

Phase II Final Status Survey Report Mallinckrodt Columbium-Tantalum Plant

St. Louis, Missouri

Chapter 32

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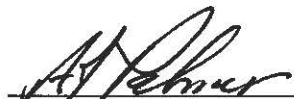
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ABBREVIATIONS AND ACRONYMS

%	percent
β	beta
AECOM	AECOM Technical Services
bgs	below grade surface
C-T	columbium-tantalum
CFR	Code of Federal Regulations
cpm	counts per minute
DCGL	derived concentration guideline level
DP	decommissioning plan
dpm	disintegrations per minute
dpm/100 cm ²	disintegrations per minute per 100 square centimeters
DQO	data quality objectives
EMC	elevated measurement comparison
FSS	Final Status Survey
FSSR	Final Status Survey Report
keV	kiloelectron-volt
m ²	square meters
MARSSIM	Multi-Agency Radiation and Site Investigation Manual (NUREG-1575)
min	minute
NIST	National Institute of Standards and Technology
NRC	U.S. Nuclear Regulatory Commission
Tc	technetium
WRS	Wilcoxon Rank Sum

32.0 RESULTS SUMMARY FOR PLANT 7 PAVEMENT SU3

This chapter of the Final Status Survey Report (FSSR) presents the results of the final status survey (FSS) and data assessment for Plant 7 pavement survey unit SU3 in accordance with Columbium-Tantalum (C-T) Phase II Decommissioning Plan (DP) Section 14.5. The FSS for this Class 2 survey unit was completed by AECOM Technical Services (AECOM) in September and October of 2011. The SU3 data assessment was performed based on the assumptions, methods, and performance criteria established to satisfy the data quality objectives (DQOs) in accordance with the C-T Phase II DP Section 14.4.3.8. The summary statistics provide numerical values for measures of central tendency (i.e., mean, median), variation (i.e., standard deviation), and spread (i.e., minimum, maximum). Data evaluation and statistical analyses were performed and a separate decision was made for each survey unit of the C-T Plant as to its suitability for release for unrestricted use based upon the industrial use scenario release criterion as established in C-T Phase II DP Chapter 5.

32.1 OVERVIEW

SU3 is a Class 2 survey unit comprising of the concrete troughs located between and along north side of west and east wastewater neutralization basins in C-T Plant 7W. The survey unit consists of all basin features other than the large, flat surfaces of the basins themselves, specifically the troughs and adjoining concrete wall (vertical) surfaces, including collection header and drains located in center of basin floors and on east wall of west basin and west wall of east basin. The survey unit is approximately 407 square meters (m²) in size, which is less than the size limit of 10,000 m² for Class 2 survey units for pavement (per C-T Phase II DP, Table 14-4). Class 2 was the appropriate classification because the survey unit had potential residual radioactivity that was not expected to exceed the DCGL_w. Figure 32-1 shows the location of SU3 within the Plant 7W area.

Liner and debris material were removed from the basin and the exposed concrete surfaces were power washed. Figure 32-5, Figure 32-6, and Figure 32-3 are photographs of SU3 after exposing and power washing the concrete.

