999	583.19	84.50	6.37E+03	5.42E+03
Pb-212	1.000	74.81	9.60		
		77.11	17.50		
		87.20	6.30		
		89.80	1.75		
		115.19	0.60		
		238.63*	44.60	3.43E+04	1.40E+04
		300.09	3.41		
Th-231	0.983	26.64	18.70		
		84.21*	8.00	7.05E+04	7.99E+04
		89.95	1.25		

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity

Energy Tolerance : 1.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000 sigma

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T ***
****

Nuclide Name	Nuclide ID Confidence	Weighted Mean Activity (pCi/m2)	Weighted Mean Activity Uncertainty
K-40	0.985	8.89E+05	1.55E+05
Cs-137	0.986	1.50E+04	6.63E+03
Tl-208	0.999	6.37E+03	5.42E+03
Pb-212	1.000	3.43E+04	1.40E+04
Th-231	0.983	7.05E+04	7.99E+04

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000 sigma

**********U N I D E N T I F I E D P E A K S**********
Peak Locate Performed on: 5/14/2015 @ 10:14:44 AM
Peak Locate From Channel: 50
Peak Locate To Channel: 8192

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide

All peaks were identified.

****
***** N U C L I D E M D A R E P O R T **
****

Detector Name: 5452
Sample Geometry:
Sample Title: CP_Containment_0.153_Steel
Nuclide Library Used: C:\GENIE2K\CAMFILES\Zion_LiB.NLB

Nuclide Name	Energy (keV)	Yield (%)	Line MDA (pCi/m^2)	Nuclide MDA (pCi/m^2)	Activity (pCi/m^2)	Dec. Level (pCi/m^2)
+K-40	1460.81	10.67	1.06E+05	1.06E+05	8.89E+05	4.71E+04
Mn-54	834.83	99.97	6.62E+03	6.62E+03	1.88E+03	2.85E+03
Co-60	1173.22	100	3.76E+03	3.76E+03	-5.06E+03	1.33E+03
	1332.49	100	8.45E+03		4.95E+03	3.64E+03
Nb-94	702.63	100	6.07E+03	5.78E+03	1.13E+03	2.61E+03
	871.10	100	5.78E+03		1.92E+01	2.42E+03

SN-113	255.12	1.93	3.03E+05	9.00E+03	6.53E+04	1.40E+05
	391.69	64.90	9.00E+03		-2.70E+03	4.02E+03
Cs-134	475.35	1.46	3.61E+05	6.47E+03	8.19E+04	1.57E+05
	563.23	8.38	6.47E+04		-2.48E+04	2.78E+04
	569.32	15.43	3.97E+04		7.38E+03	1.74E+04
	604.70	97.60	7.40E+03		2.96E+02	3.30E+03
	795.84	85.40	6.47E+03		-2.91E+03	2.71E+03
	801.93	8.73	8.56E+04		1.64E+04	3.76E+04
	1038.57	1.00	5.70E+05		-1.04E+05	2.34E+05
	1167.94	1.80	3.16E+05		-1.42E+05	1.28E+05
	1365.15	3.04	1.34E+05		9.04E+03	4.76E+04
+Cs-137	661.65*	85.12	8.21E+03	8.21E+03	1.50E+04	3.63E+03
+Tl-208	583.19*	84.50	8.32E+03	8.32E+03	6.37E+03	3.71E+03
Bi-211	72.87	1.20	1.06E+06	6.96E+04	-4.79E+05	5.08E+05
	351.10	12.20	6.96E+04		2.96E+04	3.24E+04
	404.80	4.10	1.48E+05		2.16E+03	6.62E+04
	426.90	1.90	3.04E+0		-8.13E+03	1.35E+05
	831.80	3.30	1.71E+0		-4.11E+04	7.17E+04
Pb-211	404.80	3.00	2.02E+0	2.02E+05	2.96E+03	9.04E+04
	427.10	1.40	4.21E+0		2.48E+04	1.87E+05
	831.80	2.80	2.02E+0		-4.11E+04	8.45E+04
Bi-212	39.86	1.10	5.05E+0	5.88E+04	-1.74E+06	2.45E+06
	727.17	11.80	5.88E+0		1.56E+04	2.58E+04
	785.42	2.00	2.87E+0		-2.06E+05	1.21E+05
	1620.56	2.75	1.64E+0		-3.10E+04	5.82E+04
Pb-212	74.81	9.60	1.42E+05	1.84E+04	1.52E+05	6.86E+04
	77.11	17.50	6.24E+04		3.00E+03	2.99E+04
	87.20	6.30	1.44E+05		2.78E+04	6.87E+04
	89.80	1.75	4.21E+05		-1.53E+05	1.99E+05
	115.19	0.60	1.15E+06		2.65E+05	5.44E+05
	238.63*	44.60	1.84E+04		3.43E+04	8.65E+03
	300.09	3.41	1.73E+05		-3.33E+04	7.88E+04
Bi-214	609.31	46.30	2.33E+04	2.33E+04	2.49E+04	1.08E+04
	768.36	5.04	1.26E+05		4.90E+04	5.42E+04
	806.17	1.23	5.62E+05		9.23E+04	2.45E+05
	934.06	3.21	1.78E+05		2.03E+04	7.37E+04
	1120.29	15.10	7.14E+04	2.33E+04	3.56E+04	3.22E+04
	1155.19	1.69	3.11E+05		-7.60E+04	1.24E+05
	1238.11	5.94	1.27E+05		-9.08E+03	5.41E+04
	1280.96	1.47	5.03E+05		-2.89E+03	2.12E+05
	1377.67	4.11	2.10E+05		1.40E+05	9.02E+04
	1385.31	0.78	8.02E+05		-1.61E+05	3.24E+05
	1401.50	1.39	5.10E+05		1.33E+05	2.11E+05
	1407.98	2.48	2.71E+05		-5.15E+03	1.11E+05
	1509.19	2.19	2.79E+05		2.66E+04	1.11E+05
	1661.28	1.15	3.99E+05		0.00E+00	1.41E+05
	1729.60	3.05	2.35E+05		3.74E+04	9.48E+04
	1764.49	15.80	6.74E+04		2.88E+04	2.93E+04

	1847.44	2.12	3.00E+05		9.99E+04	1.62E+05
	2118.54	1.21	0.00E+00		0.00E+00	0.00E+00
Pb-214	74.81	6.33	2.15E+05	2.42E+04	2.30E+05	1.04E+05
	77.11	10.70	1.02E+05		4.91E+03	4.89E+04
	87.20	3.70	2.45E+05		3.88E+04	1.17E+05
	89.80	1.03	7.16E+05		-2.59E+05	3.38E+05
	241.98	7.49	7.41E+04		-8.92E+03	3.39E+04
	295.21	19.20	3.61E+04		1.32E+04	1.67E+04
	351.92	37.20	2.42E+04		2.38E+04	1.13E+04
	785.91	1.10	5.43E+05		-1.31E+05	2.31E+05
Ra-226	186.21	3.28	2.11E+05	2.10E+05	8.24E+04	9.88E+04
	89.95	2.10	3.47E+05	3.67E+04	-1.98E+05	1.64E+05
	93.35	3.50	2.39E+05		1.35E+05	1.14E+05
	129.08	2.80	2.15E+05		1.98E+04	1.01E+05
	209.28	4.40	1.46E+05		3.45E+04	6.81E+04
	270.23	3.60	1.75E+05		7.57E+04	8.03E+04
	327.64	3.20	2.01E+05		7.23E+04	9.19E+04
Ac-228	338.32	11.40	5.82E+04		1.83E+04	2.66E+04
	409.51	2.13	2.96E+05		-1.32E+04	1.33E+05
	463.00	4.40	1.77E+05		4.55E+04	8.07E+04
	794.70	4.60	1.36E+05		-1.43E+04	5.81E+04
	911.60	27.70	3.67E+04		3.26E+04	1.66E+04
	964.60	5.20	1.46E+05		2.42E+04	6.33E+04
	969.11	16.60	5.63E+04		3.01E+04	2.52E+04
	1587.90	3.71	1.83E+05		7.77E+04	7.38E+04
Pa-234M	766.36	0.29	2.29E+06	6.68E+05	4.08E+05	9.97E+05
	1001.03	0.84	6.68E+05		-1.95E+05	2.74E+05
Th-234	92.38	2.81	2.76E+05	2.76E+05	-1.33E+05	1.31E+05
	92.80	2.77	2.94E+05		3.01E+04	1.40E+05
	112.81	0.28	2.28E+06		-1.30E+06	1.07E+06
U-235	89.96	1.50	4.63E+05	1.23E+04	-2.78E+05	2.30E+05
	93.35	2.50	3.35E+05		1.89E+05	2.30E+05
	105.00	1.00	6.99E+05		3.07E+05	1.59E+05
	109.14	1.50	4.81E+05		2.97E+05	3.30E+05
	143.76	10.50	6.20E+04		7.46E+03	2.28E+05
	163.35	4.70	1.03E+05		-7.82E+04	4.74E+04
	185.71	54.00	1.23E+04		7.78E+02	5.76E+03
	202.12	1.00	5.15E+05		-7.04E+04	2.36E+05
	205.31	4.70	1.26E+05		1.03E+04	5.83E+04
	59.54	36.30	4.04E+04	4.04E+04	-1.48E+04	1.94E+04

+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
> = Calculated MDA is zero due to zero counts in the region or the region is outside the spectrum
@ = Half-life too short to be able to perform the decay correction

Containment Sump Geometries: Zion Reactor Building Cavity Flood Sump Efficiency

The Unit 1 and Unit 2 Containment sumps located on the 565 foot elevation that were modeled using Geometry Composer are mirror images of each other and separate geometries were not required. The sumps modeled were the Reactor Cavity Flood Sump and the Reactor Building Recirculation Sump. The sumps were modeled using the Room templates consisting of four sides and a bottom. The contamination was modeled as surface contamination where 10 percent of the surface activity was assumed to be associated with each of the four walls and 60 percent was expected to be contained on the floor of the sumps. A single geometry and source to detector distance was used for each sump model.

The Geometries are titled:

- Zion Reactor Bldg Cavity Flood Sump
- Zion Reactor Bldg Recirc Sump

Geometry Composer Report

CANBERRA

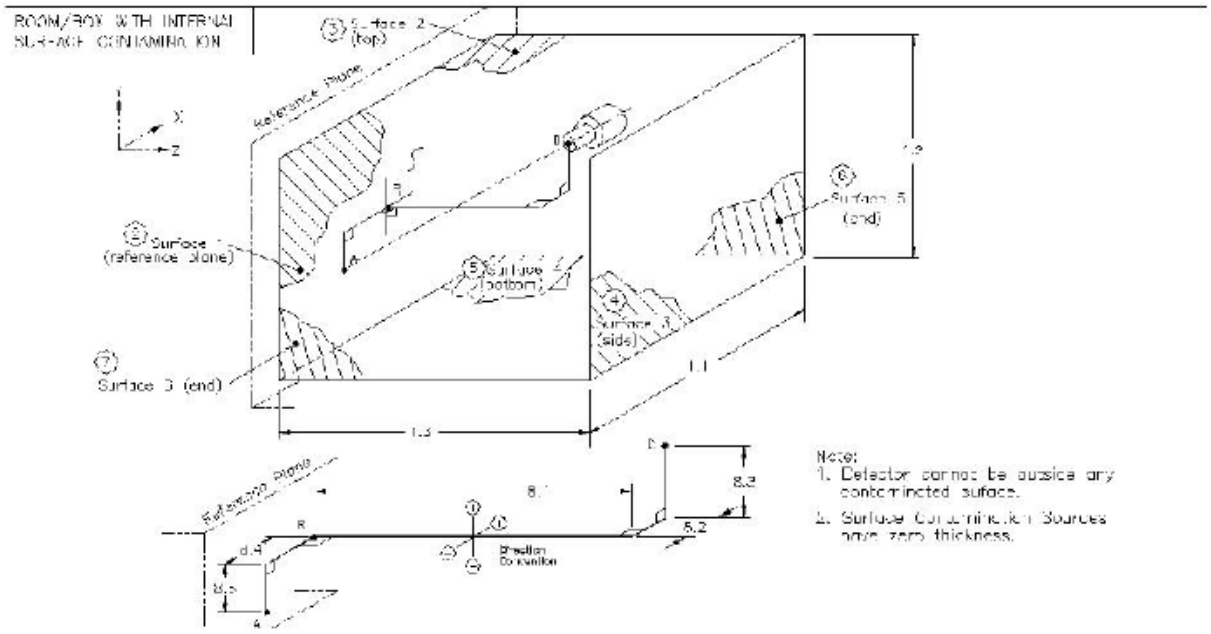
Date: Monday, March 19, 2018 - 08:16:00
Description: Zion Rx Bldg Cavity Flood sump
Comment: 128" by 103" by 76.5" deep pit with surface contamination
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\ROOM\Zion Rx Bldg Cavity Flood sump.geo
Software: ISOCS
Template: ROOM, Version: (default)
Detector: 5456
Collimator: 50mm-180d new (newISOCS 50mm side 180deg collimation [no collimator])
Environment: Temperature = 22 °C, Pressure = 760 mm Hg, Relative Humidity = 30%
Integration: Convergence = 1.00%, MDRPN = 2^4 (16), CRPN = 2^4 (16)

Dimensions (inches)

No.	Description	d.1	d.2	d.3	d.4	d.5	d.6	Material	Density	Rel. Conc.
1	Room/Box	128	103	76.5						
2	Surface 1									0.60
3	Surface 2									0.10
4	Surface 3									
5	Surface 4									0.10
6	Surface 5									0.10
7	Surface 6									0.10
8	Source-Detector	76.5	0	0	0	0				

List of energies for efficiency curve generation

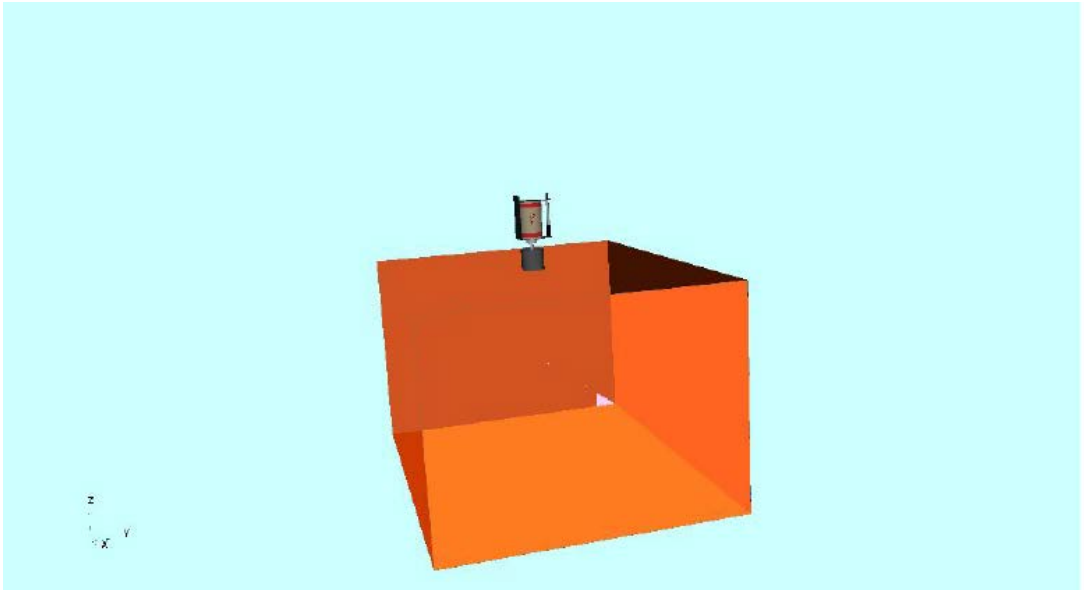
59.5 88.0 122.1 165.9 391.7 661.7 898.0 1173.2
1332.5 1836.0



Geometry Composer Report

CANBERRA

Date:	Monday, March 19, 2018 - 08:16:00
Description:	Zion Rx Bldg Cavity Flood sump
Comment:	128" by 103" by 76.5" deep pit with surface contamination
File Name:	C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\ROOM\Zion Rx Bldg Cavity Flood sump.geo
Software:	ISOCS
Template:	ROOM, Version: (default)



ISOCS/LABSOCS RESULTS

```
ISOCS/LabSOCS File:  C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\ROOM\Zion Rx Bldg Cavity
ISOCS/LabSOCS Time:  03/20/18 18:54:06
Template:            ROOM
Geom Description:    AVITY_FLOOD_SUMP
Comment:             ISOCS:128"_BY_103"_BY_76.5"_DEEP_PIT_WITH_SURFACE_CONTAMINATION
Detector:            5456
Collimator:          50MM-180D_NEW
Convergence:         1.00 %
Area [Sq Meters]:    3.1308e+001 (C)
Mass [Grams]:        0.0000e+000 (C)
Length [Meters]:     not used
 (C) = Value calculated by ISOCS
 (U) = Value modified by user
```

Energy	Efficiency	%Uncertainty	%Convergence	Final # of Voxels
59.54	3.85986e-005	10.0	-0.002853	40955
88.03	4.08417e-005	10.0	-0.002747	40955
122.06	4.00894e-005	10.0	-0.000555	40955
165.85	3.66111e-005	8.0	0.001817	40955
391.69	2.17719e-005	8.0	0.001735	40955
661.65	1.55409e-005	6.0	-0.000303	40955
898.02	1.29671e-005	6.0	-0.001449	40955
1173.22	1.10160e-005	4.0	-0.002628	40955
1332.49	1.02369e-005	4.0	-0.003842	40955
1836.01	8.25503e-006	4.0	-0.003604	40955

Geometry Composer Report

CANBERRA

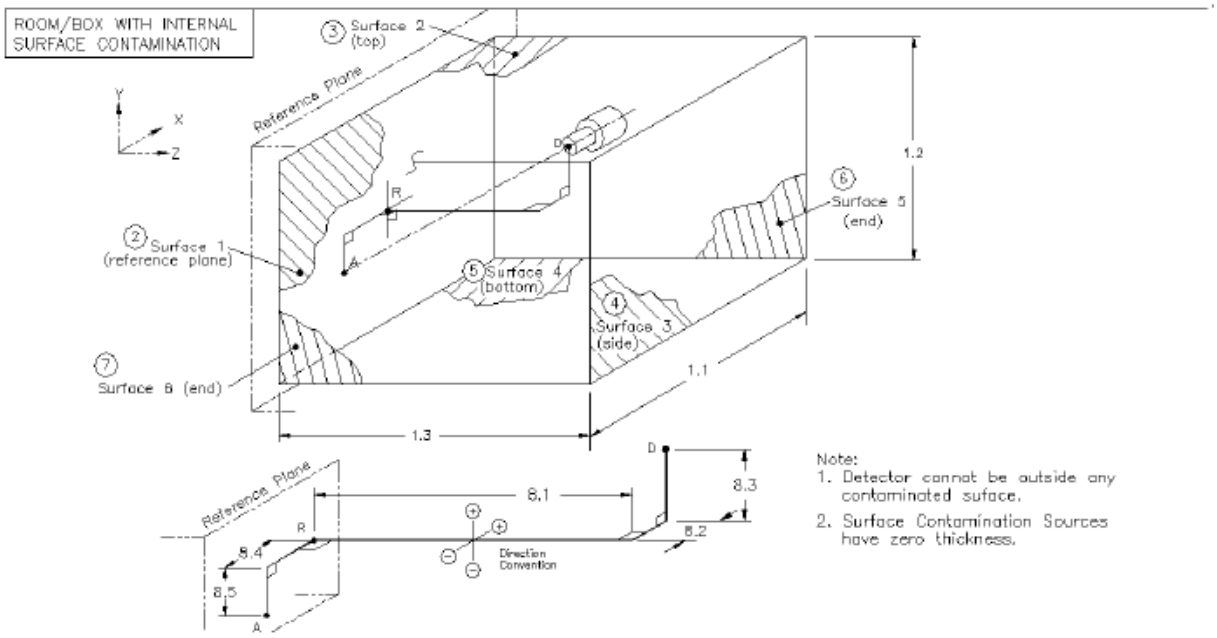
Date: Friday, August 03, 2018 - 14:35:35
Description: Zion Rx Bldg Recirc sump
Comment: 163" by 169" by 78" deep pit with surface contamination
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\ROOM\Zion Rx Bldg Recirc sump.geo
Software: ISOCS
Template: ROOM, Version: (default)
Detector: 5456
Collimator: 50mm-180d new (newISOCS 50mm side 180deg collimation [no collimator])
Environment: Temperature = 22 °C, Pressure = 760 mm Hg, Relative Humidity = 30%
Integration: Convergence = 1.00%, MDRPN = 2^4 (16), CRPN = 2^4 (16)

Dimensions (inches)

No.	Description	d.1	d.2	d.3	d.4	d.5	d.6	Material	Density	Rel. Conc.
1	Room/Box	163	169	78						
2	Surface 1									0.60
3	Surface 2									0.10
4	Surface 3									
5	Surface 4									0.10
6	Surface 5									0.10
7	Surface 6									0.10
8	Source-Detector	78	0	0	0	0				

List of energies for efficiency curve generation

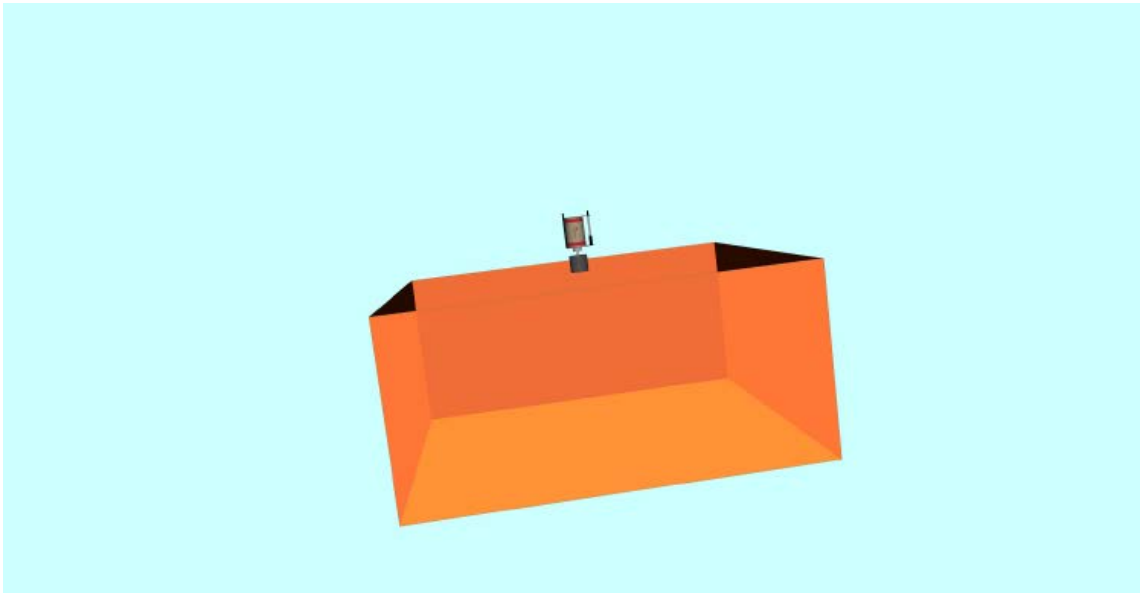
59.5 88.0 122.1 165.9 391.7 661.7 898.0 1173.2
1332.5 1836.0



Geometry Composer Report

CANBERRA

Date:	Friday, August 03, 2018 - 14:35:35
Description:	Zion Rx Bldg Recirc sump
Comment:	163" by 169" by 78" deep pit with surface contamination
File Name:	C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\ROOM\Zion Rx Bldg Recirc sump.geo
Software:	ISOCS
Template:	ROOM, Version: (default)



ISOCS/LABSOCS RESULTS

ISOCS/LabSOCS File: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\ROOM\Zion Rx Bldg Recirc
ISOCS/LabSOCS Time: 03/20/18 18:47:58
Template: ROOM
Geom Description: BLDG_RECIRC_SUMP
Comment: ISOCS:163"_BY_169"_BY_78"_DEEP_PIT_WITH_SURFACE_CONTAMINATION
Detector: 5456
Collimator: 50MM-180D_NEW
Convergence: 1.00 %
Area [Sq Meters]: 5.1186e+001 (C)
Mass [Grams]: 0.0000e+000 (C)
Length [Meters]: not used
(C) = Value calculated by ISOCS
(U) = Value modified by user

Energy	Efficiency	%Uncertainty	%Convergence	Final # of Voxels
59.54	2.70971e-005	10.0	-0.024068	40955
88.03	2.87040e-005	10.0	-0.036731	40955
122.06	2.80942e-005	10.0	-0.048459	40955
165.85	2.55635e-005	8.0	-0.039362	40955
391.69	1.51720e-005	8.0	-0.010034	40955
661.65	1.08547e-005	6.0	-0.008713	40955
898.02	9.08148e-006	6.0	-0.008306	40955
1173.22	7.72663e-006	4.0	-0.009226	40955
1332.49	7.19646e-006	4.0	-0.007929	40955
1836.01	5.80463e-006	4.0	-0.008250	40955

Containment Under Vessel (Incore) ISOCS Geometries For Final Status Surveys

General

At the time that TSD 14-022 was developed, the decommissioning approach for the Under Vessel concrete for both Containment basements was complete removal. Consequently, the document assumed conditions similar to the exposed liner above the 565 foot elevation. The approach was altered in late 2016 and it was decided to attempt to leave all concrete below the 565 foot elevation in the Under Vessel area with residual radioactivity less than the DCGL as the end-state. Additional remediation and subsequent core sampling was required to quantify the remaining residual radioactivity (including both gamma emitting and HTD ROC). The core sampling also defined the depth of contamination associated with the Under Vessel concrete and augments the information required for developing the geometry and subsequent efficiency for the ISOCS measurements.

Discussion

For both Unit 1 and Unit 2 Containment Under Vessel concrete, the gamma and HTD results of the continuing characterization core sampling (see Tables 4 and 5 of this Release Record for data used for Unit 2 Containment) were examined to develop initial geometries for the ISOCS. These initial geometries were based on the available data and were conservative. The geometries used were modeled using the Exponential Circular Plane (ECP) template included as part of the Canberra Geometry Composer software and is described in TSD 14-022. The initial Under Vessel (Incore) geometry parameters are provided in Table A below.

