OSR 19-350 (Rev 4-17-2013)

Engineering Calculation Amendment (ECA) Cover Sheet

Proc Ref. E7, 2.31; E7, 1.54

Sheet 1 of 24

Project/Task SDIP - Saltstone	**ECA Number** N-ECA-Z-00002	**Project/Task Number** Y544
Title Salt Solution Receipt Tank (SSRT) Dose Rate and Shielding Evaluation	**Functional Classification** PS	
	Discipline Nuclear	
Amended Type 1 Calculation (Number, Rev) N-CLC-Z-00021, Rev. 0	**ECA Status** ☐ Preliminary ☒ Confirmed ☐ Incorporation Not Required	
Computer Program Number Monte Carlo N-Particle (MCNP) 5, MCNP Visual Editor ☐ N/A	**Version/Release No.** 1.6, X24G	
Reason for Change N-CLC-Z-00021, Rev. 0 was based on two SSRTs receiving decontaminated salt solution (DSS) from the Salt Waste Processing Facility (SWPF) which is not scheduled to begin operations until December 2018. This ECA will update N-CLC-Z-00021 based on an alternate SSRT configuration that would allow the receipt of higher activity DSS from the current Actinide Removal Processing (ARP)/Modular Caustic Side Solvent Extraction Unit (MCU) until SWPF begins operations. Results of this ECA will be used to develop an interim SSRT operating strategy as well as to provide dose rate inputs to a project time-and-motion study (TMS) and external dose assessment (EDA).	**DC/RO** N/A	**Date** N/A

Description of Change and Summary of Conclusions

0.015 Ci/gal Cs-137 DSS can be processed into SSRT1 only up to 15,000 gallons without any additional tanktop or platform shielding. Dose rates above the SSRT enclosure platform are not expected to exceed 100 mrem/hour @ 30 cm (Radiation Area). However, under these processing conditions dose rates at the current fenceline 36' North of the SSRT enclosure will exceed the Controlled Area dose rate criterion of 0.05 mrem/hour. To support these operational conditions, either the fenceline (Radiological Buffer Area (RBA) boundary), would need to be moved or a new RBA boundary barricade would need to be established outside the fenceline at least 10 feet further North. Likewise, penetrations through the SSRT1 enclosure platform are not expected to increase dose rates above the platform thereby maintaining its Radiation Area status. No supplemental shielding around the penetrations is required, but should be considered around the manway as an As Low As Reasonably Achievable (ALARA) implementation based on personnel occupancy as dose rates there challenge 100 mrem/hour @ 30 cm. All individual transfer line dose rates are also expected to be less than 100 mrem/hour @ 30 cm for 0.015 Ci/gal DSS processing. Again, no additional shielding is specifically required, but a minimum of one layer of lead blankets (or equivalent) around the four transfer lines between the SSRT and CCBT enclosures should be considered as an ALARA implementation for transient conditions. Dose rate results from this ECA (see Tables 9 – 14) will be combined with updated TMS data to complete an EDA in hopes of ensuring annual personnel doses associated with 0.015 Ci/gal DSS processing up to 15,000 gallons into SSRT1 only will meet the radiological design basis total effective dose limit of 1,000 mrem/person/year. The EDA may also identify locations where temporary shielding can easily be added to minimize personnel doses ALARA and less than the facility administrative control limit of 500 mrem/year.

REVISIONS

Rev No.	Revision Description
0	Evaluate dose rates and shielding associated with SSRT processing of salt solution more radioactive than for which it was originally designed.
N/A	

SIGN OFF

Rev No.	Originator (Print / Sign & Date)	Verification/Checking Method	Verifier/Checker (Print / Sign & Date)	Manager (Print / Sign & Date)
0	M. A. Broome 12/22/15	☐ Design Check (GS/PS only) ☒ Document Review ☐ Qualification Testing ☐ Alternate Calculation ☐ Operational Testing	C. C. Swanek 12/22/15	R. D. Thames 12/22/2015
N/A		☐ Design Check (GS/PS only) ☐ Document Review ☐ Qualification Testing ☐ Alternate Calculation ☐ Operational Testing		

Additional Reviewer (Print Name) N/A	**Signature** N/A	**Date** N/A
Design Authority (Print Name) W. C. Miles, Jr.	**Signature**	**Date** 12/22/2015
Release to Outside Agency (Print Name) N/A	**Signature** N/A	**Date** N/A

Security Classification of the ECA

UNCLASSIFIED

Engineering Calculation Amendment (ECA) Continuation Sheet

ECA Number	Rev. Number
N-ECA-Z-00002	0

INTRODUCTION

MCNP radiation transport modeling in N-CLC-Z-00021, Rev. 0, *Salt Solution Receipt Tank (SSRT) Dose Rate and Shielding Evaluation* was based on [Ref. 1]:

- both SSRT1 and SSRT2 in operation;
- both SSRTs full of DSS to a maximum operational capacity of 60,000 gallons each;
- a maximum Cs-137 concentration in the DSS of 0.0002 Ci/gal; and
- no shielding credit for any structural steel framing on top of an SSRT or supporting the ½"-thick steel SSRT enclosure platform was included (i.e., modeled as empty cell air space between the SSRT tanktops and the underside of the platform).

This ECA will update and rerun those same MCNP radiation transport models based on:

- only the SSRT1 in operation[1];
- a lesser maximum operational capacity of 15,000 gallons;
- a higher maximum Cs-137 concentration in the DSS of 0.015 Ci/gal; and
- including the structural steel framing on top of SSRT1 and supporting the SSRT1 enclosure platform (i.e., both in the formerly empty cell air space)[2].

Processing 75x more radioactive DSS (i.e., = 0.015 Ci/gal ÷ 0.0002 Ci/gal) requires a single SSRT at less than maximum capacity (i.e., ≤15,000 gallons) in order to meet the original radiological dose rate criteria for this project. Those criteria continue to be:

- Dose rates anywhere outside the SSRT enclosure >100 mrem//hour @ 30 cm (High Radiation Area) are prohibited;
- Dose rates on top of the SSRT enclosure are ≤100 mrem/hour (Radiation Area);
- Dose rates around the SSRT enclosure inside the fence are ≤5.0 mrem/hour (Radiological Buffer Area); and
- Dose rates outside the fence are ≤0.05 mrem/hour (Controlled Area).

No additional steel or lead shielding either on the SSRT1 tanktop or on the enclosure platform is included in this ECA.

NOTES:

[1]Preliminary radiation transport modeling indicated that SSRT2, due to its proximity to areas west and northwest of the SSRT enclosure where non-radworkers could be present, could not receive any quantity of 0.015 Ci/gal Cs-137 DSS without exceeding radiological dose rate criteria.

[2]Structural steel framing on top of SSRT2 and supporting the SSRT2 platform was not modeled because SSRT2 is empty and has no source term to be shielded.

OPEN ITEMS

There are no open items associated with this ECA.

Engineering Calculation Amendment (ECA) Continuation Sheet

ECA Number N-ECA-Z-00002

Rev. Number 0

REFERENCES

1. N-CLC-Z-00021, Rev. 0, *Salt Solution Receipt Tank (SSRT) Dose Rate and Shielding Evaluation,* 11/29/12.

2. N-CLC-Z-00027, Rev. 0, *Saltstone Disposal Unit (SDU) 6 Dose Rate and Bulk Shielding Evaluation,* 7/15/13.

3. J-JZ-Z-00206, Rev. 0, *Saltstone Instrument Scaling and Setpoint Document Z201-ZZZL-7506 Salt Solution Receipt Tank #1 – DSS Level,* 7/9/15.

4. J-J6-Z-00002, Rev. 1, *Salt Solution Receipt Tk-0001 and Tk-0002 Level Setting Diagram,* 2/3/15.

5. M-DS-Z-00026, Rev. 5, *Salt Solution Receipt Tank Data Sheet,* 11/17/11.

6. U-TC-Z-00001, Rev. 13, *Task Requirements and Criteria Document, Salt Solution Receipt Tanks - Saltstone Facility Modifications,* 8/26/15.

7. SRR-RPE-2015-00004, Rev. 0, *Radiological Impacts at ARP/MCU, Tank 50 and Saltstone Facilities for Salt Batch 8 Processing without MST Strikes,* 4/13/15.

8. CBI Document No. 174992-000-SP-01-000201, Rev. 2, *Orientation SSR Tanks TK-0001 & TK-0002 (2) 26'-0 Dia x 19'6 Flat Roof Tanks Savannah River Remediation, LLC Aiken, SC,* 6/21/11.

9. CBI Document No. 174992-000-SP-01-001201, Rev. 1, *Roof Rafters Installation SSR Tanks Tk-0001 & Tk-0002 (2) 26'-0 Dia x 19'-6 Flat Roof Tanks Savannah River Remediation, LLC Aiken, SC,* 6/21/11.

10. CBI Document No. 174992-000-SP-01-002101, Rev. 1, *Roof Nozzle Gusset Plate Details SSR Tanks Tk-0001 & Tk-0002 (2) 26'-0 Dia x 19'-6 Flat Roof Tanks Savannah River Remediation, LLC Aiken, SC,* 3/18/11.

11. CBI Document No. 174992-000-SP-01-002301, Rev. 2, *Roof Nozzle Installation SSR Tanks Tk-0001 & Tk-0002 (2) 26'-0 Dia x 19'-6 Flat Roof Tanks Savannah River Remediation, LLC Aiken, SC,* 3/25/11.

12. CBI Document No. 174992-000-SP-01-002302, Rev. 0, *Roof Nozzle Installation SSR Tanks Tk-0001 & Tk-0002 (2) 26'-0 Dia x 19'-6 Flat Roof Tanks Savannah River Remediation, LLC Aiken, SC,* 2/24/10.

13. CBI Document No. 174992-000-SP-01-001202, Rev. 0, *Roof Rafter Assembly Details SSR Tanks Tk-0001 & Tk-0002 (2) 26'-0 Dia x 19'-6 Flat Roof Tanks Savannah River Remediation, LLC Aiken, SC,* 2/24/10.

14. SRS Drawing No. C-SP-Z-00001, Rev. 2, *Saltstone Production Facility - Z Area Tank 50 Return to Service SSRT Tank Enclosure Platform Framing Plan Sections and Details,* 7/21/15.

15. *The Engineering Toolbox – American Wide Flange Beams ASTM A6 in English Units,* 12/4/15. <http://www.engineeringtoolbox.com/american-wide-flange-steel-beams-d_1319.html>

16. SRS Drawing No. WB01455A-000003, Rev. H, *Outline Installation Drawing,* 6/6/11.

17. CBI Document No. 174992-000-SP-01-002201, Rev. 0, *Roof Manhole Installation SSR Tanks Tk-0001 & Tk-0002 (2) 26'-0 Dia x 19'-6 Flat Roof Tanks Savannah River Remediation, LLC Aiken, SC, 2/24/10*.

18. CBI Document No. 174992-000-SP-01-002202, Rev. 1, *Roof Manhole Assembly SSR Tanks Tk-0001 & Tk-0002 (2) 26'-0 Dia x 19'-6 Flat Roof Tanks Savannah River Remediation, LLC Aiken, SC,* 8/21/15.

Engineering Calculation Amendment (ECA) Continuation Sheet

ECA Number N-ECA-Z-00002

Rev. Number 0

INPUTS & ASSUMPTIONS

1. The 0.015 Ci/gal DSS source term energy spectrum is presented in Table 1 [Ref. 2].

Table 1 – 0.015 Ci/gal DSS Source Term Energy Spectrum

Group	Min	Max	Strength (γ/sec/gal)	Fraction	Group	Min	Max	Strength (γ/sec/gal)	Fraction
1	0.01	0.05	4.517E+07	9.0322E-02	10	1.33	1.66	1.480E+05	2.9594E-04
2	0.05	0.10	7.051E+05	1.4099E-03	11	1.66	2.00	1.120E+01	2.2396E-08
3	0.10	0.20	5.134E+05	1.0266E-03	12	2.00	2.50	1.617E+00	3.2334E-09
4	0.20	0.30	8.829E+04	1.7654E-04	13	2.50	3.00	1.381E-03	2.7614E-12
5	0.30	0.40	5.127E+04	1.0252E-04	14	3.00	4.00	0.000E+00	0.0000E+00
6	0.40	0.60	2.830E+06	5.6589E-03	15	4.00	5.00	0.000E+00	0.0000E+00
7	0.60	0.80	4.490E+08	8.9782E-01	16	5.00	6.50	0.000E+00	0.0000E+00
8	0.80	1.00	1.137E+06	2.2735E-03	17	6.50	8.00	0.000E+00	0.0000E+00
9	1.00	1.33	4.413E+05	8.8242E-04	18	8.00	10.00	0.000E+00	0.0000E+00
							Total	5.001E+08	1.000E+00

2. Three SSRT1 capacities will be evaluated:

   - 2,600 gallons (= 9,842,071 cc) represents the approximate low indicator level down to which an SSRT can be pumped [Refs. 3, 4, 5].
   - 8,235 gallons (= 31,172,868 cc) represents the lowest capacity implemented for freeze protection [Ref. 6];
   - 15,000 gallons (= 56,781,180 cc) represents the potential maximum operating capacity for 0.015 Ci/gal DSS.