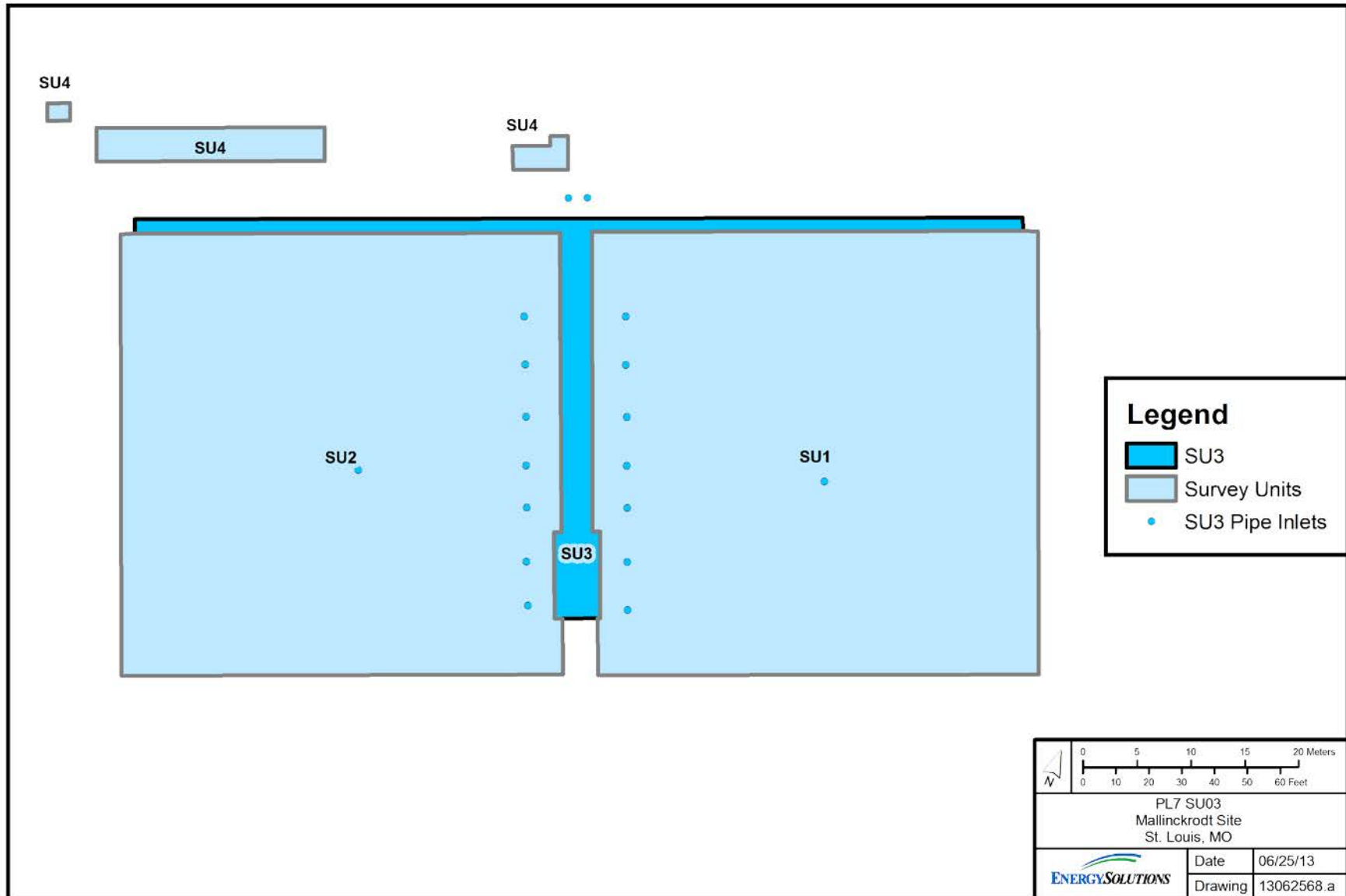


Figure 32-1 Location of Pavement SU3 in C-T Plant 7W



**Figure 32-2 Photograph of Plant 7W West Basin
Northwest Corner Looking East**



**Figure 32-3 Photograph of Middle
Trough Looking South**

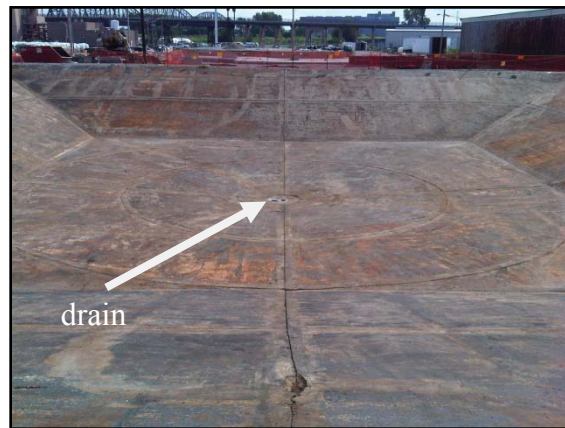


**Figure 32-4 Photograph of Plant 7W East Basin
Northeast Corner Looking West**

Several drains lead from the wastewater basins. A drain is located at each of the basins. Figure 32-5 and Figure 32-6 show the bottom of the west and east basin, respectively.



**Figure 32-5 Photograph of Plant 7W West
Basin Looking East**



**Figure 32-6 Photograph of Plant 7W East
Basin Looking East**

Figure 32-7 and Figure 32-8 show the northern trough connection pipe.



Figure 32-7 Photograph of Northern Trough Connection Pipe



Figure 32-8 Photograph of Northern Trough Connection Pipe

A series of pipes were situated to carry material from the east and west basins to the central trough. Figure 32-9 and Figure 32-10 show the east and west basin transfer pipes, respectively.

Two pipes penetrate the northern basin wall and give access to the central trough. Presumably, a pump or pumps transported the liquid from the bottom of the trough to the outlet. Figure 32-11 is a photo of the central trough outlet pipes.



Figure 32-9 Photograph of East Basin Transfer Pipes



Figure 32-10 Photograph of West Basin Transfer Pipes



Figure 32-11 Photograph of West Basin Transfer Pipes

32.2 REMEDIAL ACTION AND RADIOLOGICAL SUMMARY

Exposed concrete surfaces, after power washing, were surveyed using an alpha and beta-gamma scintillation detector. Survey results are summarized in Table 32-1.

Table 32-1 Post-Remediation Residual Radioactivity Summary

Type of Residual Radioactivity	Range
Removable	< 10 dpm/100 cm ² alpha < 100 dpm/100 cm ² beta-gamma
Total	10 to 660 dpm/100 cm ² alpha 100 to 6,300 dpm/100 cm ² beta-gamma

Note: cpm to dpm conversion based on instrument response to average beta energy of 86.4 keV (Tc-99)

