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PG&E Letter HBL-17-001

U.S Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Docket No. 50-133, License No. DPR-7
Humboldt Bay Power Plant, Unit 3
Final Status Survey Report for New Generation Footprint Area

Dear Commissioners and Staff:

On August 13, 2014, Pacific Gas and Electric Company (PG&E) submitted Letter HBL-14-015, "Humboldt Bay Power Plant, Unit 3 License Termination Plan, Revision 1." Section 1.2 of the License Termination Plan (LTP) describes a two-phase decommissioning approach to accomplish site release for unrestricted use and license termination.

The first phase consists of a partial site release of an area south of King Salmon Avenue. PG&E submitted a request for the partial site release in PG&E Letter HBL-16-008, "Request for Partial Release of Humboldt Bay Power Plant Unit 3 Property from the Part 50 Site," dated November 9, 2016. That submittal included a Final Status Survey (FSS) Report for the survey units within the area proposed to be released.

In the second phase, PG&E will submit FSS reports for the remaining survey units as they are completed. The first of these FSS reports pertains to the survey units for the new generation footprint area, and is included in this submittal. Upon completion of FSS reports for all survey units, PG&E will request that the remainder of the site be released for unrestricted use and that the 10 CFR Part 50 license be terminated.

The enclosure to this letter contains the FSS Report for the New Generation Footprint Area. The FSS Report demonstrates that the aggregate of the radiological data provides reasonable assurance that the new generation footprint area meets the release criteria in accordance with the Humboldt Bay Power Plant (HBPP) Unit 3 LTP. This is based on a review of the design methodology, surveys, and sample results in reference to the site-specific derived concentration guideline level. The FSS Report concludes that the survey units surveyed and sampled during the FSS should be released from further radiological controls. Therefore, the FSS Report supports the regulatory decision to terminate the license following completion of all FSS submittals for the HBPP Unit 3 site.

PG&E requests that the NRC review the enclosed information and concur with PG&E's conclusion that the area meets the LTP release criteria.

There are no new or revised regulatory commitments (as defined in NEI 99-04) made in this letter.

If you have any questions regarding this submittal, please contact Mr. William Barley at (707) 444-0856.

Sincerely,

Loren D. Sharp
Senior Director, Nuclear Decommissioning

cc: John B. Hickman, NRC Project Manager
HBPP Humboldt Distribution
Kriss M. Kennedy, NRC Region IV Administrator

Enclosure
PG&E Letter HBL-17-001

Humboldt Bay Power Plant Unit 3

Final Status Survey Report
New Generation Footprint Area

Survey Units: NGFA-EST and NGFA-WST

Pacific Gas and Electric Company

HUMBOLDT BAY POWER PLANT
FINAL STATUS SURVEY REPORT
HBPP-FSS-NGFA-EST AND
HBPP-FSS-NGFA-WST

Final Status Survey Report
New Generation Footprint Area

Survey Units: NGFA-EST and NGFA-WST

Prepared by: Dale Randall, CHP Dale Randall Date: 12-15-16
FSS Engineering Supervisor (print/sign)

Reviewed by: Gordon Madison, CHP Date: 12/15/16
FSS Engineer (print/sign)

Approved by: William Barley, CHP W. Barley Date: 12/15/16
Site Closure Manager (print/sign)

Contents

Executive Summary

This report is written to summarize the Final Status Survey (FSS) effort performed in the New Generation Footprint Area (NGFA). Additionally, the report addresses some of the concerns raised by the US Nuclear Regulatory Commission's oversight contractor, Oak Ridge Institute for Science Education (ORISE) in their Final Report issued in November 2009 (Ref.1).

During a review of HBPP-RPT-002, *Humboldt Bay Power Plant New Generation Footprint Area, Radiological Characterization Report* (ENERCON 2009) to address the issues raised by ORISE, it was found that prior to commencing with FSS activities, a characterization effort, including boring samples of deep soils and gamma scan surveys were performed. These results bolster the assertion that the area was not significantly impacted by site operations and provide context known about the radiological status of the new generation footprint area than can be gleaned from the initial FSS report alone. Accordingly, these results are considered in conjunction with the existing report such that the whole area may be evaluated for sufficiency. Additionally, the procedures governing the contractor's FSS effort was compared to current HBPP-FSS Engineering procedures for gaps.

