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August 29, 2012

Ms. Cathy Bohan
Project Manager
U.S. Department of Energy
West Valley Demonstration Project
10282 Rock Springs Road
West Valley, NY 14171-9799

DOE CONTRACT NO. DE-AC05-06OR23100
SUBJECT: VERIFICATION SURVEY REPORT OF THE SOUTH WASTE TANK FARM TRAINING/TEST TOWER AND HAZARDOUS WASTE STORAGE LOCKERS AT THE WEST VALLEY DEMONSTRATION PROJECT WEST VALLEY, NEW YORK
DCN: 5182-SR-01-0

Dear Ms. Bohan:

Oak Ridge Associated Universities (ORAU) is pleased to provide the enclosed final report detailing the verification survey results for the South Waste Tank Farm Training/Test Tower and Hazardous Waste Storage Lockers that are part of the Balance of Site Facilities Removal Project at the West Valley Demonstration Project. Comments provided on the draft report have been incorporated.

My contact information is listed below or you may contact Erika Bailey at 865.576.6659 if you have any questions or require additional information.

Sincerely,

Timothy J. Vitkus
IEAV Associate Director

TJV:fr

Enclosure

cc: File 5182

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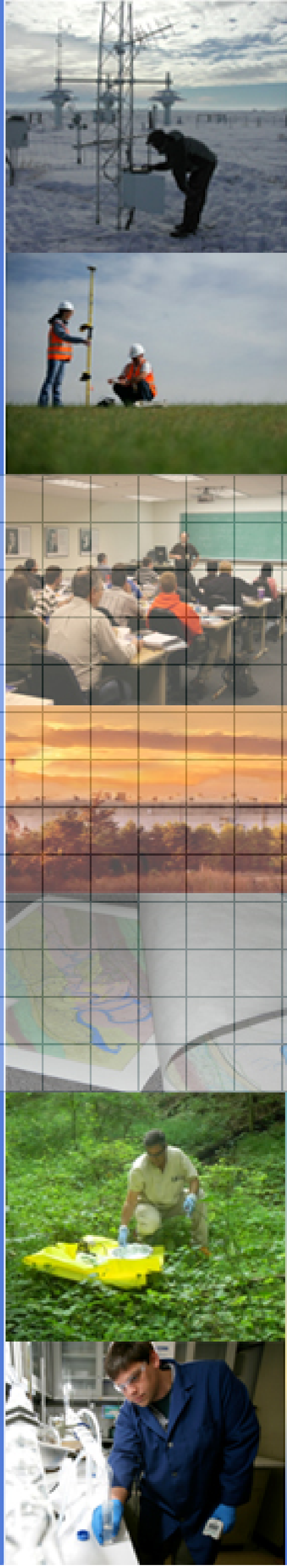

VERIFICATION SURVEY REPORT OF THE SOUTH WASTE TANK FARM TRAINING/TEST TOWER AND HAZARDOUS WASTE STORAGE LOCKERS AT THE WEST VALLEY DEMONSTRATION PROJECT WEST VALLEY, NEW YORK

P.C. Weaver

Prepared for the
U.S. Department of Energy

FINAL REPORT

OAK RIDGE ASSOCIATED UNIVERSITIES

Approved for public release; further dissemination unlimited.

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Prepared by
Phyllis C. Weaver
Independent Environmental Assessment and Verification Program

FINAL REPORT

AUGUST 2012

Prepared for the
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Prepared by Oak Ridge Associated Universities under the Oak Ridge Institute for Science and Education contract, number DE-AC05-06OR23100, with the U.S. Department of Energy.

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FINAL REPORT

AUGUST 2012

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VERIFICATION SURVEY REPORT OF THE SOUTH WASTE TANK FARM TRAINING/TEST TOWER AND HAZARDOUS WASTE STORAGE LOCKERS AT THE WEST VALLEY DEMONSTRATION PROJECT WEST VALLEY, NEW YORK

INTRODUCTION AND SITE HISTORY

The West Valley Demonstration Project for the Western New York Nuclear Service Center (WNYNSC) is located in the town of Ashford, New York, near West Valley and approximately 50 kilometers (30 miles) southeast of Buffalo, New York. CH2M Hill B&W West Valley, LLC manages and operates the 200 acres of developed site area for the U.S. Department of Energy (DOE). From 1966 to 1972, Nuclear Fuels Services, Inc. (NFS) operated a nuclear fuel reprocessing center. During that time, approximately 640 metric tons of spent reactor fuel was processed and 660,000 gallons of highly radioactive liquid waste were generated and stored in an underground waste tank. Additionally, solid wastes generated from reprocessing were disposed in a 7 acre landfill and radioactive commercial wastes were disposed in a 15 acre area east of the main plant area. NFS received waste for disposal until 1975 (DOE 2012).

CH2M Hill B&W West Valley, LLC is currently performing final status surveys of miscellaneous facilities in preparation for demolition, disposal, recycle, or reuse. This phase of decontamination and decommissioning (D&D) is referred to as the "Balance of Site Facility Removals" and includes former building slabs, storage containers, and structures. The South Waste Tank Farm Training/Test Tower and four former Hazardous Waste Storage Lockers—hereafter referred as the South Tower and Lockers, respectively, and shown in Fig.1—are included in this D&D phase and deemed ready for verification. The South Tower had been used to conduct mock-ups, testing, and training on pumps and equipment to use in the High Level Waste Tanks and Main Plant Process (MPP) Building Extraction Cells. The South Tower is a pre-engineered steel-framed structure with heavy-milled canvas siding. All of the structures had heavy, clear plastic sheeting used for the windows; the sheeting has long since disintegrated. The South Tower dimensions are 16 ft × 16 ft × 48 ft high (DOE 2012).

Four non-attached, pre-engineered steel container structures (Lockers), measuring 8 ft × 15 ft, were previously used for the storage of hazardous wastes. The stored wastes were packaged in 55-gallon drums or 5-gallon pails (DOE 2012). The Lockers were moved from the west of the MPP Building to their current location east of the MPP Building (Fig. 1). DOE indicated that the Lockers had been sampled for Resource Conservation and Recovery Act (RCRA) clean closure.

DOE has requested that Oak Ridge Associated Universities (ORAU) perform independent verification (IV) of personal and real property release programs to ensure that radiological releases of property meet the applicable authorized limits. IV is specifically required in accordance with *DOE Order 458.1 Change 1, for Radiation Protection of the Public and the Environment* (DOE 2011). Staff from ORAU's Independent Environmental Assessment and Verification (IEAV) Program performed IV of the South Tower and Lockers under the provisions of ORAU's Oak Ridge Institute for Science and Education (ORISE) contract with DOE.

