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Mercury Dispersion Modeling and Purge Ventilation Stack Height Determination for Tank 35H Bulk Sludge Removal

Steve Weinbeck

October 2019

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EXECUTIVE SUMMARY

The SRNL Atmospheric Technologies Group performed an analysis of mercury emissions from the H-Tank Farm Tank 35-H to assess worst case 15-minute, 1-hour and 8-hour average concentrations and evaluate whether the ACIGH Short-Term Exposure Limit (STEL), PAC (Protection Action Criteria), or Threshold Limit Value (TLV) levels for mercury are exceeded. This analysis was also used to establish a minimum stack height at which ambient mercury concentration would not exceed the regulatory limits. The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) was used as the dispersion modeling tool for this analysis. The PAC standard is not exceeded for any of the stack heights, or release scenario. A 100 ft stack for the 50 mg/m^3 modeling scenario and 110 ft for the 100 mg/m^3 are necessary to prevent all exceedances at all receptors. If the highest receptor on the Evaporator West Stack Platform is excluded from the domain, then the maximum heights are 65 ft and 105 ft for the 50 mg/m^3 and the 100 mg/m^3 modeling scenarios, respectively.

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ACGIH	American Conference of Governmental Industrial Hygienists
AMS	American Meteorological Society
AEGLs	Acute Exposure Guideline Levels
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AERMET	AERMOD Meteorological Preprocessor
AGL	Above Ground Level
ASL	Above Sea Level
ATG	Atmospheric Technologies Group
BPIP-Prime	Building Profile Input Program- Prime Algorithm
Cfm	Cubic feet per minute
EPA	Environmental Protection Agency
LIDAR	Light Detection and Ranging
NAD27	North American Datum 1927
NLCD92	National Land Cover Database 1992
NWS	National Weather Service
PAC	Protection Action Criteria
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
STEL	Short Term Exposure Limit
TLV	Threshold Limit Value
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

1.0 Introduction

Using established thresholds, the Atmospheric Technologies Group (ATG) has been asked to evaluate the exposure of workers to ambient mercury concentrations resulting from the H-Area tank farm Tank 35H purge ventilation stack emissions, against three different exposure criteria. The American Conference of Governmental Industrial Hygienists (ACGIH) short term exposure limit (STEL) for dimethyl mercury and 8–hour threshold limit value (TLV) for mercury in the workplace are 0.030 mg/m^3 (30 µg/m^3) and 0.025 mg/m^3 (25 µg/m^3), respectively (Ref. 1). The STEL for dimethyl mercury was used to assess short term exposure because a STEL for elemental mercury has not been reported by the ACGIH ambient concentrations standard. The Protective Action Criteria (PAC) for mercury (vapor) exposure, which is 8.9 mg/m^3 (8900 µg/m^3) for a 1-hour averaging period, representing an acute exposure guideline levels (AEGLs) that describe the human health effect from once-in-a-lifetime, or rare (extreme) exposure to airborne chemicals (Ref. 2). Mercury concentrations were predicted for ground-level breathing height and other specified work areas around Tank 35H.

To predict mercury concentrations from the Tank 35H emissions, observed weather data for SRS was taken from a five-year (2007-2011) record of hourly meteorological conditions and used to calculate the amount of atmospheric dispersion for 1-hour and 8-hour time periods. Hourly-averaged modeled concentrations were adjusted to represent 15-minute values for comparison to the 15-minute STEL using the following equation (Ref. 3):

$$\boldsymbol{C_{15min} = C_{60min}\left(\frac{60}{15}\right)^{0.2} = 1.3\ C_{60min}} \tag{1}$$

By multiplying the hourly concentrations by a factor of 1.3, the concentration is representative of concentrations sampled on a 15-minute time averaged period. Comparisons of the calculated concentrations can be made to the standards and estimates of worker safety and potential mitigation methods can easily be made.

2.0 Methodology

Modeling was conducted with the Environmental Protection Agency (EPA) AMS/EPA Regulatory Model (AERMOD) dispersion model, which is recommended by the EPA for regulatory air quality analyses (Ref. 4). The model allows for vertical variability in wind, turbulence, temperature and incorporates boundary layer parameters for dispersion in both stable and convective atmospheric situations (Refs. 5 and 6). More information on ATG's software quality assurance plan for AERMOD can be found in C-SQP-G-00076 (Ref. 7). For this regulatory modeling, AERMOD was executed in default (regulatory) mode. AERMOD is routinely used for tank and multiple stack emissions, and has physics included to model building wake effects.

Meteorological data files used as input to AERMOD were prepared using EPA's AERMOD Meteorological preprocessor (AERMET, Ref. 8), which incorporates the National Weather Service's (NWS) hourly observations from Bush Field in Augusta, GA, twice-daily upper air soundings from the NWS Atlanta, GA radiosonde station and quality assured 15-minute values of wind and temperature at four levels (4, 18, 36 and 61 meters) of the Savannah River Site (SRS) Central Climatology tower located near N-area.

For onsite data, values were extracted from the meteorological database and written to a text file only if there were no associated quality flags. When the data did not meet quality control criteria, a missing value code was assigned consistent with AERMET requirements. Quality assurance procedures for SRS meteorological data are described in Reference 9. For details on the processing of the most recent five-year quality assured dataset (2007-2011) see References 10 and 11.