The FSS documented in the ENERCON 2009 report (Ref. 2) did not follow the conventional guidance of the Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM) because of the method the contractors used to clear the area. An abundance of data was collected that goes above and beyond the MARSSIM survey requirements. The preponderance of radiological data demonstrates that the NGFA Survey Area meets the release criteria. Through various contractors, Humboldt Bay Power Plant (HBPP) collected approximately 150 samples in the NGFA Survey Area with depths ranging from surface soils to 7.5 feet below grade.

Of the characterization samples collected since 1997, the highest positive result was 1.23 pCi/g from a sample taken at a depth of 4.5 feet in characterization data collected in 2008 by TRC Solutions, Inc., as provided in the ENERCON Correspondence (Ref. 5). Site specific Derived Concentration Guideline Levels (DCGLs) were in early development and had not been submitted to the USNRC during the characterization of these survey units. Therefore, the sample results were initially compared to an interim DCGL equivalent of 11 pCi/g (Cs-137), as listed in the USNRC "Interim Screening Values of Common Radionuclides for Soil Surface Contamination Levels" (64 FR 68395). However, this FSS Report was developed by comparing the ENERCON 2009 data against the more conservative, site-specific DCGL for Cs-137 (7.9 pCi/g) as listed in the HBPP License Termination Plan (LTP) (Ref. 6). It should be noted that the site-specific derivation of the soil DCGL, which considers the dose contribution from all appropriate pathways (including groundwater) for the average member of the critical group (i.e., resident farmer), is discussed in Section 6.4.5 of the HBPP LTP (Ref 6). The MARSSIM recommended action level for samples in a Class 3 survey unit is 50% of the DCGL, or 3.95 pCi/g.

The characterization data section discussed later in this report describes the data review of three characterization studies from the 2008 ENERCON Correspondence (Ref. 5) and should not be confused with the final status survey data summaries provided from the

2009 ENERCON Report (Ref. 2). It is acknowledged that the surveys submitted as final based on the 2009 ENERCON Report were not fully compliant with the MARSSIM methodology (Ref. 3). On balance, a sufficient effort was made to ensure adequate characterizations were performed to ensure the release of this portion of the PG&E property will be in accordance with provisions of the September 11, 2007, License Amendment No. 40 to DPR 7 (Attachment 4). A review of the design methodology, surveys, and sample results in reference to the site-specific DCGL concludes that the aggregate of the radiological data provides sufficient confidence to ensure that the subject area meets the release criteria. Summaries of the FSS Design Criteria and Direct Soil Results for Units NGFA-EST and NGFA-WST are presented in Table A and Table B respectively.

NGFA-EST Executive Summary Table A

Feature	Design Criteria	Comment
Synopsis of FSS of NGFA-EST (Eastern Portion of Footprint)		
Survey Unit Land Area	8,821 m^2	Per Geographical Information System (GIS) measurements and AutoCAD generated maps
Classification [(1)]	Class 3	Based on Subcontractor review of HBPP Historical Site Assessment (HSA)
Final Status Survey Plan [(1)]	N/A	Developed by contractor prior to the implementation of current FSS procedure.
Grid Spacing	N/A	Randomly generated layout using Visual Sample Plan.
DCGL	7.9 pCi/g (Cs-137)	Contractor originally selected 11 pCi/g per NUREG 1757 (Ref. 4). Conservatively adjusted to 7.9 pCi/g to achieve 25 mrem/yr TEDE, per HBPP LTP, Rev.01.
Scan Survey Area Coverage [(1)]	10% (Minimum)	The current LTP requires 1-10% of area coverage for Class 3 survey units.
Number of Measurements [(1)]	14	Developed using a conservatively assigned relative shift of 3, with Type I (α) and Type II (β) decision error values of 0.05 per Table 5.5 of MARSSIM (Ref. 3)

Summary of Results NGFA-EST		
Value	**Results (pCi/g)**	**Comments**
Min. Value	-2.79E-02	Cs-137
Max. Value	1.95E-01	Cs-137
Mean	2.76E-02	Cs-137
Median	1.17E-02	Cs-137
Std. Dev.	5.83E-02	Cs-137
No. of Bias Measurements	None	N/A

(1) Criteria obtained from subcontractor-provided report, HBPP-RPT-002, *Humboldt Bay Power Plant New Generation Footprint Area Radiological Characterization Report*, Rev. 0, 09-01-2009, ENERCON, Murrysville, PA.