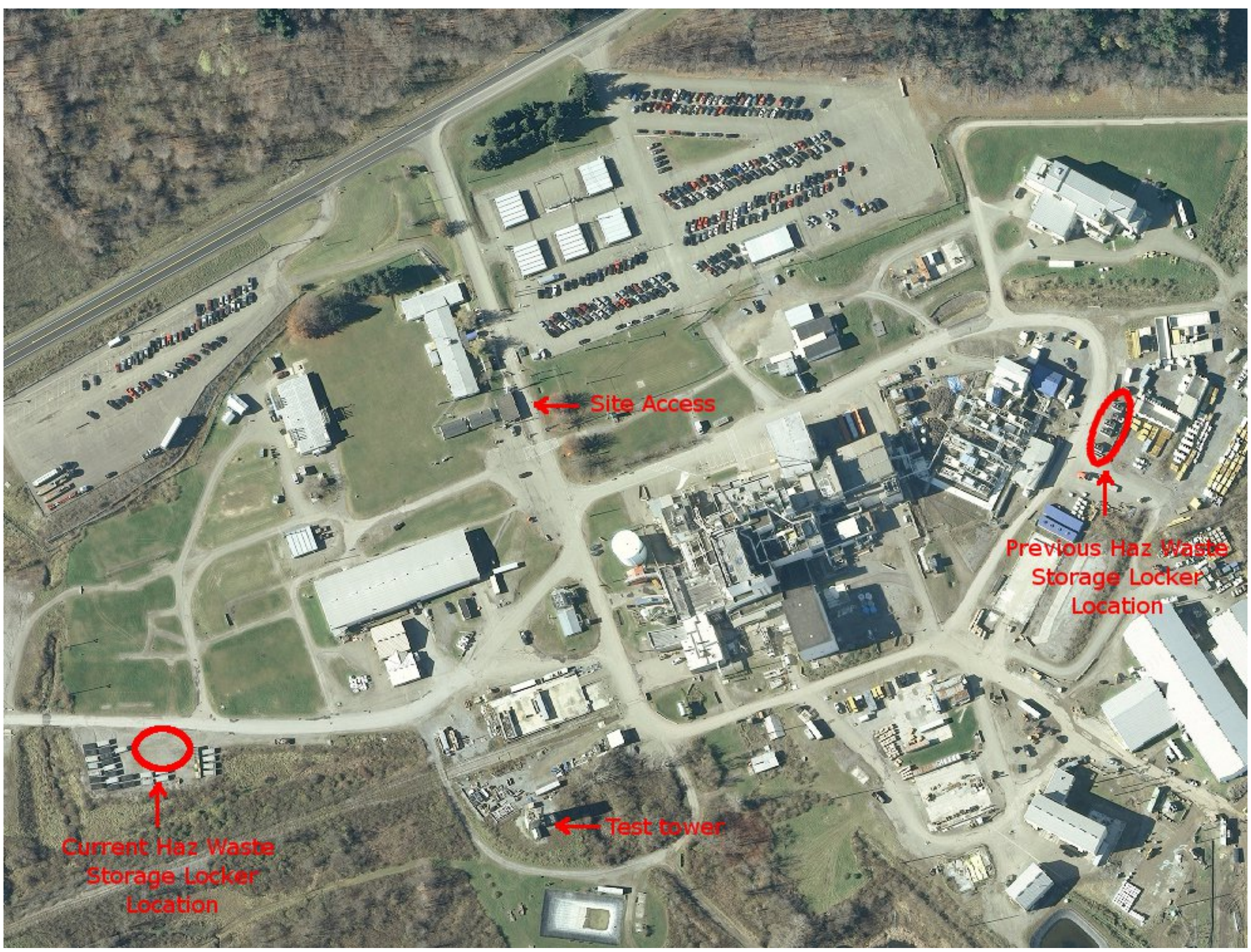

Fig. 1. West Valley Demonstration Project Site

SURVEY PROCEDURES

On June 24 and 25, 2012, ORAU performed independent field survey activities of the South Tower and Lockers. Activities performed by the ORAU survey team were conducted in accordance with the project-specific plan (ORAU 2012a), ORAU/ORISE Survey Procedures Manual (ORAU/ORISE 2012a), and the ORAU Quality Program Manual (ORAU 2012b).

SURFACE SCANS

Surface scans for alpha and alpha-plus-beta radiation were performed on accessible interior surfaces and components using hand-held Ludlum Model No. 43-68 gas proportional detectors coupled to Ludlum Model No. 2221 ratemeter-scalers with audible indicators and hand-held data loggers (Trimble GeoXH). Also, a qualitative scan for gamma radiation was performed using Ludlum Model No. 44-10 sodium iodide scintillation detectors, also coupled to Ludlum Model No. 2221 ratemeter-scalers. Approximately 50% of the South Tower walls up to the six-story level and portions of the large, center test pipe were scanned. Approximately 75% of each Locker was scanned (considerably more than required, based on historical process knowledge), with the exception of Locker HAZ-07, which had leaked. Mold was visible on the ceiling and the Locker contained a small amount of standing water in the floor. Visible rust/water stains, indicative of reoccurring leaks, were also noted on the floor.

The *a priori* scan minimum detectable concentrations (MDC_{SCAN}) for the survey instruments were calculated to ensure that the instrument could be used to detect the radionuclides of concern (ROCs). Identification of elevated radiation levels was based on increases in the audible signal from the indicating instrument.

The alpha-plus-beta surface MDC_{SCAN} was estimated using the approach described in NUREG-1507 (NRC 1998). MDC_{SCAN} is a function of the background and other variables. Parameters selected for calculating a MDC_{SCAN} included first determining the minimum number of net source counts (s_i) above the detector background (b) in the observation interval (i) at the specified level of performance (d'). The observation interval is a function of scan speed and an *a priori* hot spot size of concern, with 100 cm^2 serving as the default area. The following equation from NUREG-1507 is used:

$$s_i = d'\sqrt{b_i}$$

The observation interval was two seconds. The specified level of performance (d') at the first scanning stage of 90% true positive and a 25% false positive rate, yielded a d' value of 1.96 (NUREG-1507, Table 6.1). The ambient detector background (b) was 324 counts per minute (cpm). The number of detector background counts expected during the observation interval (b_i) is:

$$b_i = (324\ \text{cpm})(2\ \text{s})(1\ \text{min}/60\ \text{s}) = 11\ \text{counts}$$

$$s_i = 6.5\ \text{counts}$$

The minimum detectable count rate may then be calculated based on the following:

$$MDCR = s_i \times (60/i)$$

$$MDCR = 11 \times (60\ \text{s/min})/2\text{s}) = 195\ \text{cpm}$$

The equation for calculating the MDC_{SCAN} in surface activity units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2) is:

$$Scan\ MDC = \frac{MDCR}{\sqrt{p}\ \varepsilon_i\ \varepsilon_s\ \frac{probe\ area}{100\ cm^2}}$$

The surveyor efficiency (p) is 0.5, the default value provided in NUREG-1507. The beta total efficiency (ε_{Total}) of 0.11 is a product of the gas proportional detectors instrument efficiency (ε_i) of 0.45, calibrated to Tc-99, and the applied, conservative surface efficiency (ε_s) of 0.25. The detector physical area is 126 cm^2. The alpha-plus-beta MDC_{SCAN} is therefore 2,000 dpm/100 cm^2.

The alpha MDC_{SCAN} was determined using the calculational approach described in Section 6.7.2.2 of MARSSIM (DOE 2000), which is based on the probability (P) of detecting a single count in while passing the detector over an area of contamination—100 cm^2—at a predetermined guideline level for given scan rates.

$$AlphaScanMDC = \frac{[-\ln(1-P)]60}{i * \varepsilon_{Total}}$$

Setting the Alpha MDC_{SCAN} at the $DCGL_w$, using the calculated total efficiency (ε_{Total}) of 0.10 (for the gas proportional detector), a scan rate of approximately 2.5 cm per second, and an observation interval (i) of 4 seconds, ORAU determined that the probability of detecting a "hot-spot" of approximately 100 dpm/100 cm^2 was approximately 50%.

SURFACE ACTIVITY MEASUREMENTS

As stated in the project-specific plan (ORAU 2012a), a direct surface measurement for total alpha and total beta activity would be performed at any location of elevated direct radiation identified during surface scans. A smear sample would be collected from each direct measurement location to determine removable gross alpha and gross beta activity levels. No locations of elevated direct radiation were identified; therefore no direct surface measurements were performed and no smear samples were collected.

GUIDELINES

DOE has the authority to release real property that may contain residual radioactive materials for reuse, disposal, or free release under DOE Order 458.1 (DOE 2011). This order and the associated guidance are designed to provide radiation protection to the public and environment. Radiological releases of real property may be based on current, pre-approved surface contamination guidelines as shown in Table 1, authorized or supplemental release criteria, or materials defined as indistinguishable from background radiation levels (ORAU 2012a). Based on historical process knowledge, the expected ROCs include (but are not limited to): Cs-137, Sr-90, Tc-99, U-235, U-238, transuranics, and H-3.