32.3 DATA COLLECTION

Data collection was performed based on the assumptions, methods, and performance criteria established to satisfy the DQOs in accordance with the C-T Phase II DP, Sections 14.4.1 and 14.4.3. Details regarding FSS design and quality assurance and quality control applicable to all survey units were discussed in Chapters 4 and 5, respectively, of this FSSR.

32.3.1 Beta Surface Activity Scans

A beta surface scan was performed over the basin surfaces to locate radiation anomalies that might indicate areas with elevated residual radioactivity where further data collection (i.e., biased measurement) was warranted. Drains and pipe outlets were scanned with an alpha-beta scintillator detector (Ludlum 43-93) probe to allow access into the smaller features.

32.3.2 Surface Activity Measurements

Surface activity measurements to be used for the statistical test were collected at a frequency and at representative locations throughout SU3 such that a statistically sound conclusion regarding the radiological condition of the survey unit could be developed. Additional biased surface activity measurements were also collected at locations of elevated residual radioactivity identified by the beta surface activity scans. Figure 32-12 provides the beta surface activity scan results and surface activity measurement locations. A total of 17 (15 systematic and 2 beta surface activity scan biased locations) surface activity measurements were performed on the surfaces of SU3.

Table 32-2 provides the surface activity measurement results and summary statistics for the 15 systematic measurements. Table 32-3 provides the surface activity measurements results for the 2 beta surface activity scan biased measurement locations. In evaluating the data, background contributions were not accounted for in calculating surface activity. Alpha surface activity measurements were performed by AECOM, presumably for informational purposes, and are provided in the tables.

