Phase II Final Status Survey Report
Mallinckrodt Columbium-Tantalum Plant

St. Louis, Missouri

Chapter 30

Project No. 137131 **Revision 0**

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ABBREVIATIONS AND ACRONYMS

%	percent
β	beta
AECOM	AECOM Technical Services
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

30.0 RESULTS SUMMARY FOR PLANT 7 PAVEMENT SU1

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 SU1 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 August and September of 2011. The SU1 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.

30.1 OVERVIEW

SU1 is a Class 2 survey unit comprising the east wastewater neutralization basin in C-T Plant 7W. The survey unit consists of basin concrete surfaces, excluding troughs located along north and west sides of basin, and drains located in center of basin floor and on west wall. The survey unit is approximately 1,693 square meters (m^2) in size, which is less than the size limit of 10,000 m^2 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 30-1 shows the location of SU1 within the Plant 7W area.

Liner and debris material were removed from the basin and the exposed concrete surfaces were power washed. Figure 30-2 and Figure 30-3 are photographs of SU1 after exposing and power washing the concrete.

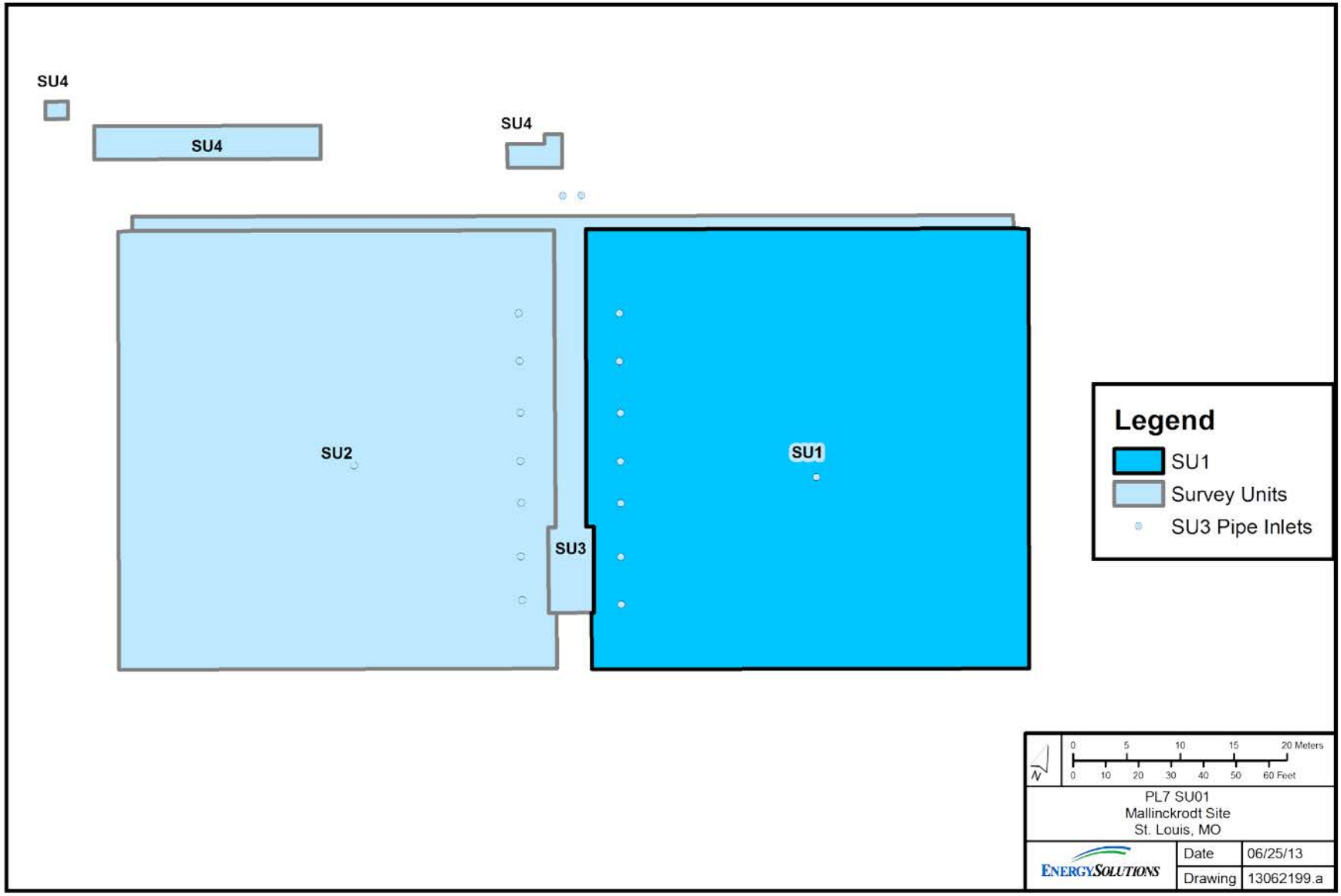


Figure 30-1 Location of Pavement SU1 in C-T Plant 7W

Figure 30-2 Photograph of Plant 7W East Basin Looking East

Figure 30-3 Photograph of Plant 7W East Basin Looking West

30.2 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 30-1.

Table 30-1 Post-Remediation Residual Radioactivity Summary

Type of Residual Radioactivity	Range
Removable	< 10 dpm/100 cm^2 alpha < 10 dpm/100 cm^2 beta-gamma
Total	40 to 590 dpm/100 cm^2 alpha 790 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)

30.3 DATA COLLECTION

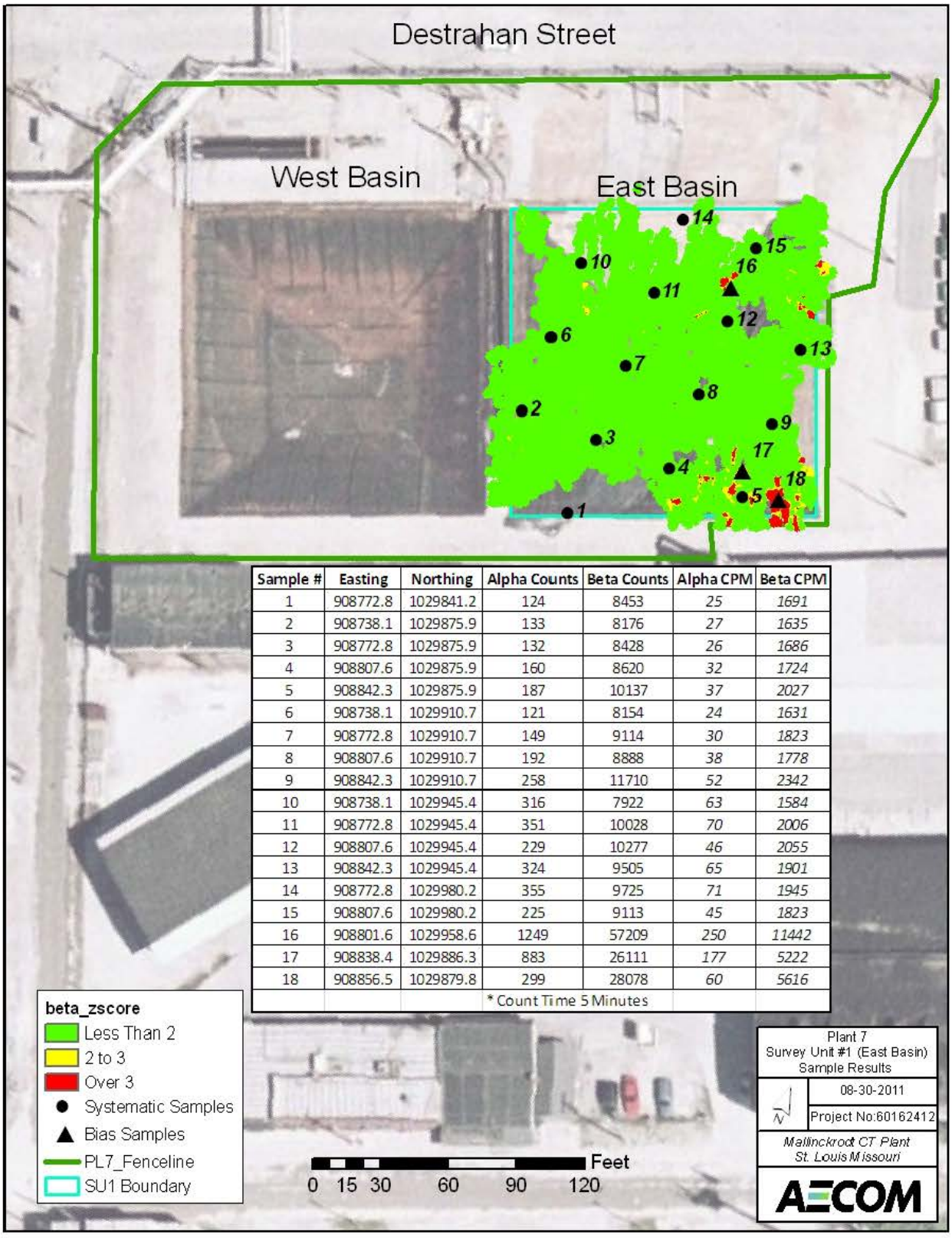
Data collection was performed based on the assumptions, methods, and performance criteria established to satisfy the DQOs in accordance with the C-T Phase II DP, Sections 14.4.1 and 14.4.3. Details regarding FSS design and quality assurance and quality control applicable to all survey units were discussed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