Values used by AERMET for roughness length, Bowen ratio and albedo were determined from EPA's AERSURFACE algorithm. Input to the algorithm consisted of a (United States Geological Survey) USGS National Land Cover Data image for 1992 (NLCD92). This image was analyzed for the area around the Central Climatology tower. Monthly values of the three surface parameters were generated and imported into AERMET.

Building information was included in AERMOD to account for downwash and re-circulation effects from nearby buildings and stacks. Building data was processed using the EPA utility Building Profile Input Program (BPIP-Prime) to determine how these obstacles affect airflow patterns and the transport of effluent discharge. Of concern is the downwash of the plume over areas where workers will spend most of their time during operations. The structures around the Tank 35H were added to the model domain for inclusion in the BPIP-Prime input (wake) and are specified in Ref. 1. This modeling domain was based on a domain previously generated for use in SRNL-STI-2016-00119 (Tank 31H, Ref. 12), SRNL-STI-2016-00453 (Tank 22H, Ref. 13) and SRNL-STI-2017-00745 (HPP-7 Ref. 14), SRNL-STI-2018-00409 (Ref. 15) and was updated with revised base heights and building information (Ref 1). The East and West Hills were also modeled as a building to ensure that wake impacts from the hills could be evaluated.

There are other ill-defined appurtenances around the Tank 35H area; however, these were not modeled for atmospheric wake, therefore adding a level of conservatism (wake area adds additional turbulence for dispersion which can lower atmospheric concentrations). The larger buildings need to be retained for AERMOD to enhance the vertical mixing of the plume centerline down to the receptor heights, increasing the near surface ground concentrations.

Terrain elevation was determined from the Savannah River Site (SRS) high resolution Light Detection and Ranging (LIDAR) dataset for SRS (Refs. 16 and 17). The area surrounding Tank 35H and the 3H Evaporator building have been graded to be 98 meters (m) ASL (Fig. 2-1). The areas on top of the east and west hills are about 98 m and 100 m, respectively. To match the elevations taken from drawings it was decided to input the graded elevation at the top of the West Hill as 98.33 m (322.625 ft, Ref. 1 pg3).

The modeling domain was defined by a receptor grid of about 13,628 receptors. Receptor grid spacing of 6 m was used to identify any potential excessive concentrations that may occur near the ground. The height of ground level receptors is nominally 1.83 m (6 feet) AGL to represent the breathing zone of a tall worker standing at ground level. The coordinate system used for this domain was a UTM grid, using the NAD27 datum. Several other additional receptors were included in addition to the ground level breathing receptors. The receptor grid includes receptors originally included as part of the Tank 31H evaluation that was performed (Ref. 16)

These locations were selected to pick particularly exposed locations where the plume would have a chance to impact workers. These additional receptors were placed at two levels in the Huts, 13 ft

(3.96m) and 26 ft (7.93m), catwalks at 20 and 47 ft, the 3H Evaporator stairs 14, 20 and 23 ft (4.26, 6.10 and 7.01 m), 23ft (7.01 m) at the PVV platform and the 5th floor breathing zone at 63 ft (19.2m) AGL. A single receptor was added at the 96 ft height for the platform (29.26 m), known as the West Stack Platform. In previous studies, when plume centerlines are close to the receptors predicted concentration can be sensitive to small changes in heights. To account for potential uncertainty in the heights relative to one another, additional receptors were added 2 ft above and 2 ft below the nominal receptor heights for the receptors on the PVV platform, the 5th Floor breathing zone, the catwalks and the 3H Evaporator stairs. Each height for the receptor is at the nominal height, plus an additional 6 ft to represent a worker breathing height (Ref. 1).

Four risers at the top of the Tank 35H were located using the locations given in Reference 1, (Labeled B4, E1, B8, and B6). Receptors were placed on the top of the risers at 26 feet (20 ft, plus 6 ft for the worker breathing height). The 241-3H control room was also added as a potential source of worked exposure, by adding 15 receptors (a 5 by 3 grid) on top of the building (39.83 ft (39ft 10inches) 33ft 10 inches for the building plus 6 foot for the breathing height, Ref. 19).

The stack discharge temperature range is estimated to be 25°C to 60°C, for conservatism 30ºC was used in modelling. The inside diameter of the stack is 6 inches (Ref. 1). The initial stack height was 10-ft to examine the areas being impacted by mercury emissions (Ref. 1).

To have the correct units for input to AERMOD, the concentration of mercury in the stack discharge was converted to a mass release rate by using the flow rate of 350 cfm, (maximum flow rate, see Ref. 1). While two stack flow rates were given, the larger of the two was selected to use for the modeling since the maximum flow will give the largest source term for mercury and is therefore conservative. The emission rate for the Tank 35H stack (in g/s) was determined using the following calculation based on inputs from Reference 1:

$$\frac{100\ \text{mg}}{\text{m}^3} \times \frac{1\text{g}}{1000\text{mg}} \times \left(\frac{1\text{m}}{3.28\text{ft}}\right)^3 \times \frac{350\ \text{ft}^3}{\text{min}} \times \frac{1\ \text{min}}{60\ \text{sec}} = 0.016516\ \text{g/s}$$

$$\frac{50\text{mg}}{\text{m}^3} \times \frac{1\text{g}}{1000\text{mg}} \times \left(\frac{1\text{m}}{3.28\text{ft}}\right)^3 \times \frac{350\ \text{ft}^3}{\text{min}} \times \frac{1\ \text{min}}{60\ \text{sec}} = 0.008258\ \text{g/s}$$