Table 1. Release Criteria for Building Surface Contamination			
Surface Activity Measurements			
	Average	Maximum	Removable
Net beta-gamma activity (dpm/100cm^2)	5,000	15,000	1,000
Net beta activity (dpm/100cm^2)	1000	3,000	200
Net alpha activity—uranium (dpm/100cm^2)	5,000	15,000	1,000
Net alpha activity—transuranics (dpm/100cm^2)	100	300	20

Rather than the Table 1 criteria, the South Tower and Lockers are to be released based on indistinguishable-from-background criteria. Therefore, the IV surveys relied upon medium- to high-density scan coverage while listening to the audio output of the detector. Any locations where count rates were distinguishable from background were to be marked for further investigation and direct measurements. Scan data were electronically captured so that the data could be plotted and presented in a manner that would illustrate that the data were not distinguishable from a normal background count rate distribution, or alternatively, that outliers were present that were potentially indicative of contamination.

DATA INTERPRETATION

Data were returned to the ORAU facility in Oak Ridge, Tennessee for interpretation. Quantile (Q) plots of alpha and alpha-plus-beta surface scan data are provided as a graphical technique for determining if there is a common distribution in data sets. The advantages of the Q-plot are as follows.

Population distributional aspects can be evaluated simultaneously. The aspects that can be detected include:

- Shifts in scale
- Changes in symmetry (skewness of the data)
- The presence of outliers

Q-plots were generated by uploading the survey area data into the U.S. Environmental Protection Agency's ProUCL software. On the Q-plots, the Y-axis represents observed gross count rates in cpm and also as surface activity in units of dpm/100 cm^2. The dpm/100 cm^2 values were calculated by subtracting the detector background and correcting for the detector efficiency and geometry. The X-axis represents the data quantiles about the mean value. A normal distribution that is not skewed by outliers (i.e., a background radiation population) will appear as a straight line with the slope of the line subject to the degree of variability among the data population. Values less than the mean are represented in the negative quantiles and the values greater than the mean are represented in the positive quantiles. If present, outlier measurements that indicate the presence of contamination or locations that require further investigation are apparent in the upper-right quadrant as points above the main population axis.

FINDINGS AND RESULTS

Contractor data were not provided to ORAU for review prior to performing verification activities. ORAU utilized gamma scans as an initial qualitative tool to identify locations that could potentially require additional investigation. There were no indications of elevated gamma radiation. Alpha and alpha-plus-beta scans of the interior surfaces of the South Tower and each Locker did not identify any locations of elevated direct radiation distinguishable from background. As such, no direct or removable surface activity measurements were performed. The Q-plots and summary statistics for the alpha-plus-beta scans of the Lockers and South Tower are provided in Appendix A, Figs. A-1 to A-5. The Q-plots have a similar distribution for the two sample data plots. The distributions do not indicate presence of any outliers.

Alpha scan Q-plot results are provided in Appendix B (Figs. B-1 to B-5). The very low alpha count rates shown in the figures are extrapolated values given by converting a 1-second data capture to a cpm value. For example, most of the alpha data captured will be a zero count but an instantaneous read-out of one count will be converted to 60 cpm, two counts converted to 120 cpm, etc. These factors combine such that the data will not present as the characteristic straight, sloped line indicative of background levels as seen in the alpha-plus-beta plots. Therefore, this inherent alpha count rate extrapolation error requires that the alpha surface activity plots be viewed simply as a means to illustrate whether there were any significant deviations from the background count rate range.

The on-site verification survey determinations, as documented in the data plots, showed that the alpha-plus-beta and alpha activity levels for each of the surveyed items were predominantly indistinguishable from background. Therefore, the results of the independent verification survey supported the site conclusion that the South Tower and Lockers meet site guidance for release.

SUMMARY

In summary, a team from ORAU's IEAV Program performed verification survey activities on the South Test Tower and four Hazardous Waste Storage Lockers. Scan data collected by ORAU determined that both the alpha and alpha-plus-beta activity was representative of radiological background conditions. The count rate distribution showed no outliers that would be indicative of alpha or alpha-plus-beta count rates in excess of background. It is the opinion of ORAU that IV data collected support the site's conclusions that the South Tower and Lockers sufficiently meet the site criteria for release to recycle and reuse.

REFERENCES

DOE 2000. *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM),* DOE/HS-004; NUREG-1575, Supp. 1; EPA 402-R-09-001. U.S. Department of Energy, U.S. Nuclear Regulatory Commission, and U.S. Environmental Protection Agency. Washington, DC. August.

DOE 2011. *DOE Order 458.1, Chg 1, Radiation Protection of the Public and the Environment.* U.S. Department of Energy. Washington, D.C. March 8.

DOE 2012. *2012 Balance of Site Facility Removals Subject to Independent Verification.* U.S. Department of Energy. West Valley, New York. April 2.

NRC 1998. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions.* NUREG-1507. U.S. Nuclear Regulatory Commission. Washington, D.C. January.

ORAU 2012a. *Proposed Project-Specific Plan For Independent Verification Of The Balance Of Site Facility Removals at the West Valley Demonstration Project.* Oak Ridge Associated Universities. Oak Ridge, Tennessee. June 11.

ORAU 2012b. *Quality Program Manual for the Independent Environmental Assessment and Verification Program.* Oak Ridge Associated Universities. Oak Ridge, Tennessee. June 26.

ORAU/ORISE 2012. *Survey Procedures Manual.* Oak Ridge Institute for Science and Education, managed by Oak Ridge Associated Universities. Oak Ridge, Tennessee. May 11.

APPENDIX A
ALPHA-PLUS-BETA Q-PLOTS

Hazardous Waste Storage Locker HAZ-04 Q-plot Summary Statistics for Raw Full Dataset						
Variable	**NumObs**	**Min**	**Max**	**Mean**	**Median**	**SD**
Beta scan (cpm)	546	161	339	243	238	35
Beta Scan Activity (dpm/100 cm2)	546	-462	823	126	94	251

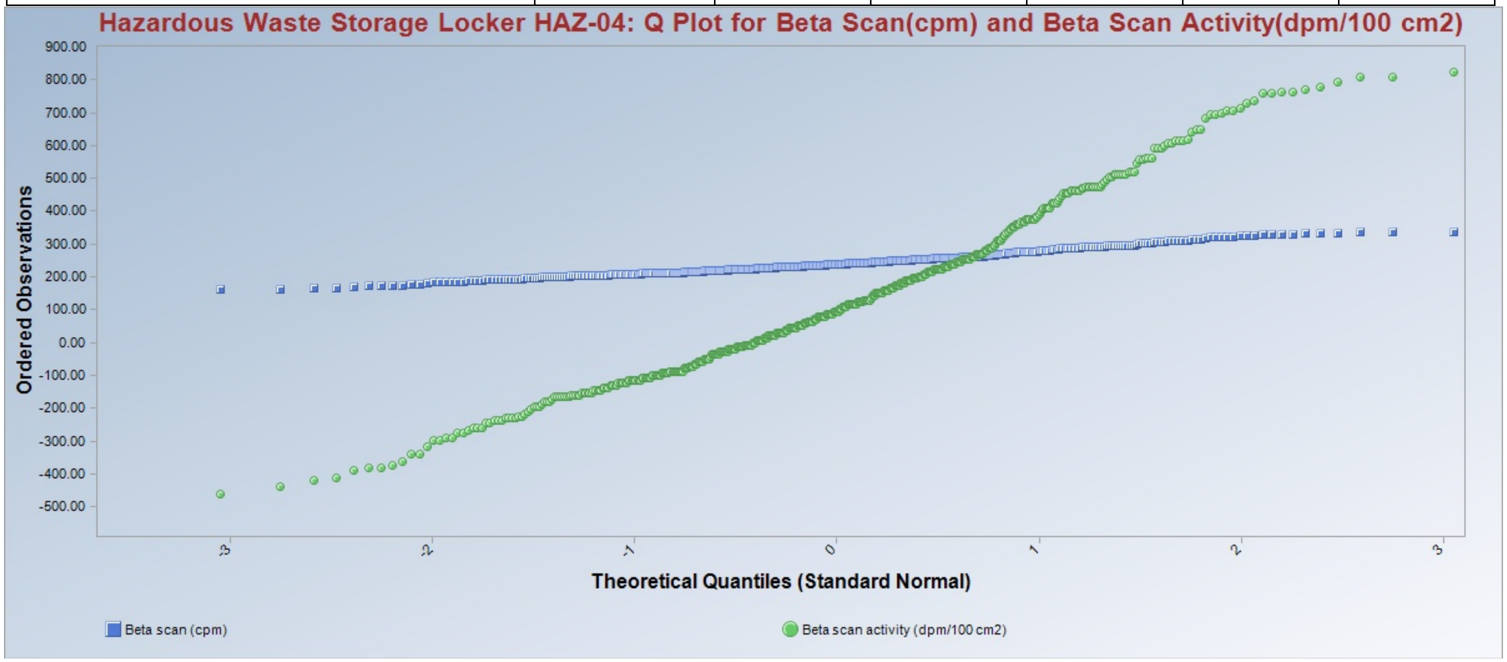

Fig. A-1. Alpha-plus-beta Q-plot for Hazardous Waste Storage Locker HAZ-04

Hazardous Waste Storage Locker HAZ-05 Q-plot
Summary Statistics for Raw Full Dataset