30.3.1 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.

30.3.2 Surface Activity Measurements

Surface activity measurements to be used for the statistical test were collected at a frequency and at representative locations throughout SU1 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 30-4 provides the beta surface activity scan results and surface activity measurement locations. A total of 18 (15 systematic and 3 beta surface activity scan biased locations) surface activity measurements were performed on the surfaces of SU1.



Sample #	Easting	Northing	Alpha Counts	Beta Counts	Alpha CPM	Beta CPM
1	908772.8	1029841.2	124	8453	*25*	*1691*
2	908738.1	1029875.9	133	8176	*27*	*1635*
3	908772.8	1029875.9	132	8428	*26*	*1686*
4	908807.6	1029875.9	160	8620	*32*	*1724*
5	908842.3	1029875.9	187	10137	*37*	*2027*
6	908738.1	1029910.7	121	8154	*24*	*1631*
7	908772.8	1029910.7	149	9114	*30*	*1823*
8	908807.6	1029910.7	192	8888	*38*	*1778*
9	908842.3	1029910.7	258	11710	*52*	*2342*
10	908738.1	1029945.4	316	7922	*63*	*1584*
11	908772.8	1029945.4	351	10028	*70*	*2006*
12	908807.6	1029945.4	229	10277	*46*	*2055*
13	908842.3	1029945.4	324	9505	*65*	*1901*
14	908772.8	1029980.2	355	9725	*71*	*1945*
15	908807.6	1029980.2	225	9113	*45*	*1823*
16	908801.6	1029958.6	1249	57209	*250*	*11442*
17	908838.4	1029886.3	883	26111	*177*	*5222*
18	908856.5	1029879.8	299	28078	*60*	*5616*
			* Count Time 5 Minutes			

Figure 30-4 Beta Surface Activity Scans and Surface Activity Measurement Locations

Table 30-2 provides the surface activity measurement results and summary statistics for the 15 systematic measurements. Table 30-3 provides the surface activity measurements results for the 3 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.