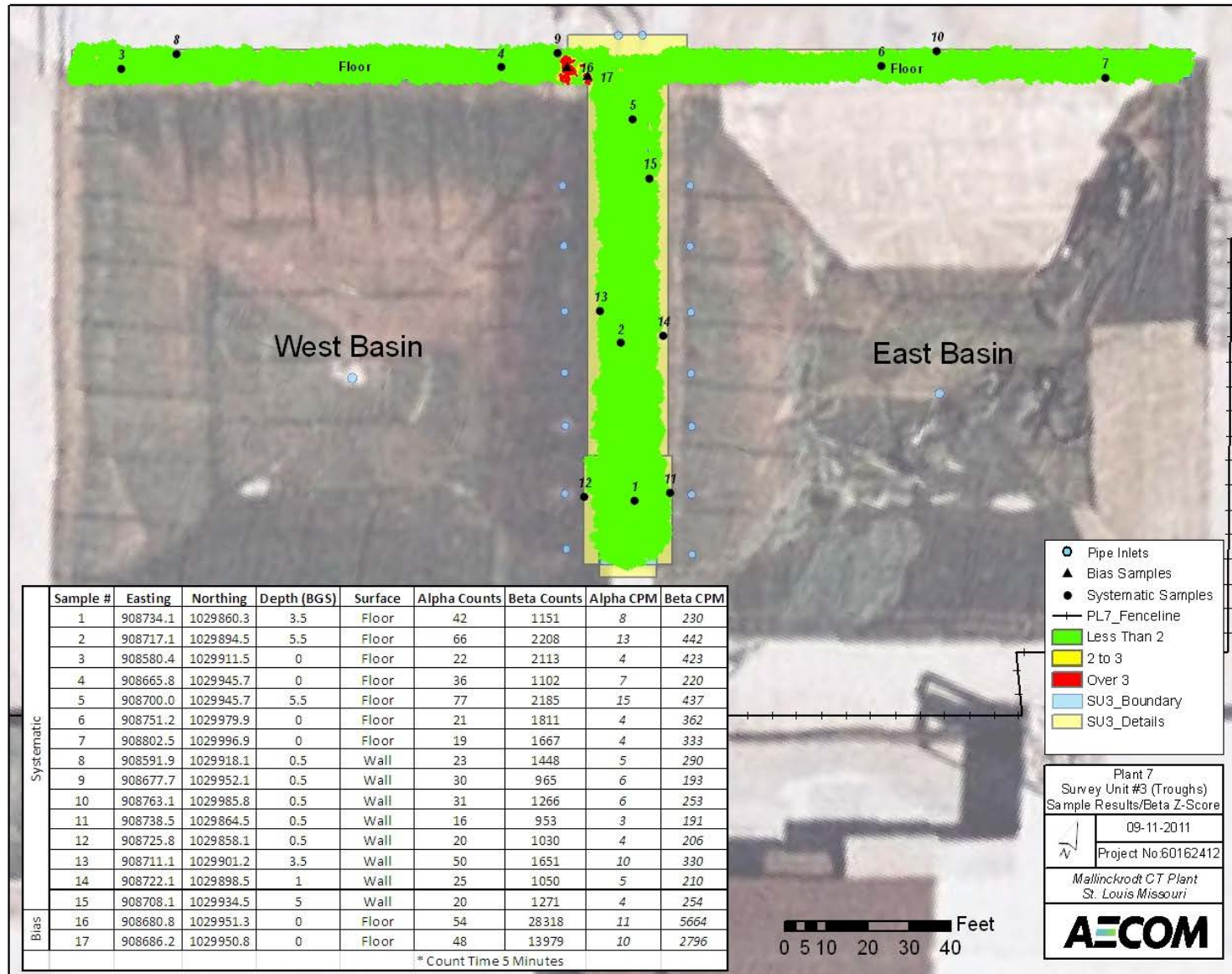


Figure 32-12 Beta Surface Activity Scans and Surface Activity Measurement Locations