   [NOTE: 15,000 gallons was based on a preliminary estimate of 13,209 gallons [Ref. 7] and subsequent radiation transport modeling indicating any higher capacity would result in exceeding an HRA dose rate of 100 mrem/hour @ 30 cm above the SSRT1 platform.]

3. SSRT1 tanktop structural steel I-beam and plate stiffener dimensions are presented in Tables 2 and 3, respectively [Refs. 8, 9, 10, 11, 12, 13, 15].

Table 2 – SSRT1 Tanktop I-Beam Dimensions

I-Beam Size	Height*		Length		Width		Web Thickness	
	(in)	(cm)	(in)	(cm)	(in)	(cm)	(in)	(cm)
W12x106	12.89	32.74	317.50	806.45	12.22	31.04	0.61	1.55
W12x35	12.50	31.75	49.50	125.73	6.56	16.66	0.30	0.76
W12x14	11.91	30.25	279.50	709.93	3.97	10.08	0.20	0.51
W12x14	11.91	30.25	169.50	430.53	3.97	10.08	0.20	0.51

[NOTE: Actual W12 I-beam heights per Reference 8 vary slightly around 12 inches (e.g., 11.91”, 12.50”, 12.89”). For ease and convenience of MCNP modeling, they were all input as 12 inches (30.48 cm) in order to be flush and level across the SSRT1 tanktop. This is conservative to negligible as it results in slightly less steel shielding.]

Table 3 – SSRT1 Tanktop Plate Stiffener Dimensions

Stiffener	Length		Width		Thickness	
	(in)	(cm)	(in)	(cm)	(in)	(cm)
N5	53.00	134.62	14.63	37.15	0.75	1.91
N15	56.50	143.51				
N8	51.25	130.18	12.00	30.48	0.75	1.91
N6, N9, N11, N17	53.00	134.62				
N10	53.75	136.53				
N3, N4, N12, N13, N14, N16, N17	56.50	143.51				

4. SSRT1 enclosure platform structural steel framing I-beam rafter dimensions are presented in Table 4 [Refs. 14, 15].

Table 4 – SSRT1 Enclosure Platform I-Beam Dimensions

I-Beam Size	Height		Length		Width		Web Thickness	
	(in)	(cm)	(in)	(cm)	(in)	(cm)	(in)	(cm)
W8x13	8.00	20.32	60.00	152.40	4.00	10.16	0.23	0.58
W10x30	10.47	26.59	66.00	167.64	5.81	14.76	0.30	0.76
W12x40	11.94	30.33	148.00	375.92	8.00	20.32	0.30	0.76
W24x62	23.70	60.20	426.00	1082.04	7.04	17.88	0.43	1.09

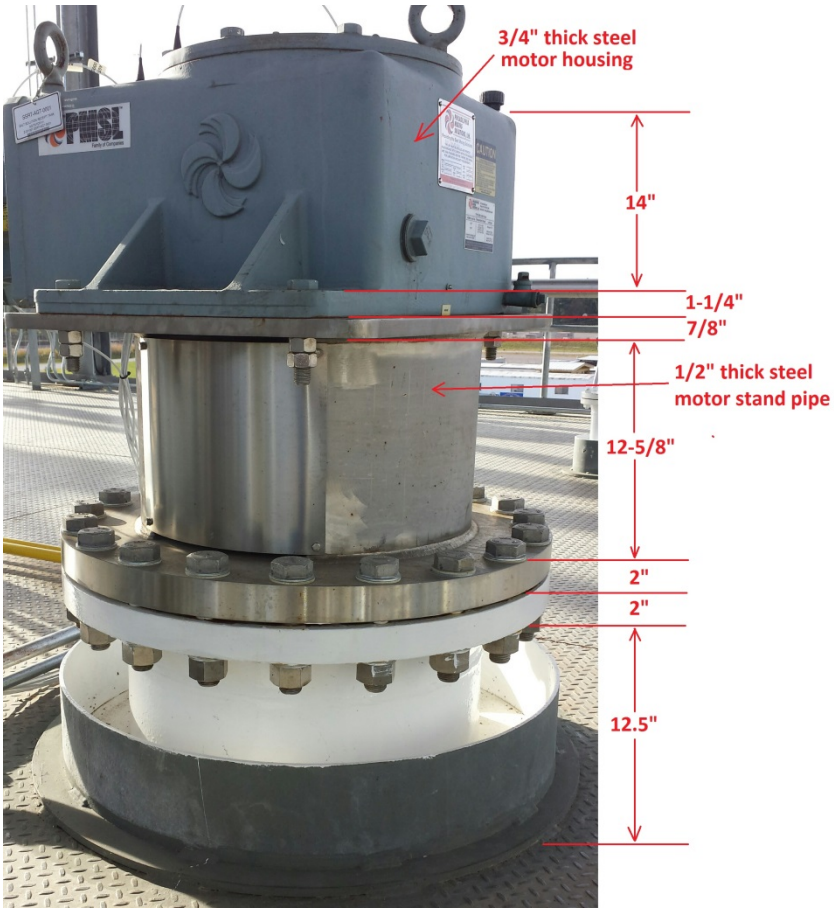
5. Structural steel I-beam connectors were not modeled. This was done for ease and convenience of MCNP modeling. It is conservative to negligible as it results in small gaps between the I-beams and slightly less steel shielding.

6. Structural steel I-beams were modeled flush against the interior of the SSRT1 concrete enclosure. I-beam wall pockets were not modeled. This was done for ease and convenience of MCNP modeling. It is conservative to negligible as it results in slightly less steel shielding.

7. An open barrel ladder over the Pump Gallery that was omitted in the original N-CLC-Z-00021 radiological evaluation was included in the revised MCNP radiation transport models of the SSRT enclosure in this ECA. It was modeled as a 44" x 40" (111.76 cm x 101.60 cm) opening in the NE corner of the platform to evaluate potential radiation streaming from the pumps in the Pump Gallery below [Ref. 14].

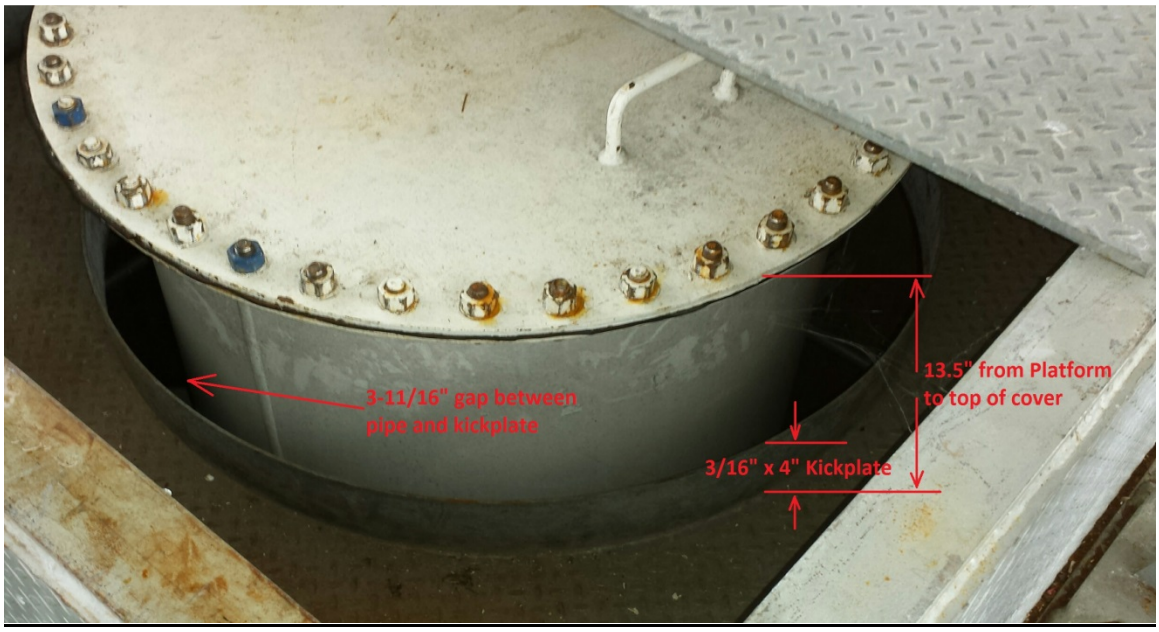
8. Updated agitator platform penetration details were obtained from Reference 16 and measured field conditions (see Figure 1).

Figure 1 – Agitator Field Conditions



9. Updated manway access platform penetration details were obtained from References 17 and 18 as well as from measured field conditions (see Figure 2).

Figure 2 – Manway Field Conditions



ANALYTICAL METHODS AND COMPUTATIONS

The basic methodology was to rerun the same MCNP models used in N-CLC-Z-00021, Rev. 0 with slight revisions as follows:

- redefine the source input for the 0.015 Ci/gal source term;
- adjust the extent of the SSRT1 fill height so as to correspond to the three lower tank volume(s);
- add two layers of structural steel – one on the tanktop, one supporting the platform – in the cell space previously modeled as air;
- add the ladder opening in the platform above the Pump Gallery; and
- add some additional detector (tally) locations.

1. SSRT1 Models

SSRT1 volumes (V) of 2,600 gallons (9,842,071 cc), 8,235 gallons (31,172,868 cc) and 15,000 gallons (56,781,180 cc) result in the following revised fill heights (h):

$V = \pi * r^2 * h$ where radius (r) is 395.45 cm $\leftrightarrow$ $h = V/\pi * r^2$
h_{2600} = (9,842,071 cc) / ($(\pi)*(395.45\text{ cm})^2$) = 20.03 cm
h_{8235} = (31,172,868 cc) / ($(\pi)*(395.45\text{ cm})^2$) = 63.45 cm
h_{15000} = (56,781,180 cc) / ($(\pi)*(395.45\text{ cm})^2$) = 115.58 cm

Revised tally multipliers (TMs) for each volume were determined as follows. The original N-CLC-Z-00021 radiological evaluation input 43 gallons of DSS between the Pump Room pumps and the four transfer lines exiting the SSRT enclosure. This amount remains unchanged. When summed with the three new volumes being evaluated and multiplied by the new 0.015 Ci/gal DSS source strength of 5.001E+08 γ/sec/gal (from Table 1), revised TMs for each MCNP model are:

TM_{2600} = (2,600 gallons + 43 gallons)*(5.001E+08 γ/sec/gal) = 1.3218 γ/sec;
TM_{8235} = (8,235 gallons + 43 gallons)*(5.001E+08 γ/sec/gal) = 4.13983E+12 γ/sec; and
TM_{15000} = (15,000 gallons + 43 gallons)*(5.001E+08 γ/sec/gal) = 7.523E+12 γ/sec.

SSRT1 enclosure platform structural steel framing is represented in Figures 2 and 3 below. Figure 3 shows a plan view of the I-beam locations with dimensions. Figure 4 shows a 3-dimensionsal (3D), MCNP Visual Editor representation of the I-beam layout. Table 5 lists the additional lines of MCNP input code necessary to model the framing (based on Input 4 – Table 4).

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Figure 3 – SSRT1 Enclosure Platform Structural Steel Framing Dimensions

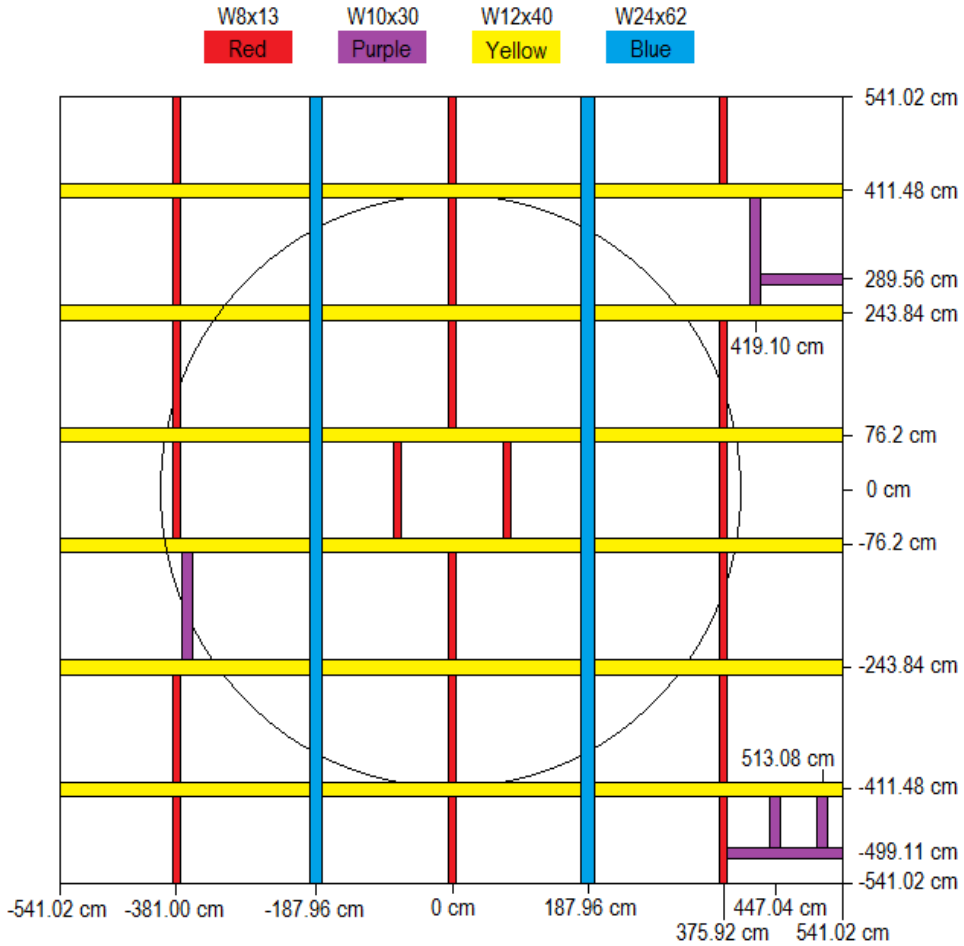

Figure 4 – MCNP Visual Editor Representation of SSRT1 Enclosure Platform Structural Steel Framing