NGFA-WST Executive Summary Table B

Feature	Design Criteria	Comment
Synopsis of FSS of NGFA-WST (Western Portion of Footprint)		
Survey Unit Land Area	10,015 m^2	Per Geographical Information System (GIS) measurements and AutoCAD generated maps
Classification[(1)]	Class 3	Based on Subcontractor review of HBPP Historical Site Assessment (HSA)
Final Status Survey Plan [(1)]	N/A	Developed by subcontractor prior to the implementation of current FSS procedures.
Grid Spacing	N/A	Randomly generated layout using Visual Sample Plan.
DCGL	7.9 pCi/g (Cs-137)	Contractor originally selected 11 pCi/g per NUREG 1757 (Ref. 4). Conservatively adjusted to 7.9 pCi/g to achieve 25 mrem/yr TEDE, per HBPP LTP, Rev.01.
Scan Survey Area Coverage[(1)]	10% (Minimum)	The LTP requires 1- 10% of area coverage for Class 3 survey units
Number of Measurements[(1)]	14	Developed using a conservatively assigned relative shift of 3, with Type I (α) and Type II (β) decision error values of 0.05 per Table 5.5 of MARSSIM (Ref. 3)

Summary of Results NGFA-WST		
Value	**Results (pCi/g)**	**Comments**
Min. Value	-2.72E-02	Cs-137
Max. Value	5.10E-02	Cs-137
Mean	2.39E-02	Cs-137
Median	2.77E-02	Cs-137
Std. Dev.	2.07E-02	Cs-137
No. of Bias Measurements	None	N/A

(1) Criteria obtained from subcontractor-provided report, HBPP-RPT-002, *Humboldt Bay Power Plant New Generation Footprint Area Radiological Characterization Report*, Rev. 0, 09-01-2009, ENERCON, Murrysville, PA.

Background

On April 4, 2007, PG&E submitted a license amendment request (LAR) to assure that FSS efforts to be completed prior to the construction of the new fossil generation facility would be acceptable, provided that isolation and control mechanisms were maintained through the implementation of cross-contamination prevention and monitoring plans and procedures. On September 11, 2007 the LAR was granted.

License Amendment No. 40 to DPR 7 States:

> "To demonstrate compliance with the NRC License Termination Rule, the Final Status Survey for Humboldt Bay Power Plant, Unit No. 3 license termination may utilize the results of the licensee's surveys of the area underlying the new fossil generation facility, referred to as the Humboldt Bay Repowering Project, provided cross contamination prevention and monitoring plan is maintained."

In preparation for the aforementioned survey, a characterization survey inclusive of sub-surface sampling was performed and is documented in Ref. 5. Based on the low levels of Cs-137 detected in the sampling results, the area was deemed to be a Class 3 MARSSIM survey unit and a survey was performed utilizing the generic DCGLs (Ref 4). The cross contamination prevention and monitoring plan was formally incorporated September 2013 into the Area Surveillance Following Final Status Survey Program (i.e., Area Surveillance Survey Plan, or ASSP) as stipulated in the LTP to assure that land and structural survey areas or units having undergone successful final status surveys remain unchanged until final site release. It also should be noted that three separate sources of characterization information were used (i.e., IT/Duratek, ENERCON, and TRC) for the 2009 ENERCON Correspondence regarding Radiological Status of the Humboldt Bay Repowering Project (HBRP) Soils (Ref 5). The data collection and results evaluation efforts for the surveys performed were deemed by ENERCON to be of sufficient quality and quantity that a high degree of confidence was achieved to indicate that future worker(s) assigned to the HBRP facility will not receive "significant radiation dose above background" as a result of residual radioactive materials.

Release Area Description

The survey area for release consists of land areas located on the southeast portion of the site, specific to the footprint of the New Generation Footprint Area. Previous usage of this area consisted of a gravel parking lot, office trailers, a paint shop, sand blasting facility and storage warehouses. The area also contained two diesel storage tanks.