Variable	NumObs	Min	Max	Mean	Median	SD
Beta Scan (cpm)	808	122	318	227	229	36
Beta Scan Activity (dpm/100 cm2)	808	-743	671	17	29	257

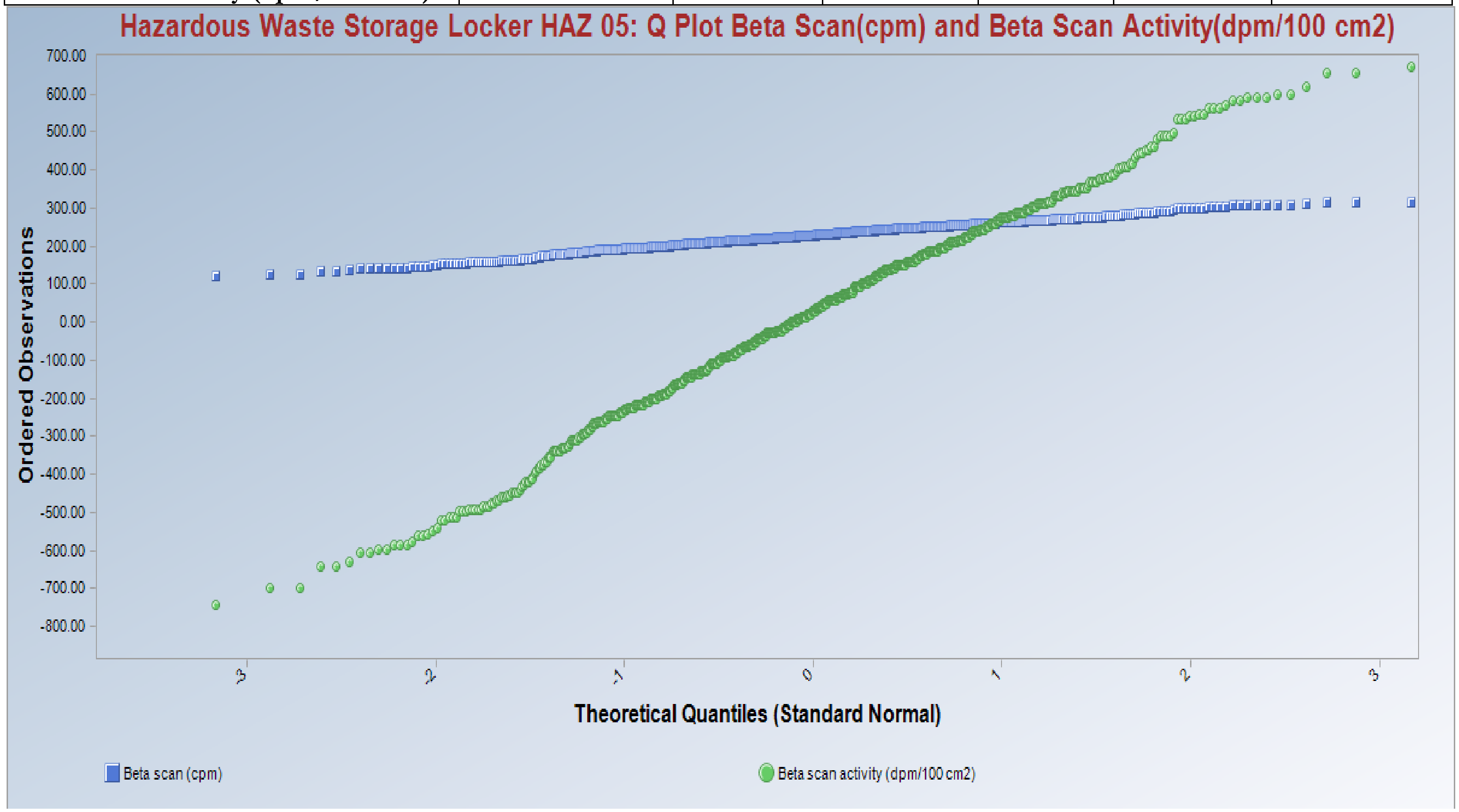

Fig. A-2. Alpha-plus-beta Q-plot for Hazardous Waste Storage Locker HAZ-05

Hazardous Waste Storage Locker HAZ-06 Q-plot Summary Statistics for Raw Full Dataset						
Variable	**NumObs**	**Min**	**Max**	**Mean**	**Median**	**SD**
Beta Scan (cpm)	850	144	377	225	219	42
Beta Scan Activity (dpm/100 cm2)	850	-584	1,097	-3	-43	305