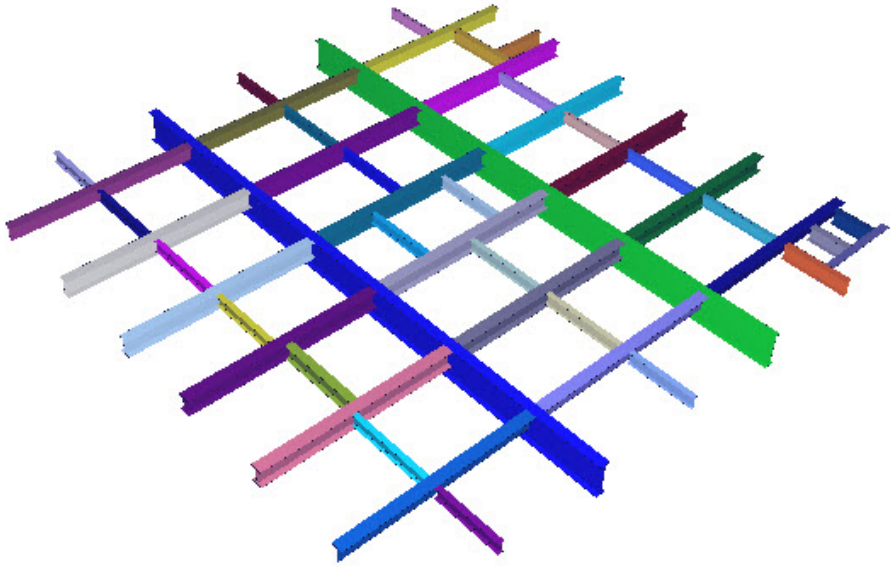

Table 5 – MCNP Input Code for SSRT1 Enclosure Structural Steel

STEEL MEMBER	Macrobody*	X_{min}	X_{max}	Y_{min}	Y_{max}	Z_{min}	Z_{max}
Right W24x62 Top Flange	RPP	179.02	196.90	-541.02	541.02	735.51	736.60
Right W24x62 Web	RPP	187.41	188.51	-541.02	541.02	677.49	735.51
Right W24x62 Bottom Flange	RPP	179.02	196.90	-541.02	541.02	676.40	677.49
Left W24x62 Top Flange	RPP	-196.90	-179.02	-541.02	541.02	735.51	736.60
Left W24x62 Web	RPP	-188.51	-187.41	-541.02	541.02	677.49	735.51
Left W24x62 Bottom Flange	RPP	-196.90	-179.02	-541.02	541.02	676.40	677.49
Right W12x40 #1 Top Flange	RPP	196.90	541.02	401.32	421.64	735.84	736.60
Right W12x40 #1 Web	RPP	196.90	541.02	411.10	411.86	707.03	735.84
Right W12x40 #1 Bottom Flange	RPP	196.90	541.02	411.10	411.86	706.27	707.03
Right W12x40 #2 Top Flange	RPP	196.90	541.02	233.68	254.00	735.84	736.60
Right W12x40 #2 Web	RPP	196.90	541.02	243.46	244.22	707.03	735.84
Right W12x40 #2 Bottom Flange	RPP	196.90	541.02	233.68	254.00	706.27	707.03
Right W12x40 #3 Top Flange	RPP	196.90	541.02	66.04	86.36	735.84	736.60
Right W12x40 #3 Web	RPP	196.90	541.02	75.82	76.58	707.03	735.84
Right W12x40 #3 Bottom Flange	RPP	196.90	541.02	66.04	86.36	706.27	707.03
Right W12x40 #4 Top Flange	RPP	196.90	541.02	-86.36	-66.04	735.84	736.60
Right W12x40 #4 Web	RPP	196.90	541.02	-76.58	-75.82	707.03	735.84
Right W12x40 #4 Bottom Flange	RPP	196.90	541.02	-86.36	-66.04	706.27	707.03
Right W12x40 #5 Top Flange	RPP	196.90	541.02	-254.00	-233.68	735.84	736.60
Right W12x40 #5 Web	RPP	196.90	541.02	-244.22	-243.46	707.03	735.84
Right W12x40 #5 Bottom Flange	RPP	196.90	541.02	-254.00	-233.68	706.27	707.03
Right W12x40 #6 Top Flange	RPP	196.90	541.02	-421.64	-401.32	735.84	736.60
Right W12x40 #6 Web	RPP	196.90	541.02	-411.86	-411.10	707.03	735.84
Right W12x40 #6 Bottom Flange	RPP	196.90	541.02	-411.86	-411.10	706.27	707.03
Center W12x40 #1 Top Flange	RPP	-179.02	179.02	401.32	421.64	735.84	736.60
Center W12x40 #1 Web	RPP	-179.02	179.02	411.10	411.86	707.03	735.84
Center W12x40 #1 Bottom Flange	RPP	-179.02	179.02	411.10	411.86	706.27	707.03
Center W12x40 #2 Top Flange	RPP	-179.02	179.02	233.68	254.00	735.84	736.60
Center W12x40 #2 Web	RPP	-179.02	179.02	243.46	244.22	707.03	735.84
Center W12x40 #2 Bottom Flange	RPP	-179.02	179.02	233.68	254.00	706.27	707.03
Center W12x40 #3 Top Flange	RPP	-179.02	179.02	66.04	86.36	735.84	736.60
Center W12x40 #3 Web	RPP	-179.02	179.02	75.82	76.58	707.03	735.84
Center W12x40 #3 Bottom Flange	RPP	-179.02	179.02	66.04	86.36	706.27	707.03
Center W12x40 #4 Top Flange	RPP	-179.02	179.02	-86.36	-66.04	735.84	736.60
Center W12x40 #4 Web	RPP	-179.02	179.02	-76.58	-75.82	707.03	735.84
Center W12x40 #4 Bottom Flange	RPP	-179.02	179.02	-86.36	-66.04	706.27	707.03
Center W12x40 #5 Top Flange	RPP	-179.02	179.02	-254.00	-233.68	735.84	736.60
Center W12x40 #5 Web	RPP	-179.02	179.02	-244.22	-243.46	707.03	735.84
Center W12x40 #5 Bottom Flange	RPP	-179.02	179.02	-254.00	-233.68	706.27	707.03
Center W12x40 #6 Top Flange	RPP	-179.02	179.02	-421.64	-401.32	735.84	736.60
Center W12x40 #6 Web	RPP	-179.02	179.02	-411.86	-411.10	707.03	735.84
Center W12x40 #6 Bottom Flange	RPP	-179.02	179.02	-411.86	-411.10	706.27	707.03
Left W12x40 #1 Top Flange	RPP	-541.02	-196.90	401.32	421.64	735.84	736.60
Left W12x40 #1 Web	RPP	-541.02	-196.90	411.10	411.86	707.03	735.84
Left W12x40 #1 Bottom Flange	RPP	-541.02	-196.90	411.10	411.86	706.27	707.03
Left W12x40 #2 Top Flange	RPP	-541.02	-196.90	233.68	254.00	735.84	736.60
Left W12x40 #2 Web	RPP	-541.02	-196.90	243.46	244.22	707.03	735.84
Left W12x40 #2 Bottom Flange	RPP	-541.02	-196.90	233.68	254.00	706.27	707.03
Left W12x40 #3 Top Flange	RPP	-541.02	-196.90	66.04	86.36	735.84	736.60
Left W12x40 #3 Web	RPP	-541.02	-196.90	75.82	76.58	707.03	735.84
Left W12x40 #3 Bottom Flange	RPP	-541.02	-196.90	66.04	86.36	706.27	707.03
Left W12x40 #4 Top Flange	RPP	-541.02	-196.90	-86.36	-66.04	735.84	736.60
Left W12x40 #4 Web	RPP	-541.02	-196.90	-76.58	-75.82	707.03	735.84
Left W12x40 #4 Bottom Flange	RPP	-541.02	-196.90	-86.36	-66.04	706.27	707.03
Left W12x40 #5 Top Flange	RPP	-541.02	-196.90	-254.00	-233.68	735.84	736.60
Left W12x40 #5 Web	RPP	-541.02	-196.90	-244.22	-243.46	707.03	735.84

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Table 5 – MCNP Input Code for SSRT1 Enclosure Structural Steel

STEEL MEMBER	Macrobody*	X_{min}	X_{max}	Y_{min}	Y_{max}	Z_{min}	Z_{max}
Left W12x40 #5 Bottom Flange	RPP	-541.02	-196.90	-254.00	-233.68	706.27	707.03
Left W12x40 #6 Top Flange	RPP	-541.02	-196.90	-421.64	-401.32	735.84	736.60
Left W12x40 #6 Web	RPP	-541.02	-196.90	-411.86	-411.10	707.03	735.84
Left W12x40 #6 Bottom Flange	RPP	-541.02	-196.90	-411.86	-411.10	706.27	707.03
Left W8x13 #1 Top Flange	RPP	-386.08	-375.92	421.64	541.02	736.37	736.60
Left W8x13 #1 Web	RPP	-381.12	-380.88	421.64	541.02	716.51	736.37
Left W8x13 #1 Bottom Flange	RPP	-386.08	-375.92	421.64	541.02	716.28	716.51
Left W8x13 #2 Top Flange	RPP	-386.08	-375.92	254.00	401.32	736.37	736.60
Left W8x13 #2 Web	RPP	-381.12	-380.88	254.00	401.32	716.51	736.37
Left W8x13 #2 Bottom Flange	RPP	-386.08	-375.92	254.00	401.32	716.28	716.51
Left W8x13 #3 Top Flange	RPP	-386.08	-375.92	86.36	233.68	736.37	736.60
Left W8x13 #3 Web	RPP	-381.12	-380.88	86.36	233.68	716.51	736.37
Left W8x13 #3 Bottom Flange	RPP	-386.08	-375.92	86.36	233.68	716.28	716.51
Left W8x13 #4 Top Flange	RPP	-386.08	-375.92	-66.04	66.04	736.37	736.60
Left W8x13 #4 Web	RPP	-381.12	-380.88	-66.04	66.04	716.51	736.37
Left W8x13 #4 Bottom Flange	RPP	-386.08	-375.92	-66.04	66.04	716.28	716.51
Left W8x13 #6 Top Flange	RPP	-386.08	-375.92	-401.32	-254.00	736.37	736.60
Left W8x13 #6 Web	RPP	-381.12	-380.88	-401.32	-254.00	716.51	736.37
Left W8x13 #6 Bottom Flange	RPP	-386.08	-375.92	-401.32	-254.00	716.28	716.51
Left W8x13 #7 Top Flange	RPP	-386.08	-375.92	-541.02	-421.64	736.37	736.60
Left W8x13 #7 Web	RPP	-381.12	-380.88	-541.02	-421.64	716.51	736.37
Left W8x13 #7 Bottom Flange	RPP	-386.08	-375.92	-541.02	-421.64	716.28	716.51
Center W8x13 #1 Top Flange	RPP	-5.08	5.08	421.64	541.02	736.37	736.60
Center W8x13 #1 Web	RPP	-0.12	0.12	421.64	541.02	716.51	736.37
Center W8x13 #1 Bottom Flange	RPP	-5.08	5.08	421.64	541.02	716.28	716.51
Center W8x13 #2 Top Flange	RPP	-5.08	5.08	254.00	401.32	736.37	736.60
Center W8x13 #2 Web	RPP	-0.12	0.12	254.00	401.32	716.51	736.37
Center W8x13 #2 Bottom Flange	RPP	-5.08	5.08	254.00	401.32	716.28	716.51
Center W8x13 #3 Top Flange	RPP	-5.08	5.08	86.36	233.68	736.37	736.60
Center W8x13 #3 Web	RPP	-0.12	0.12	86.36	233.68	716.51	736.37
Center W8x13 #3 Bottom Flange	RPP	-5.08	5.08	86.36	233.68	716.28	716.51
Center W8x13 #4L Top Flange	RPP	-81.28	-71.12	-66.04	66.04	736.37	736.60
Center W8x13 #4L Web	RPP	-76.32	-76.08	-66.04	66.04	716.51	736.37
Center W8x13 #4L Bottom Flange	RPP	-81.28	-71.12	-66.04	66.04	716.28	716.51
Center W8x13 #4R Top Flange	RPP	71.12	81.28	-66.04	66.04	736.37	736.60
Center W8x13 #4R Web	RPP	76.08	76.32	-66.04	66.04	716.51	736.37
Center W8x13 #4R Bottom Flange	RPP	71.12	81.28	-66.04	66.04	716.28	716.51
Center W8x13 #5 Top Flange	RPP	-5.08	5.08	-233.68	-86.36	736.37	736.60
Center W8x13 #5 Web	RPP	-0.12	0.12	-233.68	-86.36	716.51	736.37
Center W8x13 #5 Bottom Flange	RPP	-5.08	5.08	-233.68	-86.36	716.28	716.51
Center W8x13 #6 Top Flange	RPP	-5.08	5.08	-401.32	-254.00	736.37	736.60
Center W8x13 #6 Web	RPP	-0.12	0.12	-401.32	-254.00	716.51	736.37
Center W8x13 #6 Bottom Flange	RPP	-5.08	5.08	-401.32	-254.00	716.28	716.51
Center W8x13 #7 Top Flange	RPP	-5.08	5.08	-541.02	-421.64	736.37	736.60
Center W8x13 #7 Web	RPP	-0.12	0.12	-541.02	-421.64	716.51	736.37
Center W8x13 #7 Bottom Flange	RPP	-5.08	5.08	-541.02	-421.64	716.28	716.51
Right W8x13 #1 Top Flange	RPP	370.84	381.00	421.64	541.02	736.37	736.60
Right W8x13 #1 Web	RPP	375.80	376.04	421.64	541.02	716.51	736.37
Right W8x13 #1 Bottom Flange	RPP	370.84	381.00	421.64	541.02	716.28	716.51
Right W8x13 #3 Top Flange	RPP	370.84	381.00	86.36	233.68	736.37	736.60
Right W8x13 #3 Web	RPP	375.80	376.04	86.36	233.68	716.51	736.37
Right W8x13 #3 Bottom Flange	RPP	370.84	381.00	86.36	233.68	716.28	716.51
Right W8x13 #4 Top Flange	RPP	370.84	381.00	-66.04	66.04	736.37	736.60
Right W8x13 #4 Web	RPP	375.80	376.04	-66.04	66.04	716.51	736.37
Right W8x13 #4 Bottom Flange	RPP	370.84	381.00	-66.04	66.04	716.28	716.51
Right W8x13 #5 Top Flange	RPP	370.84	381.00	-233.68	-86.36	736.37	736.60
Right W8x13 #5 Web	RPP	375.80	376.04	-233.68	-86.36	716.51	736.37