These structures were characterized and removed prior to performance of the 2007 soil characterization surveys (Ref. 4). The survey area includes two survey units: New Generation Footprint Area West (NGFA-WST); the western portion of the footprint area; and New Generation Footprint Area East (NGFA-EST); the eastern portion of the footprint area. See Figure 1 for a map of the NGFA-EST and NGFA-WST survey units.

Survey Unit Designation (NGFA-EST and NGFA-WST)

This report covers survey units NGFA-EST and NGFA-WST. A review of the Humboldt Bay Power Plant Historical Site Assessment (HSA) indicated that the soil in this area was potentially impacted by Unit 3 operations, with the primary radionuclides of concern being Cs-137 and Co-60.

As site specific DCGLs were not available at the time the survey unit surveys were designed, both survey units were preliminarily designated as Class 3 survey units based on the USNRC screening values of NUREG-1757, Vol. 1, Appendix B (Ref. 4). Based upon the identification of radioactive material well below the Derived Concentration Guideline Levels (DCGLs), it was concluded that there was a low probability for residual radioactivity in concentrations greater than a small fraction of the DCGLs, justifying a final survey unit classification of Class 3.

Therefore, as Survey Units NGFA-EST and NGFA-WST were designated as Class 3 units, the process undertaken by the subcontractor was verified by HBPP-FSS Engineering as meeting the general requirements of Section 4.4 of the MARSSIM.

Survey Unit Description (NGFA-EST and NGFA-WST)

As summarized in the ENERCON FSS report HBPP-RPT-002, Rev 0 (Ref. 2) "Humboldt Bay Power Plant New Generation Footprint Area Radiological Characterization Report", the area was divided into two Survey Units; referred to as the East (EST) and West (WST) Sections, as shown in Figure 1. Prior to the construction of the New Generation Power Plant, the area formerly consisted of a gravel parking lot, office trailers, a paint shop and sandblasting facility, some storage warehouses, and two diesel storage tanks.

Each unit was designated as a FSS Class 3 area. Survey unit NGFA-EST had an area of approximately eight thousand eight hundred and twenty-one square meters (8,821 m^2). Survey unit NGFA-WST had an area of approximately ten thousand fifteen square meters (10,015 m^2).