For the figures in this report, once mercury concentration values were calculated for each receptor, the value was transformed to percent of corresponding standard. This was done by multiplying each value by a scaling factor of 4.3 and 4.0, to obtain a percent of the STEL or TLV for the 15-minute and 8-hour period, respectively. These scaling factors were obtained using the following calculation:

$$\%\ \text{of STEL} = \frac{1.3}{30\ \mu g/m^3} \times 100 = 4.3$$

where the value 1.3 in the first equation is incorporated from Eq. 1 to obtain a value representative of a 15-minute period.

$$\%\ \text{of TLV} = \frac{1.0}{25\ \mu g/m^3} \times 100 = 4.0$$

$$\%\ \text{of PAC} = \frac{1.0}{8900\ \mu g/m^3} \times 100 = 0.01124$$

The third factor is shown for the PAC standard. Since the modeled values in this report were significantly below the PAC threshold, these were not displayed.

Figure 2-1. Aerial photo of H-Tank farm with LIDAR elevation (green contours) with receptors (dots) around H-tank Farm (Ref. 3).

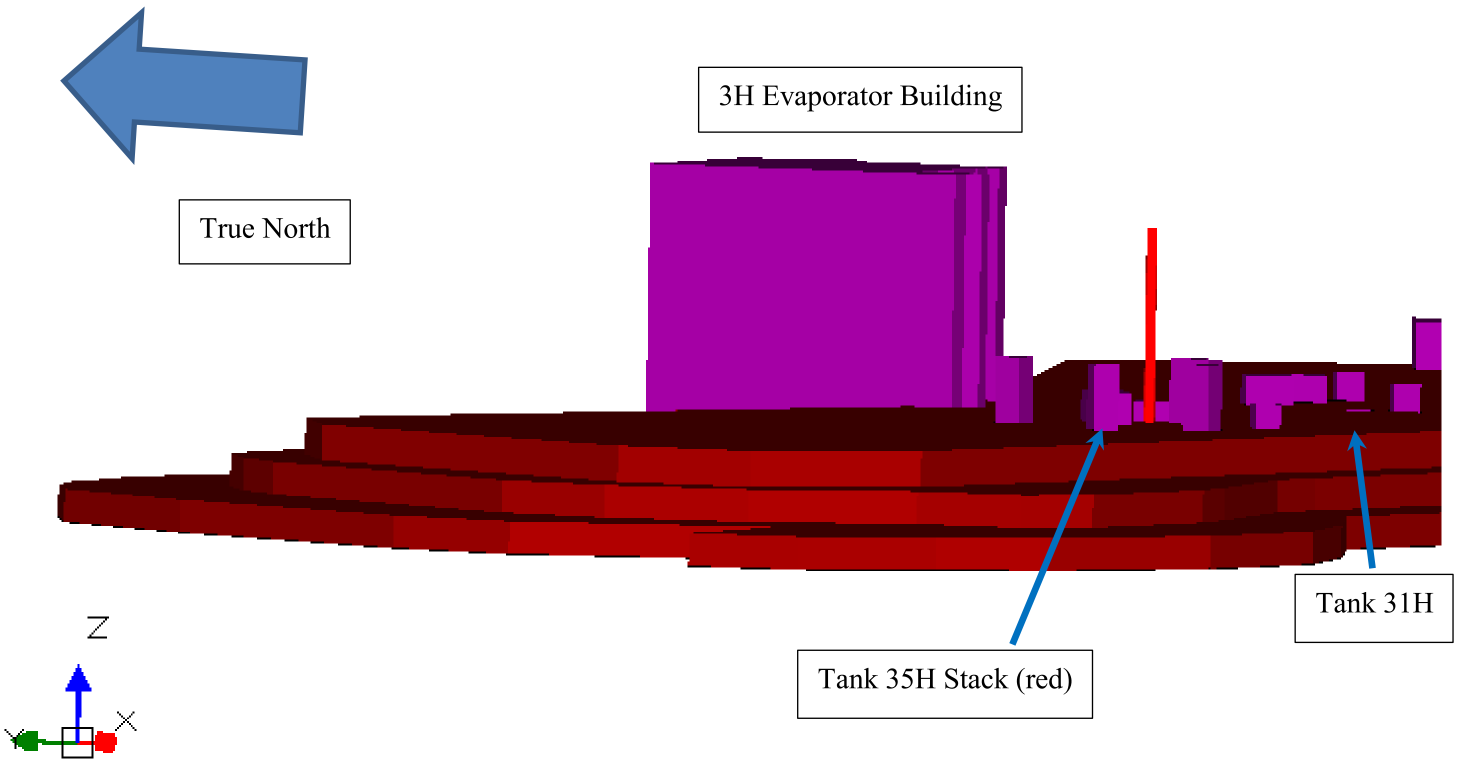

Figure 2-2. Three-dimensional view of the buildings around Tank 35H facility for the 60-foot stack height from AERMOD modeling domain. The tanks are represented by purple circles, hills by brown, buildings in purple, and the stack is in red. Blue arrow shows the direction of the True North. View is from the True West direction and above.

3.0 Results and Discussion

Results of the modeling scenarios are listed in Tables 3-1 and 3-2. Two emissions scenarios were modeled starting with a stack height of 10-ft and increased in 10-ft increments until the modeled concentration no longer exceeded the applicable standard at any receptor in the modeling domain, and each was performed for an initial concentration of 50 mg/m^3 and 100 mg/m^3 for the stack concentration. When an increase in the stack height caused the receptor locations to no longer exceed the PAC, STEL, or TLV standards, then an intermediate height was run to further refine the allowable stack height.