Table A - Under Vessel Initial Exponential Circular Plane Geometry Parameters

Unit	Analysis	Depth of Contamination (cm)	DRL* (cm)
2	Total Average Activity	14.0	6.4
2	Weighted Fraction Average	17.8	8.6
1	Total Average Activity	16.5	8.1
1	Weighted Fraction Average	21.6	21.6

*Depth Relaxation Length as described in TSD 14-022.

Based on Table A data, the more conservative geometry parameters were selected for the Unit 2 Under Vessel FSS Sample Plan. These included the Depth of Contamination at 17.8 cm and a DRL of 8.6 cm.

While surveys were being conducted in Unit 2 Under Vessel area, the data used to develop the parameters in Table A were reviewed. In order to be consistent with TSD 14-022, the depth of contamination is determined by examining the average activity and converting the lambda (λ) value generated by curve fitting exponential functions to the core data and subsequently, into the

contamination depth and DRL value used with the ISOCS Exponential Circular Plane Template in Geometry Composer. TSD 14-022 (equation 3) defines lambda where:

$$\ln(0.368) = -\lambda DRL\ cm = -1$$

$$\lambda = \frac{1}{DRL\ cm}$$

This activity examination was performed using the most recent Under Vessel core data and the associated spreadsheets and graphs (see Under Vessel A2-1 and A2-2) present both the data and results. The curve fit activity was used to develop a chart of total activity over depth and the cumulative value at the 90 percentile activity was used to select the depth of contamination.

As shown in the spreadsheets in 2A-1 and 2A-2, the evaluation resulted in a depth of contamination for Containment Units 1 and 2 under vessel of 15.24 cm and a DRL of 6.9 cm. Table B below presents the new parameter values based on using the total activity as described above.

Table B - Revised Under Vessel Exponential Circular Plane Geometry Parameters

Unit	Analysis	Depth of Contamination (cm)	DRL (cm)
1	Total Average Activity	15.24	6.9
2	Total Average Activity	15.24	6.9

It was decided that instead of using the new parameter values in Table B to continue using the parameter values of 17.8 cm contamination depth and DRL of 8.6 cm in that the values are conservative, reasonable and prudent. Table C compares the Under Vessel geometry to the geometry created using the parameters in Table B for Co-60, Cs-137, Eu-152, Eu-154 and Eu-155. Table D compares the two geometries using the Sum of Fractions which is the approach used for data assessment and the final acceptance of FSS data.

For Under Vessel ISOCS measurements, four variations of the current geometry were used. The geometries variation is the source to detector distance of 1.0, 1.5, 2.0 and 3.0 meters. 2A-5 presents the Geometry Composer parameters and efficiency associated with each of the geometries. The geometries are files used for Genie2000 Spectrum Analysis Software are named as followed:

- 3M90D_ECP_17.8cm.geo
- 2M90D_ECP_17.8cm.geo
- 1.5M90D_ECP_17.8cm.geo
- 1M90D_ECP_17.8cm.geo

In addition to the above geometries another was created for the Under Vessel sump. This geometry was designed using Geometry Composer's Rectangular Plane template. The contamination was distributed over a depth of 17.8 centimeters and 10 layers. The first 7.62 cm was divided into 1.27 cm segments (6) and the remaining 10.16 cm was divided into 4 segments (layers 2.54 cm thick). The associated concrete puck(s) activity for each layer was included as the Relative Concentration.

Table C - Difference Between the Under Vessel (UV) Geometry Used and Table B Geometry

Nuclides	UV Geometry* (pCi/m^2)	Geometry From Table B (pCi/m^2)	$\left(\frac{UV\ Geometry - Table\ 2\ Geometry}{UV\ Geometry}\right)$
Co-60	3.10E+06	2.80E+06	0.097 (9.7%)
Cs-137	4.14E+06	3.69E+06	0.109 (10.9%)
Eu-152	1.10E+07	9.70E+06	0.118 (11.8%)
Eu-154	4.30E+05	3.86E+05	0.102 (10.2%)
Eu-155	7.87E+05	6.75E+05	0.142 (14.2%)

*Where current geometry parameter for depth is 17.8 cm and DRL is 8.6 cm; the file analyzed is from under vessel

The Gamma Spectrum Analysis Reports used to create Table C are found in Attachment A2-3.

Table D - Difference Between Under Vessel (UV) and Table B Geometry SOF

UV Geometry* SOF	Geometry From Table B SOF	$\left(\frac{UV\ Geometry\ SoF - Table\ 2\ Geometry\ SOF}{UV\ Geometry\ SOF}\right)$
0.597	0.536	0.102 (10.2%)

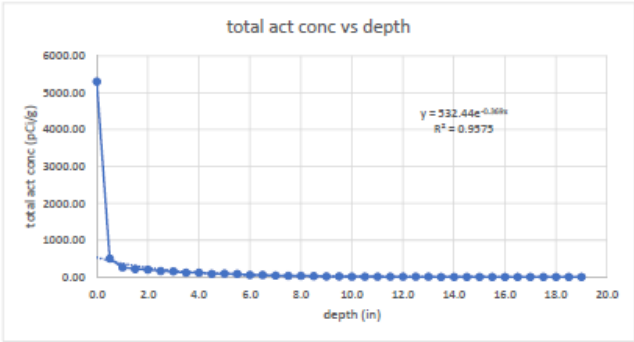
The SOF spreadsheet used to create Table D is found in Attachment A2-4.

As noted in both Tables C and D, the UV geometry which using a thicker depth of contamination (17.8 cm) and larger DRL (8.6 cm) is ten percent more conservative than the Table B geometries.

Attachment 2A-1 Unit 2 --Under Vessel Core Results for Contamination Depth and DRL Parameters

Depth	Cs-137 Average	Co-60 Average	Eu-152 Average	Eu-154 Average	total	curve fit act	Cumulative %	Cs-137 fraction	Co-60 fraction	Eu-152 fraction	Eu-154 fraction
0.0	5032.36	43.18	209.78	14.32	5299.64	532.44	16.86	0.95	0.01	0.04	0.00
0.5	232.33	20.40	231.78	12.00	496.50	442.73	30.88	0.47	0.04	0.47	0.02
1.0	23.69	20.90	207.50	11.23	263.33	368.14	42.54	0.09	0.08	0.79	0.04
1.5	11.57	15.47	180.90	9.86	217.79	306.12	52.23	0.05	0.07	0.83	0.05
2.0	7.82	14.54	168.95	7.33	198.65	254.54	60.29	0.04	0.07	0.85	0.04
2.5	3.30	12.70	141.17	6.27	163.44	211.66	67.00	0.02	0.08	0.86	0.04
3.0	2.95	10.42	124.60	13.33	151.30	176.00	72.57	0.02	0.07	0.82	0.09
3.5	2.94	8.14	102.30	4.46	117.84	146.35	77.20	0.02	0.07	0.87	0.04
4.0	2.37	7.94	101.13	5.54	116.98	121.69	81.06	0.02	0.07	0.86	0.05
4.5	1.23	6.16	71.06	4.35	82.80	101.19	84.26	0.01	0.07	0.86	0.05
5.0	0.67	6.26	77.97	3.38	88.27	84.14	86.93	0.01	0.07	0.88	0.04
5.5	0.19	4.76	70.98	4.27	80.20	69.96	89.14	0.00	0.06	0.89	0.05
6.0	0.18	4.32	48.86	2.37	55.73	58.18	90.98	0.00	0.08	0.88	0.04
6.5	0.15	3.78	44.48	2.26	50.66	48.37	92.51	0.00	0.07	0.88	0.04
7.0	0.18	2.77	35.02	2.14	40.11	40.22	93.79	0.00	0.07	0.87	0.05
7.5	0.14	2.09	28.21	1.59	32.03	33.45	94.85	0.00	0.07	0.88	0.05
8.0	0.23	1.60	24.80	2.33	28.96	27.81	95.73	0.01	0.06	0.86	0.08
8.5	0.16	1.54	20.09	1.45	23.24	23.13	96.46	0.01	0.07	0.86	0.06
9.0	0.12	1.01	14.06	2.06	17.25	19.23	97.07	0.01	0.06	0.81	0.12
9.5	0.17	0.85	12.57	0.94	14.53	15.99	97.58	0.01	0.06	0.86	0.06
10.0	0.12	0.67	9.17	0.37	10.33	13.30	98.00	0.01	0.06	0.89	0.04
10.5	0.08	0.54	7.10	0.71	8.43	11.06	98.35	0.01	0.06	0.84	0.08
11.0	0.08	0.38	4.73	1.10	6.29	9.19	98.64	0.01	0.06	0.75	0.17
11.5	0.11	0.34	4.11	0.65	5.20	7.64	98.88	0.02	0.07	0.79	0.12
12.0	0.16	0.28	3.39	0.81	4.64	6.36	99.08	0.04	0.06	0.73	0.18
12.5	0.13	0.27	2.76	0.72	3.88	5.29	99.25	0.03	0.07	0.71	0.18
13.0	0.11	0.22	2.39	0.53	3.25	4.40	99.39	0.03	0.07	0.74	0.16
13.5	0.08	0.17	1.78	0.43	2.46	3.65	99.50	0.03	0.07	0.72	0.17
14.0	0.09	0.17	2.00	0.54	2.80	3.04	99.60	0.03	0.06	0.71	0.19
14.5	0.08	0.18	1.89	0.57	2.72	2.53	99.68	0.03	0.07	0.70	0.21
15.0	0.18	0.14	1.29	0.60	2.21	2.10	99.75	0.08	0.06	0.58	0.27
15.5	0.16	0.16	0.99	0.44	1.75	1.75	99.80	0.09	0.09	0.57	0.25
16.0	0.55	0.13	0.81	0.41	1.90	1.45	99.85	0.29	0.07	0.43	0.22
16.5	0.09	0.11	0.73	0.34	1.27	1.21	99.89	0.07	0.09	0.58	0.26
17.0	0.10	0.11	0.70	0.34	1.25	1.00	99.92	0.08	0.09	0.56	0.28
17.5	0.08	0.09	0.57	0.21	0.95	0.84	99.94	0.09	0.09	0.60	0.22
18.0	0.10	0.09	0.70	0.30	1.20	0.69	99.97	0.09	0.08	0.58	0.25
18.5	0.11	0.07	0.37	0.21	0.76	0.58	99.98	0.14	0.09	0.49	0.28
19.0	0.16	0.08	0.30	0.25	0.80	0.48	100.00	0.20	0.11	0.38	0.31

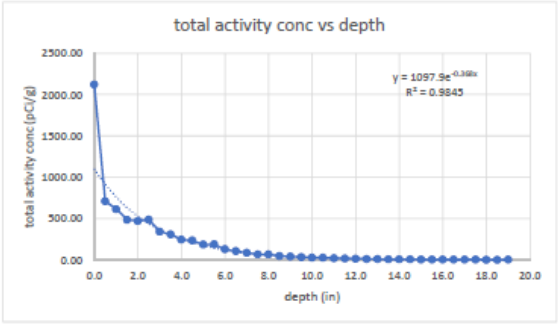
total =>	3157.89	
depth of contam (90% of total) =>	6.00	inches
depth of contam (90% of total) =>	15.24	cm
exponent =>	-0.369	
DRL =>	2.71	inches
DRL =>	6.88	cm



Attachment 2A-2 Unit 2 --Under Vessel Core Results for Contamination Depth and DRL Parameters

Depth	Cs-137 Average	Co-60 Average	Eu-152 Average	Eu-154 Average	total	curve fit act	Cumulative %	Cs-137 fraction	Co-60 fraction	Eu-152 fraction	Eu-154 fraction
0.0	1638.26	51.71	409.95	23.11	2123.03	1097.90	16.82	0.77	0.02	0.19	0.01
0.5	205.28	39.34	443.44	23.02	711.08	913.38	30.81	0.29	0.06	0.62	0.03
1.0	54.59	42.11	492.61	24.53	613.84	759.88	42.45	0.09	0.07	0.80	0.04
1.5	14.54	30.60	419.77	20.62	485.52	632.17	52.14	0.03	0.06	0.86	0.04
2.0	58.35	27.96	364.67	18.23	469.21	525.92	60.19	0.12	0.06	0.78	0.04
2.5	24.70	28.74	412.39	20.07	485.91	437.53	66.90	0.05	0.06	0.85	0.04
3.0	6.61	21.47	299.95	13.26	341.28	364.00	72.47	0.02	0.06	0.88	0.04
3.5	3.61	27.45	265.38	12.02	308.45	302.82	77.11	0.01	0.09	0.86	0.04
4.0	3.45	18.29	213.43	9.16	244.32	251.93	80.97	0.01	0.07	0.87	0.04
4.5	0.63	18.42	204.84	10.01	233.90	209.59	84.18	0.00	0.08	0.88	0.04
5.0	0.68	12.18	164.37	7.10	184.33	174.37	86.85	0.00	0.07	0.89	0.04
5.5	1.65	8.94	171.48	5.88	187.96	145.06	89.08	0.01	0.05	0.91	0.03
6.0	1.38	9.66	112.08	4.88	127.99	120.68	90.92	0.01	0.08	0.88	0.04
6.5	0.80	9.25	92.90	4.53	107.49	100.40	92.46	0.01	0.09	0.86	0.04
7.0	0.28	6.32	77.67	3.23	87.51	83.53	93.74	0.00	0.07	0.89	0.04
7.5	0.15	4.69	58.07	2.99	65.90	69.49	94.81	0.00	0.07	0.88	0.05
8.0	0.34	5.70	56.46	2.31	64.80	57.81	95.69	0.01	0.09	0.87	0.04
8.5	0.05	3.23	43.40	0.38	47.06	48.09	96.43	0.00	0.07	0.92	0.01
9.0	0.09	2.43	34.55	1.66	38.73	40.01	97.04	0.00	0.06	0.89	0.04
9.5	0.15	2.05	29.35	1.52	33.06	33.29	97.55	0.00	0.06	0.89	0.05
10.0	0.08	1.92	23.33	0.85	26.19	27.69	97.98	0.00	0.07	0.89	0.03
10.5	0.09	2.40	21.95	1.15	25.60	23.04	98.33	0.00	0.09	0.86	0.04
11.0	0.08	1.52	16.82	0.83	19.25	19.17	98.62	0.00	0.08	0.87	0.04
11.5	0.07	1.07	13.42	1.04	15.60	15.95	98.87	0.00	0.07	0.86	0.07
12.0	0.07	0.96	11.10	0.81	12.94	13.27	99.07	0.01	0.07	0.86	0.06
12.5	0.07	0.51	7.73	0.93	9.25	11.04	99.24	0.01	0.06	0.84	0.10
13.0	0.27	0.70	7.15	0.51	8.63	9.18	99.38	0.03	0.08	0.83	0.06
13.5	0.18	0.34	3.85	1.37	5.73	7.64	99.50	0.03	0.06	0.67	0.24
14.0	0.07	0.35	4.52	1.07	6.01	6.35	99.59	0.01	0.06	0.75	0.18
14.5	0.14	0.33	3.40	1.23	5.10	5.29	99.68	0.03	0.06	0.67	0.24
15.0	0.20	0.26	2.53	0.30	3.30	4.40	99.74	0.06	0.08	0.77	0.09
15.5	0.05	0.12	1.32	0.49	1.99	3.66	99.80	0.03	0.06	0.66	0.25
16.0	1.49	0.11	0.81	0.22	2.64	3.04	99.85	0.57	0.04	0.31	0.08
16.5	0.16	0.11	1.08	0.51	1.87	2.53	99.88	0.09	0.06	0.58	0.27
17.0	2.15	0.10	0.77	0.43	3.45	2.11	99.92	0.62	0.03	0.22	0.13
17.5	1.61	0.08	0.53	0.32	2.54	1.75	99.94	0.63	0.03	0.21	0.13
18.0	0.11	0.10	0.68	0.18	1.06	1.46	99.97	0.10	0.09	0.64	0.17
18.5	0.07	0.08	0.76	0.34	1.25	1.21	99.98	0.05	0.07	0.61	0.27
19.0	1.09	0.11	0.79	0.34	2.33	1.01	100.00	0.47	0.05	0.34	0.15

total =>	6527.63	
depth of contam (90% of total) =>	6.00	inches
depth of contam (90% of total) =>	15.24	cm
exponent =>	-0.368	
DRL =>	2.72	inches
DRL =>	6.90	cm



Attachment 2A-3 Gamma Spectrum Analysis Reports for Table C

```
**************************************************************************
*****        G A M M A   S P E C T R U M   A N A L Y S I S          *****
**************************************************************************


Filename: C:\GENIE2K\CAMFILES\00002471.CNF

Report Generated On              : 3/6/2018    5:41:30 AM

Sample Title                     : B101110AFSFC003GD
Sample Description               : U1 CTMT
Sample Identification            : 003
Sample Type                      : GAMMA DIRECT
Sample Geometry                  :

Peak Locate Threshold            :  3.00
Peak Locate Range (in channels)  :    85 -  8192
Peak Area Range (in channels)    :    85 -  8192
Identification Energy Tolerance  :   10.000 keV

Sample Size                      :  2.830E+001 M^2

Sample Taken On                  : 3/3/2018    9:58:00 AM
Acquisition Started              : 3/3/2018    9:51:41 AM

Live Time                        :      600.0 seconds
Real Time                        :      607.1 seconds

Dead Time                        :   1.17 %


              Energy Calibration Used Done On       : 1/13/2015
              Efficiency Calibration Used Done On   : 1/30/2018
              Efficiency ID                         : 3M90D ECP 17 8CM
```

Peak Analysis Report 3/6/2018 5:41:30 AM Page 2

****
***** PEAK ANALYSIS REPORT *****
****

Detector Name: 5452
Sample Title: B101110AFSFC003GD
Peak Analysis Performed on: 3/6/2018 5:41:30 AM
Peak Analysis From Channel: 85
Peak Analysis To Channel: 8192

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	113-	123	117.01	28.84	1.41	3.31E+002	90.09	5.70E+002
2	153-	168	160.88	39.83	1.40	1.90E+003	180.84	2.09E+003
3	176-	189	182.40	45.21	1.03	4.88E+002	139.81	1.60E+003
4	285-	309	301.46	75.02	1.16	3.66E+003	360.86	7.00E+003
5	332-	346	340.68	84.84	1.30	8.67E+002	244.80	4.88E+003
6	401-	408	404.54	100.82	0.33	4.80E+001	135.60	2.26E+003
7	482-	497	488.54	121.85	1.10	3.63E+003	251.70	4.05E+003
8	974-	988	979.80	244.81	1.17	8.27E+002	142.41	1.46E+003
9	1368-	1388	1378.06	344.48	1.38	2.66E+003	161.09	1.05E+003
10	1640-	1650	1645.30	411.35	1.00	1.32E+002	71.27	4.76E+002
11	1772-	1787	1776.89	444.28	0.99	2.91E+002	94.39	6.36E+002
12	2634-	2659	2647.21	662.01	1.49	3.30E+003	155.51	6.46E+002
13	2744-	2765	2755.72	689.16	1.33	1.26E+002	87.80	4.77E+002
14	3103-	3124	3116.14	779.30	1.46	1.12E+003	107.17	4.63E+002
15	3462-	3480	3469.96	867.79	1.61	3.19E+002	81.86	4.01E+002
16	3843-	3870	3856.91	964.55	1.64	1.29E+003	112.31	4.15E+002
17	4012-	4028	4020.27	1005.40	0.72	7.86E+001	61.44	2.76E+002
18	4208-	4219	4213.19	1053.64	0.29	1.03E+001	37.92	1.38E+002
19	4330-	4370	4344.51	1086.47	1.87	1.22E+003	128.85	4.67E+002
20	4435-	4461	4449.38	1112.69	1.84	1.27E+003	105.54	3.45E+002
21	4679-	4708	4694.38	1173.93	1.86	2.42E+003	121.07	2.62E+002
22	4844-	4863	4851.97	1213.33	1.57	1.04E+002	46.11	1.22E+002
23	5092-	5109	5099.79	1275.27	1.08	1.24E+002	40.83	9.01E+001
24	5189-	5209	5197.90	1299.80	1.81	1.41E+002	39.96	7.06E+001
25	5316-	5345	5331.92	1333.29	1.93	2.54E+003	110.54	1.07E+002
26	5618-	5649	5634.09	1408.81	2.22	2.13E+003	100.65	8.20E+001
27	5839-	5855	5845.60	1461.67	1.70	7.39E+001	25.81	2.81E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 2.000 sigma

Interference Corrected Activity Report 3/6/2018 5:41:30 AM Page 3

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: B101110AFSFC003GD
Nuclide Library Used: C:\GENIE2K\CAMFILES\Zion Lib-BNL.NLB

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (pCi/M^2)	Activity Uncertainty
K-40	0.999	1460.82*	10.66	9.10801E+005	3.27679E+005
Co-60	0.999	1173.23*	99.85	2.98078E+006	2.81221E+005
		1332.49*	99.98	3.22906E+006	2.94063E+005
Cs-137	1.000	661.66*	85.10	4.14212E+006	5.34266E+005
Eu-152	1.000	121.78*	28.67	9.42804E+006	1.99795E+006
		344.28*	26.60	8.89693E+006	1.55822E+006
		1408.01*	21.07	1.30846E+007	1.21617E+006
Eu-154	0.682	123.07*	40.40	6.69064E+006	1.42231E+006
		723.30	20.06		
		1274.43*	34.80	4.47286E+005	1.51858E+005
Eu-155	0.984	86.55*	30.70	2.42951E+006	8.40690E+005
		105.31*	21.10	1.80515E+005	5.10944E+005
Pb-212	0.941	238.63*	43.60	1.52409E+006	3.60048E+005

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 10.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000 sigma

Interference Corrected Activity Report 3/6/2018 5:41:30 AM Page 4

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/M^2)	Wt mean Activity Uncertainty
	K-40	0.999	9.108014E+005	3.276790E+005
	Co-60	0.999	3.099378E+006	2.032415E+005
	Cs-137	1.000	4.142119E+006	5.342661E+005
	Eu-152	1.000	1.096653E+007	8.587184E+005
	Eu-154	0.682	4.298333E+005	1.509576E+005
	Eu-155	0.984	7.871652E+005	4.366272E+005
	Pb-212	0.941	1.524094E+006	3.600478E+005
X	Pb-214	0.388		

? = Nuclide is part of an undetermined solution
X = Nuclide rejected by the interference analysis
@ = Nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000 sigma

Interference Corrected Activity Report 3/6/2018 5:41:30 AM Page 5

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 3/6/2018 5:41:30 AM
Peak Locate From Channel: 85
Peak Locate To Channel: 8192

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	28.84	5.5199E-001	27.20		
2	39.83	3.1601E+000	9.54		
3	45.21	8.1404E-001	28.63		
4	75.02	6.1042E+000	9.85		
10	411.35	2.1997E-001	54.00		
11	444.28	4.8498E-001	32.44	D-Esc.	
13	689.16	2.0917E-001	69.96	Sum	
14	779.30	1.8742E+000	9.53	Sum	
15	867.79	5.3100E-001	25.69	Tol.	Nb-94
16	964.55	2.1446E+000	8.73	Tol.	Ac-228
17	1005.40	1.3098E-001	78.18	Sum	
18	1053.64	1.7190E-002	367.69		
19	1086.47	2.0346E+000	10.55		
20	1112.69	2.1221E+000	8.29	Tol.	Bi-214
22	1213.33	1.7342E-001	44.31		
24	1299.80	2.3575E-001	28.25	Sum	

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 2.000 sigma

Nuclide MDA Report 3/6/2018 5:41:30 AM Page 6

****
***** N U C L I D E M D A R E P O R T *****
****

Detector Name: 5452
Sample Geometry:
Sample Title: B101110AFSFC003GD
Nuclide Library Used: C:\GENIE2K\CAMFILES\Zion Lib-BNL.NLB

	Nuclide Name	Energy (keV)	Yield (%)	Line MDA (pCi/M^2)	Nuclide MDA (pCi/M^2)	Activity (pCi/M^2)	Dec. Level (pCi/M^2)
+	K-40	1460.82*	10.66	4.234E+005	4.23E+005	9.108E+005	1.950E+005
+	Co-60	1173.23*	99.85	1.462E+005	9.83E+004	2.981E+006	7.141E+004
		1332.49*	99.98	9.828E+004		3.229E+006	4.742E+004
	Nb-94	702.65	99.81	1.652E+005	1.65E+005	2.038E+005	8.111E+004
		871.09	99.89	1.978E+005		3.914E+005	9.737E+004
	Ag-108m	433.90	90.50	1.945E+005	1.87E+005	6.389E+004	9.585E+004
		614.30	89.80	1.873E+005		5.361E+004	9.206E+004
		722.90	90.80	1.911E+005		1.679E+005	9.391E+004
	Cs-134	604.72	97.62	1.639E+005	1.64E+005	-7.233E+003	8.051E+004
		795.86	85.46	1.875E+005		8.481E+004	9.200E+004
+	Cs-137	661.66*	85.10	2.199E+005	2.20E+005	4.142E+006	1.082E+005
+	Eu-152	121.78*	28.67	9.501E+005	4.24E+005	9.428E+006	4.716E+005
		344.28*	26.60	6.890E+005		8.897E+006	3.400E+005
		1408.01*	21.07	4.242E+005		1.308E+007	2.038E+005
+	Eu-154	123.07*	40.40	6.743E+005	2.13E+005	6.691E+006	3.346E+005
		723.30	20.06	8.684E+005		1.145E+006	4.268E+005
		1274.43*	34.80	2.130E+005		4.473E+005	1.016E+005
+	Eu-155	86.55*	30.70	1.103E+006	8.44E+005	2.430E+006	5.477E+005
		105.31*	21.10	8.441E+005		1.805E+005	4.169E+005
	Tl-208	583.19	85.00	2.014E+005	2.01E+005	-4.661E+004	9.904E+004
	Bi-212	727.33	6.67	2.582E+006	2.58E+006	6.000E+005	1.269E+006
+	Pb-212	238.63*	43.60	4.002E+005	4.00E+005	1.524E+006	1.976E+005
	Bi-214	609.32	45.49	3.548E+005	2.36E+005	5.243E+004	1.743E+005
		1120.29	14.92	9.716E+005		-5.830E+005	4.748E+005
		1764.49	15.30	2.357E+005		1.638E+005	1.053E+005
	Pb-214	295.22	18.42	1.063E+006	5.15E+005	1.186E+005	5.251E+005
		351.93*	35.60	5.149E+005		6.648E+006	2.540E+005
	Ra-226	186.21	3.64	6.373E+006	6.37E+006	-5.905E+005	3.159E+006
	Ac-228	338.32	11.27	1.675E+006	6.07E+005	-2.439E+005	8.268E+005
		911.20	25.80	6.065E+005		3.131E+005	2.972E+005
		968.97	15.80	1.555E+006		2.861E+005	7.673E+005
	Am-241	59.54	35.90	1.136E+006	1.14E+006	6.207E+005	5.631E+005