Table 32-2 Systematic Surface Activity Results

Location	Depth (ft bgs)	Surface	Alpha Counts ^a	Beta Counts ^a	Alpha CPM	Beta CPM	Alpha (dpm/100 cm ²)	Beta (dpm/100 cm ²)
1	3.5	Floor	42	1,151	8	230	38	1,534
2	5.5	Floor	66	2,208	13	442	60	2,943
3	0	Floor	22	2,113	4	423	20	2,816
4	0	Floor	36	1,102	7	220	33	1,469
5	5.5	Floor	77	2,185	15	437	70	2,912
6	0	Floor	21	1,811	4	362	19	2,414
7	0	Floor	19	1,667	4	333	17	2,222
8	0.5	Wall	23	1,448	5	290	21	1,930
9	0.5	Wall	30	965	6	193	27	1,286
10	0.5	Wall	31	1,266	6	253	28	1,687
11	0.5	Wall	16	953	3	191	15	1,270
12	0.5	Wall	20	1,030	4	206	18	1,373
13	3.5	Wall	50	1,651	10	330	46	2,200
14	1	Wall	25	1,050	5	210	23	1,399
15	5	Wall	20	1,271	4	254	18	1,694
Average:							30	1,943
Median:							23	1,694
Standard Deviation:							17	603
Minimum:							15	1,270
Maximum:							70	2,943

^a Total count time of five minutes.

Table 32-3 Biased Surface Activity Results

Location	Depth (ft bgs)	Surface	Alpha Counts ^a	Beta Counts ^a	Alpha CPM	Beta CPM	Alpha (dpm/100 cm ²)	Beta (dpm/100 cm ²)
16	0	Floor	54	28,318	11	5,664	49	37,741
17	0	Floor	48	13,979	10	2,796	44	18,630

^a Total count time of five minutes.

Surface activity measurements were also performed at drains and pipe outlets (AECOM survey number 60162412-SURV-PL7-Other-1018). Results ranged from 20 to 400 alpha dpm/100 cm² and from 818 to 3,848 dpm/100 cm².

32.4 DATA ANALYSIS

The data analysis was performed based on the assumptions, methods, and performance criteria established to satisfy the DQOs in accordance with the C-T Phase II DP, Sections 14.4.1 and 14.4.3. Details regarding FSS design and quality assurance and quality control applicable to all survey units were discussed in Chapters 4 and 5, respectively, of this FSSR.

32.4.1 Elevated Area Evaluation

There were no elevated areas identified in SU3.

32.4.2 Data Set Screening Analysis

Table 32-4 summarizes the results of the screening tests performed in accordance with Pages 14-27 through 14-29 of the C-T Phase II DP. All applicable tests demonstrating compliance passed.

Table 32-4 Screening Tests Results

Screening Test	Test Value	Conclusion
Min/Max	2,943	PASS
Low Level	N/A	Not applicable; Class 2 survey unit
DCGL _W	N/A	Not applicable; Min/Max < DCGL _W
EMC Limit	N/A	Not applicable; No elevated areas

32.4.2.1 Min/Max

Page 14-27 of the C-T Phase II DP describes calculating the Min/Max screening test value by subtracting the minimum reference area result from the maximum survey unit systematic result. Background was not accounted for in the surface activity measurements; therefore, the Min/Max screening test value was equal to the maximum survey unit result. Location 2 with a beta surface activity result of 2,943 dpm/100 cm² (from Table 32-2) was the maximum survey unit systematic result, which is the Min/Max screening test value. Because the test value was less than 180,000 β/min/100 cm², no further computations are required, i.e., DCGL_W screening and Wilcoxon Rank Sum (WRS) tests.

32.4.2.2 Low Level

In accordance with Page 14-27 of the C-T Phase II DP, the Low Level screening test is not applicable to Class 2 survey units.