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Table 5 – MCNP Input Code for SSRT1 Enclosure Structural Steel

STEEL MEMBER	Macrobody*	X_{min}	X_{max}	Y_{min}	Y_{max}	Z_{min}	Z_{max}
Right W8x13 #5 Bottom Flange	RPP	370.84	381.00	-233.68	-86.36	716.28	716.51
Right W8x13 #6 Top Flange	RPP	370.84	381.00	-401.32	-254.00	736.37	736.60
Right W8x13 #6 Web	RPP	375.80	376.04	-401.32	-254.00	716.51	736.37
Right W8x13 #6 Bottom Flange	RPP	370.84	381.00	-401.32	-254.00	716.28	716.51
W10x30 @ Access Top Flange	RPP	-373.14	-358.38	-233.68	-86.36	735.84	736.60
W10x30 @ Access Web	RPP	-366.14	-365.38	-233.68	-86.36	710.77	735.84
W10x30 @ Access Bottom Flange	RPP	-373.14	-358.38	-233.68	-86.36	710.01	710.77
W10x30 @ Ladder #1 Top Flange	RPP	411.72	426.48	254.00	401.32	735.84	736.60
W10x30 @ Ladder #1 Web	RPP	418.72	419.48	254.00	401.32	710.77	735.84
W10x30 @ Ladder #1 Bottom Flange	RPP	411.72	426.48	254.00	401.32	710.01	710.77
W10x30 @ Ladder #2 Top Flange	RPP	426.48	541.02	282.18	296.94	735.84	736.60
W10x30 @ Ladder #2 Web	RPP	426.48	541.02	289.18	289.94	710.77	735.84
W10x30 @ Ladder #2 Bottom Flange	RPP	426.48	541.02	282.18	296.94	710.01	710.77
W10x30 @ Sump #1 Top Flange	RPP	368.54	383.30	-541.02	-421.64	735.84	736.60
W10x30 @ Sump #1 Web	RPP	375.54	376.30	-541.02	-421.64	710.77	735.84
W10x30 @ Sump #1 Bottom Flange	RPP	368.54	383.30	-541.02	-421.64	710.01	710.77
W10x30 @ Sump #2 Top Flange	RPP	383.30	541.02	-506.49	-491.73	735.84	736.60
W10x30 @ Sump #2 Web	RPP	375.54	376.30	-499.49	-498.73	710.77	735.84
W10x30 @ Sump #2 Bottom Flange	RPP	368.54	383.30	-506.49	-491.73	710.01	710.77
W10x30 @ Sump #3 Top Flange	RPP	439.66	454.42	-491.73	-421.64	735.84	736.60
W10x30 @ Sump #3 Web	RPP	446.66	447.42	-491.73	-421.64	710.77	735.84
W10x30 @ Sump #3 Bottom Flange	RPP	439.66	454.42	-491.73	-421.64	710.01	710.77
W10x30 @ Sump #4 Top Flange	RPP	505.70	520.46	-491.73	-421.64	735.84	736.60
W10x30 @ Sump #4 Web	RPP	512.70	513.46	-491.73	-421.64	710.77	735.84
W10x30 @ Sump #4 Bottom Flange	RPP	505.70	520.46	-491.73	-421.64	710.01	710.77

*RPP = rectangular parallelepiped

SSRT1 tanktop structural steel I-beams and plate stiffeners are represented in Figures 5 and 6 below. Figure 5 shows a plan view of the tanktop I-beam and stiffener locations with dimensions. Figure 6 shows a 3-dimensionsal (3D), MCNP Visual Editor representation of the tanktop I-beam and stiffener layout. Table 6 lists the additional lines of MCNP input code necessary to model the I-beams and stiffeners (based on Input 3 – Tables 2 and 3).

Figure 5 - SSRT1 Tanktop Structural Steel Dimensions

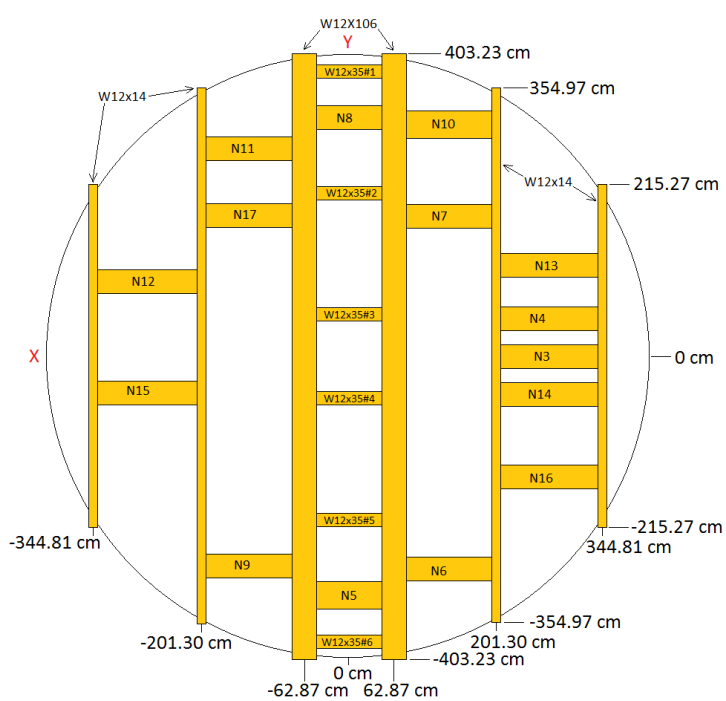

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Figure 6 - MCNP Visual Editor Representation of SSRT1 Tanktop Structural Steel

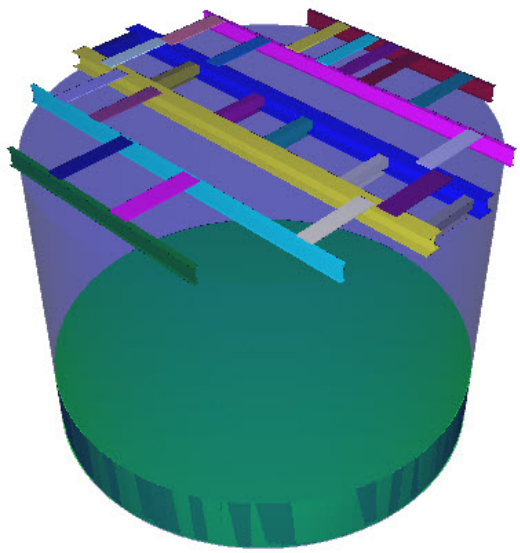


Table 6 – MCNP Input Code for SSRT1 Tanktop Structural Steel

STEEL MEMBER	Macrobody*	X_{min}	X_{max}	Y_{min}	Y_{max}	Z_{min}	Z_{max}
Right W12x106 Top Flange	RPP	47.35	78.39	-403.23	403.23	610.91	612.46
Right W12x106 Web	RPP	62.09	63.65	-403.23	403.23	583.53	610.91
Right W12x106 Bottom Flange	RPP	47.35	78.39	-403.23	403.23	581.98	583.53
Left W12x106 Top Flange	RPP	-78.39	-47.35	-403.23	403.23	610.91	612.46
Left W12x106 Web	RPP	-63.65	-62.09	-403.23	403.23	583.53	610.91
Left W12x106 Bottom Flange	RPP	-78.39	-47.35	-403.23	403.23	581.98	583.53
Inner Right W12x14 Top	RPP	196.26	206.34	-354.97	354.97	611.95	612.46
Inner Right W12x14 Web	RPP	201.04	201.56	-354.97	354.97	582.49	611.95
Inner Right W12x14 Bottom	RPP	196.26	206.34	-354.97	354.97	581.98	582.49
Inner Left W12x14 Top	RPP	-206.34	-196.26	-354.97	354.97	611.95	612.46
Inner Left W12x14 Web	RPP	-201.56	-201.04	-354.97	354.97	582.49	611.95
Inner Left W12x14 Bottom	RPP	-206.34	-196.26	-354.97	354.97	581.98	582.49
Outer Right W12x14 Top	RPP	339.77	349.85	-215.27	215.27	611.95	612.46
Outer Right W12x14 Web	RPP	344.55	345.07	-215.27	215.27	582.49	611.95
Outer Right W12x14 Bottom	RPP	339.77	349.85	-215.27	215.27	581.98	582.49
Outer Left W12x14 Top	RPP	-349.85	-339.77	-215.27	215.27	611.95	612.46
Outer Left W12x14 Web	RPP	-345.07	-344.55	-215.27	215.27	582.49	611.95
Outer Left W12x14 Bottom	RPP	-349.85	-339.77	-215.27	215.27	581.98	582.49
W12x35x1 Top Flange	RPP	-47.35	47.35	372.04	388.7	610.91	611.67
W12x35x1 Web	RPP	-62.09	62.09	379.99	380.75	583.53	610.91
W12x35x1 Bottom Flange	RPP	-47.35	47.35	372.04	388.7	582.77	583.53
W12x35x2 Top Flange	RPP	-47.35	47.35	209.8	226.46	610.91	611.67
W12x35x2 Web	RPP	-62.09	62.09	217.75	218.51	583.53	610.91
W12x35x2 Bottom Flange	RPP	-47.35	47.35	209.8	226.46	582.77	583.53
W12x35x3 Top Flange	RPP	-47.35	47.35	47.56	64.22	610.91	611.67
W12x35x3 Web	RPP	-62.09	62.09	55.51	56.27	583.53	610.91
W12x35x3 Bottom Flange	RPP	-47.35	47.35	47.56	64.22	582.77	583.53
W12x35x4 Top Flange	RPP	-47.35	47.35	-64.22	-47.56	610.91	611.67
W12x35x4 Web	RPP	-62.09	62.09	-56.27	-55.51	583.53	610.91
W12x35x4 Bottom Flange	RPP	-47.35	47.35	-64.22	-47.56	582.77	583.53
W12x35x5 Top Flange	RPP	-47.35	47.35	-226.46	-209.8	610.91	611.67
W12x35x5 Web	RPP	-62.09	62.09	-218.51	-217.75	583.53	610.91
W12x35x5 Bottom Flange	RPP	-47.35	47.35	-226.46	-209.8	582.77	583.53

Table 6 – MCNP Input Code for SSRT1 Tanktop Structural Steel

STEEL MEMBER	Macrobody*	X_{min}	X_{max}	Y_{min}	Y_{max}	Z_{min}	Z_{max}
W12x35x6 Top Flange	RPP	-47.35	47.35	-388.7	-372.04	610.91	611.67
W12x35x6 Web	RPP	-62.09	62.09	-380.75	-379.99	583.53	610.91
W12x35x6 Bottom Flange	RPP	-47.35	47.35	-388.7	-372.04	582.77	583.53
N11 Stiffener	RPP	-199.4	-64.78	261.92	292.4	612.46	614.37
N17 Stiffener	RPP	-199.4	-64.78	171.55	202.03	612.46	614.37
N9 Stiffener	RPP	-199.4	-64.78	-295.15	-264.67	612.46	614.37
N8 Stiffener	RPP	-67.31	62.87	303.58	334.06	612.46	614.37
N5 Stiffener	RPP	-67.31	67.31	-337.4	-300.24	612.46	614.37
N10 Stiffener	RPP	62.87	199.4	290.57	327.73	612.46	614.37
N7 Stiffener	RPP	64.78	199.4	171.55	202.03	612.46	614.37
N6 Stiffener	RPP	64.78	199.4	-297.82	-267.34	612.46	614.37
N12 Stiffener	RPP	-344.82	-201.3	83.66	114.14	612.46	614.37
N15 Stiffener	RPP	-344.82	-201.3	-69.26	-32.13	612.46	614.37
N13 Stiffener	RPP	201.3	344.82	106.69	137.17	612.46	614.37
N4 Stiffener	RPP	201.3	344.82	35.46	65.94	612.46	614.37
N3 Stiffener	RPP	201.3	344.82	-15.24	15.24	612.46	614.37
N14 Stiffener	RPP	201.3	344.82	-65.94	-35.46	612.46	614.37
N16 Stiffener	RPP	201.3	344.82	-175.26	-144.78	612.46	614.37

*RPP = rectangular parallelepiped

2. Transfer Lines

The original N-CLC-Z-00021 radiological evaluation included MCNP models of generic transfer lines with outside diameters (ODs) of 1, 2, 3 and 4 inches and line lengths (L) from 1 to 20 feet. In this ECA, the volume of each transfer line modeled remains the same. However, when each is multiplied by the new 0.015 Ci/gal DSS source strength of 5.001E+08 γ/sec/gal (from Table 1) they result in new TMs for each model (see Table 7).