+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
> = Calculated MDA is zero due to zero counts in the region, or
the region is outside the spectrum, or MDA has not been calculated
@ = Half-life too short to be able to perform the decay correction

```
*************************************************************************
*****       G A M M A   S P E C T R U M   A N A L Y S I S         *****
*************************************************************************

Filename: C:\GENIE2K\CAMFILES\Unit 1 Under Vessel FSS\00002471.CNF

Report Generated On             : 7/24/2018   9:49:43 AM

Sample Title                    : B101110AFSFC003GD
Sample Description              : U1 CTMT
Sample Identification           : 003
Sample Type                     : GAMMA DIRECT
Sample Geometry                 :

Peak Locate Threshold           :  3.00
Peak Locate Range (in channels) :    85 -  8192
Peak Area Range (in channels)   :    85 -  8192
Identification Energy Tolerance :   10.000 keV

Sample Size                     :  2.830E+001 M^2

Sample Taken On                 : 3/3/2018    9:58:00 AM
Acquisition Started             : 3/3/2018    9:51:41 AM

Live Time                       :      600.0 seconds
Real Time                       :      607.1 seconds

Dead Time                       :   1.17 %

              Energy Calibration Used Done On       : 1/13/2015
              Efficiency Calibration Used Done On   : 7/24/2018
              Efficiency ID                         : NEW_0.1524-0.069
```

Peak Analysis Report 7/24/2018 9:49:43 AM Page 2

****
***** P E A K A N A L Y S I S R E P O R T *****
****

Detector Name: 5452
Sample Title: B101110AFSFC003GD
Peak Analysis Performed on: 7/24/2018 9:49:42 AM
Peak Analysis From Channel: 85
Peak Analysis To Channel: 8192

Peak No.	ROI start	ROI end	Peak centroid	Energy (keV)	FWHM (keV)	Net Peak Area	Net Area Uncert.	Continuum Counts
1	113-	123	117.01	28.84	1.41	3.31E+002	90.09	5.70E+002
2	153-	168	160.88	39.83	1.40	1.90E+003	180.84	2.09E+003
3	176-	189	182.40	45.21	1.03	4.88E+002	139.81	1.60E+003
4	285-	309	301.46	75.02	1.16	3.66E+003	360.86	7.00E+003
5	332-	346	340.68	84.84	1.30	8.67E+002	244.80	4.88E+003
6	401-	408	404.54	100.82	0.33	4.80E+001	135.60	2.26E+003
7	482-	497	488.54	121.85	1.10	3.63E+003	251.70	4.05E+003
8	974-	988	979.80	244.81	1.17	8.27E+002	142.41	1.46E+003
9	1368-	1388	1378.06	344.48	1.38	2.66E+003	161.09	1.05E+003
10	1640-	1650	1645.30	411.35	1.00	1.32E+002	71.27	4.76E+002
11	1772-	1787	1776.89	444.28	0.99	2.91E+002	94.39	6.36E+002
12	2634-	2659	2647.21	662.01	1.49	3.30E+003	155.51	6.46E+002
13	2744-	2765	2755.72	689.16	1.33	1.26E+002	87.80	4.77E+002
14	3103-	3124	3116.14	779.30	1.46	1.12E+003	107.17	4.63E+002
15	3462-	3480	3469.96	867.79	1.61	3.19E+002	81.86	4.01E+002
16	3843-	3870	3856.91	964.55	1.64	1.29E+003	112.31	4.15E+002
17	4012-	4028	4020.27	1005.40	0.72	7.86E+001	61.44	2.76E+002
18	4208-	4219	4213.19	1053.64	0.29	1.03E+001	37.92	1.38E+002
19	4330-	4370	4344.51	1086.47	1.87	1.22E+003	128.85	4.67E+002
20	4435-	4461	4449.38	1112.69	1.84	1.27E+003	105.54	3.45E+002
21	4679-	4708	4694.38	1173.93	1.86	2.42E+003	121.07	2.62E+002
22	4844-	4863	4851.97	1213.33	1.57	1.04E+002	46.11	1.22E+002
23	5092-	5109	5099.79	1275.27	1.08	1.24E+002	40.83	9.01E+001
24	5189-	5209	5197.90	1299.80	1.81	1.41E+002	39.96	7.06E+001
25	5316-	5345	5331.92	1333.29	1.93	2.54E+003	110.54	1.07E+002
26	5618-	5649	5634.09	1408.81	2.22	2.13E+003	100.65	8.20E+001
27	5839-	5855	5845.60	1461.67	1.70	7.39E+001	25.81	2.81E+001

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 2.000 sigma

Interference Corrected Activity Report 7/24/2018 9:49:43 AM Page 3

****
***** N U C L I D E I D E N T I F I C A T I O N R E P O R T *****
****

Sample Title: B101110AFSFC003GD
Nuclide Library Used: C:\GENIE2K\CAMFILES\Zion Lib-BNL.NLB

..... IDENTIFIED NUCLIDES .....

Nuclide Name	Id Confidence	Energy (keV)	Yield (%)	Activity (pCi/M^2)	Activity Uncertainty
K-40	0.999	1460.82*	10.66	8.27796E+005	2.97816E+005
Co-60	0.999	1173.23*	99.85	2.69231E+006	2.54005E+005
		1332.49*	99.98	2.92711E+006	2.66565E+005
Cs-137	1.000	661.66*	85.10	3.68452E+006	4.75243E+005
Eu-152	1.000	121.78*	28.67	8.10771E+006	1.71815E+006
		344.28*	26.60	7.80037E+006	1.36617E+006
		1408.01*	21.07	1.18796E+007	1.10418E+006
Eu-154	0.684	123.07*	40.40	5.75366E+006	1.22312E+006
		723.30	20.06		
		1274.43*	34.80	4.04949E+005	1.37484E+005
Eu-155	0.984	86.55*	30.70	2.06966E+006	7.16171E+005
		105.31*	21.10	1.54502E+005	4.37313E+005
Pb-212	0.941	238.63*	43.60	1.32764E+006	3.13638E+005

* = Energy line found in the spectrum.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 10.000 keV
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000 sigma

Interference Corrected Activity Report 7/24/2018 9:49:43 AM Page 4

****
***** I N T E R F E R E N C E C O R R E C T E D R E P O R T *****
****

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/M^2)	Wt mean Activity Uncertainty
	K-40	0.999	8.277965E+005	2.978163E+005
	Co-60	0.999	2.804044E+006	1.838885E+005
	Cs-137	1.000	3.684518E+006	4.752430E+005
	Eu-152	1.000	9.697404E+006	7.631186E+005
	Eu-154	0.684	3.857041E+005	1.366111E+005
	Eu-155	0.984	6.746514E+005	3.732316E+005
	Pb-212	0.941	1.327639E+006	3.136378E+005
X	Pb-214	0.388		

? = Nuclide is part of an undetermined solution
X = Nuclide rejected by the interference analysis
@ = Nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000 sigma

Interference Corrected Activity Report 7/24/2018 9:49:43 AM Page 5

********** U N I D E N T I F I E D P E A K S **********

Peak Locate Performed on: 7/24/2018 9:49:42 AM
Peak Locate From Channel: 85
Peak Locate To Channel: 8192

Peak No.	Energy (keV)	Peak Size in Counts per Second	Peak CPS % Uncertainty	Peak Type	Tol. Nuclide
1	28.84	5.5199E-001	27.20		
2	39.83	3.1601E+000	9.54		
3	45.21	8.1404E-001	28.63		
4	75.02	6.1042E+000	9.85		
10	411.35	2.1997E-001	54.00		
11	444.28	4.8498E-001	32.44	D-Esc.	
13	689.16	2.0917E-001	69.96	Sum	
14	779.30	1.8742E+000	9.53	Sum	
15	867.79	5.3100E-001	25.69	Tol.	Nb-94
16	964.55	2.1446E+000	8.73	Tol.	Ac-228
17	1005.40	1.3098E-001	78.18	Sum	
18	1053.64	1.7190E-002	367.69		
19	1086.47	2.0346E+000	10.55		
20	1112.69	2.1221E+000	8.29	Tol.	Bi-214
22	1213.33	1.7342E-001	44.31		
24	1299.80	2.3575E-001	28.25	Sum	

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet

Errors quoted at 2.000 sigma

Nuclide MDA Report 7/24/2018 9:49:43 AM Page 6

****
***** N U C L I D E M D A R E P O R T *****
****

Detector Name: 5452
Sample Geometry:
Sample Title: B101110AFSFC003GD
Nuclide Library Used: C:\GENIE2K\CAMFILES\Zion Lib-BNL.NLB

	Nuclide Name	Energy (keV)	Yield (%)	Line MDA (pCi/M^2)	Nuclide MDA (pCi/M^2)	Activity (pCi/M^2)	Dec. Level (pCi/M^2)
+	K-40	1460.82*	10.66	3.848E+005	3.85E+005	8.278E+005	1.773E+005
+	Co-60	1173.23*	99.85	1.320E+005	8.91E+004	2.692E+006	6.450E+004
		1332.49*	99.98	8.909E+004		2.927E+006	4.299E+004
	Nb-94	702.65	99.81	1.471E+005	1.47E+005	1.816E+005	7.226E+004
		871.09	99.89	1.772E+005		3.507E+005	8.723E+004
	Ag-108m	433.90	90.50	1.714E+005	1.66E+005	5.629E+004	8.445E+004
		614.30	89.80	1.663E+005		4.760E+004	8.174E+004
		722.90	90.80	1.704E+005		1.497E+005	8.373E+004
	Cs-134	604.72	97.62	1.455E+005	1.45E+005	-6.420E+003	7.146E+004
		795.86	85.46	1.676E+005		7.580E+004	8.223E+004
+	Cs-137	661.66*	85.10	1.956E+005	1.96E+005	3.685E+006	9.629E+004
+	Eu-152	121.78*	28.67	8.171E+005	3.85E+005	8.108E+006	4.055E+005
		344.28*	26.60	6.041E+005		7.800E+006	2.981E+005
		1408.01*	21.07	3.852E+005		1.188E+007	1.850E+005
+	Eu-154	123.07*	40.40	5.798E+005	1.93E+005	5.754E+006	2.878E+005
		723.30	20.06	7.742E+005		1.021E+006	3.806E+005
		1274.43*	34.80	1.928E+005		4.049E+005	9.200E+004
+	Eu-155	86.55*	30.70	9.396E+005	7.22E+005	2.070E+006	4.666E+005
		105.31*	21.10	7.224E+005		1.545E+005	3.569E+005
	Tl-208	583.19	85.00	1.786E+005	1.79E+005	-4.133E+004	8.783E+004
	Bi-212	727.33	6.67	2.302E+006	2.30E+006	5.350E+005	1.131E+006
+	Pb-212	238.63*	43.60	3.486E+005	3.49E+005	1.328E+006	1.721E+005
	Bi-214	609.32	45.49	3.149E+005	2.15E+005	4.654E+004	1.547E+005
		1120.29	14.92	8.764E+005		-5.259E+005	4.283E+005
		1764.49	15.30	2.153E+005		1.497E+005	9.624E+004
	Pb-214	295.22	18.42	9.291E+005	4.51E+005	1.036E+005	4.591E+005
		351.93*	35.60	4.514E+005		5.828E+006	2.227E+005
	Ra-226	186.21	3.64	5.525E+006	5.52E+006	-5.119E+005	2.738E+006
	Ac-228	338.32	11.27	1.468E+006	5.44E+005	-2.138E+005	7.247E+005
		911.20	25.80	5.440E+005		2.808E+005	2.666E+005
		968.97	15.80	1.397E+006		2.570E+005	6.893E+005
	Am-241	59.54	35.90	9.551E+005	9.55E+005	5.221E+005	4.736E+005

+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
> = Calculated MDA is zero due to zero counts in the region, or
the region is outside the spectrum, or MDA has not been calculated
@ = Half-life too short to be able to perform the decay correction

Attachment 2A-4 Under Vessel Sum Of Fractions for Current and Activity Derived Geometry for Table D

SYSTEMATIC ISOCS MEASUREMENTS

FSS Unit B1-02110B-F **Description** Unit 2 Containment Under Vessel **Classification** 1

Type Structural Surface Area 294 m^2

Sample ID	Location ID# (Grid No.)	FOV (m^2)	ROC	Measured Activity (pCi/m^2)	Ratio	Inferred Activity (pCi/m^2)	Activity per ROC (pCi/m^2)	Operational DCGL (pCi/m^2)	Fraction of OpDCGL	OpSOF
B1-01110AF-SFC-003-GD	003	28	H-3		1.76	7.29E+06	7.29E+06	2.37E+08	3.08E-02	0.597
			Co-60	3.10E+06			3.10E+06	1.56E+08	1.99E-02	
			Ni-63		442	1.37E+09	1.37E+09	4.00E+09	3.42E-01	
Original Geometry			Sr-90		0.021	8.70E+04	8.70E+04	1.42E+06	6.13E-02	
3M90D 17.8cm 8.6cm			Cs-134	1.64E+05			1.64E+05	2.99E+07	5.48E-03	
			Cs-137	4.14E+06			4.14E+06	3.92E+07	1.06E-01	
			Eu-152	1.10E+07			1.10E+07	3.64E+08	3.01E-02	
			Eu-154	4.30E+05			4.30E+05	3.17E+08	1.36E-03	
B1-01110AF-SFC-003-GD	003	28	H-3		1.76	6.48E+06	6.48E+06	2.37E+08	2.74E-02	0.536
			Co-60	2.80E+06			2.80E+06	1.56E+08	1.80E-02	
			Ni-63		442	1.24E+09	1.24E+09	4.00E+09	3.10E-01	
			Sr-90		0.021	7.74E+04	7.74E+04	1.42E+06	5.45E-02	
3M90D 15.24cm 6.9cm			Cs-134	1.45E+05			1.45E+05	2.99E+07	4.85E-03	
			Cs-137	3.68E+06			3.68E+06	3.92E+07	9.40E-02	
			Eu-152	9.70E+06			9.70E+06	3.64E+08	2.66E-02	
			Eu-154	3.86E+05			3.86E+05	3.17E+08	1.22E-03	

Attachment 2A-5 Under Vessel (Incore) Geometries (3M90D_ECP_17.8.geo)

Geometry Composer Report

CANBERRA

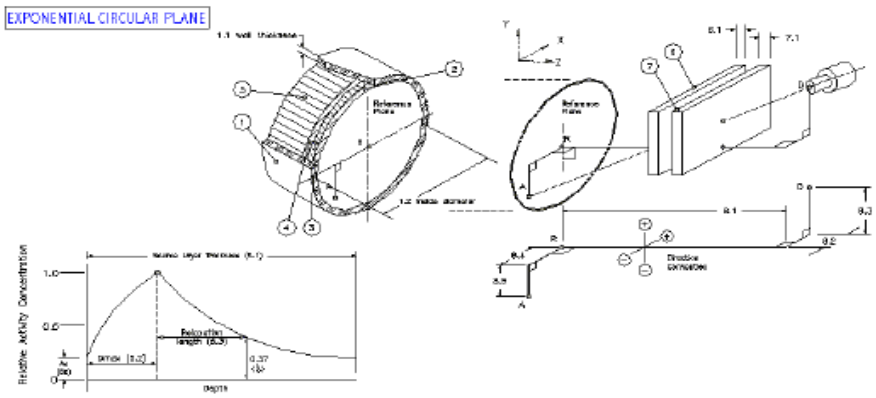
Date: Friday, July 27, 2018 - 08:42:28
Description: 3M90D_ECP_17_8cm
Comment: 3M90D_ECP_17_8cm
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\54...\3M90D_ECP_17.8cm.geo
Software: ISOCS
Template: EXPONENT_CIRCULAR_PLANE, Version: (default)
Detector: 5452
Collimator: 50mm-90d new (newISOCS 50mm side 90deg collimation [large hole collimator])
Environment: Temperature = 22 °C, Pressure = 760 mm Hg, Relative Humidity = 30%
Integration: Convergence = 1.00%, MDRPN = 2^4 (16), CRPN = 2^4 (16)

Dimensions (m)

No.	Description	d.1	d.2	d.3	d.4	d.5	d.6	Material	Density	Ao
1	Side Walls	0	6					none		
2	Layer 1	0						none		
3	Layer 2	0						none		
4	Layer 3	0						none		
5	Source Layer	0.178	0	0.086				concrete	2.3	0.90
6	Absorber1									
7	Absorber2									
8	Source-Detector	3	0	0	0	0				

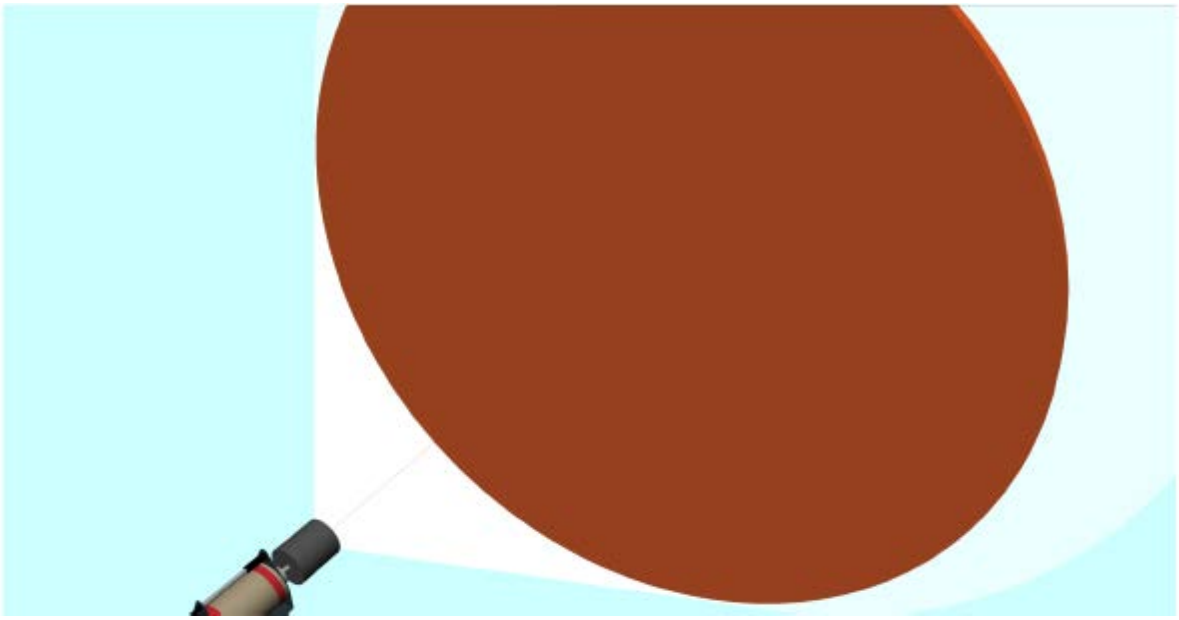
List of energies for efficiency curve generation

59.5	63.3	88.0	122.1	143.8	165.9	185.7	238.6
351.9	391.7	583.2	661.7	898.0	911.6	1001.0	1173.2
1332.5	1460.7	1764.5	1836.1				



Geometry Composer Report

Date: Friday, July 27, 2018 - 08:42:28
Description: 3M90D_ECP_17_8cm
Comment: 3M90D_ECP_17_8cm
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\545...\3M90D_ECP_17.8cm.geo
Software: ISOCS
Template: EXPONENT_CIRCULAR_PLANE, Version: (default)



ISOCS/LABSOCS RESULTS

ISOCS/LabSOCS File: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\5
ISOCS/LabSOCS Time: 01/30/18 14:48:28
Template: EXPONENT_CIRCULAR_PLANE
Geom Description: 3M90D_ECP_17_8CM
Comment: ISOCS:3M90D_ECP_17_8CM
Detector: 5452
Collimator: 50MM-90D_NEW
Convergence: 1.00 %
Area [Sq Meters]: 2.8274e+001 (C)
Mass [Grams]: 1.1827e+007 (C)
Length [Meters]: not used
(C) = Value calculated by ISOCS
(U) = Value modified by user

Energy	Efficiency	%Uncertainty	%Convergence	Final # of Voxels
59.50	1.27389e-006	10.0	0.195330	8090
63.30	1.39016e-006	10.0	0.200602	8090
88.00	1.91734e-006	10.0	0.052475	4070
122.10	2.14107e-006	10.0	0.044677	4070
143.80	2.17245e-006	10.0	-0.746682	2030
165.90	2.16351e-006	9.0	-0.661668	2030
185.70	2.13794e-006	8.0	-0.592641	2030
238.60	1.99500e-006	8.0	-0.069951	4070
351.90	1.77935e-006	8.0	-0.115858	4070
391.70	1.72282e-006	8.0	-0.119434	4070
583.20	1.54074e-006	6.0	-0.110376	4070
661.65	1.48980e-006	6.0	-0.091667	4070
898.00	1.38848e-006	5.0	-0.056246	4070
911.60	1.37997e-006	4.0	-0.050998	4070
1001.00	1.34716e-006	4.0	-0.038665	4070
1173.20	1.29499e-006	4.0	-0.023263	4070
1332.50	1.25272e-006	4.0	-0.034567	4070
1460.70	1.21225e-006	4.0	-0.019058	4070
1764.50	1.12567e-006	4.0	-0.003396	4070
1836.10	1.10912e-006	4.0	-0.003468	4070

Geometry Composer Report

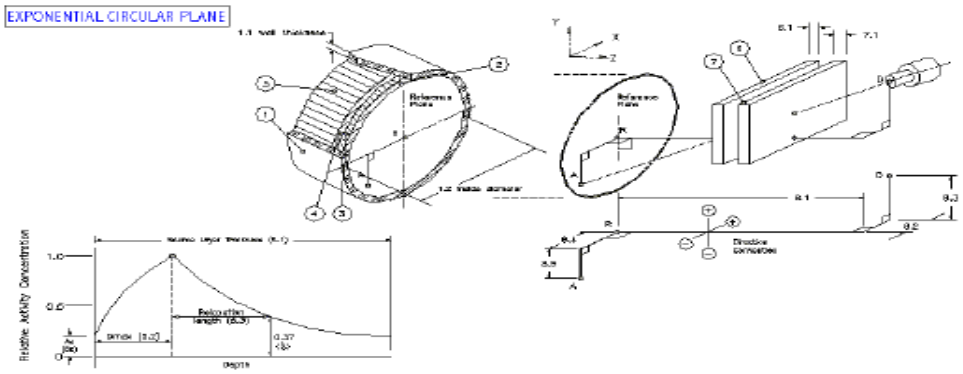
Date: Friday, July 27, 2018 - 09:06:07
Description: 2M90D_ECP_17_8cm
Comment: 2M90D_ECP_17_8cm
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\54...\2M90D_ECP_17.8cm.geo
Software: ISOCS
Template: EXPONENT_CIRCULAR_PLANE, Version: (default)
Detector: 5452
Collimator: 50mm-90d new (newISOCS 50mm side 90deg collimation [large hole collimator])
Environment: Temperature = 22 °C, Pressure = 760 mm Hg, Relative Humidity = 30%
Integration: Convergence = 1.00%, MDRPN = 2^4 (16), CRPN = 2^4 (16)

Dimensions (m)

No.	Description	d.1	d.2	d.3	d.4	d.5	d.6	Material	Density	Ao
1	Side Walls	0	4					none		
2	Layer 1	0						none		
3	Layer 2	0						none		
4	Layer 3	0						none		
5	Source Layer	0.178	0	0.086				concrete	2.3	0.90
6	Absorber1									
7	Absorber2									
8	Source-Detector	2	0	0	0	0				

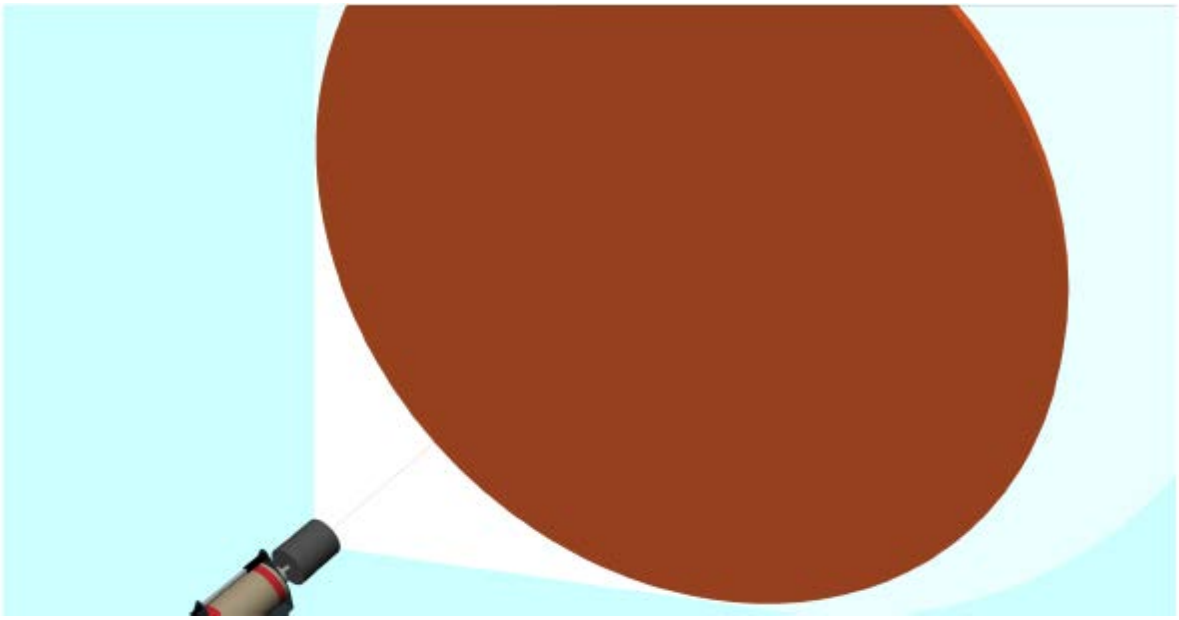
List of energies for efficiency curve generation