32.4.2.3 DCGL_w

In accordance with Page 14-28 of the C-T Phase II DP and because the Min/Max test value was less than 180,000 β/min/100 cm², the DCGL_w screening test was not applicable to this survey unit.

32.4.2.4 EMC Limit

In accordance with Page 14-28 of the C-T Phase II DP, the elevated measurement comparison (EMC) Limit screening test was not applicable to this survey unit because no elevated areas were identified.

32.4.3 WRS Test

In accordance with Page 14-29 of the C-T Phase II DP and because the Min/Max test value was less than 180,000 β/min/100 cm², the WRS Test was not required to demonstrate compliance.

32.4.4 Retrospective Analysis

A retrospective analysis was performed of the FSS results to determine whether the results met the survey design objectives, in accordance with Page 14-30 of the C-T Phase II DP. Table 32-5 provides the results of the retrospective analysis. Because the actual sample size exceeded the retrospective value sample size, the conclusion is that the survey design objectives were met.

Table 32-5 Retrospective Analysis

Parameter	<i>A Priori</i> Value	Retrospective Value Based on FSS Results (dpm/100 cm ²)
Upper Bound of Gray Region	DCGL = 180,000 β/min/100 cm ²	180,000
Lower Bound of Gray Region	0.5 x DCGL = 90,000 β/min/100 cm ²	1,943
Spatial Variability (standard deviation)	1/6 x DCGL = 30,000 β/min/100 cm ²	603
Type I Error (false positive)	0.05	0.05
Type II Error (false negative)	0.05	0.05
Relative Shift	3	295
Calculated N/2 Sample Size	15 ^a	9
Actual N/2 Sample Size	--	15

^aThe *a priori* value of 15 for the N/2 sample size was determined to be a conservative value that would allow application of either the Sign or WRS test. The *a priori* value for N/2 is 8 based on MARSSIM Table 5.3.

32.5 DEVIATIONS

In accordance with the second bullet in Section 14.5 of the C-T Phase II DP, the FSSR is required to list changes made in the FSS from what was proposed in the DP. Only one deviation

was noted. Page 14-27 of the C-T Phase II DP indicated that the “data set for the survey unit will be processed within a database using screening software developed and verified for the project.” This database was not developed; instead, a combination of Microsoft® Excel® spreadsheets and hand calculations was utilized. This deviation is not significant and does not affect the data collection or assessment.

32.6 NRC INSPECTIONS

A summary of U.S. Nuclear Regulatory Commission (NRC) inspections applicable to the FSS are provided in Section 5.8 of this FSSR. None of the inspections applied to the Plant 7 final status surveys.

32.7 CONCLUSION

FSS data were verified to be reliable, appropriately documented, and technically defensible. Specifically, the following conclusions are made:

- The instruments used to collect the data were capable of detecting the radiation type (i.e., gamma) at or below the release criteria (described in Sections 4.4 and 4.5 of this FSSR).
- The calibration of the instruments used to collect the data was current and radioactive sources used for calibration were National Institute of Standards and Technology (NIST) traceable (described in Section 5.4 of this FSSR). Specific records available upon request.
- Instrument response was checked before instrument use each day, at minimum (described in Section 5.4 of this FSSR). Specific records available upon request.
- The survey methods used to collect the data were appropriate for the media and type of radiation being measured (described in Sections 4.4 and 4.5 of this FSSR).
- The survey data consist of qualified measurement results that are representative of the area of interest.

All the applicable screening tests passed, the retrospective analysis found that the survey design objectives were met. SU3 meets the industrial use scenario release criterion as established in the C-T Phase II DP Chapter 5; and therefore, satisfies the unrestricted release provisions of Title 10, Code of Federal Regulations (CFR), Part 20, Subpart E.

32.8 REFERENCES

Mallinckrodt, *Mallinckrodt Columbium-Tantalum Phase II Decommissioning Plan*, Revision 2, August 2008.