Table 7 – Tally Multipliers for Transfer Line MCNP Models

L = Line Length (feet) V = Volume (gallons)

SS = Source Strength = 5.001E+08 γ/sec/gal TM = Tally Multiplier = V x SS (γ/sec)

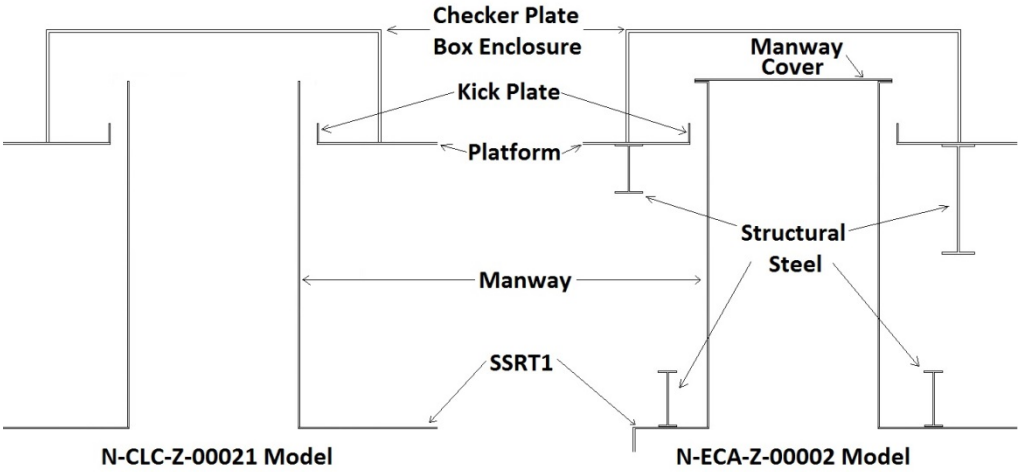
L	1" OD XFER LINE		2" OD XFER LINE		3" OD XFER LINE		4" OD XFER LINE	
	V	TM	V	TM	V	TM	V	TM
1'	0.0437	21,878,277	0.1705	85,263,179	0.3709	185,470,387	0.6370	318,569,774
2'	0.0885	44,255,790	0.3455	172,765,592	0.7556	377,884,866	1.3001	650,195,686
3'	0.1332	66,633,303	0.5204	260,268,006	1.1404	570,299,345	1.9633	981,821,598
4'	0.1780	89,010,816	0.6954	347,770,419	1.5251	762,713,824	2.6264	1,313,447,510
5'	0.2227	111,388,329	0.8704	435,272,833	1.9099	955,128,303	3.2895	1,645,073,422
6'	0.2675	133,765,842	1.0453	522,775,247	2.2946	1,147,542,783	3.9526	1,976,699,334
7'	0.3122	156,143,355	1.2203	610,277,660	2.6794	1,339,957,262	4.6157	2,308,325,246
8'	0.3570	178,520,868	1.3953	697,780,074	3.0641	1,532,371,741	5.2788	2,639,951,158
9'	0.4017	200,898,381	1.5703	785,282,487	3.4489	1,724,786,220	5.9420	2,971,577,070
10'	0.4465	223,275,894	1.7452	872,784,901	3.8336	1,917,200,699	6.6051	3,303,202,982
11'	0.4912	245,653,407	1.9202	960,287,314	4.2184	2,109,615,178	7.2682	3,634,828,894
12'	0.5360	268,030,920	2.0952	1,047,789,728	4.6031	2,302,029,657	7.9313	3,966,454,806
13'	0.5807	290,408,433	2.2701	1,135,292,142	4.9879	2,494,444,136	8.5944	4,298,080,718
14'	0.6254	312,785,946	2.4451	1,222,794,555	5.3726	2,686,858,616	9.2576	4,629,706,630
15'	0.6702	335,163,459	2.6201	1,310,296,969	5.7574	2,879,273,095	9.9207	4,961,332,542
16'	0.7149	357,540,971	2.7950	1,397,799,382	6.1421	3,071,687,574	10.5838	5,292,958,454
17'	0.7597	379,918,484	2.9700	1,485,301,796	6.5269	3,264,102,053	11.2469	5,624,584,366
18'	0.8044	402,295,997	3.1450	1,572,804,210	6.9117	3,456,516,532	11.9100	5,956,210,278
19'	0.8492	424,673,510	3.3199	1,660,306,623	7.2964	3,648,931,011	12.5732	6,287,836,190
20'	0.8939	447,051,023	3.4949	1,747,809,037	7.6812	3,841,345,490	13.2363	6,619,462,102

3. Penetrations

The original N-CLC-Z-00021 radiological evaluation evaluated platform penetrations up to 36” in diameter (i.e., manway access). It concluded that none significantly changed the dose rates above the platform thereby maintaining its Radiation Area status. Therefore, this ECA only reevaluates only the two largest platform penetrations – the 24”-diameter agitator and the 36”-diameter manway access – as bounding.

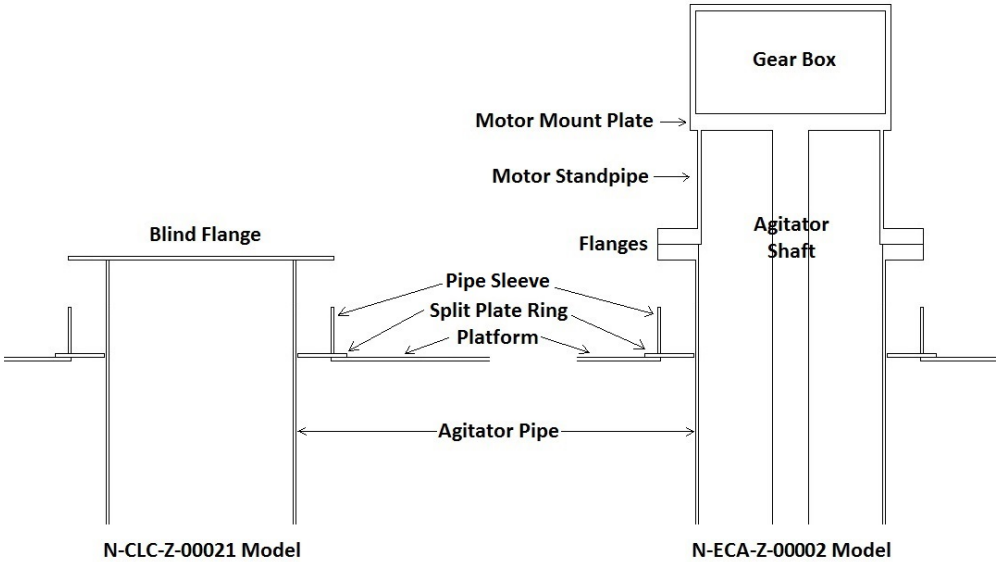
N-CLC-Z-00021 modeled the manway access as a 36”-diameter uncovered pipe through the platform surrounded by a ½”-thick galvanized steel checker plate box enclosure. Additionally, the manway was modeled directly over the center of an SSRT for ease and conservatism. No structural steel was included. This ECA includes a 5/16”-thick by 42”-diameter steel cover on the manway inside the checker plate enclosure. It also models the manway in its designed position near the southwest tank perimeter at 276.86 cm west and 160.02 south of the center of SSRT1 while it is filled to 15,000 gallons. Tanktop and platform structural steel was included. Figure 7 shows the general differences in the MCNP models.

Figure 7 – Manway MCNP Model Differences (Elevation View)



Likewise, N-CLC-Z-00021 modeled the agitator as a 24”-diameter steel pipe through the platform covered by a ½”-thick steel blind flange. This ECA replaces the blind flange with simplified versions of several major agitator components (e.g., agitator shaft, agitator stand, gearbox) that contribute shielding each greater than ½”-thick steel. The agitator is centered over SSRT1 filled to 15,000 gallons. Figure 8 shows the general differences in the MCNP models.

Figure 8 – Agitator MCNP Model Differences (Elevation View)



[NOTE: Structural steel included in the N-ECA-Z-00002 model, but not displayed in figure for clarity.]

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4. MCNP Input and Output Files

Table 8 presents a list of all 85 MCNP input and output files associated with this ECA. None are included as attachments, but all are maintained in RE&HP's dedicated workgroup folder (\\wg07\wg07data\LWO RAD ENGR\Broome).

Table 8 – MCNP Input and Output Files

Input File	Output File	Description	Input File	Output File	Description
2600	2600o	SSRT1 @ 2,600 gallon capacity	3LINE1	3LINE1o	3" OD Transfer Line @ 1' Length
8235	8235o	SSRT1 @ 8,235 gallon capacity	3LINE2	3LINE2o	3" OD Transfer Line @ 2' Length
15000	15000o	SSRT1 @ 15,000 gallon capacity	3LINE3	3LINE3o	3" OD Transfer Line @ 3' Length
1LINE1	1LINE1o	1" OD Transfer Line @ 1' Length	3LINE4	3LINE4o	3" OD Transfer Line @ 4' Length
1LINE2	1LINE2o	1" OD Transfer Line @ 2' Length	3LINE5	3LINE5o	3" OD Transfer Line @ 5' Length
1LINE3	1LINE3o	1" OD Transfer Line @ 3' Length	3LINE6	3LINE6o	3" OD Transfer Line @ 6' Length
1LINE4	1LINE4o	1" OD Transfer Line @ 4' Length	3LINE7	3LINE7o	3" OD Transfer Line @ 7' Length
1LINE5	1LINE5o	1" OD Transfer Line @ 5' Length	3LINE8	3LINE8o	3" OD Transfer Line @ 8' Length
1LINE6	1LINE6o	1" OD Transfer Line @ 6' Length	3LINE9	3LINE9o	3" OD Transfer Line @ 9' Length
1LINE7	1LINE7o	1" OD Transfer Line @ 7' Length	3LINE10	3LINE10o	3" OD Transfer Line @ 10' Length
1LINE8	1LINE8o	1" OD Transfer Line @ 8' Length	3LINE11	3LINE11o	3" OD Transfer Line @ 11' Length
1LINE9	1LINE9o	1" OD Transfer Line @ 9' Length	3LINE12	3LINE12o	3" OD Transfer Line @ 12' Length
1LINE10	1LINE10o	1" OD Transfer Line @ 10' Length	3LINE13	3LINE13o	3" OD Transfer Line @ 13' Length
1LINE11	1LINE11o	1" OD Transfer Line @ 11' Length	3LINE14	3LINE14o	3" OD Transfer Line @ 14' Length
1LINE12	1LINE12o	1" OD Transfer Line @ 12' Length	3LINE15	3LINE15o	3" OD Transfer Line @ 15' Length
1LINE13	1LINE13o	1" OD Transfer Line @ 13' Length	3LINE16	3LINE16o	3" OD Transfer Line @ 16' Length
1LINE14	1LINE14o	1" OD Transfer Line @ 14' Length	3LINE17	3LINE17o	3" OD Transfer Line @ 17' Length
1LINE15	1LINE15o	1" OD Transfer Line @ 15' Length	3LINE18	3LINE18o	3" OD Transfer Line @ 18' Length
1LINE16	1LINE16o	1" OD Transfer Line @ 16' Length	3LINE19	3LINE19o	3" OD Transfer Line @ 19' Length
1LINE17	1LINE17o	1" OD Transfer Line @ 17' Length	3LINE20	3LINE20o	3" OD Transfer Line @ 20' Length
1LINE18	1LINE18o	1" OD Transfer Line @ 18' Length	4LINE1	4LINE1o	4" OD Transfer Line @ 1' Length
1LINE19	1LINE19o	1" OD Transfer Line @ 19' Length	4LINE2	4LINE2o	4" OD Transfer Line @ 2' Length
1LINE20	1LINE20o	1" OD Transfer Line @ 20' Length	4LINE3	4LINE3o	4" OD Transfer Line @ 3' Length
2LINE1	2LINE1o	2" OD Transfer Line @ 1' Length	4LINE4	4LINE4o	4" OD Transfer Line @ 4' Length
2LINE2	2LINE2o	2" OD Transfer Line @ 2' Length	4LINE5	4LINE5o	4" OD Transfer Line @ 5' Length
2LINE3	2LINE3o	2" OD Transfer Line @ 3' Length	4LINE6	4LINE6o	4" OD Transfer Line @ 6' Length
2LINE4	2LINE4o	2" OD Transfer Line @ 4' Length	4LINE7	4LINE7o	4" OD Transfer Line @ 7' Length
2LINE5	2LINE5o	2" OD Transfer Line @ 5' Length	4LINE8	4LINE8o	4" OD Transfer Line @ 8' Length
2LINE6	2LINE6o	2" OD Transfer Line @ 6' Length	4LINE9	4LINE9o	4" OD Transfer Line @ 9' Length
2LINE7	2LINE7o	2" OD Transfer Line @ 7' Length	4LINE10	4LINE10o	4" OD Transfer Line @ 10' Length
2LINE8	2LINE8o	2" OD Transfer Line @ 8' Length	4LINE11	4LINE11o	4" OD Transfer Line @ 11' Length
2LINE9	2LINE9o	2" OD Transfer Line @ 9' Length	4LINE12	4LINE12o	4" OD Transfer Line @ 12' Length
2LINE10	2LINE10o	2" OD Transfer Line @ 10' Length	4LINE13	4LINE13o	4" OD Transfer Line @ 13' Length
2LINE11	2LINE11o	2" OD Transfer Line @ 11' Length	4LINE14	4LINE14o	4" OD Transfer Line @ 14' Length
2LINE12	2LINE12o	2" OD Transfer Line @ 12' Length	4LINE15	4LINE15o	4" OD Transfer Line @ 15' Length
2LINE13	2LINE13o	2" OD Transfer Line @ 13' Length	4LINE16	4LINE16o	4" OD Transfer Line @ 16' Length
2LINE14	2LINE14o	2" OD Transfer Line @ 14' Length	4LINE17	4LINE17o	4" OD Transfer Line @ 17' Length
2LINE15	2LINE15o	2" OD Transfer Line @ 15' Length	4LINE18	4LINE18o	4" OD Transfer Line @ 18' Length
2LINE16	2LINE16o	2" OD Transfer Line @ 16' Length	4LINE19	4LINE19o	4" OD Transfer Line @ 19' Length
2LINE17	2LINE17o	2" OD Transfer Line @ 17' Length	4LINE20	4LINE20o	4" OD Transfer Line @ 20' Length
2LINE18	2LINE18o	2" OD Transfer Line @ 18' Length	15KAGIT	15KAGITo	Agitator Penetration - SSRT1 @ 15,000 gal
2LINE19	2LINE19o	2" OD Transfer Line @ 19' Length	15KMAN	15KMANo	Manway Penetration - SSRT1 @ 15,000 gal
2LINE20	2LINE20o	2" OD Transfer Line @ 20' Length			