59.5	63.3	88.0	122.1	143.8	165.9	185.7	238.6
351.9	391.7	583.2	661.7	898.0	911.6	1001.0	1173.2
1332.5	1460.7	1764.5	1836.1				



Geometry Composer Report

Date: Friday, July 27, 2018 - 08:42:28
Description: 3M90D_ECP_17_8cm
Comment: 3M90D_ECP_17_8cm
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\545...\3M90D_ECP_17.8cm.geo
Software: ISOCS
Template: EXPONENT_CIRCULAR_PLANE, Version: (default)



Geometry Composer Report

CANBERRA

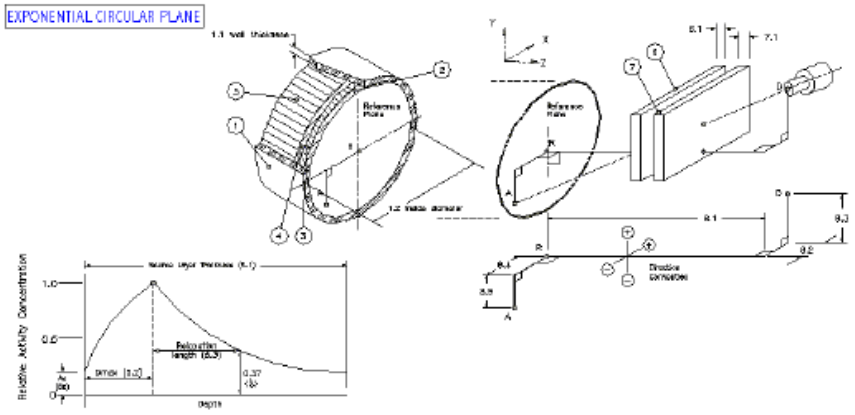
Date: Friday, July 27, 2018 - 09:20:55
Description: 1.5M90D_ECP_17_8cm
Comment: 1.5M90D_ECP_17_8cm
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\...\1.5M90D_ECP_17.8cm.geo
Software: ISOCS
Template: EXPONENT_CIRCULAR_PLANE, Version: (default)
Detector: 5452
Collimator: 50mm-90d new (newISOCS 50mm side 90deg collimation [large hole collimator])
Environment: Temperature = 22 °C, Pressure = 760 mm Hg, Relative Humidity = 30%
Integration: Convergence = 1.00%, MDRPN = 2^4 (16), CRPN = 2^4 (16)

Dimensions (m)

No.	Description	d.1	d.2	d.3	d.4	d.5	d.6	Material	Density	Ao
1	Side Walls	0	3					none		
2	Layer 1	0						none		
3	Layer 2	0						none		
4	Layer 3	0						none		
5	Source Layer	0.178	0	0.086				concrete	2.3	0.90
6	Absorber1									
7	Absorber2									
8	Source-Detector	1.5	0	0	0	0				

List of energies for efficiency curve generation

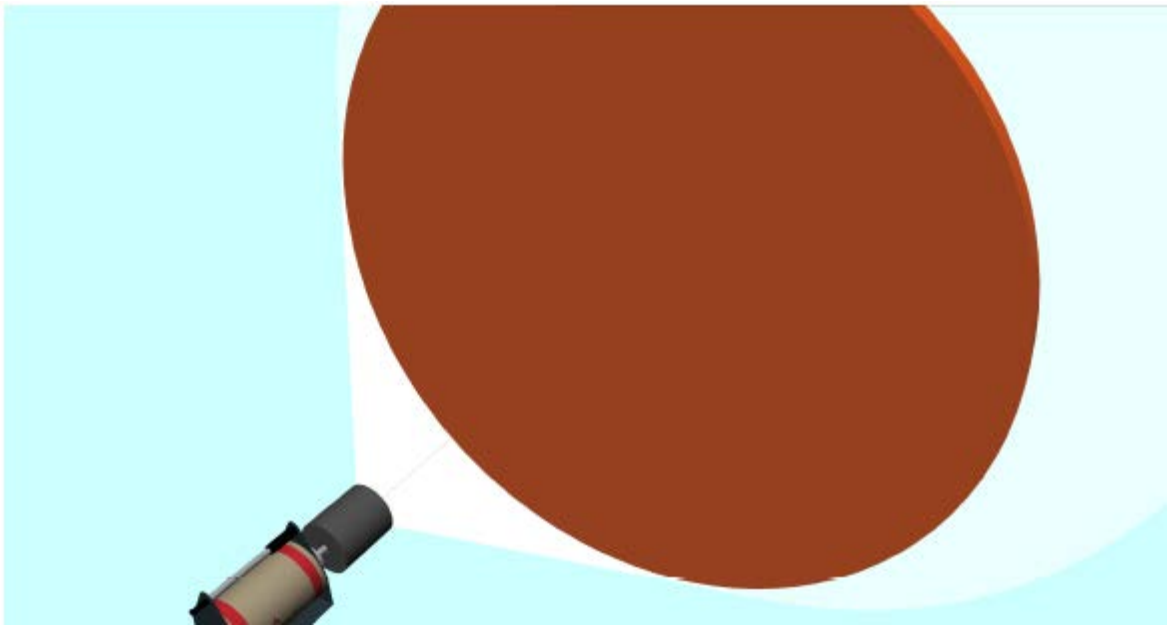
59.5	63.3	88.0	122.1	143.8	165.9	185.7	238.6
351.9	391.7	583.2	661.7	898.0	911.6	1001.0	1173.2
1332.5	1460.7	1764.5	1836.1				



Geometry Composer Report

CANBERRA

Date: Friday, July 27, 2018 - 09:06:07
Description: 2M90D_ECP_17_8cm
Comment: 2M90D_ECP_17_8cm
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\545...\2M90D_ECP_17.8cm.geo
Software: ISOCS
Template: EXPONENT_CIRCULAR_PLANE, Version: (default)



ISOCS/LABSOCS RESULTS

ISOCS/LabSOCS File: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\5
ISOCS/LabSOCS Time: 07/27/18 09:14:28
Template: EXPONENT_CIRCULAR_PLANE
Geom Description: 2M90D_ECP_17_8CM
Comment: ISOCS:2M90D_ECP_17_8CM
Detector: 5452
Collimator: 50MM-90D_NEW
Convergence: 1.00 %
Area [Sq Meters]: 1.2566e+001 (C)
Mass [Grams]: 5.2565e+006 (C)
Length [Meters]: not used
(C) = Value calculated by ISOCS
(U) = Value modified by user

Energy	Efficiency	%Uncertainty	%Convergence	Final # of Voxels
59.50	2.89809e-006	10.0	-0.617485	16180
63.30	3.15899e-006	10.0	-0.596057	16180
88.00	4.38827e-006	10.0	-0.167010	8090
122.10	4.88306e-006	10.0	-0.077938	8090
143.80	4.95116e-006	10.0	-0.036015	8090
165.90	4.93259e-006	9.0	0.307208	4070
185.70	4.86749e-006	8.0	0.244466	4070
238.60	4.55026e-006	8.0	0.120370	4070
351.90	4.05107e-006	8.0	-0.042667	4070
391.70	3.92087e-006	8.0	-0.079511	4070
583.20	3.50097e-006	6.0	-0.271467	2030
661.65	3.38375e-006	6.0	-0.246820	2030
898.00	3.14496e-006	5.0	-0.189395	2030
911.60	3.12590e-006	4.0	-0.183155	2030
1001.00	3.05166e-006	4.0	-0.204463	2030
1173.20	2.93138e-006	4.0	-0.186155	2030
1332.50	2.82645e-006	4.0	-0.167393	2030
1460.70	2.73828e-006	4.0	-0.157439	2030
1764.50	2.54157e-006	4.0	-0.127135	2030
1836.10	2.50467e-006	4.0	-0.125885	2030

Geometry Composer Report

CANBERRA

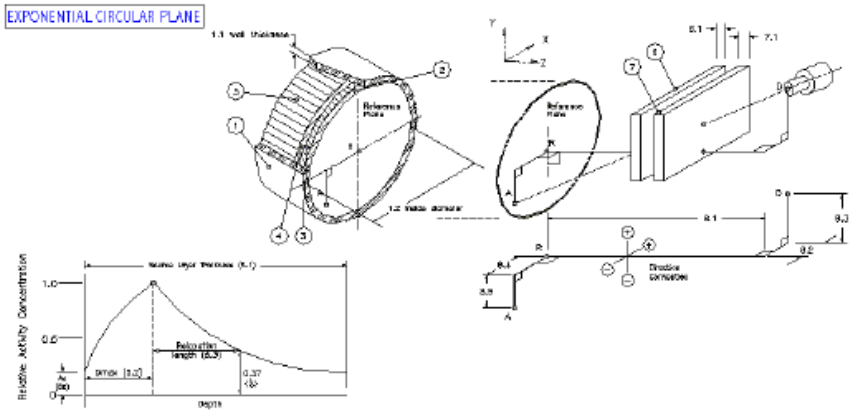
Date: Friday, July 27, 2018 - 09:20:55
Description: 1.5M90D_ECP_17_8cm
Comment: 1.5M90D_ECP_17_8cm
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\...\1.5M90D_ECP_17.8cm.geo
Software: ISOCS
Template: EXPONENT_CIRCULAR_PLANE, Version: (default)
Detector: 5452
Collimator: 50mm-90d new (newISOCS 50mm side 90deg collimation [large hole collimator])
Environment: Temperature = 22 °C, Pressure = 760 mm Hg, Relative Humidity = 30%
Integration: Convergence = 1.00%, MDRPN = 2^4 (16), CRPN = 2^4 (16)

Dimensions (m)

No.	Description	d.1	d.2	d.3	d.4	d.5	d.6	Material	Density	Ao
1	Side Walls	0	3					none		
2	Layer 1	0						none		
3	Layer 2	0						none		
4	Layer 3	0						none		
5	Source Layer	0.178	0	0.086				concrete	2.3	0.90
6	Absorber1									
7	Absorber2									
8	Source-Detector	1.5	0	0	0	0				

List of energies for efficiency curve generation

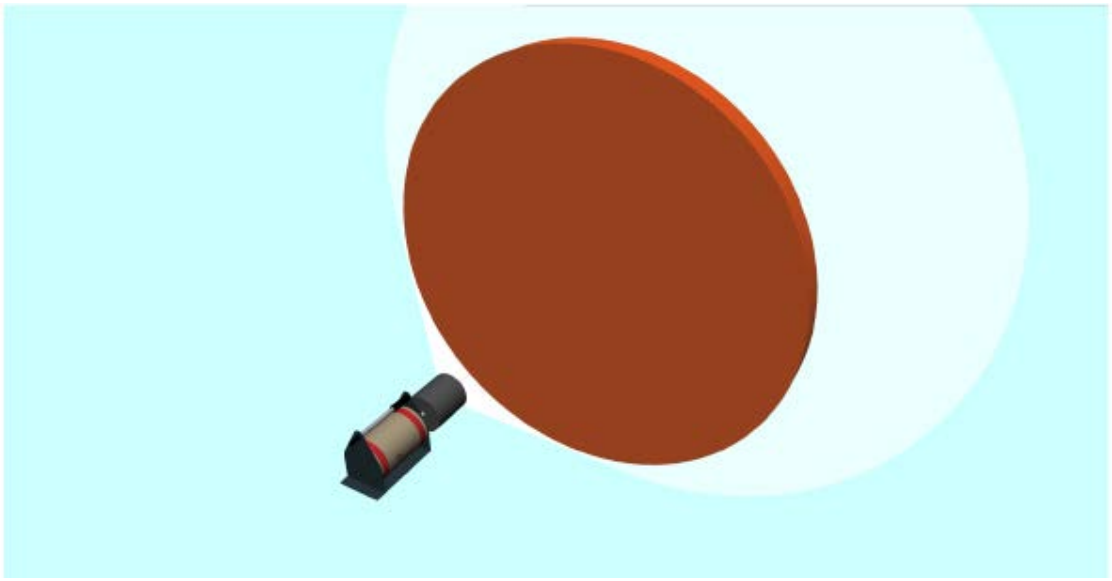
59.5	63.3	88.0	122.1	143.8	165.9	185.7	238.6
351.9	391.7	583.2	661.7	898.0	911.6	1001.0	1173.2
1332.5	1460.7	1764.5	1836.1				



Geometry Composer Report

CANBERRA

Date: Friday, July 27, 2018 - 09:20:55
Description: 1.5M90D_ECP_17_8cm
Comment: 1.5M90D_ECP_17_8cm
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\54...\1.5M90D_ECP_17.8cm.geo
Software: ISOCS
Template: EXPONENT_CIRCULAR_PLANE, Version: (default)



ISOCS/LabSOCS File: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\!
ISOCS/LabSOCS Time: 03/25/18 13:17:54
Template: EXPONENT_CIRCULAR_PLANE
Geom Description: 1.5M90D_ECP_17_8
Comment: ISOCS:1.5M90D_ECP_17_8CM
Detector: 5452
Collimator: 50MM-90D_NEW
Convergence: 1.00 %
Area [Sq Meters]: 7.0686e+000 (C)
Mass [Grams]: 2.9568e+006 (C)
Length [Meters]: not used
(C) = Value calculated by ISOCS
(U) = Value modified by user

Energy	Efficiency	%Uncertainty	%Convergence	Final # of Voxels
59.50	5.24189e-006	10.0	-0.543297	16180
63.30	5.71747e-006	10.0	-0.519762	16180
88.00	7.89563e-006	10.0	-0.147246	8090
122.10	8.76543e-006	10.0	-0.083242	8090
143.80	8.88962e-006	10.0	-0.015057	8090
165.90	8.84326e-006	9.0	0.047228	8090
185.70	8.74219e-006	8.0	0.102593	8090
238.60	8.12964e-006	8.0	-0.032260	4070
351.90	7.22642e-006	8.0	-0.638444	2030
391.70	6.99067e-006	8.0	-0.590908	2030
583.20	6.22457e-006	6.0	-0.391584	2030
661.65	6.02709e-006	6.0	-0.349792	2030
898.00	5.58922e-006	5.0	-0.241044	2030
911.60	5.55538e-006	4.0	-0.243270	2030
1001.00	5.42266e-006	4.0	-0.234460	2030
1173.20	5.20328e-006	4.0	-0.217996	2030
1332.50	5.01704e-006	4.0	-0.204570	2030
1460.70	4.85711e-006	4.0	-0.189140	2030
1764.50	4.50949e-006	4.0	-0.167184	2030
1836.10	4.44189e-006	4.0	-0.164327	2030

Geometry Composer Report

CANBERRA

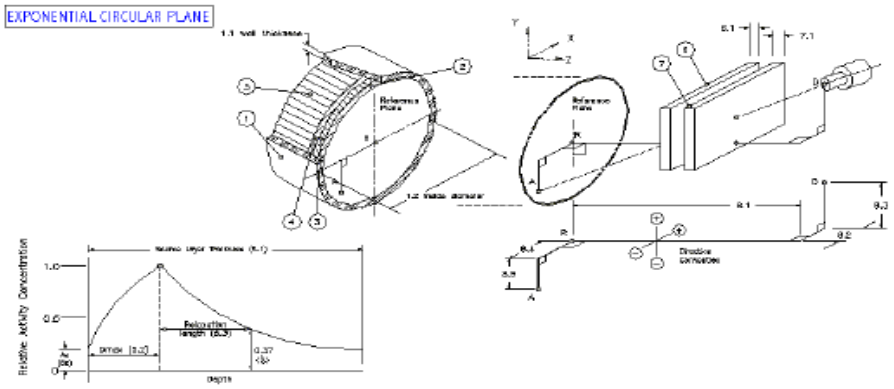
Date: Friday, July 27, 2018 - 09:39:04
Description: 1M90D_ECP_17_8cm
Comment: 1M90D_ECP_17_8cm
File Name: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\54...\1M90D_ECP_17.8cm.geo
Software: ISOCS
Template: EXPONENT_CIRCULAR_PLANE, Version: (default)
Detector: 5452
Collimator: 50mm-90d new (newISOCS 50mm side 90deg collimation [large hole collimator])
Environment: Temperature = 22 °C, Pressure = 760 mm Hg, Relative Humidity = 30%
Integration: Convergence = 1.00%, MDRPN = 2^4 (16), CRPN = 2^4 (16)

Dimensions (m)

No.	Description	d.1	d.2	d.3	d.4	d.5	d.6	Material	Density	Ao
1	Side Walls	0	2					none		
2	Layer 1	0						none		
3	Layer 2	0						none		
4	Layer 3	0						none		
5	Source Layer	0.178	0	0.086				concrete	2.3	0.90
6	Absorber1									
7	Absorber2									
8	Source-Detector	1	0	0	0	0				

List of energies for efficiency curve generation

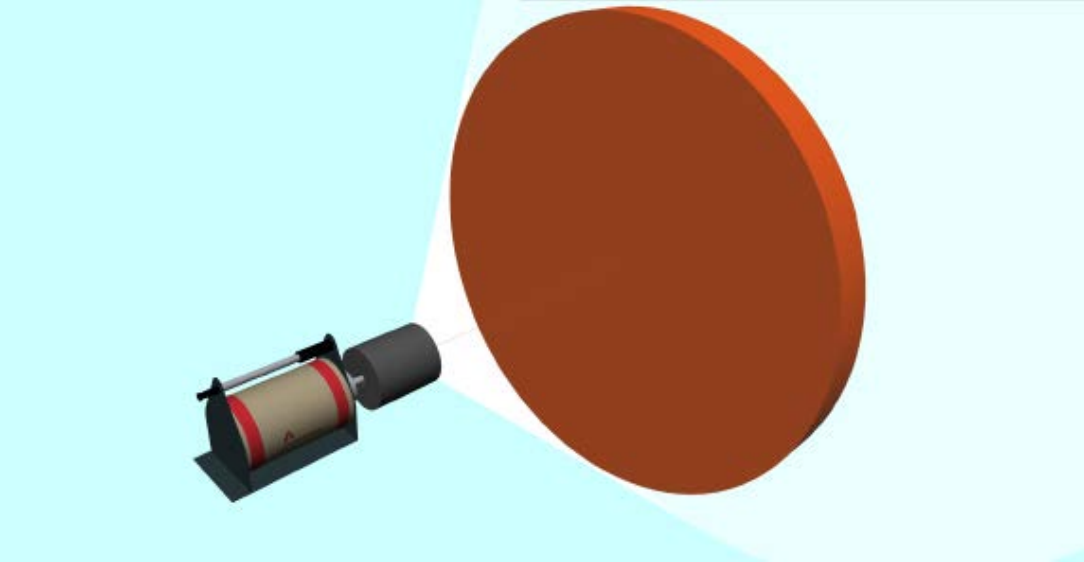
59.5	63.3	88.0	122.1	143.8	165.9	185.7	238.6
351.9	391.7	583.2	661.7	898.0	911.6	1001.0	1173.2
1332.5	1460.7	1764.5	1836.1				



Geometry Composer Report

CANBERRA

Date:	Friday, July 27, 2018 - 09:39:04
Description:	1M90D_ECP_17_8cm
Comment:	1M90D_ECP_17_8cm
File Name:	C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\545...\1M90D_ECP_17.8cm.geo
Software:	ISOCS
Template:	EXPONENT_CIRCULAR_PLANE, Version: (default)



ISOCS/LABSOCS RESULTS

ISOCS/LabSOCS File: C:\GENIE2K\isocs\data\GEOMETRY\In-Situ\EXPONENT_CIRCULAR_PLANE\!
ISOCS/LabSOCS Time: 02/14/18 11:48:00
Template: EXPONENT_CIRCULAR_PLANE
Geom Description: 1M90D_ECP_17_8CM
Comment: ISOCS:1M90D_ECP_17_8CM
Detector: 5452
Collimator: 50MM-90D_NEW
Convergence: 1.00 %
Area [Sq Meters]: 3.1416e+000 (C)
Mass [Grams]: 1.3141e+006 (C)
Length [Meters]: not used
(C) = Value calculated by ISOCS
(U) = Value modified by user

Energy	Efficiency	%Uncertainty	%Convergence	Final # of Voxels
59.50	1.18506e-005	10.0	-0.544806	16180
63.30	1.29845e-005	10.0	0.361323	8090
88.00	1.78201e-005	10.0	0.306638	8090
122.10	1.96787e-005	10.0	-0.390844	4070
143.80	1.99264e-005	10.0	-0.347873	4070
165.90	1.98799e-005	9.0	-0.515414	2030
185.70	1.96121e-005	8.0	-0.451438	2030
238.60	1.82692e-005	8.0	-0.308015	2030
351.90	1.62174e-005	8.0	-0.078730	2030
391.70	1.56817e-005	8.0	-0.007215	2030
583.20	1.39668e-005	6.0	0.206628	2030
661.65	1.34953e-005	6.0	0.258943	2030
898.00	1.25070e-005	5.0	0.335992	2030
911.60	1.24266e-005	4.0	0.325674	2030
1001.00	1.21258e-005	4.0	0.338733	2030
1173.20	1.16318e-005	4.0	0.334556	2030
1332.50	1.11913e-005	4.0	0.338439	2030
1460.70	1.08357e-005	4.0	0.334128	2030
1764.50	1.00321e-005	4.0	0.331514	2030
1836.10	9.88024e-006	4.0	0.333074	2030

Attachment 2A-6 Under Vessel Geometries (Zion Unit 2 Incore Tunnel Sump)

Geometry Composer Report

CANBERRA

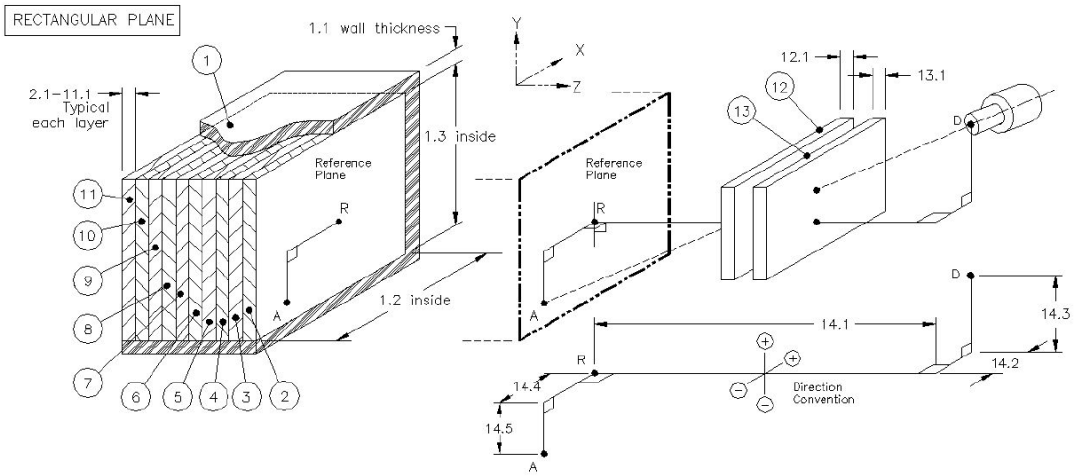
Date: Tuesday, April 10, 2018 - 12:48:23
Description: Zion Unit 1 Incore Tunnel sump
Comment: 2 ft x 2 ft by 14 in deep
File Name: C:\GENIE2K\isocs\5456 isocs\data\GEOMETRY\In-Situ\RECTANGULA...\Zion U1 Incore Tunnel sump.geo
Software: ISOCS
Template: RECTANGULAR_PLANE, Version: (default)
Detector: 5456
Collimator: 50mm-180d new (newISOCS 50mm side 180deg collimation [no collimator])
Environment: Temperature = 22 °C, Pressure = 760 mm Hg, Relative Humidity = 30%
Integration: Convergence = 1.00%, MDRPN = 2^4 (16), CRPN = 2^4 (16)

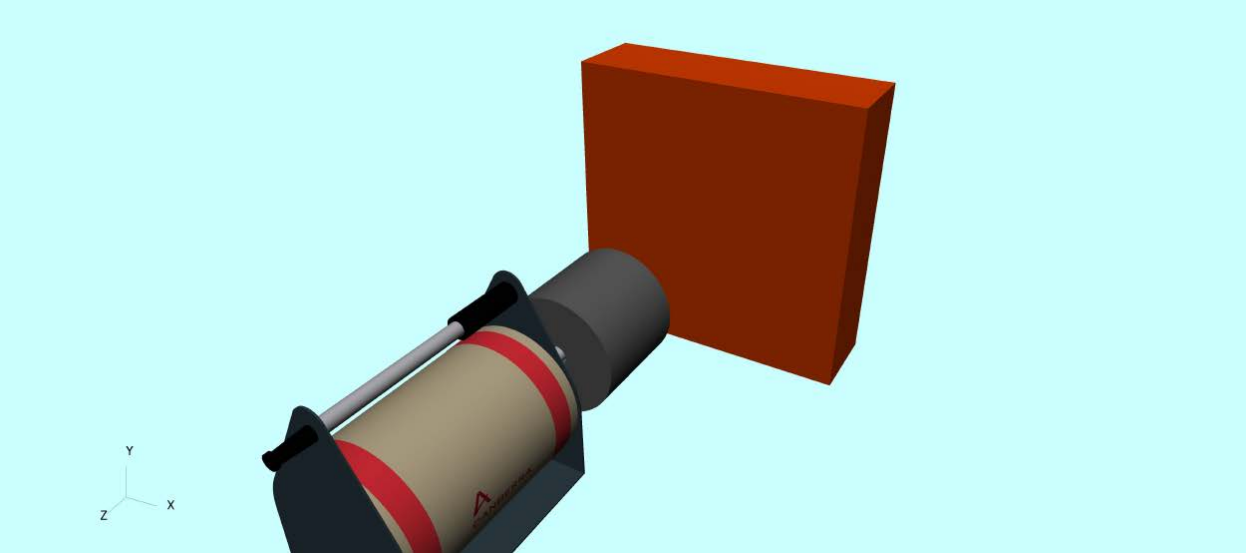
Dimensions (inches)