Historical Site Assessment Events

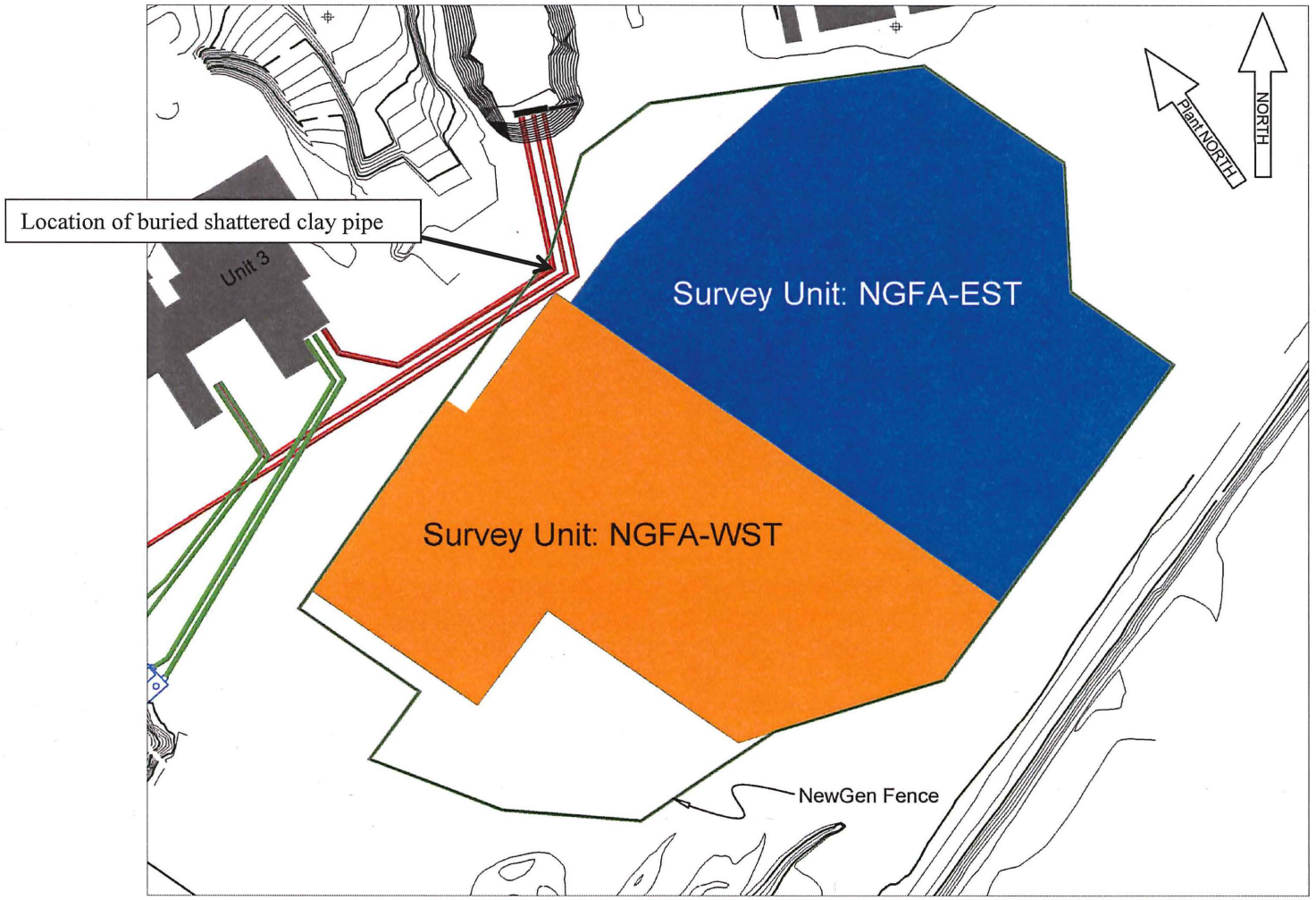
No events occurring within the designated boundary of survey units NGFA-EST and NGFA-WST were noted in the Historical Site Assessment (HSA). However, an incident occurring adjacent to the unit's northern boundary was documented as follows:

> "During excavation for the new water line tie-in for the New Generation Project on 12/12/2008 a clay line was struck by the excavator and shattered, resulting in the discovery of contamination related to a 1973 event."

The contamination levels would be significant when compared to the likely release limits and survey unit classification (i.e., Class 3). However, the location of the contaminated piping lies outside the footprint of each of the survey units, as shown in Figure 1, *New Generation Footprint Survey Units.*

It should be noted that this event was evaluated and determined to not influence the Class 3 FSS designation of NGFA-EST and NGFA-WST. Additionally, this line will be excavated in the future and at that time, the excavation footprint will be designated as a Class 1 MARSSIM survey unit.

Figure 1 - New Generation Footprint Area (NGFA) Survey Units



Characterization

The characterization results are documented in a correspondence from September 2, 2008 (Ref. 5). As shown below, results from these sampling campaigns do not indicate concentration levels exceeding the DCGL for Cs-137 (7.9 pCi/g) and Co-60 (3.8 pCi/g), per the License Termination Plan (Ref. 6).

The characterization activities include the following efforts:

- IT/Duratek summary (work performed in 1997) – Subsurface borings were advanced to a depth of 4 feet in 9 locations in the new generation area. Samples were collected at 1-foot intervals beginning at 0.5 feet. One location has 6 additional borings in the immediate area. This grouping of samples was to determine the extent of contamination located at the end of the drainage pipe that ran along the northern edge of the train tracks. The tracks and drain line had been covered by fill and gravel.

  All samples collected in the new generation area for this campaign were less than the DCGL for Cs-137. The maximum concentrations discovered were from a small grouping of borings collected at a depth of 3.0 to 3.5 feet; with specific activities ranging from 1.34 pCi/g to 1.84 pCi/g (Cs-137), respectively. Of the samples collected at various depths in this location, three of these samples had detectable Co-60 with a maximum concentration of 0.9 pCi/g. The location having these low levels of detectable Co-60 and detectable Cs-137 (at depth) is near the northern edge of the new generation area boundary. As previously stated, although detectable, these results are well below the DCGL for Cs-137 and Co-60 and do not warrant further investigation.