RESULTS

Table 9 presents dose rates for 0.015 Ci/gal DSS processing at 15,000 gallons into SSRT1 only.

Figures 9, 10 and 11 pictorially present dose rate profiles on top of and surrounding the SSRT enclosure during 0.015 Ci/gal DSS processing at 15,000 gallons, 8.235 gallons and 2,600 gallons, respectively. These are general area dose rates and do not include any effect from platform penetrations.

Tables 10, 11, 12 and 13 present dose rates from 1”-, 2”- 3”-, and 4”-diameter transfer lines, respectively, when full of 0.015 Ci/gal DSS.

Table 14 presents dose rates for the agitator and manway platform penetrations for 0.015 Ci/gal DSS processing at 15,000 gallons into SSRT1 only.

Figure 12 pictorially presents a dose rate profile for the agitator and manway platform penetrations for 0.015 Ci/gal DSS processing at 15,000 gallons into SSRT1 only.

Table 9 - Dose Rates for 0.015 Ci/gal DSS Processing into SSRT1 Only

Location	2,600 gal	8,235 gal	15,000 gal
SSRT1 Platform (mrem/hour @ 30 cm)			
SSRT1 Platform – Center Over SSRT1	57	84	95
SSRT1 Platform – Perimeter of SSRT1	48	69	76
SSRT1 Platform Perimeter – NW	24	32	35
SSRT1 Platform Perimeter – N	25	29	34
SSRT1 Platform Perimeter – NE	23	30	31
SSRT1 Platform Perimeter – E	33	50	55
SSRT1 Platform Perimeter – SE	21	28	30
SSRT1 Platform Perimeter – S	25	29	35
SSRT1 Platform Perimeter – SW	22	28	32
SSRT1 Platform Perimeter – W	31	42	53
SSRT1 Platform Perimeter – Perimeter Ave	25	33	38
SSRT1 Platform Perimeter – Entire Ave	31	42	48
SSRT2 Platform (mrem/hour @ 30 cm)			
SSRT2 Platform – Center Over SSRT2	0.2	0.3	0.3
SSRT2 Platform - NW	0.1	0.1	0.2
SSRT2 Platform - N	0.2	0.2	0.3
SSRT2 Platform - NE	0.7	1.0	1.1
SSRT2 Platform - E	1.1	1.6	1.7
SSRT2 Platform - SE	0.7	1.0	1.1
SSRT2 Platform - S	0.2	0.2	0.3
SSRT2 Platform - SW	0.1	0.1	0.2
SSRT2 Platform - W	0.1	0.2	0.2
Platform Above Pump Room (mrem/hour @ 30 cm)			
Pump Room Center	2.1	2.2	2.1
30 cm Above Pump Room Barrel Ladder	2.5	2.5	2.5
Transfer Lines Between SSRT & CCBT (mrem/hour)			
Centered In Between All Lines	201	201	201
30 cm East/West of Lines	61	61	61
5' East/West of Lines	6.4	6.4	6.4
10' East/West of Lines	1.9	1.9	1.9
Inside SSRT Cells and Pump Room (mrem/hour)			
30 cm SSRT1 (Side)	291	373	456
30 cm SSRT2 (Side)	0.1	0.1	0.1
30 cm E of E Pump in Pump Room	52	52	52
30 cm @ 45 angle from E Pump in Pump Room	60	60	60
30 cm Above E Pump in Pump Room	78	78	78
In Between Pumps in Pump Room	52	52	52
30 cm south of Pumps @ ARM	12	12	12

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Table 9 - Dose Rates for 0.015 Ci/gal DSS Processing into SSRT1 Only

Location	2,600 gal	8,235 gal	15,000 gal
Sampling Station Inside Pump Room	5.9	5.9	5.9
Bottom of Stairs Inside Pump Room	3.5	3.5	3.5
Ground Level Surrounding SSRT Enclosure (mrem/hour)			
30 cm North of Cell 2	0.02	0.02	0.03
36' North of Cell 2 @ Fence; Average 4'-6' Elevation	0.03	0.05	0.05
71' North of Cell 2 @ Fence; Average 4'-6' Elevation	0.03	0.04	0.04
89' North of Cell 2 @ Fence; Average 4'-6' Elevation	0.02	0.03	0.04
30 cm North of Cell 1	0.03	0.04	0.04
36' North of Cell 1 @ Fence; Average 4'-6' Elevation	0.04	0.06	0.06
71' North of Cell 1 @ Fence; Average 4'-6' Elevation	0.03	0.04	0.05
89' North of Cell 1 @ Fence; Average 4'-6' Elevation	0.02	0.03	0.04
30 cm North of Pump Room	0.02	0.03	0.03
36' North of Pump Room @ Fence; Average 4'-6' Elevation	0.04	0.05	0.06
71' North of Pump Room @ Fence; Average 4'-6' Elevation	0.03	0.04	0.04
89' North of Pump Room @ Fence; Average 4'-6' Elevation	0.02	0.03	0.04
30 cm East of Pump Room	0.03	0.02	0.02
10' East of Pump Room	0.02	0.03	0.03
20' East of Pump Room	0.03	0.04	0.04
30' East of Pump Room	0.03	0.04	0.04
40' East of Pump Room	0.03	0.04	0.04
50' East of Pump Room	0.03	0.04	0.04
30 cm South of Enclosure Between Cells 1 & 2	0.4	0.4	0.5
30 cm South of Enclosure Between Cell 1 & Pump Room	0.8	0.9	0.9
30 cm South of Enclosure @ Pump Room Entry	0.2	0.2	0.2
30 cm Above CCBT	0.09	0.1	0.1
30 cm Above SFT	0.05	0.07	0.08
30 cm South of SFT	0.04	0.06	0.06
50' South of SFT	0.02	0.03	0.04
30 cm West of Cell 2	0.01	0.01	0.01
10' West of Cell 2	0.01	0.02	0.02
20' West of Cell 2	0.02	0.02	0.03
30' West of Cell 2	0.02	0.03	0.03
40' West of Cell 2	0.02	0.03	0.03
50' West of Cell 2	0.02	0.03	0.03
Miscellaneous Locations (mrem/hour)			
210-Z Roof @ 25' Above Grade	0.05	0.07	0.08
210-Z Roof @ 35' Above Grade	0.08	0.1	0.1
Gate 6 North Fence	0.01	0.01	0.01
Construction Trailers (704-2Z, -4Z & -5Z)	0.01	0.01	0.01
New Admix Skid Location West	0.02	0.03	0.03
210-Z Maintenance Shop Entrance	0.02	0.03	0.03
201-Z PVV Fans & HEPAs South	0.04	0.06	0.06
Engineering Trailer 704-14Z NW	0.01	0.02	0.02

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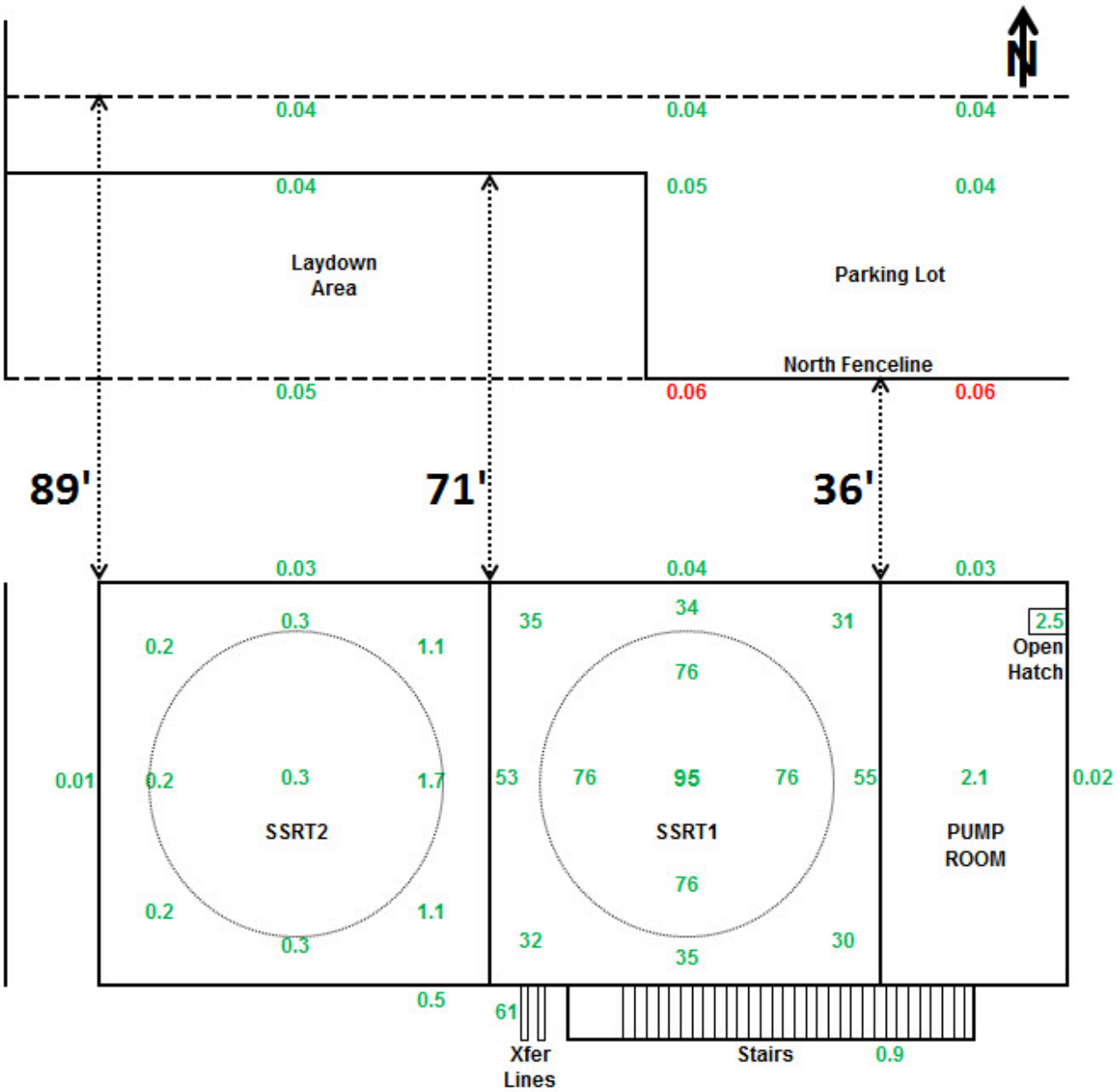
Figure 9 – SSRT Enclosure Dose Rate Profile for 0.015 Ci/gal DSS Processing @ 15,000 Gallon SSRT1 Capacity



[NOTE: Green dose rates meet radiological project design criteria of ≤0.05 mrem/hour (Controlled Area) or ≤100 mrem/hour (Radiation Area). Red dose rates do not.]