The PAC standard is not exceeded for any of the stack heights, or release scenarios. The TLV (8-hr) standard for mercury are included in Tables 3-1 and 3-2. The values for the TLV standard are the same or greater than the STEL values, so only the STEL values will be examined in detail, since those values are bounding for this analysis.

For all the receptors in the modeling domain included (Table 3-1), the stack height necessary to avoid an exceedance is 100 ft for the 50 mg/m^3 modeling scenario and 110 ft for the 110 mg/m^3. Without the receptor on the top of the 3H Evaporator Building platform (labeled Evaporator West Stack Platform breathing level in Ref. 1), a 65 ft stack for the 50 mg/m^3 modeling scenario and 105 ft for the 100 mg/m^3 are necessary to prevent all exceedances (Table 3-2).

	All receptors					
	50 mg/m^3			100 mg/m^3		
Ht(ft)	15-min	1-hour	8-hour	15-min	1-hour	8-hour
10	**2,956.0**	2,273.9	**1,115.0**	**5,912.0**	4,547.7	**2,229.9**
20	**1,908.7**	1,468.2	**545.0**	**3,817.4**	2,936.5	**1,090.1**
30	**480.4**	369.5	**79.8**	**960.7**	739.0	**159.6**
40	**427.5**	328.8	**85.1**	**854.9**	657.6	**170.3**
50	**285.8**	219.9	**47.2**	**571.7**	439.7	**94.4**
57	**246.9**	189.9	**36.7**	**493.7**	379.8	**73.4**
60	**183.3**	141.0	**39.8**	**366.7**	282.1	**79.6**
65	**202.7**	156.0	**44.3**	**405.5**	311.9	**88.7**
70	**185.6**	142.8	**45.0**	**371.2**	285.6	**90.0**
80	**298.4**	229.6	**45.0**	**596.9**	459.1	**90.1**
90	**451.9**	347.6	**56.1**	**903.7**	695.2	**112.3**
100	17.6	13.5	5.0	**35.1**	27.0	9.9
105	17.0	13.1	3.8	**34.0**	26.2	7.6
110	12.7	9.8	3.2	25.4	19.5	6.5

Table 3-1. Maximum ambient concentrations (µg/m^3) associated to Tank 35H emissions for 15-minute, 1-hour and 8-hour periods for all receptors with 50 and 100 mg/m^3 tank concentrations. Includes platform receptor at the top of 3H Evaporator Building.

Values in bold text and yellow highlights exceed exposure limits for respective time periods (0.030 mg/m^3 or 30 µg/m^3 for 15-min STEL, 8.9 mg/m^3 or 8,900 µg/m^3 for 1-hour PAC and 0.025 mg/m^3 or 25 µg/m^3 for 8-hour TLV).

	All receptors except West Stack Platform					
	50 mg/m^3			100 mg/m^3		
Ht(ft)	15-min	1-hour	8-hour	15-min	1-hour	8-hour
10	**2,984.3**	2,295.6	**1,124.6**	**5,912.0**	4,547.7	**2,229.9**
20	**1,908.7**	1,468.2	**545.0**	**3,817.4**	2,936.5	**1,090.1**
30	**480.4**	369.5	**79.8**	**960.7**	739.0	**159.6**
40	**427.5**	328.8	**85.1**	**854.9**	657.6	**170.3**
50	**285.8**	219.9	**47.2**	**571.7**	439.7	**94.4**
57	**246.9**	189.9	24.0	**493.7**	379.8	**47.9**
60	**157.9**	121.5	15.6	**315.9**	243.0	**31.2**
65	27.7	21.3	8.7	**55.4**	42.6	17.3
70	27.2	20.9	6.4	**54.4**	41.9	12.8
80	24.5	18.9	5.4	**49.1**	37.8	10.8
90	21.6	16.6	4.8	**43.2**	33.2	9.6
100	15.6	12.0	4.0	**31.3**	24.1	7.9
105	14.5	11.2	3.6	29.0	22.3	7.1
110	12.7	9.8	3.2	25.4	19.5	6.5

Table 3-2. Maximum ambient concentrations (µg/m^3) associated to Tank 35H emissions for 15-minute, 1-hour and 8-hour periods for all receptors with 50 and 100 mg/m^3 tank concentrations. Does not include platform receptor at the top of 3H Evaporator Building.

Values in bold text and yellow highlights exceed exposure limits for respective time periods (0.030 mg/m^3 or 30 µg/m^3 for 15-min STEL, 8.9 mg/m^3 or 8,900 µg/m^3 for 1-hour PAC and 0.025 mg/m^3 or 25 µg/m^3 for 8-hour TLV).

The values for heights where exceedances were last present were examined to understand the plume behavior, by looking at contours of the mercury concentrations.

Figures 3-1 and 3-2, when the stack is at the 90-ft receptor, has the exceedance at the 3H Evaporator West Stack receptor, located at 96 ft. For Figure 3-3 the exceedances shift to the next lower receptor, which is located on the 5th floor, although there are values just at the STEL down off the Hill, downwind of the West Hill to the southeast of the 341-2H Control Room. For these three cases, the major impact occurs when the stack is approximately the same as the receptor height.