Table 30-2 Systematic Surface Activity Results

Location	Alpha Counts [a]	Beta Counts [a]	Alpha CPM	Beta CPM	Alpha (dpm/100 cm^2)	Beta (dpm/100 cm^2) [b]
1	124	8,453	25	1,691	53	2,185
2	133	8,176	27	1,635	57	2,114
3	132	8,428	26	1,686	56	2,179
4	160	8,620	32	1,724	68	2,229
5	187	10,137	37	2,027	80	2,621
6	121	8,154	24	1,631	52	2,108
7	149	9,114	30	1,823	64	2,356
8	192	8,888	38	1,778	82	2,298
9	258	11,710	52	2,342	110	3,027
10	316	7,922	63	1,584	135	2,048
11	351	10,028	70	2,006	150	2,593
12	229	10,277	46	2,055	98	2,657
13	324	9,505	65	1,901	138	2,457
14	355	9,725	71	1,945	152	2,514
15	225	9,113	45	1,823	96	2,356
				Average:	93	2,383
				Median:	82	2,356
				Standard Deviation:	36	266
				Minimum:	52	2,048
				Maximum:	152	3,027

[a] Total count time of five minutes.

[b] Surface activity measurements were performed using an 821 cm^2 detector and reported values include a geometry correction factor of 8.21 (821 cm^2 / 100 cm^2). For the surface activity measurements, it could be conservatively assumed that all of the activity was concentrated into a 100 cm^2 area within the detector's field of view and the remaining area had no activity (background levels). With that assumption, the calculated range without using the geometry correction factor was 16,814 to 24,852 dpm/100 cm^2. These results did not exceed the $DCGL_W$ of 180,000 β/min/100 cm^2.

Table 30-3 Biased Surface Activity Results

Location	Alpha Counts [a]	Beta Counts [a]	Alpha CPM	Beta CPM	Alpha (dpm/100 cm^2)	Beta (dpm/100 cm^2) [b]
16	1,249	57,209	250	11,442	534	14,791
17	883	26,111	177	5,222	377	6,751
18	299	28,078	60	5,616	128	7,259

[a] Total count time of five minutes.

[b] Surface activity measurements were performed using an 821 cm^2 detector and reported values include a geometry correction factor of 8.21 (821 cm^2 / 100 cm^2). For the surface activity measurements, it could be conservatively assumed that all of the activity was concentrated into a 100 cm^2 area within the detector's field of view and the remaining area had no activity (background levels). With that assumption, the calculated range without using the geometry correction factor was 55,426 to 121,434 dpm/100 cm^2. These results did not exceed the $DCGL_W$ of 180,000 β/min/100 cm^2.

30.4 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.

30.4.1 Elevated Area Evaluation

There were no elevated areas identified in SU1.

30.4.2 Data Set Screening Analysis

Table 30-4 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 30-4 Screening Tests Results

Screening Test	Test Value	Conclusion
Min/Max	3,027	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

30.4.2.1 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 9 with a beta surface activity result of 3,027 dpm/100 cm^2 (from Table 30-2) 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 cm^2, no further computations are required, i.e., $DCGL_W$ screening and Wilcoxon Rank Sum (WRS) tests.

30.4.2.2 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.

30.4.2.3 $DCGL_W$

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 cm^2, the $DCGL_W$ screening test was not applicable to this survey unit.

30.4.2.4 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.

30.4.3 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 cm^2, the WRS Test was not required to demonstrate compliance.

30.4.4 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 30-5 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 30-5 Retrospective Analysis

Parameter	*A Priori* 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	2,383
Spatial Variability (standard deviation)	1/6 x DCGL = 30,000 β/min/100 cm^2	266
Type I Error (false positive)	0.05	0.05
Type II Error (false negative)	0.05	0.05
Relative Shift	3	667
Calculated N/2 Sample Size	15 [a]	9
Actual N/2 Sample Size	--	15

[a] The *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.

30.5 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.

30.6 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.

30.7 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. SU1 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.

30.8 REFERENCES

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