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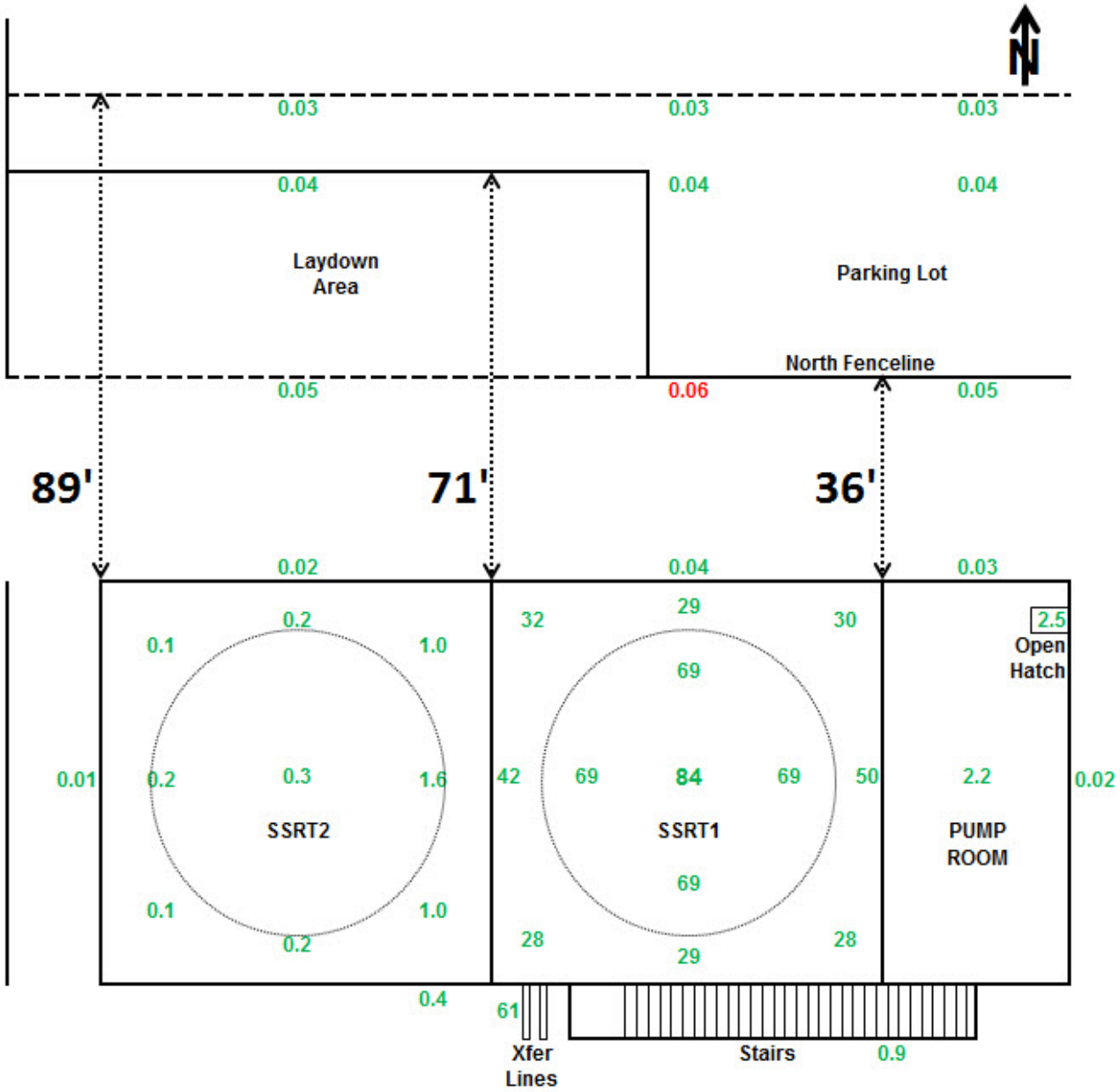
Figure 10 – SSRT Enclosure Dose Rate Profile for 0.015 Ci/gal DSS Processing @ 8,235 Gallon SSRT1 Capacity



[NOTE: Green dose rates meet radiological project design criteria of ≤0.05 mrem/hour (Controlled Area) or ≤100 mrem/hour (Radiation Area). Red dose rates do not.]

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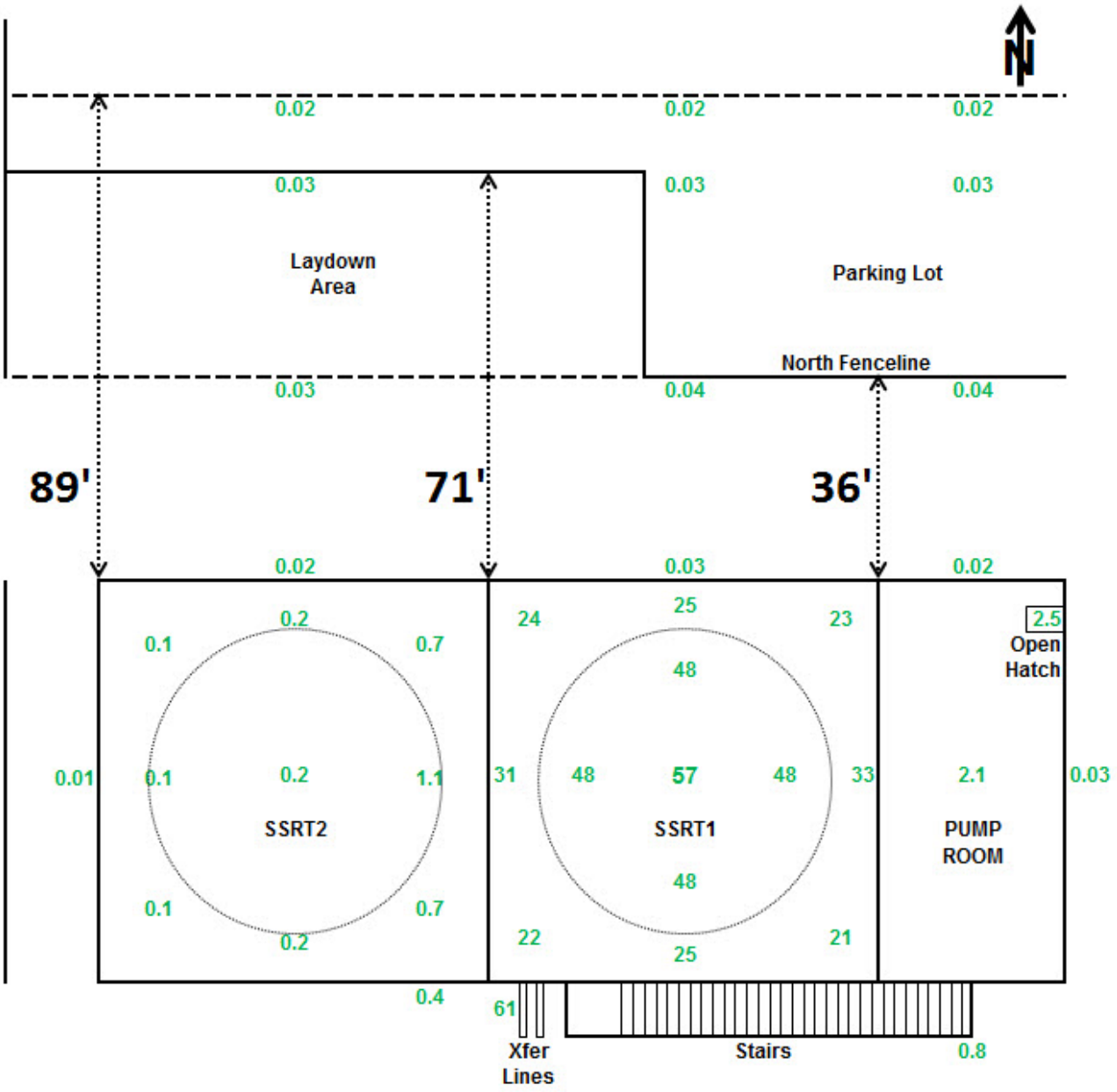
Figure 11 – SSRT Enclosure Dose Rate Profile for 0.015 Ci/gal DSS Processing @ 2,600 Gallon SSRT1 Capacity



[NOTE: Green dose rates meet radiological project design criteria of ≤0.05 mrem/hour (Controlled Area) or ≤100 mrem/hour (Radiation Area).]

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Table 10 - 1" OD Unshielded Transfer Line Dose Rates (mrem/hour) @ 0.015 Ci/gal DSS

Distance	Line Length																			
	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'
Contact	22	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
30 cm	1.9	3.3	4.0	4.5	4.7	4.9	5.0	5.1	5.1	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.2	5.3	5.2	5.3
2'	0.5	1.0	1.4	1.7	1.9	2.0	2.2	2.3	2.3	2.4	2.4	2.5	2.5	2.5	2.5	2.6	2.6	2.6	2.6	2.6
3'	0.2	0.5	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7
4'	0.1	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2
5'	0.09	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9
6'	0.06	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7
7'	0.04	0.09	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6
8'	0.03	0.07	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5
9'	0.03	0.05	0.08	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4
10'	0.02	0.04	0.07	0.09	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
11'	0.02	0.04	0.05	0.07	0.09	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3
12'	0.02	0.03	0.05	0.06	0.08	0.09	0.1	0.1	0.1	0.15	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3
13'	0.01	0.03	0.04	0.05	0.07	0.08	0.09	0.10	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
14'	0.01	0.02	0.03	0.05	0.06	0.07	0.08	0.09	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
15'	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2
16'	0.01	0.02	0.03	0.03	0.04	0.05	0.06	0.07	0.08	0.08	0.09	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2
17'	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.08	0.09	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
18'	0.01	0.01	0.02	0.03	0.03	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.09	0.09	0.1	0.1	0.1	0.1	0.1	0.1
19'	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.08	0.09	0.09	0.1	0.1	0.1	0.1
20'	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06	0.07	0.07	0.08	0.08	0.08	0.09	0.09	0.1	0.1

Table 11 - 2" OD Unshielded Transfer Line Dose Rates (mrem/hour) @ 0.015 Ci/gal DSS

Distance	Line Length																			
	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'
Contact	60	67	68	69	69	69	69	69	69	69	69	70	69	69	69	69	69	69	69	69
30 cm	6.1	10	13	14	15	16	16	16	16	16	16	16	16	16	16	16	16	17	17	16
2'	1.7	3.3	4.5	5.5	6.2	6.7	7.1	7.4	7.6	7.8	7.9	8.1	8.1	8.2	8.2	8.3	8.3	8.3	8.4	8.4
3'	0.8	1.6	2.2	2.8	3.3	3.8	4.1	4.4	4.6	4.8	4.9	5.0	5.1	5.2	5.3	5.4	5.4	5.5	5.5	5.5
4'	0.4	0.9	1.3	1.7	2.1	2.4	2.6	2.9	3.0	3.2	3.4	3.5	3.6	3.7	3.7	3.8	3.9	3.9	4.0	4.0
5'	0.3	0.6	0.9	1.1	1.4	1.6	1.8	2.0	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.9	3.0	3.0	3.1
6'	0.2	0.4	0.6	0.8	1.0	1.2	1.3	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.2	2.3	2.3	2.4	2.4
7'	0.2	0.3	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.7	1.8	1.8	1.9	1.9	2.0
8'	0.1	0.2	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.5	1.6	1.6
9'	0.09	0.2	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.2	1.3	1.3	1.4
10'	0.07	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.2
11'	0.06	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	0.9	1.0	1.0
12'	0.05	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9
13'	0.04	0.09	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8
14'	0.04	0.08	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.7
15'	0.03	0.07	0.1	0.14	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.6
16'	0.03	0.06	0.09	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
17'	0.03	0.05	0.08	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5
18'	0.02	0.05	0.07	0.09	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4
19'	0.02	0.04	0.06	0.08	0.11	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4
20'	0.02	0.04	0.06	0.08	0.10	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4

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Table 12 - 3" OD Unshielded Transfer Line Dose Rates (mrem/hour) @ 0.015 Ci/gal DSS