In Figure 3-4, the heights that exceed the STEL are due to downwash caused by the hill itself. The stack on Tank 35 is located at a height of over 100 ft, so that the plume is not impacting the much lower 5th floor doors (~65 ft). Since the West Hill was input as a 10-meter height building with 3 tiers, the aerodynamic wake is capturing the lower portion of the wide mercury plume from the 100 mg/m^3 release scenario. Downwash from the West Hill is mixing the mercury down to the surface along the west side, where the stack is close to the slope. This is presumably because the plume has not had enough distance to dilute the mercury plume before it is mixed down off the hill.

4.0 Conclusions

The summary of maximum concentrations modeled (Tables 3-1 and 3-2) shows that the PAC standard is not exceeded for either the 50 or 100 mg/m^3 release scenarios.

The STEL standard is exceeded for all the modeling runs that include all receptors in the modeling domain (Tables 3-1), the stack height would need to be 100 ft and 110 ft for the 25 mg/m^3 and 50 mg/m^3 modeling scenarios, respectively.

If the West Stack Breathing Platform is excluded from the modeling domain, the stack heights of 65 ft for the 50 mg/m^3 and 105 ft for the 100 mg/m^3 modeling scenarios would prevent exceedances at any receptors from the Tank 35H stack.

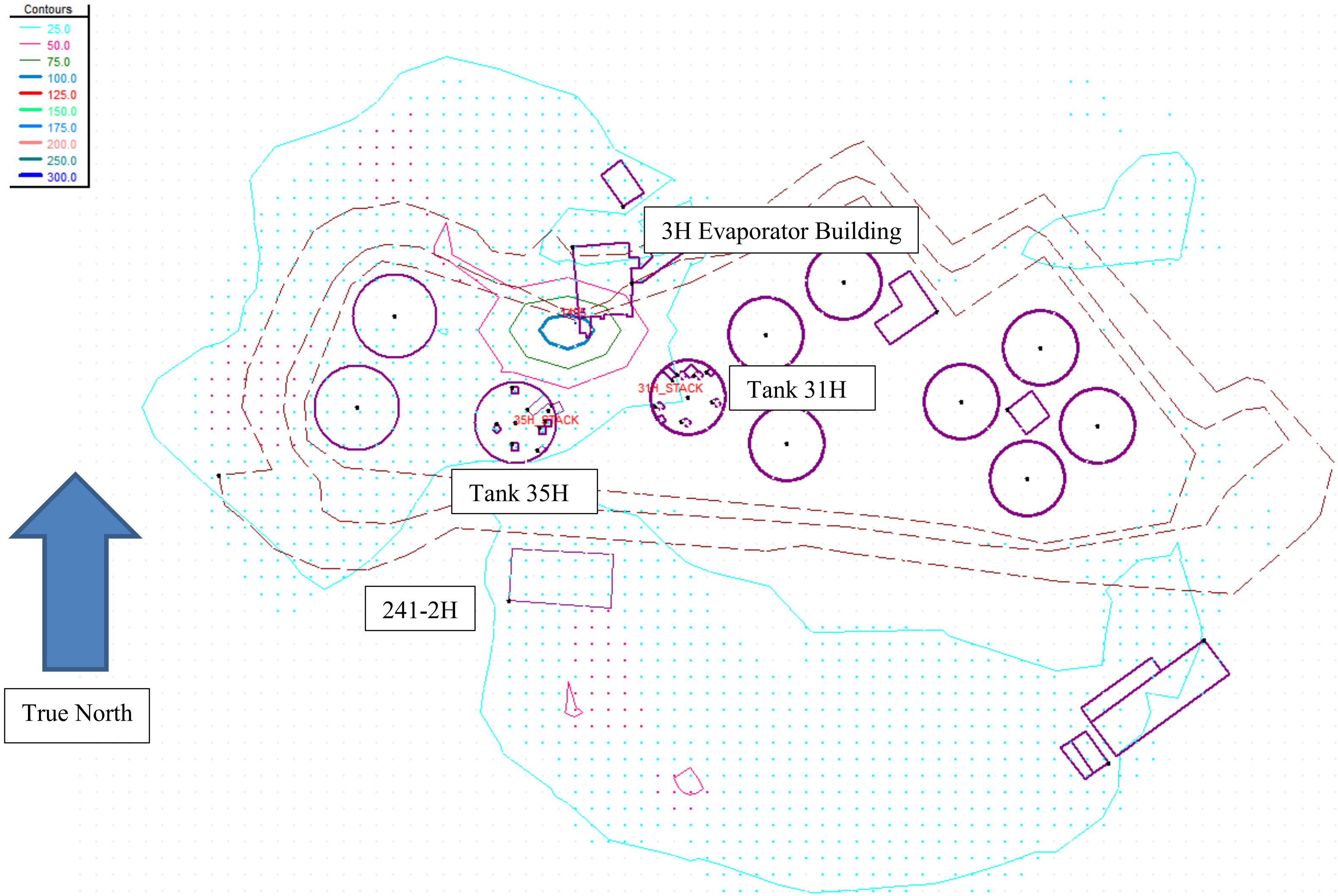

Figure 3-1. STEL Exceedances expressed as percent of standard for Tank 35H with a 90-foot stack and 50 mg/m³ release concentration scenario. Numerical receptor values shown for values above 100 percent of STEL (>30 µg/m³). Contours show values that exceed 25% of STEL. Brown lines are the elevation contours of the hill. Purple lines are the outlines of the buildings, huts and tanks. True North is at the top of the page.