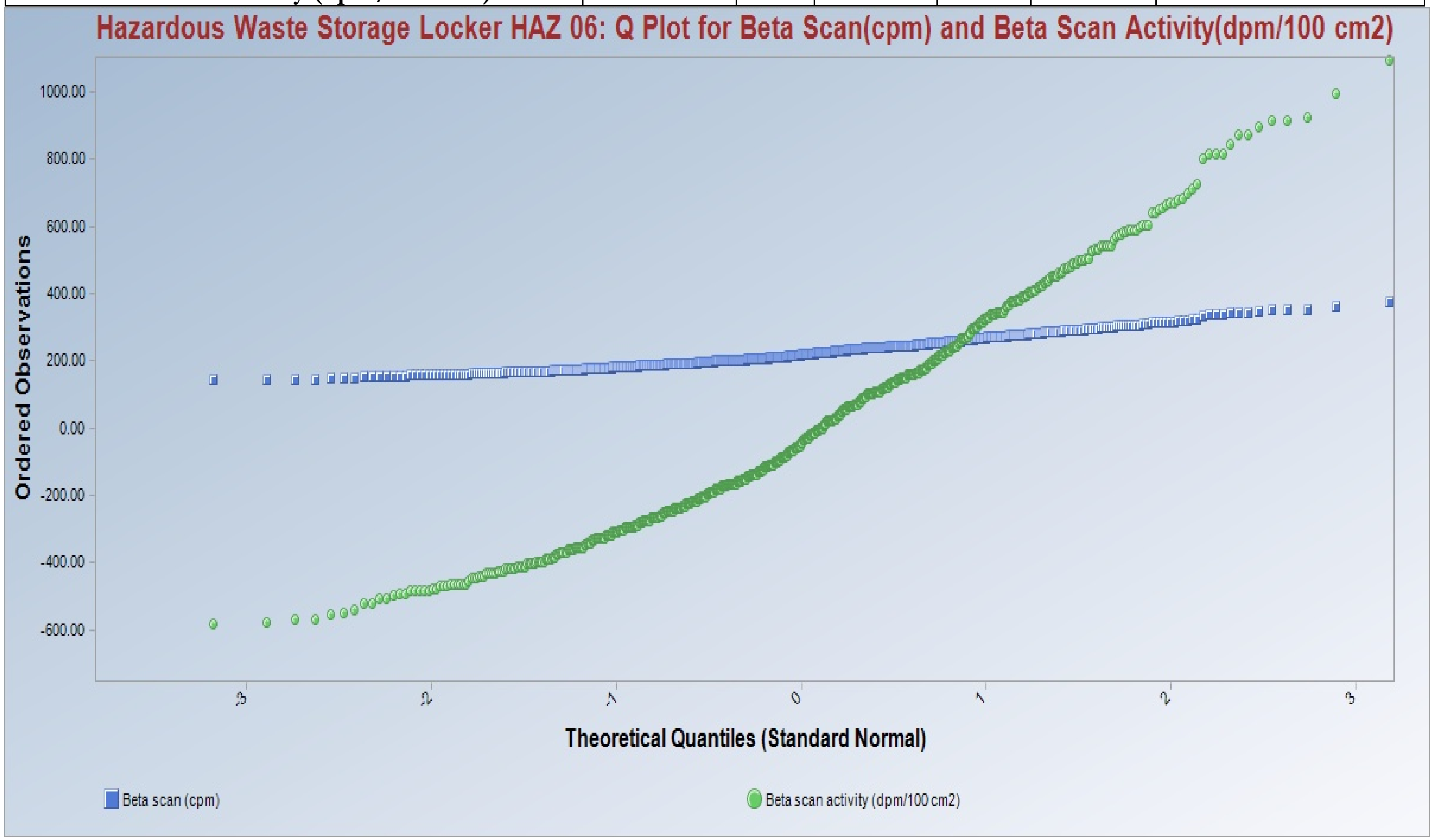

Fig. A-3. Alpha-plus-beta Q-plot for Hazardous Waste Storage Locker HAZ-06

Hazardous Waste Storage Locker HAZ-07 Q-plot Summary Statistics for Raw Full Dataset						
Variable	**NumObs**	**Min**	**Max**	**Mean**	**Median**	**SD**
Beta Scan (cpm)	458	156	343	238	234	36
Beta Scan Activity (dpm/100 cm2)	458	-498	851	93	65	262

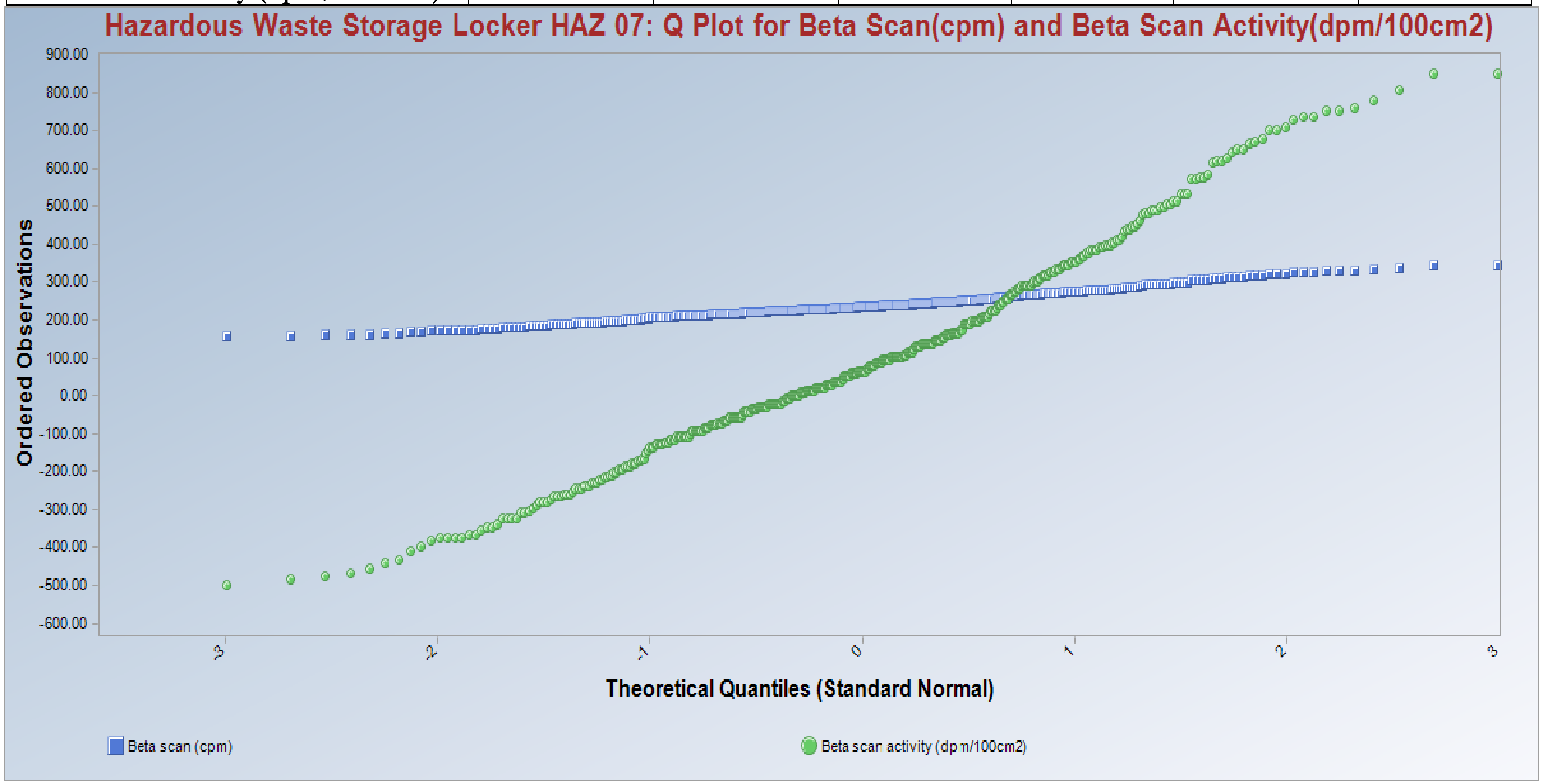

Fig. A-4. Alpha-plus-beta Q-plot for Hazardous Waste Storage Locker HAZ-07

Waste Tank Farm Training/Test Tower Summary Statistics for Raw Full Dataset						
Variable	**NumObs**	**Min**	**Max**	**Mean**	**Median**	**SD**
Beta Scan (cpm)	1,824	78	553	256	250	71
Beta Scan Activity (dpm/100 cm2)	1,824	-1,775	1,652	-494	-534	512