No.	Description	d.1	d.2	d.3	d.4	d.5	d.6	Material	Density	Rel. Conc.
1	Side Walls	0	24	24				none		
2	Layer 1	0.5						concrete	2.3	532.44
3	Layer 2	0.5						concrete	2.3	442.73
4	Layer 3	0.5						concrete	2.3	368.14
5	Layer 4	0.5						concrete	2.3	306.12
6	Layer 5	0.5						concrete	2.3	254.54
7	Layer 6	0.5						concrete	2.3	211.66
8	Layer 7	1						concrete	2.3	161.17
9	Layer 8	1						concrete	2.3	111.44
10	Layer 9	1						concrete	2.3	77.05
11	Layer 10	1						concrete	2.3	53.28
12	Absorber1							none		
13	Absorber2									
14	Source-Detector	14	0	0	0	0				

List of energies for efficiency curve generation

59.5 88.0 122.1 165.9 391.7 661.7 898.0 1173.2
1332.5 1836.0




Y
Z
X

ATTACHMENT 3
SIGN TEST

Sign Test - Unit 2 Containment Basement Above 565 foot Elevation

Survey Area	02100			Description	Unit 2 Containment Basement
Survey Unit	B1-02100A-F			Description	Area Above 565 foot Elevation
Classification	1	Type I Error	0.05	# of Measurements	164

#	SOF (Ws)	1-Ws	Sign
1	0.045	0.96	+1
2	0.075	0.93	+1
3	0.045	0.96	+1
4	0.053	0.95	+1
5	0.058	0.94	+1
6	0.040	0.96	+1
7	0.029	0.97	+1
8	0.042	0.96	+1
9	0.036	0.96	+1
10	0.037	0.96	+1
11	0.042	0.96	+1
12	0.052	0.95	+1
13	0.056	0.94	+1
14	0.040	0.96	+1
15	0.078	0.92	+1
16	0.059	0.94	+1
17	0.075	0.93	+1
18	0.151	0.85	+1
19	0.332	0.67	+1
20	0.099	0.90	+1
21	0.100	0.90	+1
22	0.034	0.97	+1
23	0.019	0.98	+1
24	0.060	0.94	+1
25	0.066	0.93	+1
26	0.068	0.93	+1
27	0.040	0.96	+1
28	0.055	0.95	+1
29	0.072	0.93	+1
30	0.065	0.94	+1
31	0.042	0.96	+1
32	0.060	0.94	+1
33	0.055	0.94	+1

#	SOF (Ws)	1-Ws	Sign
83	0.034	0.97	+1
84	0.037	0.96	+1
85	0.036	0.96	+1
86	0.055	0.95	+1
87	0.032	0.97	+1
88	0.028	0.97	+1
89	0.027	0.97	+1
90	0.049	0.95	+1
91	0.035	0.97	+1
92	0.026	0.97	+1
93	0.048	0.95	+1
94	0.037	0.96	+1
95	0.044	0.96	+1
96	0.038	0.96	+1
97	0.044	0.96	+1
98	0.038	0.96	+1
99	0.040	0.96	+1
100	0.075	0.92	+1
101	0.099	0.90	+1
102	0.030	0.97	+1
103	0.041	0.96	+1
104	0.044	0.96	+1
105	0.168	0.83	+1
106	0.613	0.39	+1
107	0.035	0.96	+1
108	0.038	0.96	+1
109	0.035	0.96	+1
110	0.042	0.96	+1
111	0.037	0.96	+1
112	0.025	0.97	+1
113	0.023	0.98	+1
114	0.036	0.96	+1
115	0.985	0.01	+1

Sign Test - Unit 2 Containment Basement Above 565 foot Elevation (continued)

#	SOF (Ws)	1-Ws	Sign
34	0.037	0.96	+1
35	0.037	0.96	+1
36	0.069	0.93	+1
37	0.044	0.96	+1
38	0.031	0.97	+1
39	0.045	0.95	+1
40	0.060	0.94	+1
41	0.082	0.92	+1
42	0.059	0.94	+1
43	0.052	0.95	+1
44	0.044	0.96	+1
45	0.027	0.97	+1
46	0.039	0.96	+1
47	0.034	0.97	+1
48	0.040	0.96	+1
49	0.039	0.96	+1
50	0.024	0.98	+1
51	0.059	0.94	+1
52	0.042	0.96	+1
53	0.035	0.97	+1
54	0.037	0.96	+1
55	0.049	0.95	+1
56	0.049	0.95	+1
57	0.053	0.95	+1
58	0.040	0.96	+1
59	0.047	0.95	+1
60	0.051	0.95	+1
61	0.059	0.94	+1
62	0.044	0.96	+1
63	0.059	0.94	+1
64	0.106	0.89	+1
65	0.071	0.93	+1
66	0.035	0.97	+1
67	0.058	0.94	+1
68	0.082	0.92	+1
69	0.056	0.94	+1
70	0.049	0.95	+1
71	0.033	0.97	+1

#	SOF (Ws)	1-Ws	Sign
116	0.288	0.71	+1
117	0.037	0.96	+1
118	0.038	0.96	+1
119	0.023	0.98	+1
120	0.091	0.91	+1
121	0.128	0.87	+1
122	0.021	0.98	+1
123	0.046	0.95	+1
124	0.036	0.96	+1
125	0.047	0.95	+1
126	0.189	0.81	+1
127	0.116	0.88	+1
128	0.031	0.97	+1
129	0.028	0.97	+1
130	0.018	0.98	+1
131	0.039	0.96	+1
132	0.032	0.97	+1
133	0.023	0.98	+1
134	0.033	0.97	+1
135	0.034	0.97	+1
136	0.041	0.96	+1
137	0.030	0.97	+1
138	0.040	0.96	+1
139	0.029	0.97	+1
140	0.047	0.95	+1
141	0.098	0.90	+1
142	0.049	0.95	+1
143	0.032	0.97	+1
144	0.034	0.97	+1
145	0.038	0.96	+1
146	0.022	0.98	+1
147	0.040	0.96	+1
148	0.025	0.97	+1
149	0.039	0.96	+1
150	0.042	0.96	+1
151	0.048	0.95	+1
152	0.024	0.98	+1
153	0.027	0.97	+1

Sign Test - Unit 2 Containment Basement Above 565 foot Elevation (continued)

#	SOF (Ws)	1-Ws	Sign
72	0.025	0.98	+1
73	0.055	0.95	+1
74	0.053	0.95	+1
75	0.027	0.97	+1
76	0.033	0.97	+1
77	0.064	0.94	+1
78	0.034	0.97	+1
79	0.031	0.97	+1
80	0.041	0.96	+1
81	0.054	0.95	+1
82	0.048	0.95	+1

#	SOF (Ws)	1-Ws	Sign
154	0.035	0.97	+1
155	0.036	0.96	+1
156	0.066	0.93	+1
157	0.069	0.93	+1
158	0.056	0.94	+1
159	0.072	0.93	+1
160	0.065	0.94	+1
161	0.062	0.94	+1
162	0.195	0.81	+1
163	0.080	0.92	+1
164	0.252	0.75	+1

Number of positive differences (S+) 164

Critical Value 93

The Survey Unit MEETS the Acceptance Criteria

Sign Test - Unit 2 Containment Basement Under Vessel Area

Survey Area	02100			Description	Unit 2 Containment Basement
Survey Unit	B1-02110A-F			Description	Under Vessel Area
Classification	1	Type I Error	0.05	# of Measurements	54

HTDs Inferred Using Table 5-15 Ratios

#	SOF (Ws)	1-Ws	Sign
1	0.214	0.79	+1
2	0.154	0.85	+1
3	1.129	(0.13)	-1
4	0.102	0.90	+1
5	0.142	0.86	+1
6	0.095	0.91	+1
7	0.080	0.92	+1
8	0.076	0.92	+1
9	0.319	0.68	+1
10	0.333	0.67	+1
11	0.109	0.89	+1
12	0.137	0.86	+1
13	0.106	0.89	+1
14	0.572	0.43	+1
15	0.846	0.15	+1
16	0.453	0.55	+1
17	0.777	0.22	+1
18	0.762	0.24	+1
19	0.674	0.33	+1
20	0.771	0.23	+1
21	0.289	0.71	+1
22	0.281	0.72	+1
23	0.059	0.94	+1
24	0.157	0.84	+1
25	0.006	0.99	+1
26	0.013	0.99	+1
27	0.009	0.99	+1
28	0.007	0.99	+1
29	0.014	0.99	+1
30	0.058	0.94	+1
31	0.007	0.99	+1
32	0.027	0.97	+1
33	0.033	0.97	+1

Addition of Measured Max HTD of 0.083

#	SOF (Ws)	1-Ws	Sign
1	0.192	0.81	+1
2	0.152	0.85	+1
3	0.457	0.54	+1
4	0.105	0.90	+1
5	0.109	0.89	+1
6	0.105	0.90	+1
7	0.099	0.90	+1
8	0.108	0.89	+1
9	0.174	0.83	+1
10	0.181	0.82	+1
11	0.121	0.88	+1
12	0.145	0.86	+1
13	0.138	0.86	+1
14	0.234	0.77	+1
15	0.378	0.62	+1
16	0.199	0.80	+1
17	0.285	0.71	+1
18	0.289	0.71	+1
19	0.282	0.72	+1
20	0.316	0.68	+1
21	0.177	0.82	+1
22	0.223	0.78	+1
23	0.097	0.90	+1
24	0.115	0.88	+1
25	0.085	0.91	+1
26	0.089	0.91	+1
27	0.087	0.91	+1
28	0.087	0.91	+1
29	0.089	0.91	+1
30	0.111	0.89	+1
31	0.085	0.91	+1
32	0.097	0.90	+1
33	0.100	0.90	+1

Sign Test - Unit 2 Containment Basement Under Vessel Area (continued)

#	SOF (Ws)	1-Ws	Sign
34	0.058	0.94	+1
35	0.180	0.82	+1
36	0.004	1.00	+1
37	0.003	1.00	+1
38	0.002	1.00	+1
39	0.002	1.00	+1
40	0.004	1.00	+1
41	0.006	0.99	+1
42	0.208	0.79	+1
43	0.229	0.77	+1
44	0.224	0.78	+1
45	0.099	0.90	+1
46	0.161	0.84	+1
47	0.140	0.86	+1
48	0.108	0.89	+1
49	0.184	0.82	+1
50	0.083	0.92	+1
51	0.060	0.94	+1
52	0.094	0.91	+1
53	0.015	0.99	+1
54	0.058	0.94	+1

#	SOF (Ws)	1-Ws	Sign
34	0.111	0.89	+1
35	0.176	0.82	+1
36	0.084	0.92	+1
37	0.084	0.92	+1
38	0.084	0.92	+1
39	0.084	0.92	+1
40	0.084	0.92	+1
41	0.086	0.91	+1
42	0.189	0.81	+1
43	0.200	0.80	+1
44	0.083	0.92	+1
45	0.113	0.89	+1
46	0.119	0.88	+1
47	0.132	0.87	+1
48	0.113	0.89	+1
49	0.168	0.83	+1
50	0.100	0.90	+1
51	0.101	0.90	+1
52	0.111	0.89	+1
53	0.090	0.91	+1
54	0.111	0.89	+1

Number of positive differences (S+) 54 Number of positive differences (S+) 54

Critical Value 33 Critical Value 33

The Survey Unit MEETS the Acceptance Criteria

ATTACHMENT 4
QC MEASUREMENT ASSESSMENTS

Replicate Measurement Assessment

Survey Unit # 02100 Survey Unit Name Unit 2 Containment Above 565 foot

Sample Plan # B1-02100A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #45. The standard measurement was B1-02100DF-SWM-045-GD, the comparison sample was B1-02100DF-QWM-045-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Compariso n Ratio	Acceptable (Y/N)
Cs-137	1.67E+04	1.07E+04	1.57	N/A	2.58E+04	1.03E+04	1.54	N
K-40	6.39E+05	1.53E+05	4.18	0.5 - 2.0	5.94E+05	1.50E+05	0.93	Y

Comments/Corrective Actions: The resolution when using Cs-137 was insufficient. Comparison was then made using K-40. There was acceptable agreement between the standard measurement and the replicate measurement. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02100 Survey Unit Name Unit 2 Containment Above 565 foot

Sample Plan # B1-02100A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #50. The standard measurement was B1-02100DF-SWM-050-GD, the comparison sample was B1-02100DF-QWM-050-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Comparison Ratio	Acceptable (Y/N)
Cs-137	1.97E+04	9.31E+03	2.12	N/A	2.18E+04	9.40E+03	1.11	N
K-40	6.45E+05	1.50E+05	4.30	0.5 - 2.0	5.48E+05	1.59E+05	0.85	Y

Comments/Corrective Actions: The resolution when using Cs-137 was insufficient. Comparison was then made using K-40. There was acceptable agreement between the standard measurement and the replicate measurement. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02100 Survey Unit Name Unit 2 Containment Above 565 foot

Sample Plan # B1-02100A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #60. The standard measurement was B1-02100DF-SWM-060-GD, the comparison sample was B1-02100DF-QWM-060-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Compariso n Ratio	Acceptable (Y/N)
Cs-137	4.01E+04	1.34E+04	2.99	N/A	3.66E+04	1.40E+04	0.91	N
K-40	5.59E+05	1.48E+05	3.78	N/A	5.60E+05	1.44E+05	1.00	N

Comments/Corrective Actions: The resolution when using Cs-137 and K-40 while using the acceptance criteria from NRC Inspection Procedure, No. 84750 was not comparable. IAW section 4.2.2 of the QAPP, agreement is ultimately determined when the same conclusion is reached for each compared result in the professional opinion of the RE. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02100 Survey Unit Name Unit 2 Containment Above 565 foot

Sample Plan # B1-02100A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #100. The standard measurement was B1-02100DF-SFM-100-GD, the comparison sample was B1-02100DF-QFM-100-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Compariso n Ratio	Acceptable (Y/N)
Cs-137	3.64E+04	1.20E+04	3.04	N/A	2.41E+04	1.20E+04	0.66	N
K-40	6.79E+05	1.54E+05	4.41	0.5 - 2.0	5.45E+05	1.47E+05	0.80	Y

Comments/Corrective Actions: The resolution when using Cs-137 was insufficient. Comparison was then made using K-40. There was acceptable agreement between the standard measurement and the replicate measurement. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02100 Survey Unit Name Unit 2 Containment Above 565 foot

Sample Plan # B1-02100A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #115. The standard measurement was B1-02100DF-SFM-115-GD, the comparison sample was B1-02100DF-QFM-115-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Comparison Ratio	Acceptable (Y/N)
Cs-137	4.11E+04	2.64E+04	1.56	N/A	4.17E+04	1.38E+04	1.02	N
K-40	7.37E+05	1.57E+05	4.69	0.5 - 2.0	6.10E+05	1.48E+05	0.83	Y

Comments/Corrective Actions: The resolution when using Cs-137 was insufficient. Comparison was then made using K-40. There was acceptable agreement between the standard measurement and the replicate measurement. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02100 Survey Unit Name Unit 2 Containment Above 565 foot

Sample Plan # B1-02100A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #119. The standard measurement was B1-02100DF-SFM-119-GD, the comparison sample was B1-02100DF-QFM-119-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Comparison Ratio	Acceptable (Y/N)
Cs-137	2.82E+04	1.12E+04	2.51	N/A	3.20E+04	1.20E+04	1.14	N
K-40	6.48E+05	1.55E+05	4.18	0.5 - 2.0	6.49E+05	1.68E+05	1.00	Y

Comments/Corrective Actions: The resolution when using Cs-137 was insufficient. Comparison was then made using K-40. There was acceptable agreement between the standard measurement and the replicate measurement. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02100 Survey Unit Name Unit 2 Containment Above 565 foot

Sample Plan # B1-02100A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #139. The standard measurement was B1-02100DF-SFM-139-GD, the comparison sample was B1-02100DF-QFM-139-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Comparison Ratio	Acceptable (Y/N)
Cs-137	9.20E+04	2.33E+04	3.95	N/A	9.53E+04	2.29E+04	1.04	N
K-40	5.75E+05	1.51E+05	3.81	N/A	6.06E+05	1.56E+05	1.05	N

Comments/Corrective Actions: The resolution when using Cs-137 and K-40 while using the acceptance criteria from NRC Inspection Procedure, No. 84750 was not comparable. IAW section 4.2.2 of the Quality Assurance Project Plan (QAPP), agreement is ultimately determined when the same conclusion is reached for each compared result in the professional opinion of the RE. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02100 Survey Unit Name Unit 2 Containment Above 565 foot

Sample Plan # B1-02100A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #150. The standard measurement was B1-02100DF-SFM-150-GD, the comparison sample was B1-02100DF-QFM-150-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Comparison Ratio	Acceptable (Y/N)
Co-60	2.21E+04	6.33E+03	3.49	N/A	2.74E+04	6.70E+03	1.24	N
K-40	6.74E+05	1.61E+05	4.19	0.5 - 2.0	5.61E+05	1.57E+05	0.83	Y

Comments/Corrective Actions: The resolution when using Cs-137 was insufficient. Comparison was then made using K-40. There was acceptable agreement between the standard measurement and the replicate measurement. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02100 Survey Unit Name Unit 2 Containment Above 565 foot

Sample Plan # B1-02100A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #165. The standard measurement was B1-02100DF-SFM-165-GD, the comparison sample was B1-02100DF-QFM-165-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Compariso n Ratio	Acceptable (Y/N)
Cs-137	2.55E+04	9.90E+03	2.58	N/A	1.27E+04	8.05E+03	0.50	N
K-40	5.93E+05	1.51E+05	3.93	N/A	6.48E+05	1.52E+05	1.09	N

Comments/Corrective Actions: The resolution when using Cs-137 and K-40 while using the acceptance criteria from NRC Inspection Procedure, No. 84750 was not comparable. IAW section 4.2.2 of the QAPP, agreement is ultimately determined when the same conclusion is reached for each compared result in the professional opinion of the RE. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02110 Survey Unit Name Unit 2 Containment Under Vessel Area

Sample Plan # B1-02110A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #16. The standard measurement was B1-02110DF-SWC-016-GD, the comparison sample was B1-02110DF-QWC-016-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Compariso n Ratio	Acceptable (Y/N)
Cs-137	8.43E+05	1.94E+05	4.34	0.5 - 2.0	5.65E+05	1.73E+05	0.67	Y

Comments/Corrective Actions: There was acceptable agreement between the standard measurement and the replicate measurement. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02110 Survey Unit Name Unit 2 Containment Under Vessel Area

Sample Plan # B1-02110A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #17. The standard measurement was B1-02110DF-SWC-017-GD, the comparison sample was B1-02110DF-QWC-017-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Compariso n Ratio	Acceptable (Y/N)
Cs-137	4.14E+06	5.37E+05	7.70	0.6 - 1.66	4.17E+06	5.40E+05	1.01	Y

Comments/Corrective Actions: There was acceptable agreement between the standard measurement and the replicate measurement. No further action is necessary.

Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

Replicate Measurement Assessment

Survey Unit # 02110 Survey Unit Name Unit 2 Containment Under Vessel Area

Sample Plan # B1-02110A-F

Sample Description: Comparison of replicate ISOCS measurements collected from measurement location #51. The standard measurement was B1-01110AF-SWC-051-GD, the comparison sample was B1-02110DF-QWC-051-GD.

STANDARD					COMPARISON			
ROC	Activity Value	Standard Error	Resolution	Agreement Range	Activity Value	Standard Error	Compariso n Ratio	Acceptable (Y/N)
Cs-137	2.44E+05	6.37E+04	3.83	N/A	2.50E+05	6.79E+04	1.03	N
K-40	1.52E+06	3.77E+05	4.03	0.5 - 2.0	1.84E+06	4.02E+05	1.21	Y

Comments/Corrective Actions: The resolution when using Cs-137 was insufficient. Comparison was then made using K-40. There was acceptable agreement between the standard measurement and the replicate measurement. No further action is necessary.

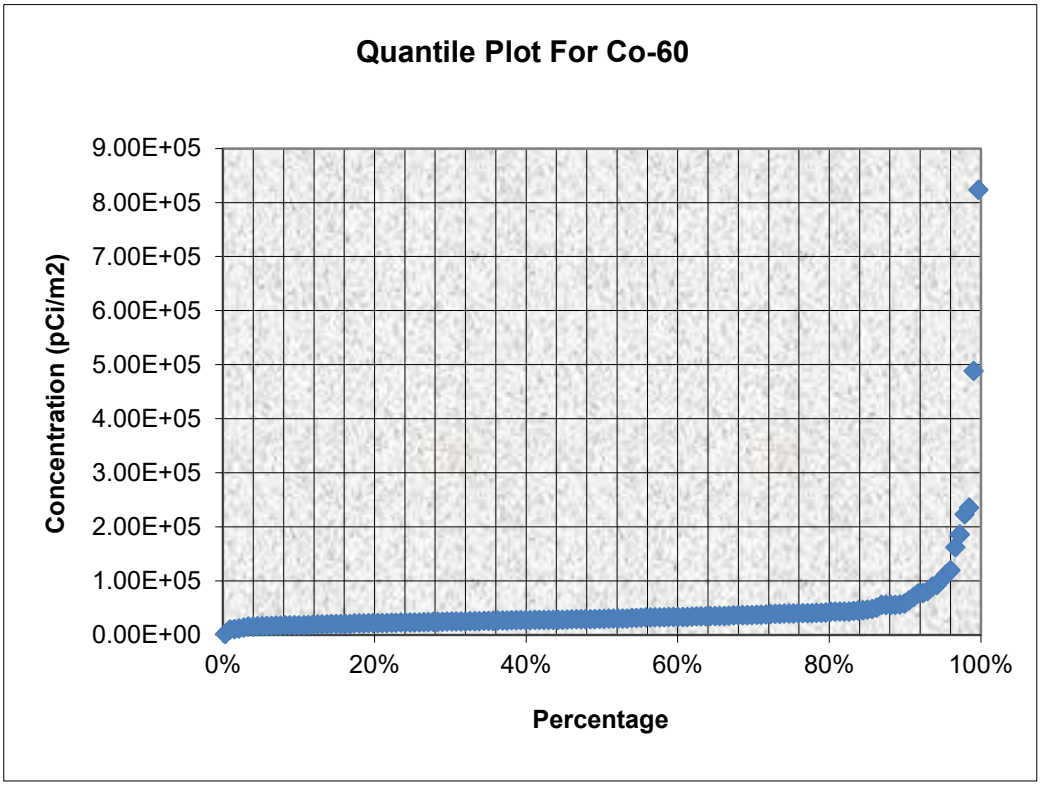
Table is provided to show acceptance criteria used to assess split samples.