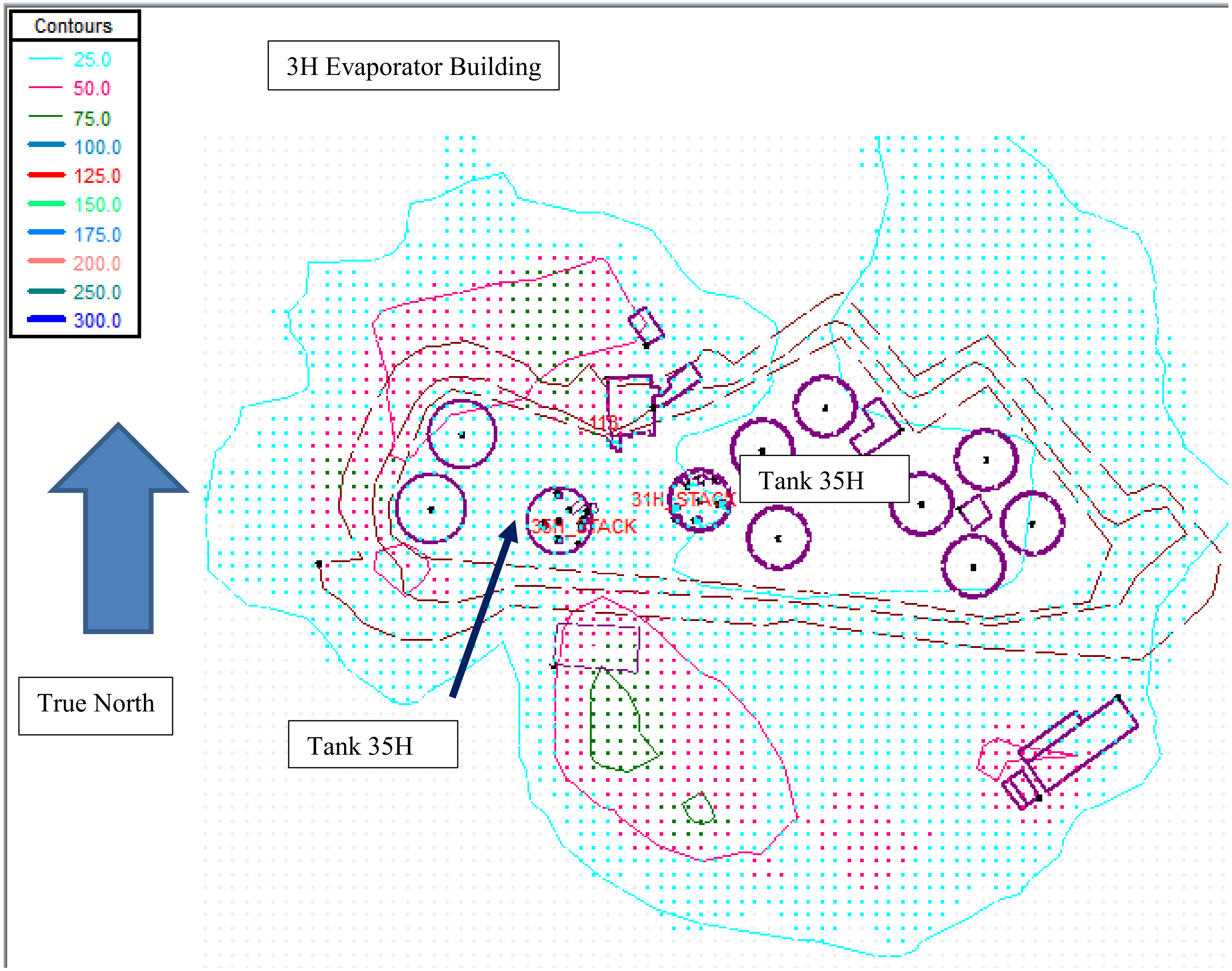

Figure 3-2. Close up of the TLV Exceedances expressed as a percent of standard for Tank 35H with a 105-foot stack and 100 mg/m^3 release concentration scenario. Numerical receptor values shown for values above 100 percent of TLV (>30 µg/m^3). Contours show values that exceed 25% of TLV. Brown lines are the elevation contours of the hill, labeled in meters AGL. Purple lines are the outlines of the buildings, huts and tanks. True North is at the top of the page.