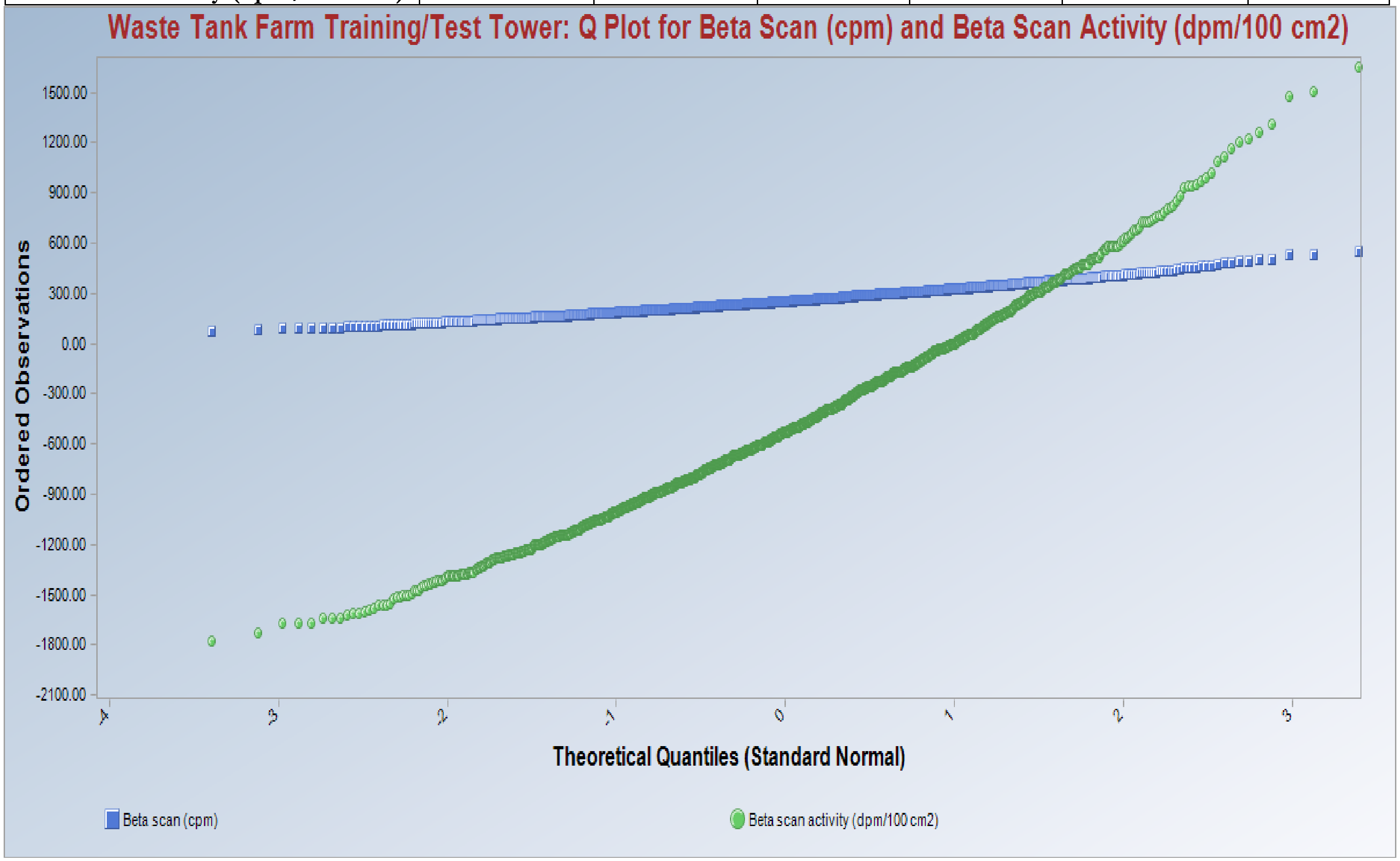

Fig. A-5. Alpha-plus-beta Q-plot for Waste Tank Farm Training/Test Tower

APPENDIX B
ALPHA Q-PLOTS

Hazardous Waste Storage Locker HAZ-04 Q-plot
Summary Statistics for Raw Full Dataset

Variable	NumObs	Min	Max	Mean	Median	SD
Alpha Scan (cpm)	1,208	0	23	3	3	3
Alpha Scan Activity (dpm/100 cm2)	1,208	-38	252	4	0	44

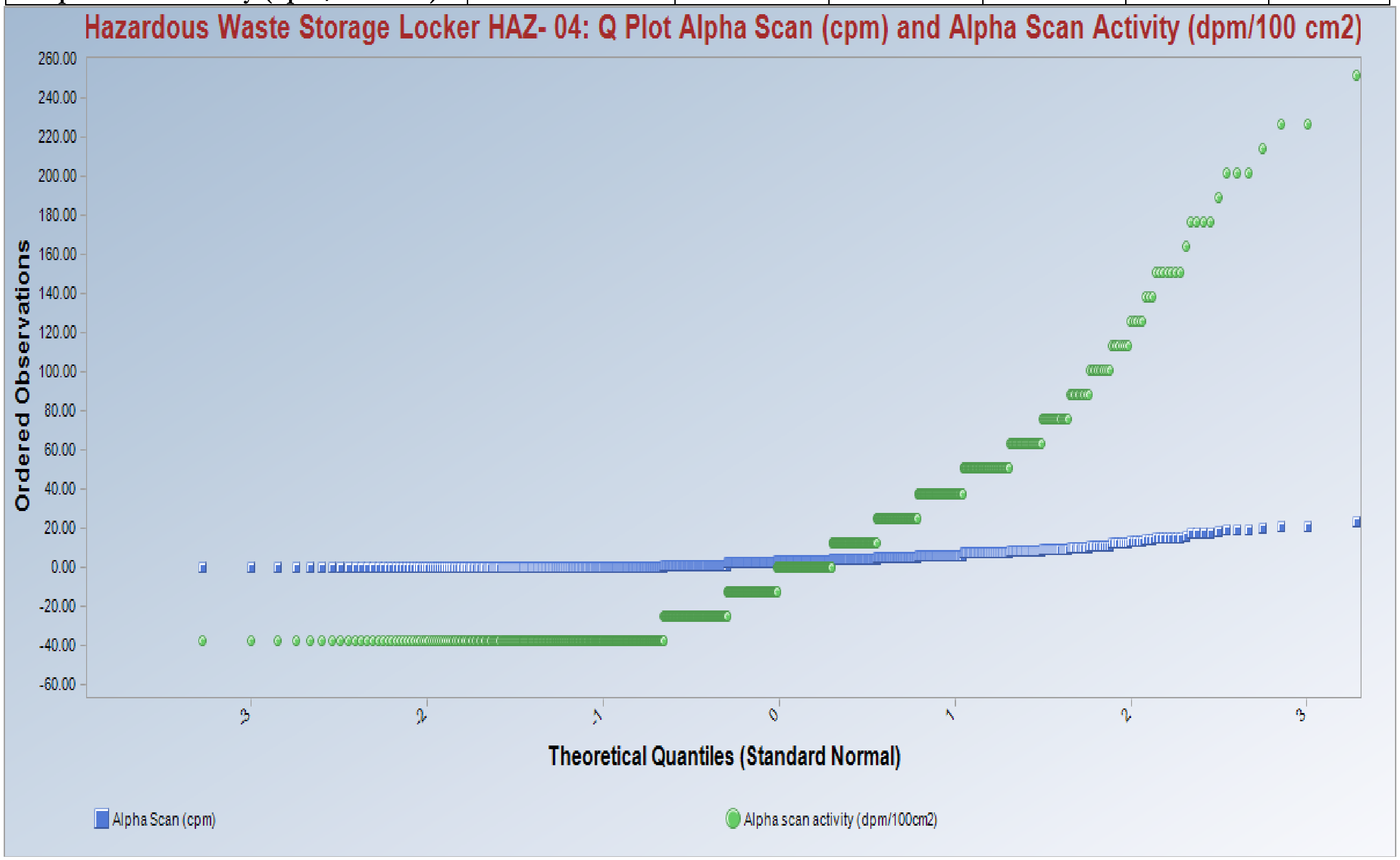

Fig. B-1. Alpha Q-plot for Hazardous Waste Storage Locker HAZ-04

Hazardous Waste Storage Locker HAZ-05 Q-plot Summary Statistics for Raw Full Dataset						
Variable	**NumObs**	**Min**	**Max**	**Mean**	**Median**	**SD**
Alpha Scan (cpm)	1,112	0	15	3	2	3
Alpha Scan Activity (dpm/100 cm2)	1,112	-38	151	-6	-19	37