Resolution	Agreement Range
4 - 7	0.5 - 2.0
8 - 15	0.6 - 1.66
16 - 50	0.75 - 1.33
51 - 200	0.80 - 1.25
>200	0.85 - 1.18

ATTACHMENT 5
GRAPHICAL PRESENTATIONS

QUANTILE PLOT FOR Co-60

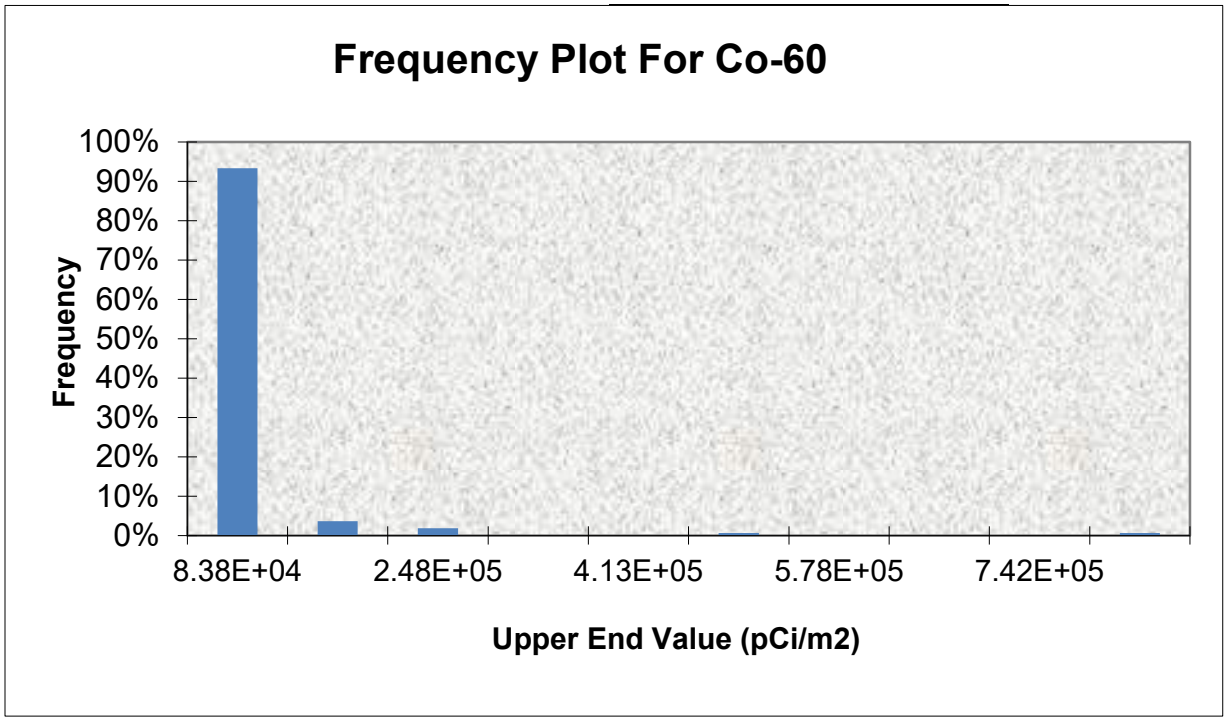
Survey Unit: 02100
Survey Unit Name: Unit 2 Containment Above 565 ft
Mean: 4.49E+04 pCi/m^2



RANK	Co-60	%	RANK	Co-60	%	RANK	Co-60	%	RANK	Co-60	%	RANK	Co-60	%	RANK	Co-60	%
1	1.49E+03	0%	31	2.13E+04	19%	61	2.64E+04	37%	91	3.19E+04	55%	121	3.87E+04	73%	151	7.67E+04	92%
2	1.00E+04	1%	32	2.14E+04	19%	62	2.66E+04	38%	92	3.21E+04	56%	122	3.94E+04	74%	152	7.75E+04	92%
3	1.03E+04	2%	33	2.16E+04	20%	63	2.68E+04	38%	93	3.21E+04	56%	123	3.94E+04	75%	153	8.10E+04	93%
4	1.16E+04	2%	34	2.16E+04	20%	64	2.68E+04	39%	94	3.22E+04	57%	124	3.97E+04	75%	154	8.89E+04	94%
5	1.35E+04	3%	35	2.17E+04	21%	65	2.71E+04	39%	95	3.22E+04	58%	125	3.99E+04	76%	155	9.22E+04	94%
6	1.53E+04	3%	36	2.17E+04	22%	66	2.72E+04	40%	96	3.25E+04	58%	126	3.99E+04	77%	156	1.02E+05	95%
7	1.54E+04	4%	37	2.21E+04	22%	67	2.72E+04	41%	97	3.28E+04	59%	127	4.00E+04	77%	157	1.12E+05	95%
8	1.57E+04	5%	38	2.23E+04	23%	68	2.73E+04	41%	98	3.28E+04	59%	128	4.02E+04	78%	158	1.19E+05	96%
9	1.57E+04	5%	39	2.27E+04	23%	69	2.74E+04	42%	99	3.29E+04	60%	129	4.05E+04	78%	159	1.62E+05	97%
10	1.61E+04	6%	40	2.28E+04	24%	70	2.74E+04	42%	100	3.29E+04	61%	130	4.09E+04	79%	160	1.86E+05	97%
11	1.61E+04	6%	41	2.29E+04	25%	71	2.74E+04	43%	101	3.31E+04	61%	131	4.13E+04	80%	161	2.23E+05	98%
12	1.69E+04	7%	42	2.29E+04	25%	72	2.76E+04	44%	102	3.33E+04	62%	132	4.30E+04	80%	162	2.36E+05	98%
13	1.71E+04	8%	43	2.29E+04	26%	73	2.76E+04	44%	103	3.38E+04	63%	133	4.30E+04	81%	163	4.88E+05	99%
14	1.76E+04	8%	44	2.33E+04	27%	74	2.78E+04	45%	104	3.40E+04	63%	134	4.32E+04	81%	164	8.23E+05	100%
15	1.76E+04	9%	45	2.35E+04	27%	75	2.84E+04	45%	105	3.42E+04	64%	135	4.32E+04	82%			
16	1.76E+04	9%	46	2.38E+04	28%	76	2.85E+04	46%	106	3.45E+04	64%	136	4.32E+04	83%			
17	1.76E+04	10%	47	2.39E+04	28%	77	2.86E+04	47%	107	3.45E+04	65%	137	4.42E+04	83%			
18	1.77E+04	11%	48	2.40E+04	29%	78	2.88E+04	47%	108	3.47E+04	66%	138	4.48E+04	84%			
19	1.81E+04	11%	49	2.44E+04	30%	79	2.88E+04	48%	109	3.48E+04	66%	139	4.51E+04	84%			
20	1.85E+04	12%	50	2.45E+04	30%	80	2.89E+04	48%	110	3.51E+04	67%	140	4.66E+04	85%			
21	1.90E+04	13%	51	2.46E+04	31%	81	2.90E+04	49%	111	3.62E+04	67%	141	4.78E+04	86%			
22	1.92E+04	13%	52	2.46E+04	31%	82	2.91E+04	50%	112	3.62E+04	68%	142	5.04E+04	86%			
23	1.95E+04	14%	53	2.48E+04	32%	83	2.92E+04	50%	113	3.63E+04	69%	143	5.51E+04	87%			
24	1.97E+04	14%	54	2.49E+04	33%	84	2.97E+04	51%	114	3.65E+04	69%	144	5.55E+04	88%			
25	1.97E+04	15%	55	2.52E+04	33%	85	2.98E+04	52%	115	3.66E+04	70%	145	5.57E+04	88%			
26	1.99E+04	16%	56	2.55E+04	34%	86	3.00E+04	52%	116	3.68E+04	70%	146	5.57E+04	89%			
27	2.00E+04	16%	57	2.55E+04	34%	87	3.00E+04	53%	117	3.68E+04	71%	147	5.57E+04	89%			
28	2.02E+04	17%	58	2.55E+04	35%	88	3.02E+04	53%	118	3.75E+04	72%	148	5.80E+04	90%			
29	2.08E+04	17%	59	2.58E+04	36%	89	3.09E+04	54%	119	3.83E+04	72%	149	6.39E+04	91%			
30	2.12E+04	18%	60	2.62E+04	36%	90	3.14E+04	55%	120	3.86E+04	73%	150	7.02E+04	91%			

HISTOGRAM FOR Co-60

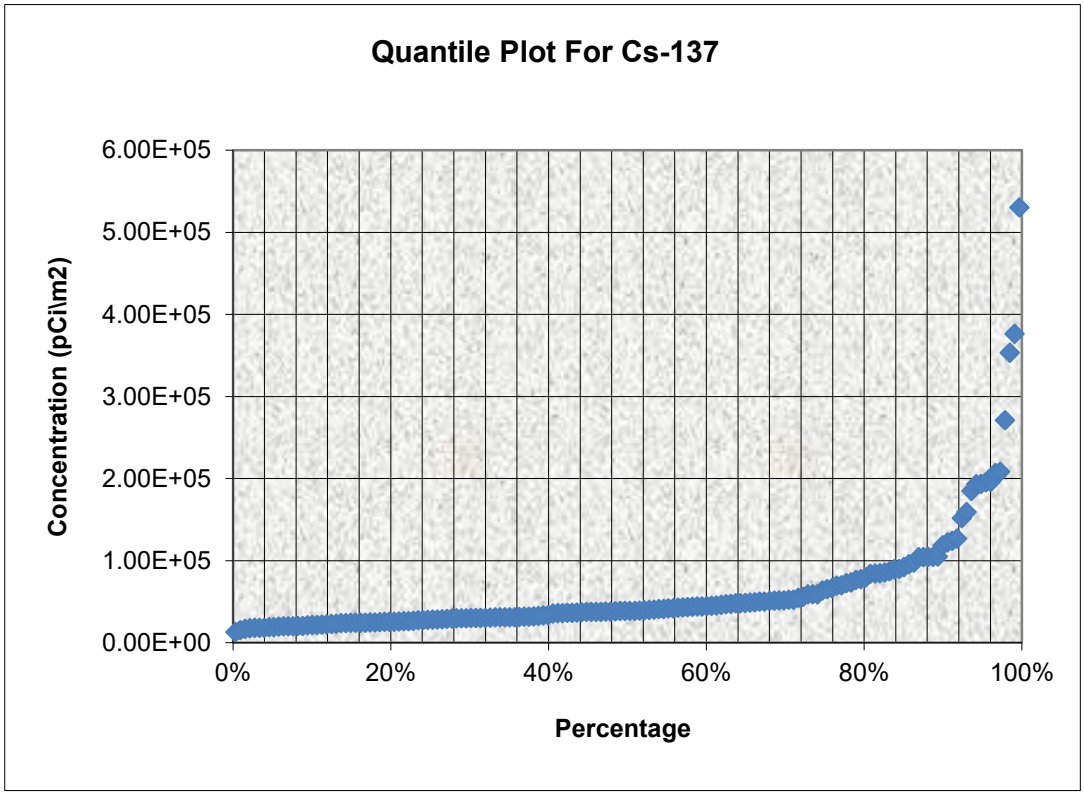
Survey Unit:	**02100**	
Survey Unit Name:	**Unit 2 Containment Above 565 ft**	
Mean:	4.49E+04	pCi/m^2
Median:	2.92E+04	pCi/m^2
ST DEV:	7.74E+04	
Skew:	7.71E+00	



Upper Value	Observation Frequency	Observation %
8.38E+04	153	93%
1.66E+05	6	4%
2.48E+05	3	2%
3.31E+05	0	0%
4.13E+05	0	0%
4.95E+05	1	1%
5.78E+05	0	0%
6.60E+05	0	0%
7.42E+05	0	0%
8.25E+05	1	1%
TOTAL	164	100%

QUANTILE PLOT FOR Cs-137

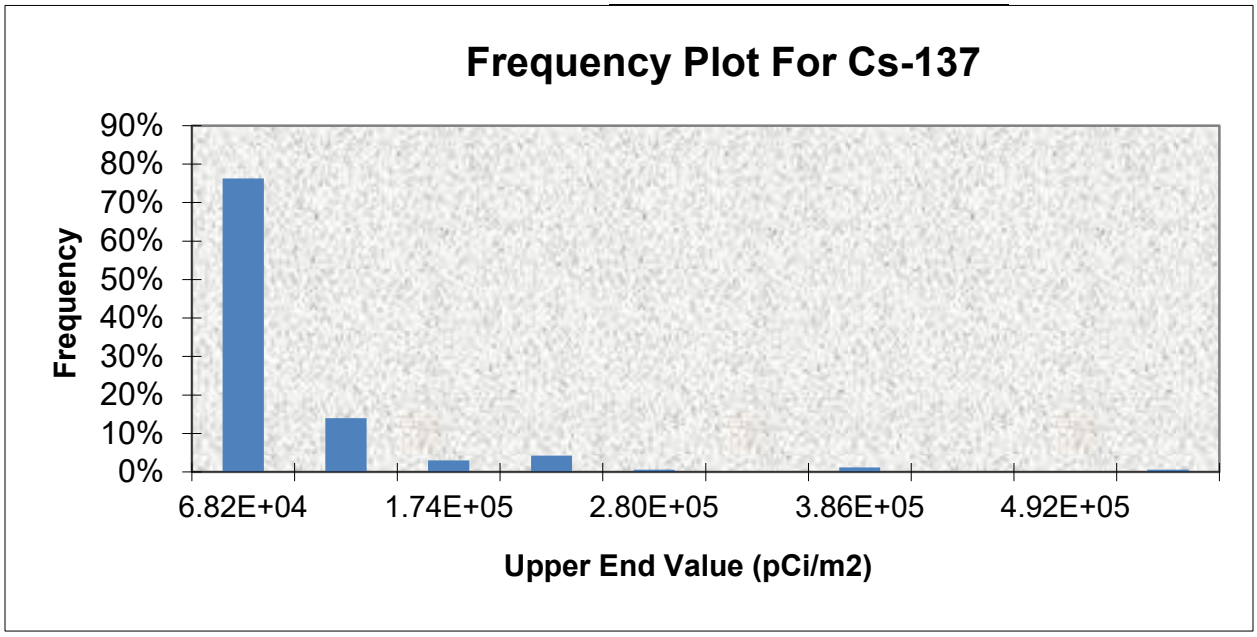
Survey Unit: 02100
Survey Unit Name: Unit 2 Containment Above 565 ft
Mean: 6.08E+04 pCi/m^2



RANK	Cs-137	%	RANK	Cs-137	%	RANK	Cs-137	%	RANK	Cs-137	%	RANK	Cs-137	%	RANK	Cs-137	%
1	1.28E+04	0%	31	2.48E+04	19%	61	3.15E+04	37%	91	4.16E+04	55%	121	5.89E+04	73%	151	1.27E+05	92%
2	1.52E+04	1%	32	2.52E+04	19%	62	3.16E+04	38%	92	4.17E+04	56%	122	5.90E+04	74%	152	1.52E+05	92%
3	1.67E+04	2%	33	2.52E+04	20%	63	3.18E+04	38%	93	4.25E+04	56%	123	6.33E+04	75%	153	1.59E+05	93%
4	1.74E+04	2%	34	2.55E+04	20%	64	3.24E+04	39%	94	4.29E+04	57%	124	6.51E+04	75%	154	1.85E+05	94%
5	1.78E+04	3%	35	2.58E+04	21%	65	3.32E+04	39%	95	4.31E+04	58%	125	6.62E+04	76%	155	1.93E+05	94%
6	1.79E+04	3%	36	2.59E+04	22%	66	3.34E+04	40%	96	4.35E+04	58%	126	6.93E+04	77%	156	1.93E+05	95%
7	1.81E+04	4%	37	2.61E+04	22%	67	3.54E+04	41%	97	4.40E+04	59%	127	6.97E+04	77%	157	1.95E+05	95%
8	1.86E+04	5%	38	2.66E+04	23%	68	3.58E+04	41%	98	4.40E+04	59%	128	7.25E+04	78%	158	1.96E+05	96%
9	1.86E+04	5%	39	2.74E+04	23%	69	3.60E+04	42%	99	4.43E+04	60%	129	7.31E+04	78%	159	2.07E+05	97%
10	1.95E+04	6%	40	2.74E+04	24%	70	3.60E+04	42%	100	4.47E+04	61%	130	7.62E+04	79%	160	2.08E+05	97%
11	1.97E+04	6%	41	2.77E+04	25%	71	3.61E+04	43%	101	4.52E+04	61%	131	7.71E+04	80%	161	2.71E+05	98%
12	1.99E+04	7%	42	2.81E+04	25%	72	3.64E+04	44%	102	4.58E+04	62%	132	7.93E+04	80%	162	3.53E+05	98%
13	2.00E+04	8%	43	2.82E+04	26%	73	3.72E+04	44%	103	4.67E+04	63%	133	8.36E+04	81%	163	3.76E+05	99%
14	2.01E+04	8%	44	2.84E+04	27%	74	3.73E+04	45%	104	4.73E+04	63%	134	8.42E+04	81%	164	5.30E+05	100%
15	2.02E+04	9%	45	2.87E+04	27%	75	3.74E+04	45%	105	4.78E+04	64%	135	8.46E+04	82%			
16	2.12E+04	9%	46	2.94E+04	28%	76	3.74E+04	46%	106	4.79E+04	64%	136	8.54E+04	83%			
17	2.14E+04	10%	47	2.94E+04	28%	77	3.75E+04	47%	107	4.83E+04	65%	137	8.68E+04	83%			
18	2.14E+04	11%	48	2.96E+04	29%	78	3.76E+04	47%	108	4.86E+04	66%	138	8.94E+04	84%			
19	2.17E+04	11%	49	2.96E+04	30%	79	3.79E+04	48%	109	4.91E+04	66%	139	8.95E+04	84%			
20	2.23E+04	12%	50	2.99E+04	30%	80	3.82E+04	48%	110	4.99E+04	67%	140	9.20E+04	85%			
21	2.27E+04	13%	51	2.99E+04	31%	81	3.85E+04	49%	111	5.00E+04	67%	141	9.56E+04	86%			
22	2.29E+04	13%	52	3.00E+04	31%	82	3.86E+04	50%	112	5.07E+04	68%	142	9.75E+04	86%			
23	2.38E+04	14%	53	3.01E+04	32%	83	3.87E+04	50%	113	5.12E+04	69%	143	1.04E+05	87%			
24	2.40E+04	14%	54	3.02E+04	33%	84	3.87E+04	51%	114	5.14E+04	69%	144	1.04E+05	88%			
25	2.41E+04	15%	55	3.06E+04	33%	85	3.91E+04	52%	115	5.15E+04	70%	145	1.04E+05	88%			
26	2.41E+04	16%	56	3.06E+04	34%	86	3.95E+04	52%	116	5.22E+04	70%	146	1.05E+05	89%			
27	2.41E+04	16%	57	3.07E+04	34%	87	3.96E+04	53%	117	5.22E+04	71%	147	1.05E+05	89%			
28	2.41E+04	17%	58	3.07E+04	35%	88	4.01E+04	53%	118	5.47E+04	72%	148	1.18E+05	90%			
29	2.44E+04	17%	59	3.09E+04	36%	89	4.08E+04	54%	119	5.56E+04	72%	149	1.22E+05	91%			
30	2.47E+04	18%	60	3.13E+04	36%	90	4.11E+04	55%	120	5.87E+04	73%	150	1.24E+05	91%			

HISTOGRAM FOR Cs-137

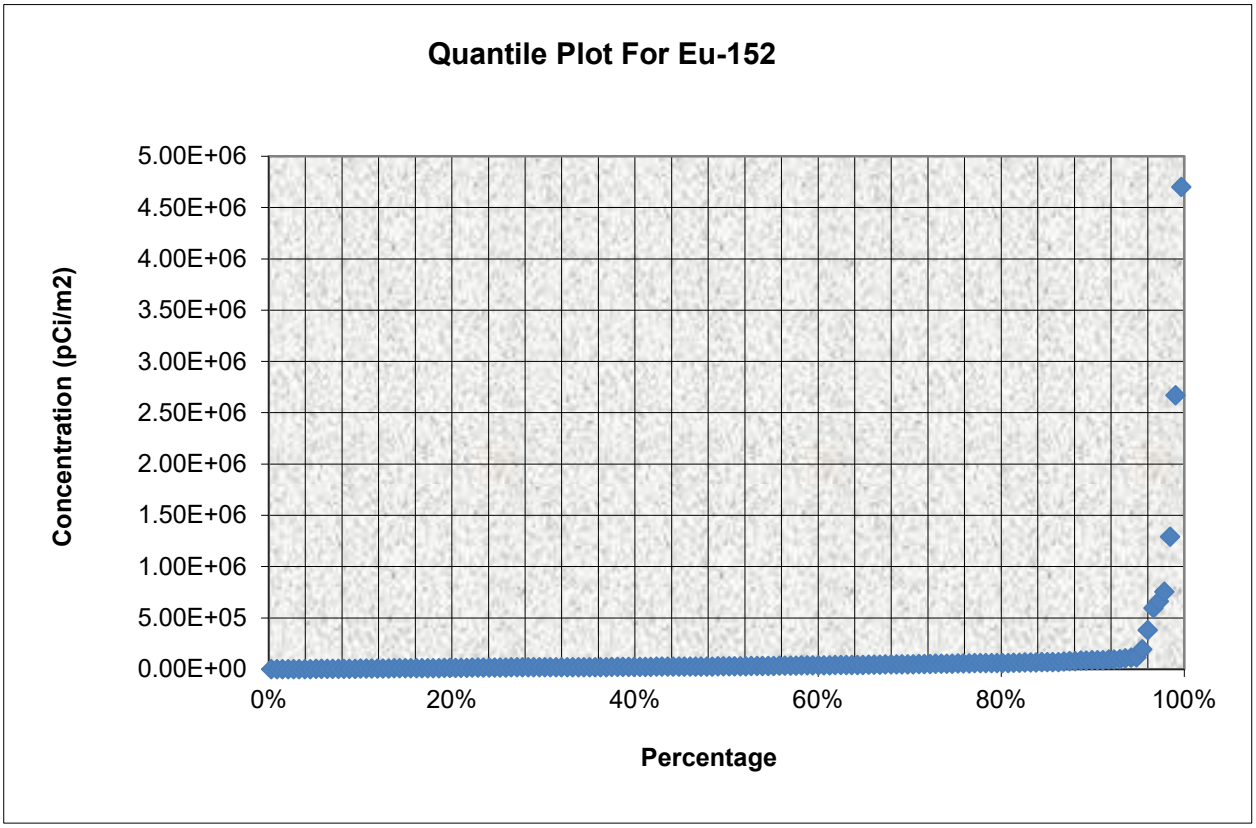
Survey Unit:	**02100**	
Survey Unit Name:	**Unit 2 Containment Above 565 ft**	
Mean:	6.08E+04	pCi/m^2
Median:	3.86E+04	pCi/m^2
ST DEV:	6.71E+04	
Skew:	3.83E+00	



Upper Value	Observation Frequency	Observation %
6.82E+04	125	76%
1.21E+05	23	14%
1.74E+05	5	3%
2.27E+05	7	4%
2.80E+05	1	1%
3.33E+05	0	0%
3.86E+05	2	1%
4.39E+05	0	0%
4.92E+05	0	0%
5.45E+05	1	1%
TOTAL	164	100%

QUANTILE PLOT FOR Eu-152

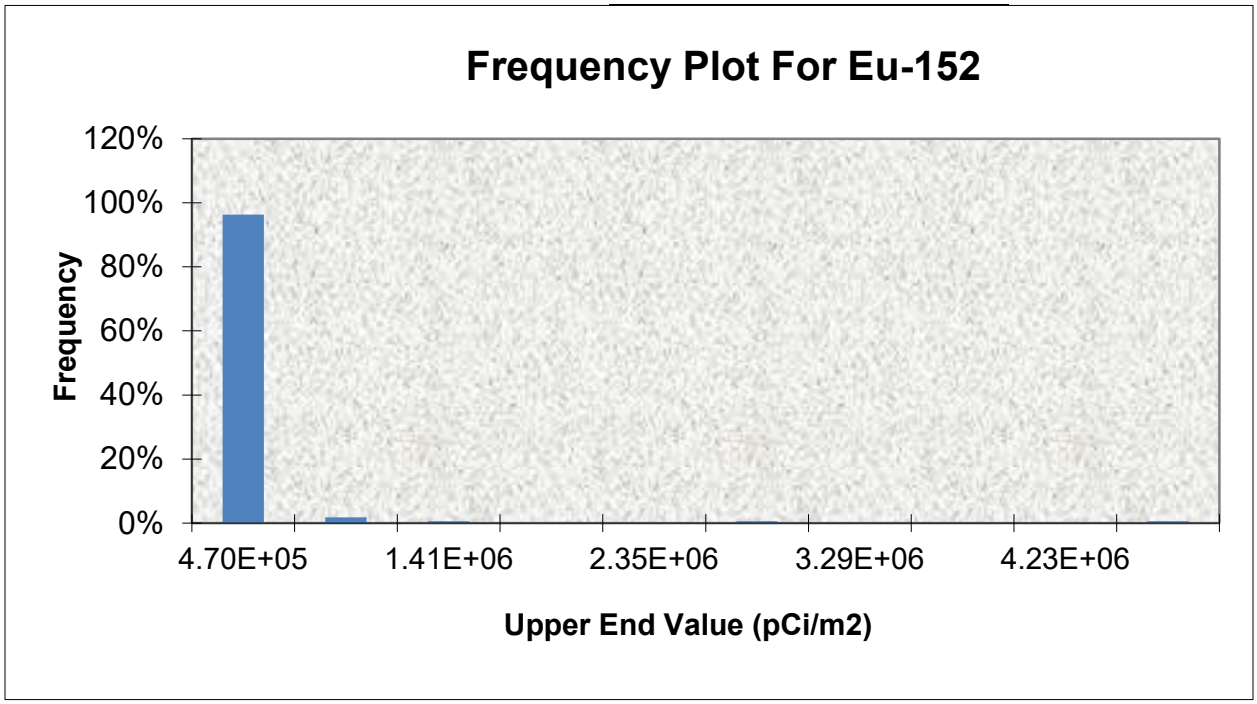
Survey Unit: 02100
Survey Unit Name: Unit 2 Containment Above 565 ft
Mean: 9.91E+04 pCi/m^2



RANK	Eu-152	%	RANK	Eu-152	%	RANK	Eu-152	%	RANK	Eu-152	%	RANK	Eu-152	%	RANK	Eu-152	%
1	0.00E+00	0%	31	9.35E+03	19%	61	1.86E+04	37%	91	3.10E+04	55%	121	5.06E+04	73%	151	9.23E+04	92%
2	0.00E+00	1%	32	1.01E+04	19%	62	1.89E+04	38%	92	3.16E+04	56%	122	5.13E+04	74%	152	9.25E+04	92%
3	0.00E+00	2%	33	1.04E+04	20%	63	1.99E+04	38%	93	3.25E+04	56%	123	5.29E+04	75%	153	9.55E+04	93%
4	0.00E+00	2%	34	1.05E+04	20%	64	2.01E+04	39%	94	3.29E+04	57%	124	5.33E+04	75%	154	1.05E+05	94%
5	0.00E+00	3%	35	1.09E+04	21%	65	2.02E+04	39%	95	3.37E+04	58%	125	5.52E+04	76%	155	1.12E+05	94%
6	0.00E+00	3%	36	1.17E+04	22%	66	2.03E+04	40%	96	3.45E+04	58%	126	5.58E+04	77%	156	1.15E+05	95%
7	0.00E+00	4%	37	1.33E+04	22%	67	2.10E+04	41%	97	3.47E+04	59%	127	5.63E+04	77%	157	1.92E+05	95%
8	0.00E+00	5%	38	1.34E+04	23%	68	2.11E+04	41%	98	3.47E+04	59%	128	5.72E+04	78%	158	3.78E+05	96%
9	3.74E+02	5%	39	1.36E+04	23%	69	2.13E+04	42%	99	3.58E+04	60%	129	5.73E+04	78%	159	5.93E+05	97%
10	7.10E+02	6%	40	1.37E+04	24%	70	2.20E+04	42%	100	3.59E+04	61%	130	5.73E+04	79%	160	6.60E+05	97%
11	1.19E+03	6%	41	1.40E+04	25%	71	2.22E+04	43%	101	3.71E+04	61%	131	5.73E+04	80%	161	7.54E+05	98%
12	1.68E+03	7%	42	1.49E+04	25%	72	2.27E+04	44%	102	3.76E+04	62%	132	5.73E+04	80%	162	1.29E+06	98%
13	2.09E+03	8%	43	1.51E+04	26%	73	2.30E+04	44%	103	3.79E+04	63%	133	5.90E+04	81%	163	2.67E+06	99%
14	2.32E+03	8%	44	1.57E+04	27%	74	2.31E+04	45%	104	3.81E+04	63%	134	5.94E+04	81%	164	4.70E+06	100%
15	2.40E+03	9%	45	1.57E+04	27%	75	2.33E+04	45%	105	3.87E+04	64%	135	5.95E+04	82%			
16	2.45E+03	9%	46	1.58E+04	28%	76	2.33E+04	46%	106	4.01E+04	64%	136	6.26E+04	83%			
17	3.22E+03	10%	47	1.61E+04	28%	77	2.33E+04	47%	107	4.04E+04	65%	137	6.36E+04	83%			
18	4.13E+03	11%	48	1.62E+04	29%	78	2.37E+04	47%	108	4.09E+04	66%	138	6.38E+04	84%			
19	4.61E+03	11%	49	1.63E+04	30%	79	2.40E+04	48%	109	4.21E+04	66%	139	6.55E+04	84%			
20	4.76E+03	12%	50	1.64E+04	30%	80	2.40E+04	48%	110	4.25E+04	67%	140	6.66E+04	85%			
21	4.80E+03	13%	51	1.67E+04	31%	81	2.52E+04	49%	111	4.45E+04	67%	141	6.69E+04	86%			
22	5.43E+03	13%	52	1.68E+04	31%	82	2.67E+04	50%	112	4.46E+04	68%	142	6.82E+04	86%			
23	6.68E+03	14%	53	1.69E+04	32%	83	2.68E+04	50%	113	4.47E+04	69%	143	7.19E+04	87%			
24	6.77E+03	14%	54	1.72E+04	33%	84	2.77E+04	51%	114	4.49E+04	69%	144	7.56E+04	88%			
25	7.99E+03	15%	55	1.76E+04	33%	85	2.79E+04	52%	115	4.52E+04	70%	145	7.69E+04	88%			
26	8.32E+03	16%	56	1.78E+04	34%	86	2.79E+04	52%	116	4.55E+04	70%	146	8.28E+04	89%			
27	8.38E+03	16%	57	1.81E+04	34%	87	2.92E+04	53%	117	4.83E+04	71%	147	8.28E+04	89%			
28	8.45E+03	17%	58	1.85E+04	35%	88	2.99E+04	53%	118	4.97E+04	72%	148	8.45E+04	90%			
29	8.58E+03	17%	59	1.86E+04	36%	89	3.09E+04	54%	119	4.98E+04	72%	149	8.52E+04	91%			
30	9.04E+03	18%	60	1.86E+04	36%	90	3.10E+04	55%	120	5.00E+04	73%	150	8.60E+04	91%			