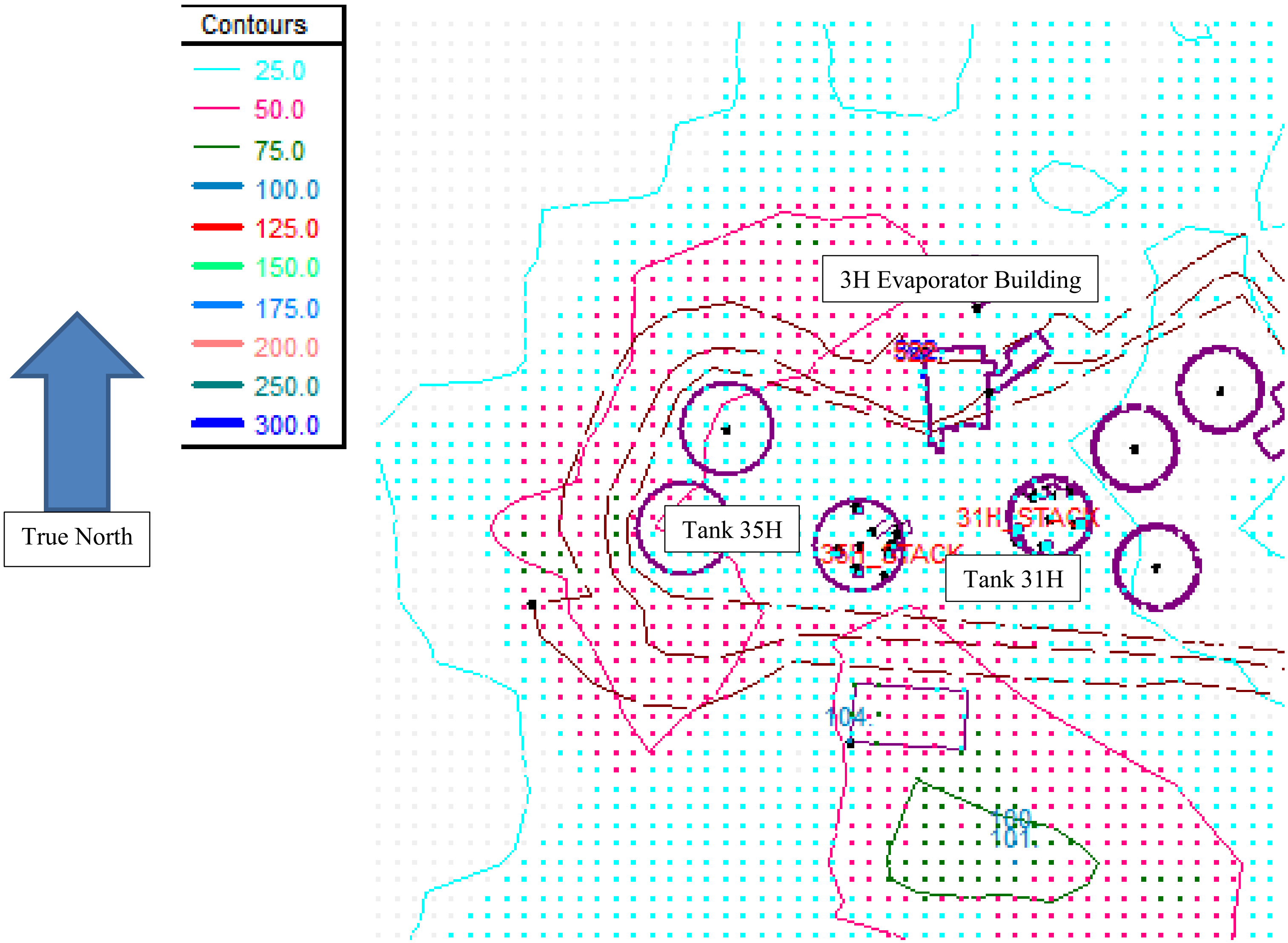

Figure 3-3. STEL Exceedances expressed as a percent of standard for Tank 35H with a 60-foot stack and 50 mg/m^3 release concentration scenario. Numerical receptor values shown for values above 100 percent of STEL (>30 µg/m^3). Purple lines are the outlines of the buildings, huts and tanks. True North is at the top of the page.