- ENERCON Data Summary (work performed in 2007-2008) – The survey of the area indicated no significant detectable contamination from HBPP Unit 3 nuclear reactor operations. One surface sample result (n=14) indicated a maximum concentration value of 0.653 pCi/g Cs-137, with no sample exceeding the DCGL for Cs-137. Additional analysis for Cm-242/244, Sr-90 and Tritium resulted in no detectable activity.

- TRC Data Summary (2008) – TRC solutions, Inc. advanced 44 borings at depth with approximately 3 samples per boring. In addition to the remedial investigation analyses for non-radiological materials, all samples were submitted for gamma spectroscopy analysis. One sample collected at a depth of 4.5 feet had the maximum concentration of 1.23 pCi/g Cs-137, and all subsurface samples collected from the borings in Humboldt Bay Repowering Project (HBRP) Area were less than the DCGL for Cs-137. Additional samples were not taken as the activity level was determined to be below the established release criteria.

Remedial Action Surveys and Activities

Radiological remediation was not performed within the boundaries of the designated survey units; therefore, no remedial action surveys were performed. Soil material excavated prior to commencing with construction was monitored for Cs-137 by means of a windowed Na(Tl) detector. Neither this method, nor the monitoring performed on trucks utilizing a gross count gamma sensitive monitor detected radiological material exceeding a small fraction of the DCGL (1-2 pCi/g range for Cs-137).

Scoping Surveys

Scoping Surveys were not performed in this area based on the contractor's assessment as a non-industrialized area.

Survey Unit Design Information (NGFA-EST and NGFA-WST)

The survey units were classified based on the potential to contain residual radioactive material relative to the DCGLs. The level of effort associated with planning a survey is based on the complexity of the survey and nature of the hazards. The FSS plan uses an integrated sample design that combines scanning surveys and sampling which can be either random or biased. Although a formal FSS Plan was not used, the FSS Design discussion described in Section 3.3 of HBPP-RPT-002 (Reference 2) meets the general requirements provided in Section 5 of the MARSSIM for Class 3 survey units.

Data Quality Objectives (DQOs)

FSS design and planning incorporates the DQO process as described in Section 2 of the MARSSIM.

The DQO process incorporates hypothesis testing and probabilistic sampling distributions to control decision errors during data analysis. Hypothesis testing is a process based on the scientific method that compares a baseline condition to an alternate condition. The baseline condition is technically known as the null hypothesis. Hypothesis testing rests on the premise that the null hypothesis is true and that sufficient evidence must be provided for rejection. In designing the survey plan, the underlying assumption, or null hypothesis is that residual activity in the survey unit exceeded the release criteria. Rejection of the null hypothesis would indicate that residual activity within the survey unit does not exceed the release criteria.

The primary objective of the FSS plan is to demonstrate that the level of residual radioactivity in Survey Units do not exceed the release criteria specified in the License Termination Plan (LTP) and that the potential dose from residual radioactivity is As Low As Reasonably Achievable (ALARA). It should be noted that a more detailed discussion of the site-specific DQOs which would normally be provided in a formal FSS Plan, can be reviewed in Section 3.1 *Data Quality Objectives*, of the HBPP New Generation Footprint Area Radiological Characterization Report (Ref. 2).

The DQO process identified the radionuclides of concern and determined the concentration variability. Soil samples were collected during 2007-2008 to establish the radiological conditions of both survey units. These results were described in the "Characterization Surveys" Section of this report, and were compiled in DGM-08-004 (Ref 5).

Cs-137 was considered the only gamma emitting radionuclide reported in concentrations with the potential for exceeding the screening criteria. The characterization data was used for the survey design and are provided in Table 1.

Instrument DQOs included a verification of the ability of the survey instrument to detect the radionuclide(s) of interest relative to the DCGL. ENERCON determined nominal instrument MDCs based on the HBPP Technical Basis Document (TBD) *Gamma Scan Detection Capabilities*, TBD-006 (Ref. 9). The calculated scan MDCs for Cs-137 and Co-60 are 23.2 and 11.2 pCi/g, respectively.