HISTOGRAM FOR Eu-152

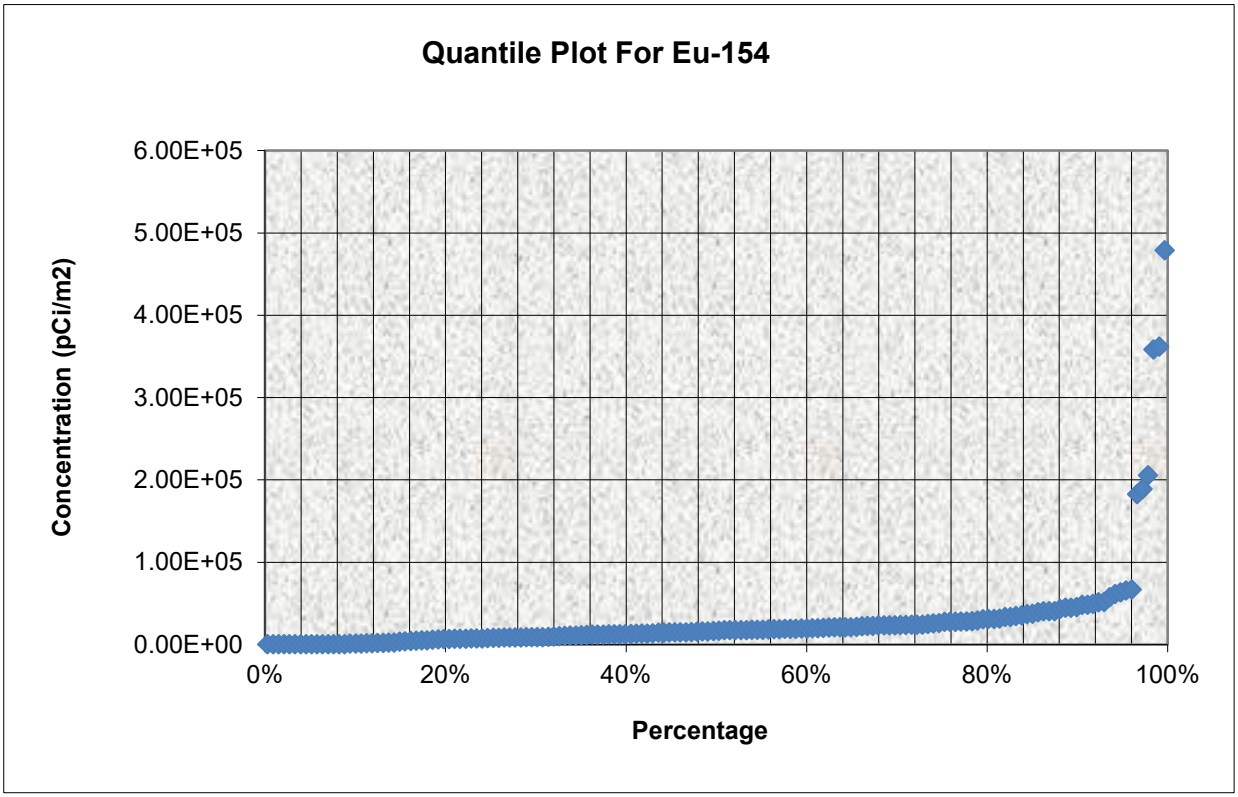
Survey Unit:	**02100**	
Survey Unit Name:	**Unit 2 Containment Above 565 ft**	
Mean:	9.91E+04	pCi/m^2
Median:	2.68E+04	pCi/m^2
ST DEV:	4.36E+05	
Skew:	8.70E+00	



Upper Value	Observation Frequency	Observation %
4.70E+05	158	96%
9.40E+05	3	2%
1.41E+06	1	1%
1.88E+06	0	0%
2.35E+06	0	0%
2.82E+06	1	1%
3.29E+06	0	0%
3.76E+06	0	0%
4.23E+06	0	0%
4.70E+06	1	1%
TOTAL	164	100%

QUANTILE PLOT FOR Eu-154

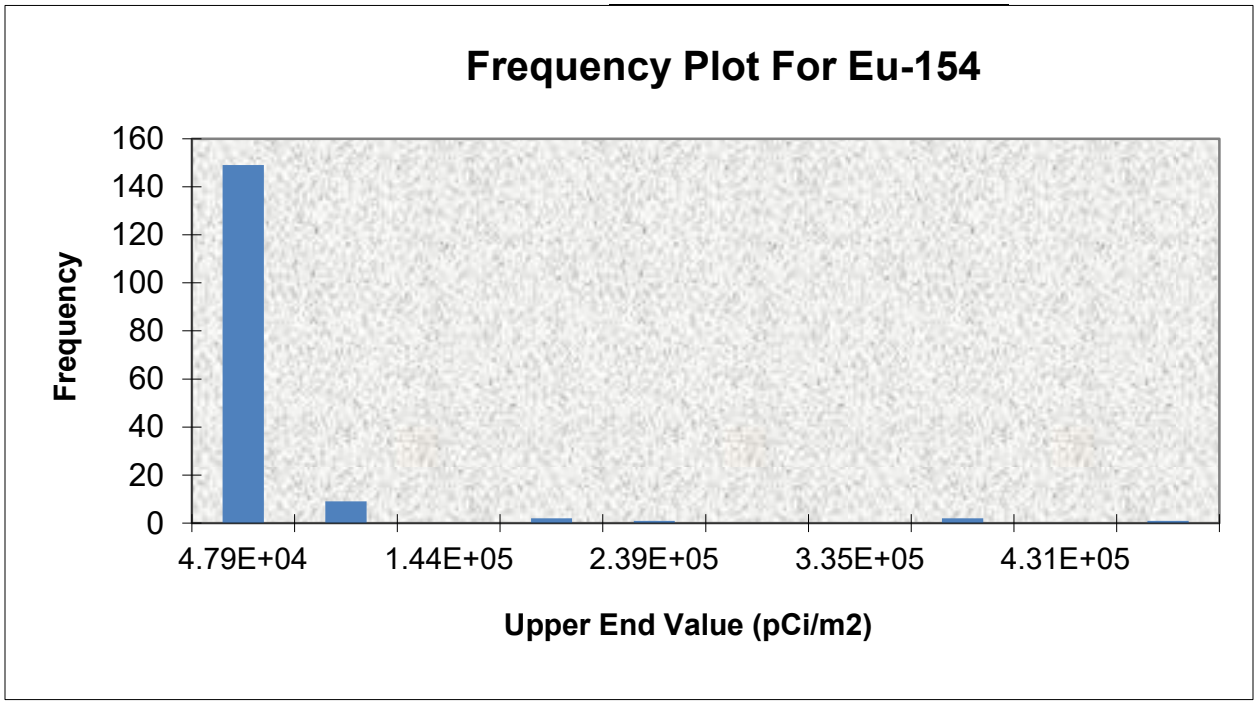
Survey Unit: 02100
Survey Unit Name: Unit 2 Containment Above 565 ft
Mean: 2.82E+04 pCi/m^2



RANK	Eu-154	%	RANK	Eu-154	%	RANK	Eu-154	%	RANK	Eu-154	%	RANK	Eu-154	%	RANK	Eu-154	%
1	0.00E+00	0%	31	5.44E+03	19%	61	1.19E+04	37%	91	1.78E+04	55%	121	2.47E+04	73%	151	2.47E+04	73%
2	0.00E+00	1%	32	5.98E+03	19%	62	1.20E+04	38%	92	1.80E+04	56%	122	2.53E+04	74%	152	2.53E+04	74%
3	0.00E+00	2%	33	6.19E+03	20%	63	1.20E+04	38%	93	1.85E+04	56%	123	2.57E+04	75%	153	2.57E+04	75%
4	0.00E+00	2%	34	6.30E+03	20%	64	1.22E+04	39%	94	1.86E+04	57%	124	2.73E+04	75%	154	2.73E+04	75%
5	0.00E+00	3%	35	6.71E+03	21%	65	1.23E+04	39%	95	1.88E+04	58%	125	2.75E+04	76%	155	2.75E+04	76%
6	0.00E+00	3%	36	6.75E+03	22%	66	1.23E+04	40%	96	1.89E+04	58%	126	2.75E+04	77%	156	2.75E+04	77%
7	0.00E+00	4%	37	6.86E+03	22%	67	1.27E+04	41%	97	1.89E+04	59%	127	2.76E+04	77%	157	2.76E+04	77%
8	0.00E+00	5%	38	7.03E+03	23%	68	1.29E+04	41%	98	1.92E+04	59%	128	2.77E+04	78%	158	2.77E+04	78%
9	0.00E+00	5%	39	7.15E+03	23%	69	1.30E+04	42%	99	1.94E+04	60%	129	2.80E+04	78%	159	2.80E+04	78%
10	0.00E+00	6%	40	7.21E+03	24%	70	1.31E+04	42%	100	1.94E+04	61%	130	2.87E+04	79%	160	2.87E+04	79%
11	0.00E+00	6%	41	7.63E+03	25%	71	1.32E+04	43%	101	1.98E+04	61%	131	3.03E+04	80%	161	3.03E+04	80%
12	0.00E+00	7%	42	7.79E+03	25%	72	1.41E+04	44%	102	1.99E+04	62%	132	3.07E+04	80%	162	3.07E+04	80%
13	0.00E+00	8%	43	7.88E+03	26%	73	1.42E+04	44%	103	2.05E+04	63%	133	3.09E+04	81%	163	3.09E+04	81%
14	0.00E+00	8%	44	8.33E+03	27%	74	1.44E+04	45%	104	2.06E+04	63%	134	3.14E+04	81%	164	3.14E+04	81%
15	0.00E+00	9%	45	8.37E+03	27%	75	1.45E+04	45%	105	2.07E+04	64%	135	3.30E+04	82%			
16	7.79E+02	9%	46	8.38E+03	28%	76	1.45E+04	46%	106	2.07E+04	64%	136	3.32E+04	83%			
17	8.04E+02	10%	47	8.41E+03	28%	77	1.46E+04	47%	107	2.08E+04	65%	137	3.43E+04	83%			
18	8.38E+02	11%	48	8.61E+03	29%	78	1.49E+04	47%	108	2.11E+04	66%	138	3.51E+04	84%			
19	1.18E+03	11%	49	8.63E+03	30%	79	1.54E+04	48%	109	2.18E+04	66%	139	3.67E+04	84%			
20	1.37E+03	12%	50	8.65E+03	30%	80	1.58E+04	48%	110	2.23E+04	67%	140	3.69E+04	85%			
21	1.70E+03	13%	51	8.65E+03	31%	81	1.59E+04	49%	111	2.24E+04	67%	141	3.90E+04	86%			
22	1.73E+03	13%	52	9.19E+03	31%	82	1.62E+04	50%	112	2.30E+04	68%	142	4.01E+04	86%			
23	2.08E+03	14%	53	9.37E+03	32%	83	1.65E+04	50%	113	2.30E+04	69%	143	4.02E+04	87%			
24	2.28E+03	14%	54	9.68E+03	33%	84	1.71E+04	51%	114	2.32E+04	69%	144	4.02E+04	88%			
25	3.29E+03	15%	55	1.01E+04	33%	85	1.72E+04	52%	115	2.33E+04	70%	145	4.30E+04	88%			
26	3.56E+03	16%	56	1.05E+04	34%	86	1.72E+04	52%	116	2.36E+04	70%	146	4.44E+04	89%			
27	4.10E+03	16%	57	1.06E+04	34%	87	1.74E+04	53%	117	2.36E+04	71%	147	4.44E+04	89%			
28	4.37E+03	17%	58	1.12E+04	35%	88	1.74E+04	53%	118	2.37E+04	72%	148	4.52E+04	90%			
29	4.64E+03	17%	59	1.15E+04	36%	89	1.75E+04	54%	119	2.37E+04	72%	149	4.78E+04	91%			
30	4.67E+03	18%	60	1.16E+04	36%	90	1.77E+04	55%	120	2.39E+04	73%	150	4.79E+04	91%			

HISTOGRAM FOR Eu-154

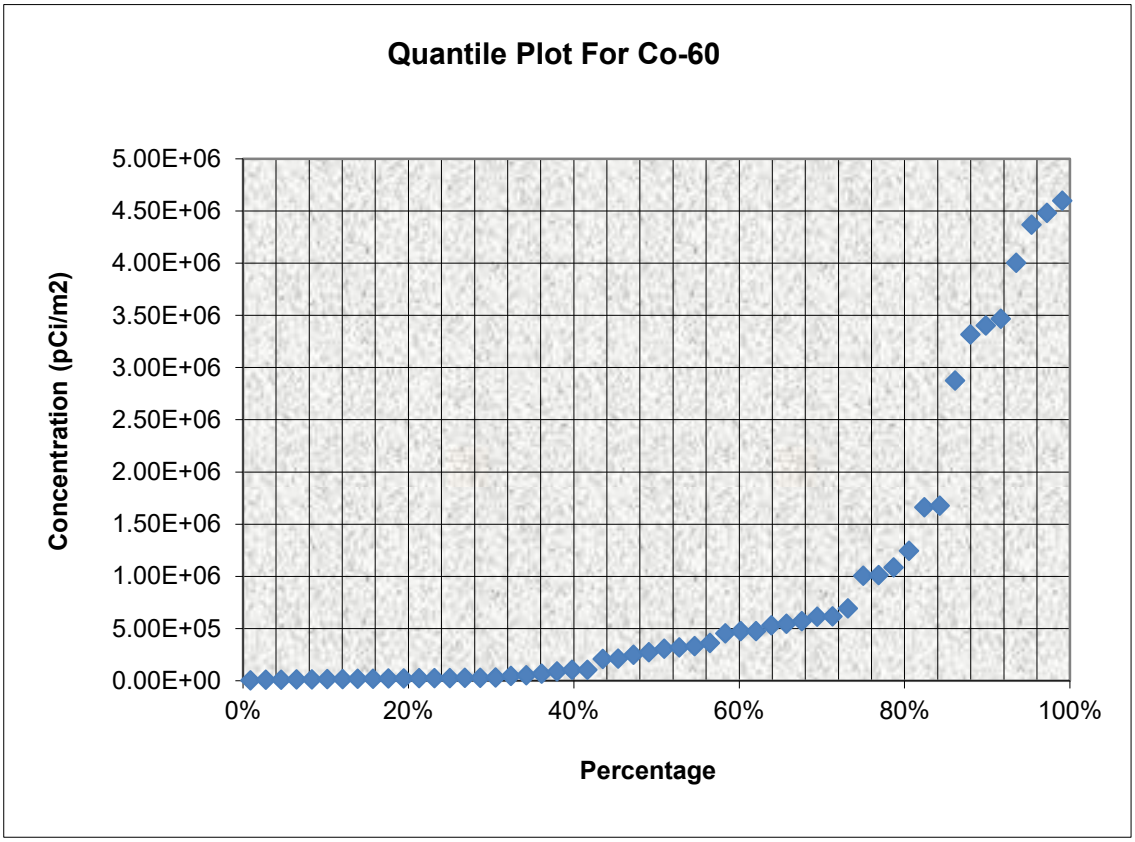
Survey Unit:	**02100**	
Survey Unit Name:	**Unit 2 Containment Above 565 ft**	
Mean:	2.82E+04	pCi/m^2
Median:	1.64E+04	pCi/m^2
ST DEV:	5.84E+05	
Skew:	5.53E+00	



Upper Value	Observation Frequency	Observation %
4.79E+04	149	91%
9.57E+04	9	5%
1.44E+05	0	0%
1.91E+05	2	1%
2.39E+05	1	1%
2.87E+05	0	0%
3.35E+05	0	0%
3.83E+05	2	1%
4.31E+05	0	0%
4.79E+05	1	1%
TOTAL	164	100%

QUANTILE PLOT FOR Co-60

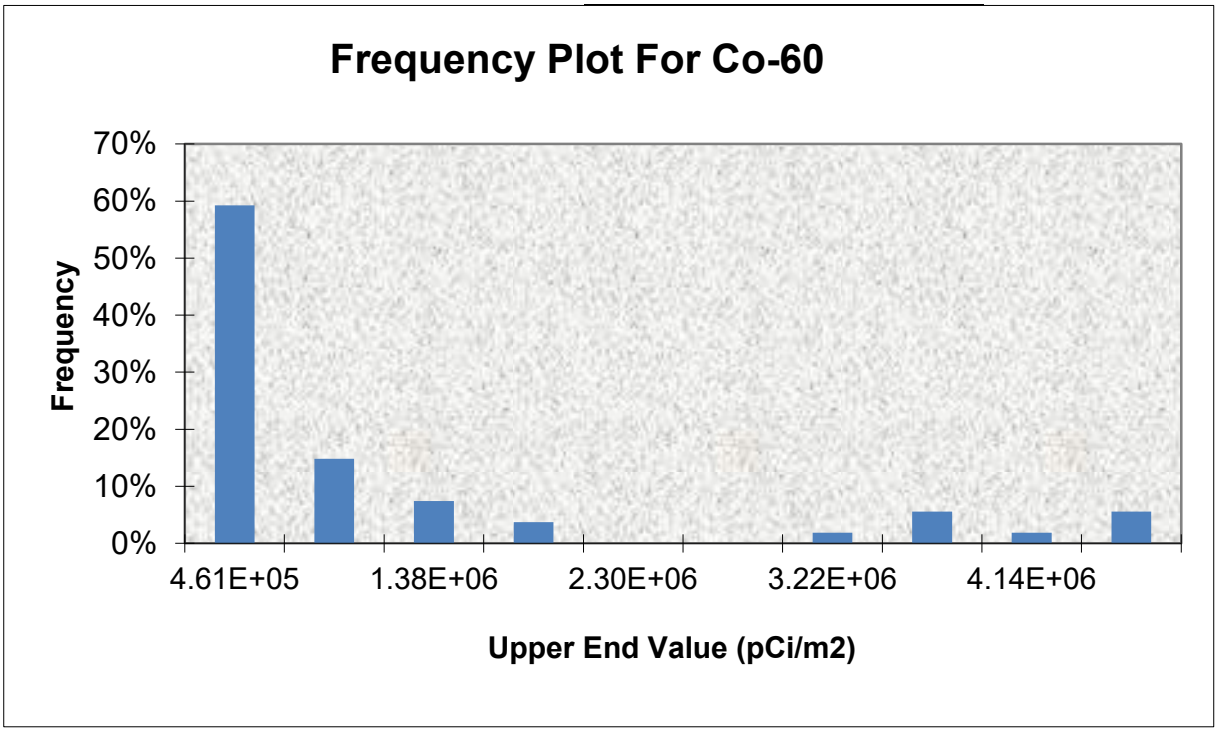
Survey Unit: 02110
Survey Unit Name: Unit 2 Under Vessel
Mean: 8.54E+05 pCi/m^2



RANK	Co-60	%	RANK	Co-60	%	RANK	Co-60	%
1	1.82E+03	1%	**19**	4.96E+04	34%	**37**	5.68E+05	68%
2	6.27E+03	3%	**20**	6.45E+04	36%	**38**	6.12E+05	69%
3	8.35E+03	5%	**21**	8.73E+04	38%	**39**	6.14E+05	71%
4	9.48E+03	6%	**22**	1.03E+05	40%	**40**	6.90E+05	73%
5	1.02E+04	8%	**23**	1.03E+05	42%	**41**	1.00E+06	75%
6	1.39E+04	10%	**24**	2.06E+05	44%	**42**	1.01E+06	77%
7	1.42E+04	12%	**25**	2.09E+05	45%	**43**	1.08E+06	79%
8	1.62E+04	14%	**26**	2.45E+05	47%	**44**	1.24E+06	81%
9	1.68E+04	16%	**27**	2.70E+05	49%	**45**	1.66E+06	82%
10	1.89E+04	18%	**28**	3.05E+05	51%	**46**	1.67E+06	84%
11	2.07E+04	19%	**29**	3.16E+05	53%	**47**	2.88E+06	86%
12	2.11E+04	21%	**30**	3.29E+05	55%	**48**	3.32E+06	88%
13	2.15E+04	23%	**31**	3.60E+05	56%	**49**	3.40E+06	90%
14	2.22E+04	25%	**32**	4.51E+05	58%	**50**	3.47E+06	92%
15	2.58E+04	27%	**33**	4.72E+05	60%	**51**	4.00E+06	94%
16	2.68E+04	29%	**34**	4.74E+05	62%	**52**	4.37E+06	95%
17	2.86E+04	31%	**35**	5.28E+05	64%	**53**	4.48E+06	97%
18	4.54E+04	32%	**36**	5.45E+05	66%	**54**	4.60E+06	99%

HISTOGRAM FOR Co-60

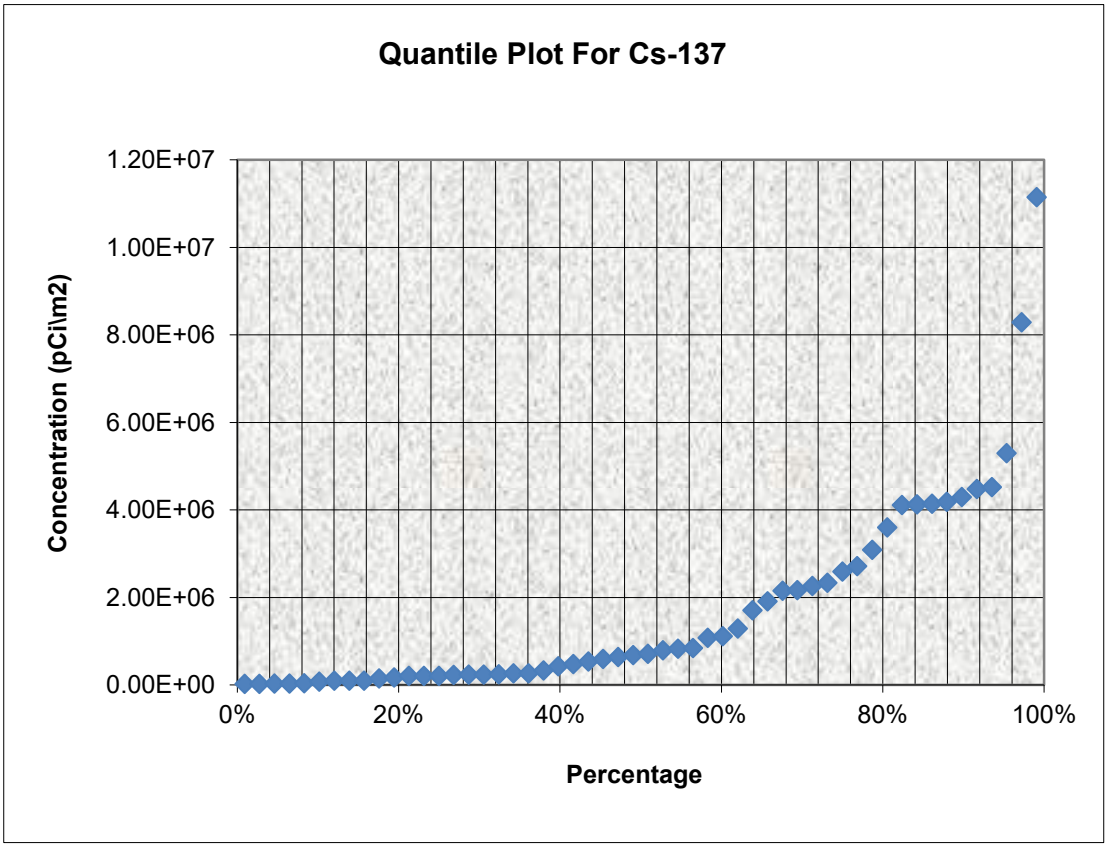
Survey Unit:	**02110**	
Survey Unit Name:	**Unit 2 Under Vessel**	
Mean:	8.54E+05	pCi/m^2
Median:	2.87E+05	pCi/m^2
ST DEV:	1.33E+06	
Skew:	1.83E+00	



Upper Value	Observation Frequency	Observation %
4.61E+05	32	59%
9.21E+05	8	15%
1.38E+06	4	7%
1.84E+06	2	4%
2.30E+06	0	0%
2.76E+06	0	0%
3.22E+06	1	2%
3.68E+06	3	6%
4.14E+06	1	2%
4.60E+06	3	6%
TOTAL	54	100%