Distance	Line Length																			
	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'
Contact	95	109	111	112	112	112	112	111	111	112	112	112	112	112	115	112	112	112	112	112
30 cm	11	19	24	26	28	29	29	29	29	30	30	30	30	30	30	30	30	30	30	30
2'	3.2	6.3	8.7	11	12	13	14	14	14	15	15	15	15	15	15	15	15	16	16	16
3'	1.5	3.0	4.4	5.5	6.5	7.3	7.9	8.4	8.8	9.1	9.4	9.6	9.8	9.9	10	10	10	10	10	10
4'	0.9	1.8	2.6	3.4	4.0	4.6	5.1	5.6	5.9	6.2	6.5	6.7	6.9	7.1	7.2	7.3	7.4	7.5	7.6	7.6
5'	0.6	1.2	1.7	2.2	2.7	3.2	3.6	3.9	4.2	4.5	4.7	4.9	5.1	5.3	5.4	5.5	5.7	5.7	5.8	5.9
6'	0.4	0.8	1.2	1.6	2.0	2.3	2.6	2.9	3.1	3.4	3.6	3.8	3.9	4.1	4.2	4.3	4.4	4.5	4.6	4.7
7'	0.3	0.6	0.9	1.2	1.5	1.7	2.0	2.2	2.4	2.6	2.8	3.0	3.1	3.3	3.4	3.5	3.6	3.7	3.8	3.8
8'	0.2	0.5	0.7	0.9	1.1	1.4	1.6	1.7	1.9	2.1	2.2	2.4	2.5	2.6	2.8	2.9	3.0	3.0	3.1	3.2
9'	0.2	0.4	0.6	0.7	0.9	1.1	1.2	1.4	1.6	1.7	1.8	2.0	2.1	2.2	2.3	2.4	2.5	2.5	2.6	2.7
10'	0.1	0.3	0.5	0.6	0.7	0.9	1.0	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.2	2.3
11'	0.1	0.2	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.5	1.6	1.7	1.8	1.8	1.9	2.0
12'	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7
13'	0.09	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.5	1.5
14'	0.07	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.2	1.3	1.3
15'	0.07	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2
16'	0.06	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1
17'	0.05	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9
18'	0.05	0.09	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9
19'	0.04	0.08	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8
20'	0.04	0.08	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7

Table 13 - 4" OD Unshielded Transfer Line Dose Rates (mrem/hour) @ 0.015 Ci/gal DSS

Distance	Line Length																			
	1'	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'	16'	17'	18'	19'	20'
Contact	131	152	155	156	156	157	157	157	157	157	156	156	156	156	157	158	157	157	158	157
30 cm	17	30	37	40	42	44	44	45	45	45	45	45	45	46	46	46	46	46	46	45
2'	5.0	9.8	14	16	19	20	21	22	23	23	23	23	24	24	24	24	24	24	24	24
3'	2.4	4.8	6.9	8.8	10	12	13	13	14	14	15	15	15	16	16	16	16	16	16	16
4'	1.4	2.8	4.2	5.4	6.5	7.4	8.2	8.8	9.4	9.9	10	11	11	11	11	12	12	12	12	12
5'	0.9	1.8	2.7	3.6	4.4	5.1	5.7	6.3	6.8	7.2	7.6	7.9	8.2	8.4	8.6	8.8	9.0	9.1	9.2	9.3
6'	0.6	1.3	2.0	2.6	3.1	3.7	4.2	4.6	5.0	5.4	5.8	6.0	6.3	6.5	6.7	6.9	7.1	7.2	7.4	7.5
7'	0.5	1.0	1.5	1.9	2.4	2.8	3.2	3.6	3.9	4.2	4.5	4.8	5.0	5.2	5.4	5.6	5.7	5.9	6.0	6.1
8'	0.4	0.7	1.1	1.5	1.8	2.2	2.5	2.8	3.1	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.7	4.9	5.0	5.1
9'	0.3	0.6	0.9	1.2	1.5	1.8	2.0	2.3	2.5	2.7	2.9	3.1	3.3	3.5	3.7	3.8	4.0	4.1	4.2	4.3
10'	0.2	0.5	0.7	1.0	1.2	1.4	1.7	1.9	2.1	2.3	2.4	2.6	2.8	2.9	3.1	3.2	3.3	3.5	3.6	3.7
11'	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.7	1.9	2.1	2.2	2.4	2.5	2.6	2.8	2.9	3.0	3.1	3.2
12'	0.2	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.5	1.6	1.8	1.9	2.0	2.1	2.3	2.4	2.5	2.6	2.7	2.8
13'	0.1	0.3	0.4	0.6	0.7	0.9	1.0	1.1	1.3	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.2	2.3	2.3	2.4
14'	0.1	0.2	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.1
15'	0.1	0.2	0.3	0.4	0.5	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.3	1.4	1.5	1.6	1.7	1.8	1.8	1.9
16'	0.09	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.1	1.2	1.3	1.4	1.4	1.5	1.6	1.6	1.7
17'	0.08	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.5	1.5
18'	0.07	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.9	1.0	1.0	1.1	1.1	1.2	1.3	1.3	1.4
19'	0.07	0.1	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.7	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2	1.3
20'	0.06	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1

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Table 14 – Platform Penetration Dose Rates for 0.015 Ci/gal DSS Processing @ 15,000 Gallon SSRT1 Capacity

Detector Location	mrem/hour
Manway Access	
30 cm above SSRT1 Platform Center	96
30 cm above box center	30
30 cm above box center N edge	51
30 cm above box NE corner	69
30 cm above box center E edge	68
30 cm above box SE corner	56
30 cm above box center S edge	31
30 cm above box SW corner	27
30 cm above box center W edge	27
30 cm above box NW corner	48
30 cm N of box; 30 cm above platform	88
30 cm N of box; even w box top	72
30 cm N of box; 30 cm above box top	61
30 cm NE of box; 30 cm above platform	91
30 cm NE of box; even w box top	79
30 cm NE of box; 30 cm above box top	75
30 cm E of box; 30 cm above platform	100
30 cm E of box; even w box top	88
30 cm E of box; 30 cm above box top	76
30 cm SE of box; 30 cm above platform	58
30 cm SE of box; even w box top	56
30 cm SE of box; 30 cm above box top	55
30 cm S of box; 30 cm above platform	60
30 cm S of box; even w box top	43
30 cm S of box; 30 cm above box top	34
30 cm SW of box; 30 cm above platform	41
30 cm SW of box; even w box top	29
30 cm SW of box; 30 cm above box top	26
30 cm W of box; 30 cm above platform	42
30 cm W of box; even w box top	30
30 cm W of box; 30 cm above box top	25
30 cm NW of box; 30 cm above platform	58
30 cm NW of box; even w box top	55
30 cm NW of box; 30 cm above box top	50
30 cm above SSRT2 Platform Center	0.3
30 cm above SSRT2 Platform NW	0.1
30 cm above SSRT2 Platform N	0.2
30 cm above SSRT2 Platform NE	1.0
30 cm above SSRT2 Platform E	1.6
30 cm above SSRT2 Platform SE	1.1
30 cm above SSRT2 Platform S	0.2
30 cm above SSRT2 Platform SW	0.1
30 cm above SSRT2 Platform W	0.1
30 cm above Pump Room Platform	2.3
30 cm above Pump Room Ladder Opening	2.6
RMS3 Readout Top of Stairs	6.5
Agitator	
30 cm Above Agitator	16
30 cm from Agitator Motor Mount Plate	61
Contact with Agitator Motor Standpipe	26
30 cm above Platform; Contact with Lower Pipe Above Sleeve Gap	57
30 cm above Platform; 30 cm Away from Lower Pipe	64
Inside Sleeve	57

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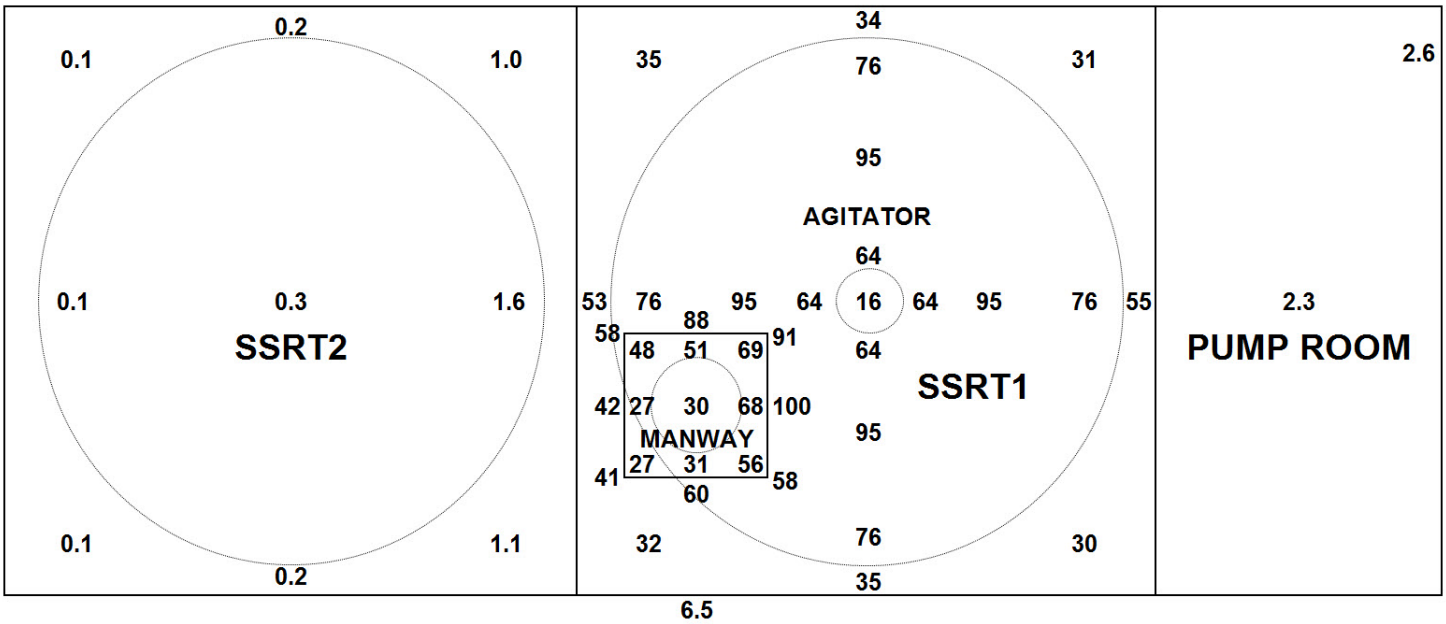
Figure 12 – Dose Rate Profile (mrem/hour @ 30 cm) for Platform Penetrations
During 0.015 Ci/gal DSS Processing @ 15,000 Gallon SSRT1 Capacity



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CONCLUSIONS

0.015 Ci/gal Cs-137 DSS can be processed into SSRT1 only up to 15,000 gallons without exceeding 100 mrem/hour @ 30 cm above the SSRT enclosure platform. At an administrative maximum operating capacity of 15,000 gallons, platform dose rates will challenge 100 mrem/hour @ 30 cm, but aren't expected to exceed it. Normal "feed and bleed" processing is expected to maintain lower SSRT1 levels between 8,000 – 12,000 gallons in which case platform dose rates will be in the range of 80-90 mrem/hour @ 30 cm. Dose rates inside the enclosure will exceed 100 mrem/hour @ 30 cm from the SSRT1 itself, but this area is not accessible during processing. Should cell access be required, evacuation of the tank to heel conditions should be considered to minimize personnel exposure. Dose rates inside the Pump Room are not expected to exceed 100 mrem/hour @ 30 cm from any component.

Dose rates surrounding the SSRT enclosure at ground level inside the fence are all expected to be ≤5.0 mrem/hour (Radiological Buffer Area) except in the immediate vicinity of the transfer lines (when full) between the SSRT and CCBT enclosures. This is a transient condition and can be managed via radiological barricades and/or temporary shielding (see below).

Dose rates at the current fenceline 36' North of the SSRT enclosure do exceed 0.05 mrem/hour when SSRT1 only is filled to 15,000 gallons with 0.015 Ci/gal DSS. To support these operational conditions, either the fenceline, which is currently contiguous with the Radiological Buffer Area (RBA) boundary, would need to be moved or a new RBA boundary barricade established outside the fenceline at least 10 feet further North.

All individual transfer line dose rates are less than 100 mrem/hour @ 30 cm for 0.015 Ci/gal DSS processing. No additional shielding is required on any individual line, but should be considered as an ALARA implementation in areas where multiple lines are grouped together and personnel occupancy is expected (e.g., where three 3"-diameter transfer lines and one 4"-diameter line cross the breezeway between the SSRT and CCBT enclosures). For example, one layer of lead blankets (or equivalent 5/8" steel) shielding the transfer lines could be expected to reduce transient dose rates there by approximately 50%. Based on Table 9 results, this would lower 30 cm dose rates from 61 to ~30 mrem/hour; 5 foot dose rates from 6.4 to ~3 mrem/hour (i.e., less than Radiation Area limits); and 10 foot dose rates from 1.9 to ~1 mrem/hour (i.e., less than Radiation Area limits).

Penetrations through the SSRT1 enclosure platform are not expected to increase the already significant Radiation Area dose rates above the platform during 0.015 Ci/gal DSS processing of up to 15,000 gallons into SSRT1 only. A High Radiation Area is not expected above the general platform. However, dose rates around the manway access are very close to exceeding 100 mrem/hour @ 30 cm because of the large gap between the 36"-diameter manway and 44"-diameter platform opening which is not covered by a split plate ring like other penetrations that limits the size of gap to 1/8". Additional shielding inside and/or on top of the checkerplate box surrounding the manway is not specifically required based on Radiation Area dose rates, but again should be considered as an ALARA implementation based on personnel occupancy as dose rates approach 100 mrem/hour @ 30 cm.

Dose rate results in this ECA will be combined with updated time-and-motion study (TMS) data to complete an external dose assessment (EDA) in hopes of ensuring annual personnel doses associated with 0.015 Ci/gal Cs-137 DSS processing up to 15,000 gallons into SSRT1 only will meet the radiological design basis total effective dose limit of 1,000 mrem/person/year. The EDA may also identify locations where temporary shielding can easily be added to minimize personnel doses ALARA and less than the facility administrative control limit of 500 mrem/year.