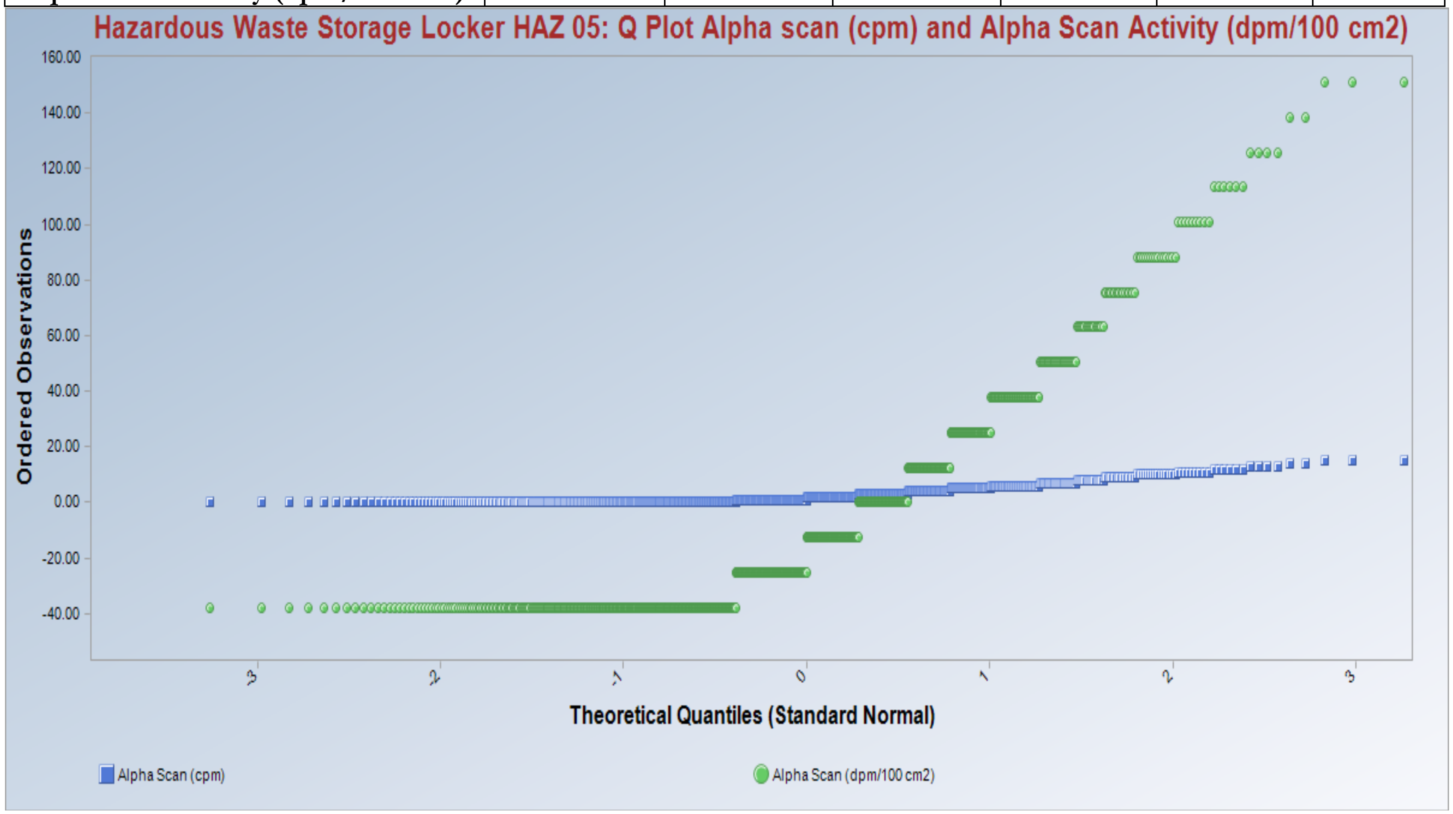

Fig. B-2. Alpha Q-plot for Hazardous Waste Storage Locker HAZ-05

Hazardous Waste Storage Locker HAZ-06 Q-plot Summary Statistics for Raw Full Dataset						
Variable	**NumObs**	**Min**	**Max**	**Mean**	**Median**	**SD**
Alpha Scan (cpm)	1,484	0	22	3	2	3
Alpha Scan Activity (dpm/100 cm2)	1,484	-38	239	-4	-13	40

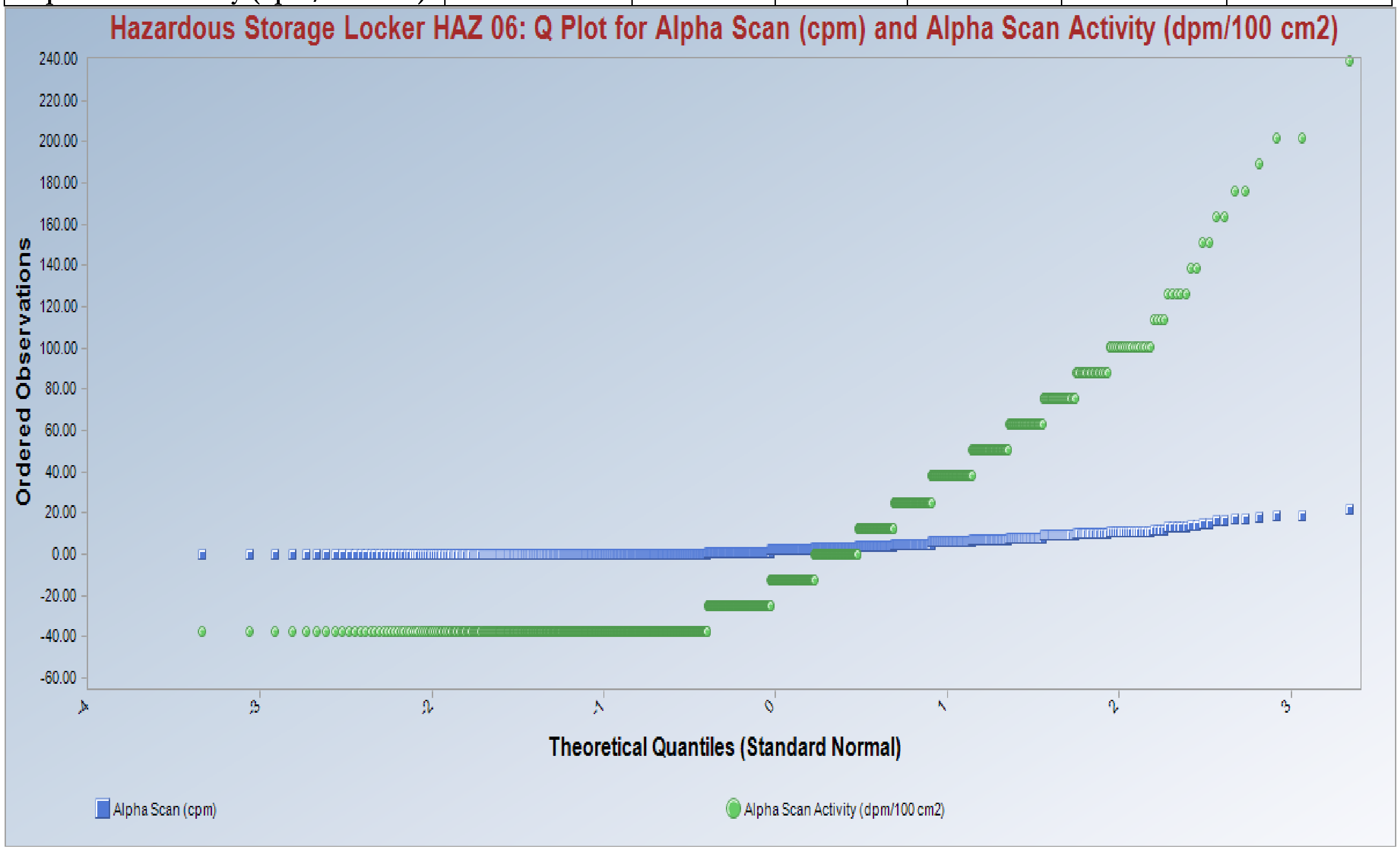

Fig. B-3. Alpha Q-plot for Hazardous Waste Storage Locker HAZ-06

Hazardous Waste Storage Locker HAZ-07 Q-plot Summary Statistics for Raw Full Dataset						
Variable	**NumObs**	**Min**	**Max**	**Mean**	**Median**	**SD**
Alpha Scan (cpm)	760	0	16	3	3	3
Alpha Scan Activity (dpm/100 cm2)	760	-38	164	4	0	39