QUANTILE PLOT FOR Cs-137

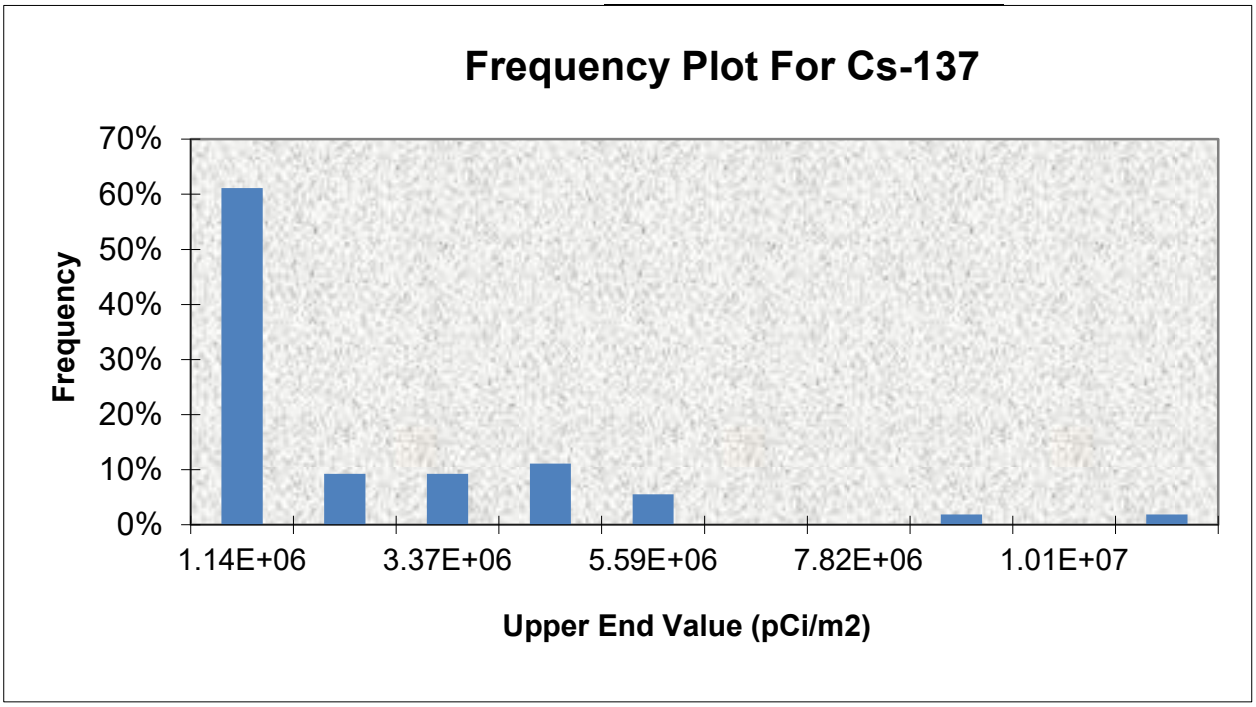
Survey Unit: 02110
Survey Unit Name: Unit 2 Under Vessel
Mean: 1.71E+06 pCi/m^2



RANK	Cs-137	%	RANK	Cs-137	%	RANK	Cs-137	%
1	2.00E+04	1%	19	2.61E+05	34%	37	2.15E+06	68%
2	2.25E+04	3%	20	2.64E+05	36%	38	2.17E+06	69%
3	2.63E+04	5%	21	3.27E+05	38%	39	2.26E+06	71%
4	3.14E+04	6%	22	4.20E+05	40%	40	2.33E+06	73%
5	3.40E+04	8%	23	4.75E+05	42%	41	2.59E+06	75%
6	7.09E+04	10%	24	5.34E+05	44%	42	2.71E+06	77%
7	9.25E+04	12%	25	5.89E+05	45%	43	3.09E+06	79%
8	9.28E+04	14%	26	6.35E+05	47%	44	3.60E+06	81%
9	9.30E+04	16%	27	6.79E+05	49%	45	4.11E+06	82%
10	1.48E+05	18%	28	7.07E+05	51%	46	4.12E+06	84%
11	1.68E+05	19%	29	7.90E+05	53%	47	4.14E+06	86%
12	2.03E+05	21%	30	8.27E+05	55%	48	4.18E+06	88%
13	2.04E+05	23%	31	8.43E+05	56%	49	4.29E+06	90%
14	2.04E+05	25%	32	1.07E+06	58%	50	4.48E+06	92%
15	2.24E+05	27%	33	1.11E+06	60%	51	4.52E+06	94%
16	2.30E+05	29%	34	1.28E+06	62%	52	5.29E+06	95%
17	2.35E+05	31%	35	1.71E+06	64%	53	8.28E+06	97%
18	2.44E+05	32%	36	1.91E+06	66%	54	1.11E+07	99%

HISTOGRAM FOR Cs-137

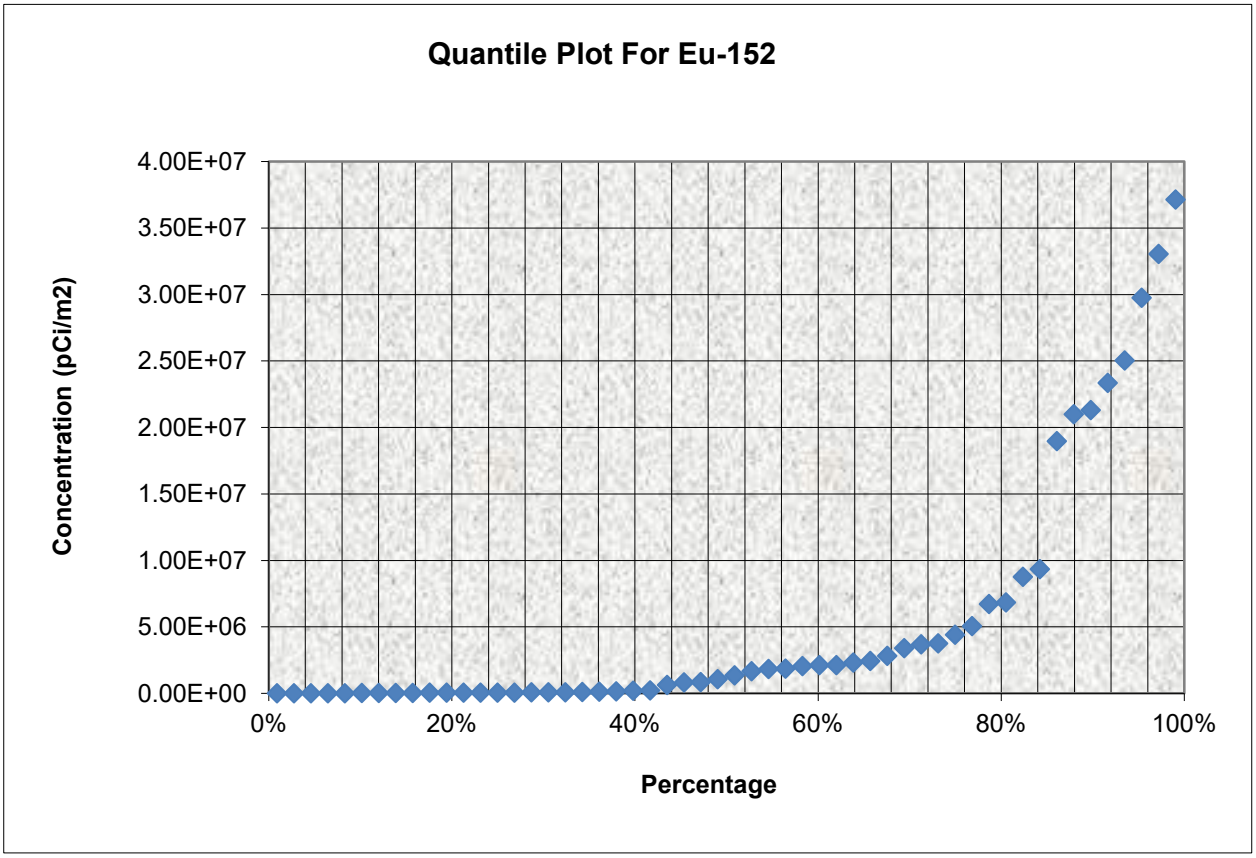
Survey Unit:	**02110**	
Survey Unit Name:	**Unit 2 Under Vessel**	
Mean:	1.71E+06	pCi/m^2
Median:	6.93E+05	pCi/m^2
ST DEV:	2.23E+06	
Skew:	2.14E+00	



Upper Value	Observation Frequency	Observation %
1.14E+06	33	61%
2.25E+06	5	9%
3.37E+06	5	9%
4.48E+06	6	11%
5.59E+06	3	6%
6.71E+06	0	0%
7.82E+06	0	0%
8.94E+06	1	2%
1.01E+07	0	0%
1.12E+07	1	2%
TOTAL	54	100%

QUANTILE PLOT FOR Eu-152

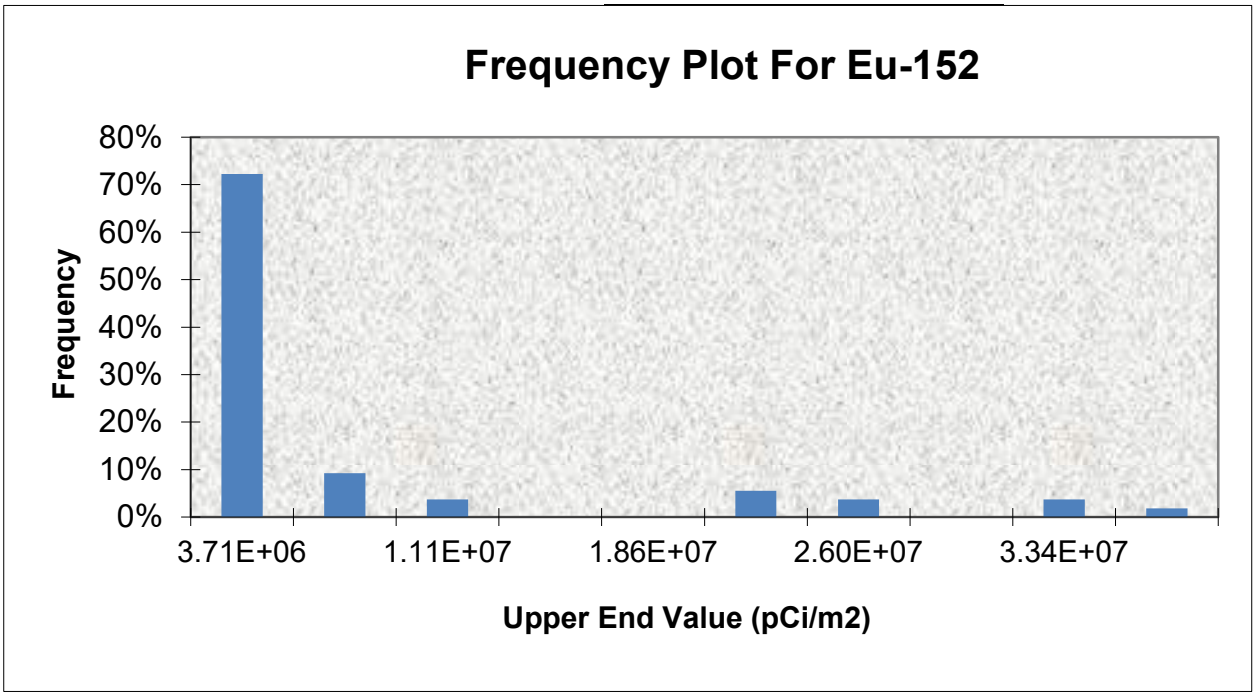
Survey Unit: 02110
Survey Unit Name: Unit 2 Under Vessel
Mean: 5.30E+06 pCi/m^2



RANK	Eu-152	%	RANK	Eu-152	%	RANK	Eu-152	%
1	0.00E+00	1%	**19**	9.16E+04	34%	**37**	2.81E+06	68%
2	0.00E+00	3%	**20**	1.20E+05	36%	**38**	3.39E+06	69%
3	0.00E+00	5%	**21**	1.35E+05	38%	**39**	3.68E+06	71%
4	0.00E+00	6%	**22**	1.82E+05	40%	**40**	3.74E+06	73%
5	1.64E+02	8%	**23**	2.03E+05	42%	**41**	4.39E+06	75%
6	5.39E+03	10%	**24**	6.24E+05	44%	**42**	5.05E+06	77%
7	5.70E+03	12%	**25**	7.99E+05	45%	**43**	6.71E+06	79%
8	1.68E+04	14%	**26**	8.30E+05	47%	**44**	6.83E+06	81%
9	1.81E+04	16%	**27**	1.05E+06	49%	**45**	8.75E+06	82%
10	2.93E+04	18%	**28**	1.34E+06	51%	**46**	9.32E+06	84%
11	3.07E+04	19%	**29**	1.66E+06	53%	**47**	1.90E+07	86%
12	3.53E+04	21%	**30**	1.83E+06	55%	**48**	2.10E+07	88%
13	4.05E+04	23%	**31**	1.84E+06	56%	**49**	2.13E+07	90%
14	4.56E+04	25%	**32**	2.04E+06	58%	**50**	2.33E+07	92%
15	4.76E+04	27%	**33**	2.10E+06	60%	**51**	2.50E+07	94%
16	5.23E+04	29%	**34**	2.12E+06	62%	**52**	2.97E+07	95%
17	5.25E+04	31%	**35**	2.30E+06	64%	**53**	3.30E+07	97%
18	6.21E+04	32%	**36**	2.41E+06	66%	**54**	3.71E+07	99%

HISTOGRAM FOR Eu-152

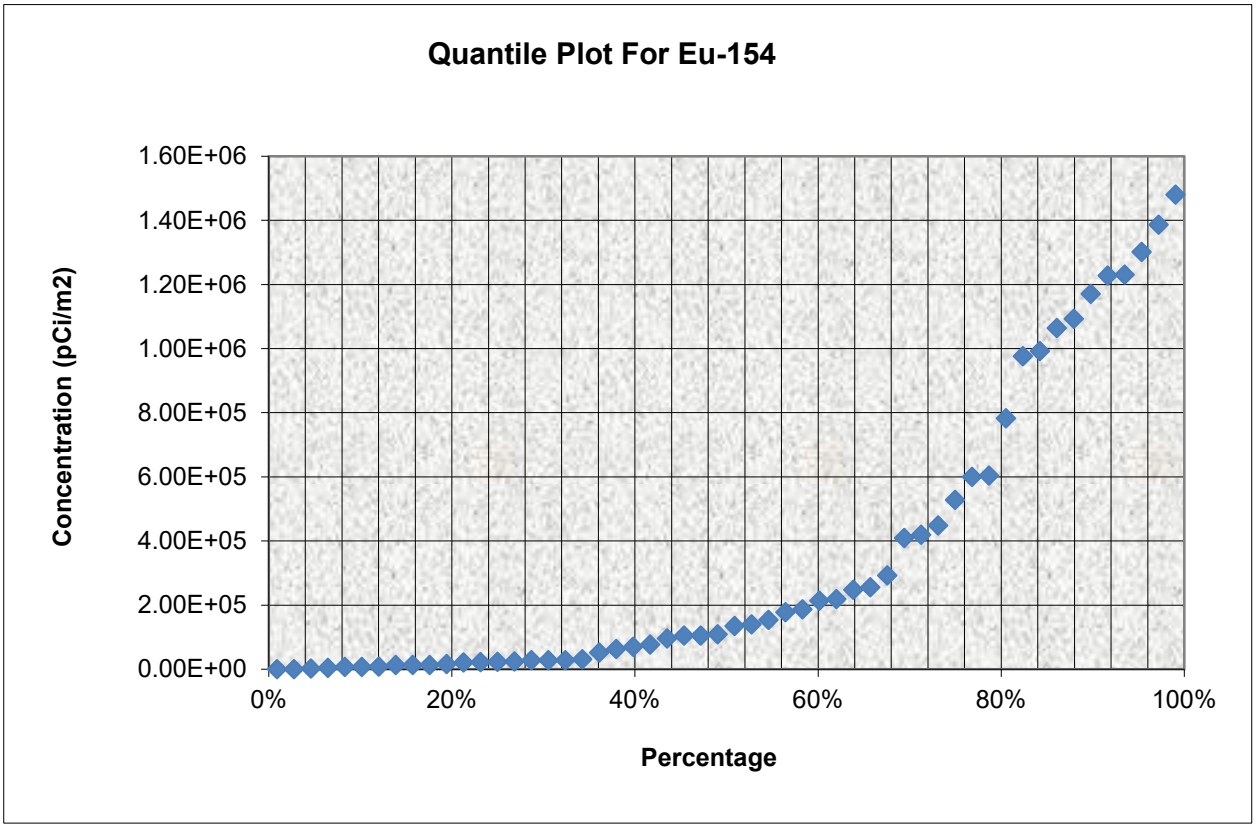
Survey Unit:	**02110**	
Survey Unit Name:	**Unit 2 Under Vessel**	
Mean:	5.30E+06	pCi/m^2
Median:	1.20E+06	pCi/m^2
ST DEV:	9.36E+06	
Skew:	2.11E+00	



Upper Value	Observation Frequency	Observation %
3.71E+06	39	72%
7.43E+06	5	9%
1.11E+07	2	4%
1.49E+07	0	0%
1.86E+07	0	0%
2.23E+07	3	6%
2.60E+07	2	4%
2.97E+07	0	0%
3.34E+07	2	4%
3.71E+07	1	2%
TOTAL	54	100%

QUANTILE PLOT FOR Eu-154

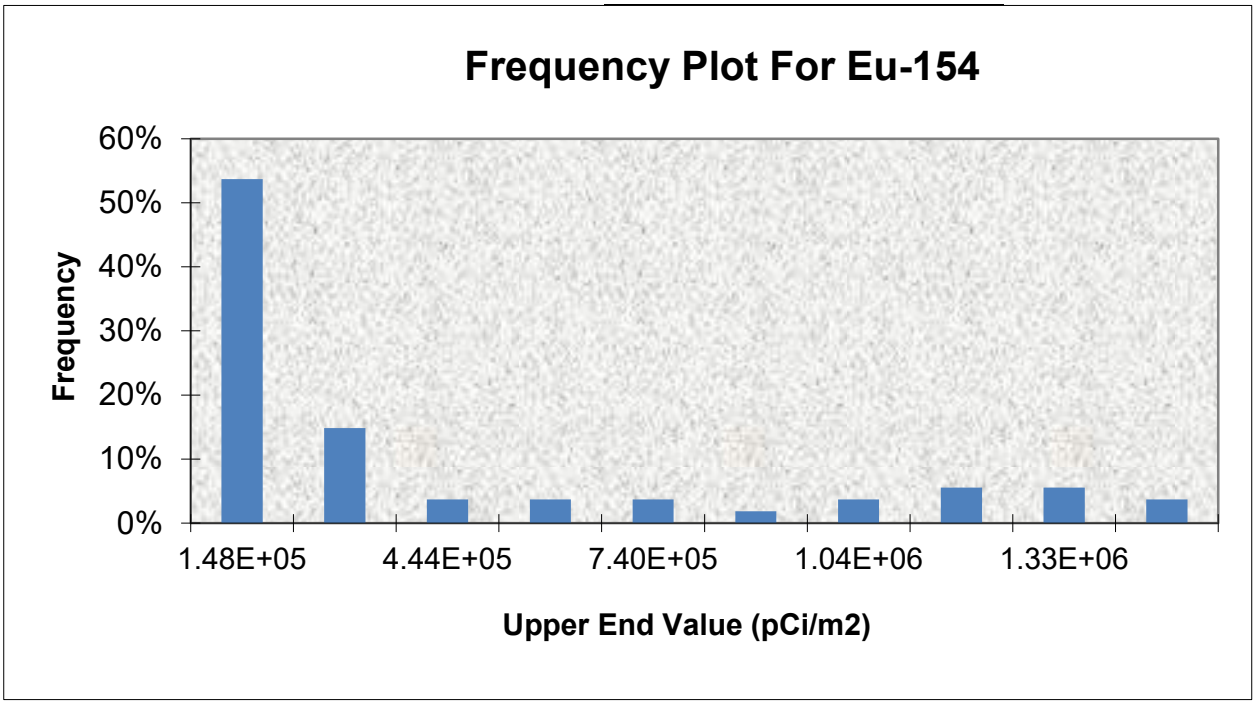
Survey Unit: 02110
Survey Unit Name: Unit 2 Under Vessel
Mean: 3.46E+05 pCi/m^2



RANK	Eu-154	%	RANK	Eu-154	%	RANK	Eu-154	%
1	0.00E+00	1%	19	3.08E+04	34%	37	2.91E+05	68%
2	0.00E+00	3%	20	5.19E+04	36%	38	4.08E+05	69%
3	1.91E+03	5%	21	6.28E+04	38%	39	4.18E+05	71%
4	3.52E+03	6%	22	6.94E+04	40%	40	4.48E+05	73%
5	6.28E+03	8%	23	7.61E+04	42%	41	5.27E+05	75%
6	6.74E+03	10%	24	9.56E+04	44%	42	6.00E+05	77%
7	7.10E+03	12%	25	1.05E+05	45%	43	6.03E+05	79%
8	1.21E+04	14%	26	1.05E+05	47%	44	7.82E+05	81%
9	1.21E+04	16%	27	1.09E+05	49%	45	9.76E+05	82%
10	1.26E+04	18%	28	1.34E+05	51%	46	9.92E+05	84%
11	1.53E+04	19%	29	1.40E+05	53%	47	1.06E+06	86%
12	2.00E+04	21%	30	1.53E+05	55%	48	1.09E+06	88%
13	2.16E+04	23%	31	1.77E+05	56%	49	1.17E+06	90%
14	2.27E+04	25%	32	1.86E+05	58%	50	1.23E+06	92%
15	2.37E+04	27%	33	2.13E+05	60%	51	1.23E+06	94%
16	2.73E+04	29%	34	2.18E+05	62%	52	1.30E+06	95%
17	2.75E+04	31%	35	2.47E+05	64%	53	1.39E+06	97%
18	2.76E+04	32%	36	2.55E+05	66%	54	1.48E+06	99%

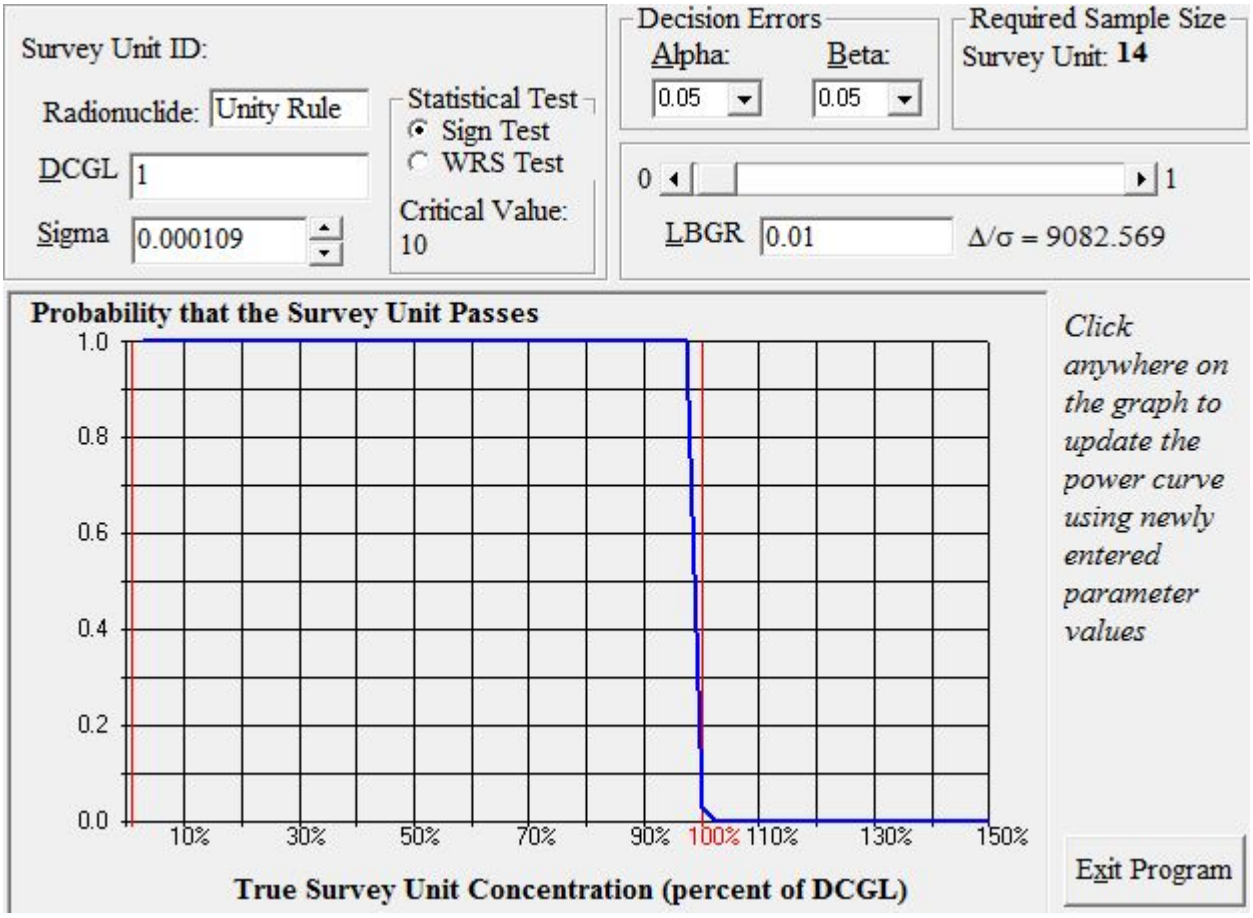
HISTOGRAM FOR Eu-154

Survey Unit:	**02110**	
Survey Unit Name:	**Unit 2 Under Vessel**	
Mean:	3.46E+05	pCi/m^2
Median:	1.21E+05	pCi/m^2
ST DEV:	4.48E+05	
Skew:	1.29E+00	



Upper Value	Observation Frequency	Observation %
1.48E+05	29	54%
2.96E+05	8	15%
4.44E+05	2	4%
5.92E+05	2	4%
7.40E+05	2	4%
8.88E+05	1	2%
1.04E+06	2	4%
1.18E+06	3	6%
1.33E+06	3	6%
1.48E+06	2	4%
TOTAL	54	100%

Retrospective Power Curve for Survey Unit



ATTACHMENT 6
ISOCS ANALYTICAL REPORTS
(See Separate File for ISOCS Reports)

ATTACHMENT 7
EBERLINE REPORTS

(See separate file for Eberline Analytical Reports)