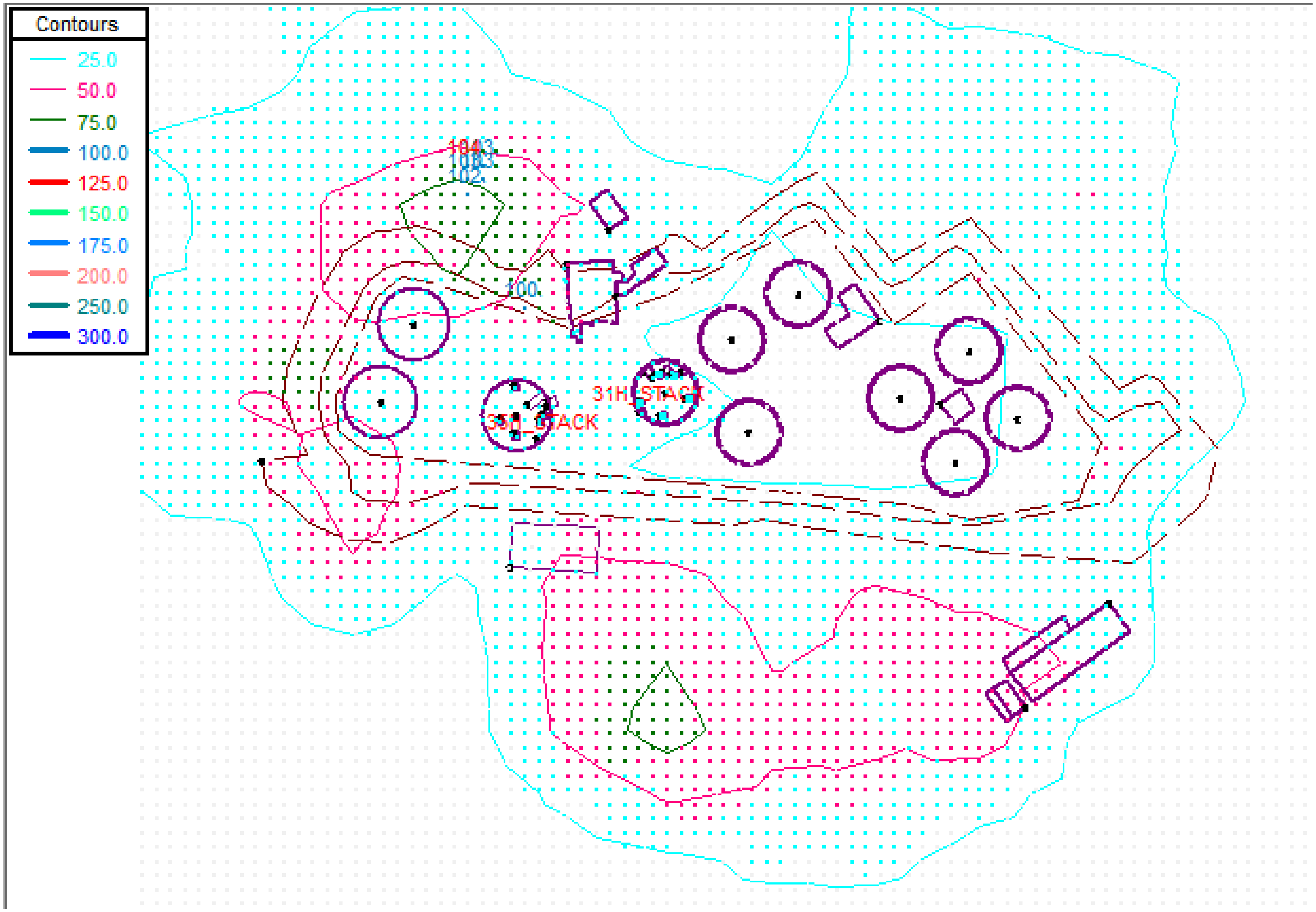

Figure 3-4. Close-up of the STEL Exceedances express[illegible]d for Tank 35H with a 100-foot stack and 100 mg/m^3 release concentration scenario. Numerical receptor valu[illegible] 100 percent of TLV (>25 µg/m^3). Contours show values that exceed 25% of TLV. Brown lines are the elevation contours of the hill, labeled in meters AGL. Purple lines are the outlines of the buildings, huts and tanks. True North is at the top of the page.

5.0 References

1. Worthy, J., Mercury Dispersion Modeling and Purge Ventilation Stack Height Determination for Tank 35H Bulk Sludge Removal, X-TTR-H-00091, Rev. 0.

2. Protective Action Criteria (PAC): Chemicals with AEGLs, ERPGs & TEELs, https://sp.eota.energy.gov/pac/TeelDocs, Revision 29A, June 2018 accessed various dates 11/30/2018 through 12/31/2018.

3. Hanna, S.R., G.A. Briggs and R.P. Hosker, 1982: Handbook on Atmospheric Diffusion. DOE/TIC-11223, Department of Energy, 102 pp.

4. U.S. Environmental Protection Agency, Guideline on Air Quality Models, 40 Code of Federal Regulations, Part 51, Appendix W.

5. U. S. Environmental Protection Agency, AERMOD: Description of Model Formulation, EPA-454/R-03-004 (2004).

6. U. S. Environmental Protection Agency, User's Guide for the AMS/EPA Regulatory Model – AERMOD and Addendum, EPA-454/B-03-001 (2004).

7. Savannah River Nuclear Solutions, Software Quality Assurance Plan for the AMS/EPA Regulatory Model (AERMOD) Software Package, C-SQP-G-00076 (2017).

8. U. S. Environmental Protection Agency, User's Guide for the AERMOD Meteorological Preprocessor (AERMET) and Addendum, EPA-454/B03-002 (2004).

9. Westinghouse Savannah River Company, Quality Assurance of Meteorological Data, Procedure Manual 15.3, Meteorological Monitoring Procedures, NTSP T-113 (2002).

10. Viner, B.J. Summary of Data Processing for the 2007-2011 SRS Meteorological Database, SRNL-STI-2013-00268, Savannah River National Laboratory (2013).

11. Scott, K.E. AERMET Meteorological Files, 2007-2011, SRNL-L2200-2013-00045, Savannah River National Laboratory (2013).

12. Weinbeck, S.W. Mercury Dispersion Modeling and Purge Ventilation Stack Height Determination for Tank 35H Bulk Sludge Removal, SRNL-STI-2016-00119, Rev. 0

13. Weinbeck, S.W. Mercury Dispersion Modeling and Purge Ventilation Stack Height Determination for Tank 22H, SRNL-STI-2016-00453, Rev. 0

14. Weinbeck, S.W., Mercury Dispersion Modeling and Purge Ventilation Stack Height Determination for Transfer Facility HPP-7, SRNL-STI-2017-00745, Rev. 0.

15. Weinbeck, S.W., Mercury Dispersion Modeling 242-25H Evaporator Portable Backup Ventilation, SRNL-STI-2018-00409, Rev. 0.

16. Weinbeck, S.W., Mercury Dispersion Modeling and Purge Ventilation Stack Height Determination for Tank 31H, SRNL-STI-2018-00654, Rev. 0.

17. SRS Explorer, http://egis4.srs.gov/srsexplorer/?app=srsroute, accessed on various dates 11/30/2017 through 12/6/2018.

18. McGaughtey, R, J., and S.E. Reutebuch, 2009: Savannah River Site 2009 LIDAR Project, FY09 Final Report., United States Department of Agriculture, Forest Service, 11pp

19. SE5-2-2005926, Rev 3. “Type 3 Salt Removal 200H Area DCS Control Building 241-2H building”, 1998.

Distribution:

C. H. Hunter	773-A
S. J. Worthy	241-162H
M. Hubbard	241-162H
J. Tihey	241-162H
A. T. Brown	704-56H
M. Schweder	704-56H
B. J. Wiedenman	773-42A