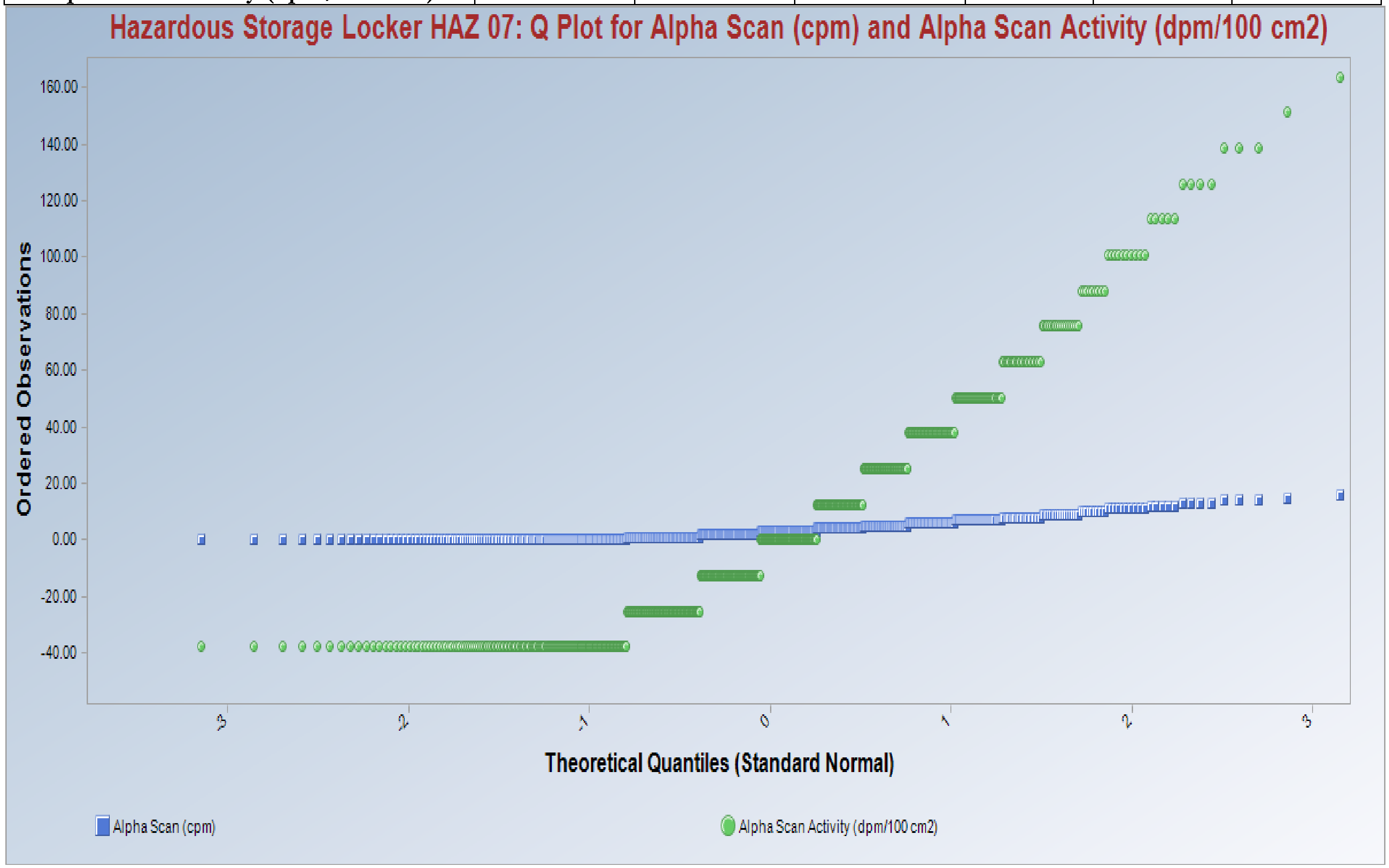

Fig. B-4. Alpha Q-plot for Hazardous Waste Storage Locker HAZ-07

Waste Tank Farm Training/Test Tower Summary Statistics for Raw Full Dataset						
Variable	**NumObs**	**Min**	**Max**	**Mean**	**Median**	**SD**
Alpha Scan (cpm)	1,785	0	22	5	4	4
Alpha Scan Activity (dpm/100 cm2)	1,785	-24	151	14	8	33

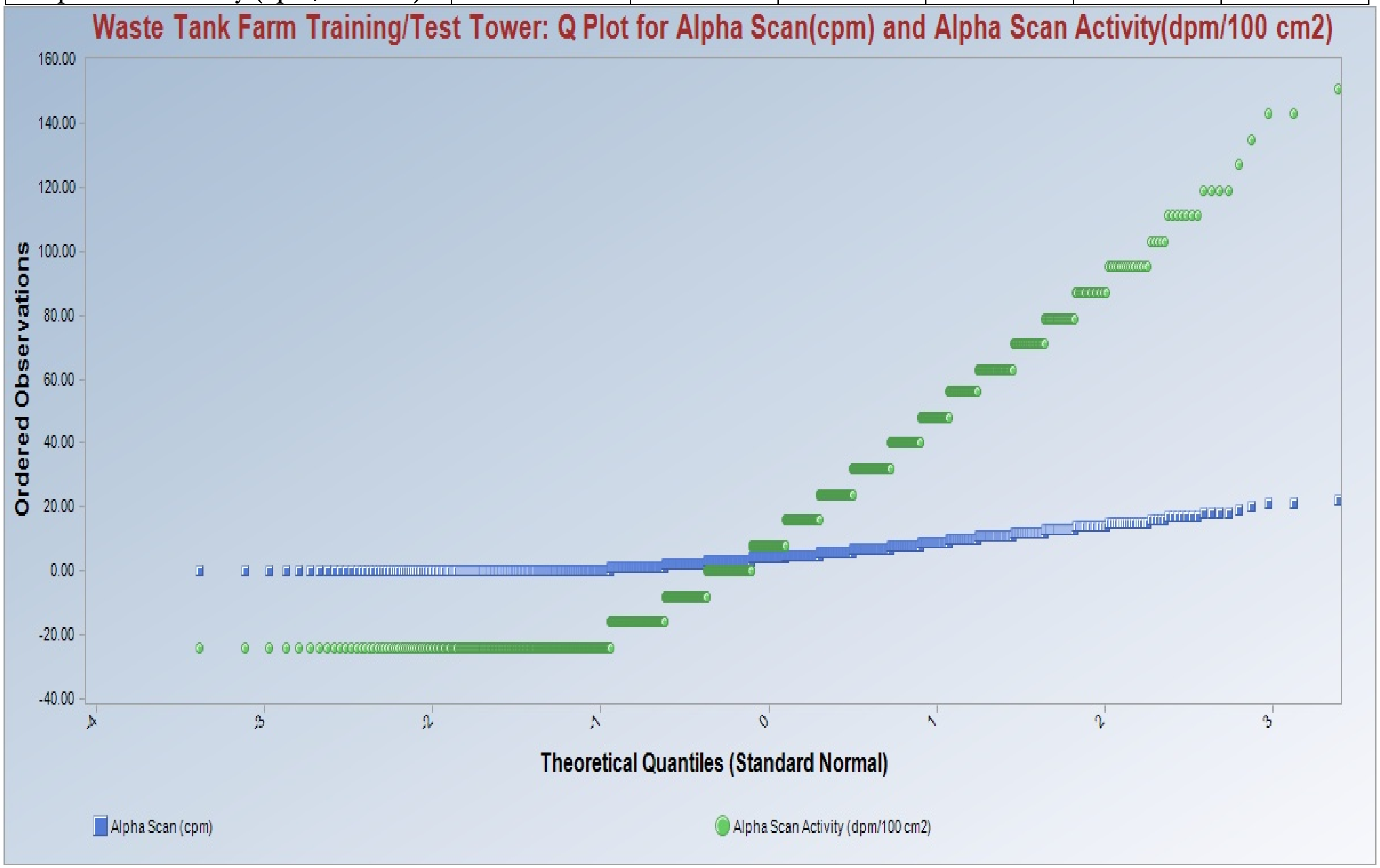

Fig. B-5. Alpha Q-plot for Waste Tank Farm Training/Test Tower