As part of the DQOs applied to laboratory processes, analysis results were reported as actual calculated results. Sample report summaries included unique sample identification, analytical method, radionuclides, results, uncertainty to two (2) standard deviations, laboratory data

qualifiers, units, and the required and observed MDCs. It should be noted that for the evaluation of the FSS Program, Quality Control (QC) Split samples were collected concurrently as a Quality Assurance (QA) measure for comparison of possible reporting bias between the ENERCON contract analytical laboratory data provided from Reference 2, and the ORISE analytical laboratory data provided from Reference 1. Enercon staff field counted all FSS samples obtained prior to shipment offsite to the offsite contract laboratory on a low-resolution (i.e., NaI) gamma system windowed to analyze the 662 keV gamma line from Cs-137. A total of four (4) split samples were collected for the FSS effort with results provided in Table C:

Table C Inter-Laboratory Split Sample Results Summary

ESI/ORISE Sample Number	Radionuclide	ESI Contract Lab Results[2]	2 Sigma Uncertainty[2]	MDA[2]	ORISE Lab Results[1]	2 Sigma Uncertainty[1]	MDA[1]
NGFA-EST-4/S0018	Co-60	2E-02	2E-02	6E-02	1E-02	3E-02	NR
	Cs-137	2E-02	2E-02	6E-02	1E-02	2E-02	NR
NGFA-EST-13/S0019	Co-60	7E-03	4E-02	8E-02	-2E-02	6E-02	NR
	Cs-137	0E-00	7E-02	6E-02	1E-01	3E-02	NR
NGFA-WST-5/S0017	Co-60	1E-02	4E-02	8E-02	2E-02	4E-02	NR
	Cs-137	1E-02	4E-02	7E-02	2E-02	2E-02	NR
NGFA-WST-7/S0016	Co-60	-2E-03	4E-02	6E-02	2E-02	3E-02	NR
	Cs-137	2E-02	3E-02	6E-02	1E-02	2E-02	NR

Notes and Acronyms:

Above results, uncertainties, and MDAs reported in units of pCi/g

ESI: ENERCON Services, Inc.

MDA: Minimum Detectable Activity

NR: Not reported

Note 1: ORISE results truncated to one significant figure from Table B-3 of Ref. 1

Note 2: For simplicity, ESI results truncated to one significant figure. Complete analysis data for the ESI split samples can be reviewed from GEL Lab results provided in Appendix D of Ref. 2.

It should be noted that all of the ESI contract laboratory (GEL) results for Co-60 and Cs-137 were less than the calculated *a-posteriori* MDA values at the 95% confidence level. While the ORISE *a-posteriori* MDA values were not reported in the cited reference, the "typical associated MDCs" for soils analyzed using gamma spectroscopy for Co-60 and Cs-137 were 0.06 pCi/g and 0.11 pCi/g respectively. While a good comparison regarding accuracy and precision cannot be made because there is not enough of each analyte present in the samples above detection levels to give good counting statistics, it is evident that both laboratory counting systems give comparable results given the different efficiencies and count times. The maximum MDA's reported in the above table are approximately 2% and 1% of the DCGL's for Co-60 and Cs-137 of 3.8 pCi/g and 7.9 pCi/g respectively, indicating that residual amounts of these analytes are not readily distinguishable from background.

Nuclide Selection and DCGLs

In the absence of a fully developed, site-specific DCGL, the ENERCON Survey Report selected the NUREG 1757 (Ref. 4) default screening value for Cs-137 of 11 pCi/g; stating, "The interim screening values will be used until site-specific DCGLs are established." Site specific DCGL of 7.9 pCi/g for Cs-137 has since been established, and is used in the development of this report.

Survey Approach and Methods

The survey was conducted using a 2"x2" NaI(Tl) gamma scintillator detector for scanning and soil sampling on the top 6-inches (0.15 m) of soil. The soil samples were analyzed by gamma spectroscopy by General Engineering Laboratories of Charleston, SC.

Number of Samples and Measurements

Statistical quantities in the ENERCON characterization data (Ref. 5) are provided in Table 1, below. It should be noted that the sample characterization results table presented below was used in the survey design of the NGFA-EST and NGFA-WST. A total of fourteen (14) samples were collected for the 2007 Characterization survey. As discussed in Reference 2, the 2007 Radiological Characterization was performed in the manner of a MARSSIM final status survey. Additionally, as provided in the ORISE Report (Ref 1), final status survey results for direct samples were essentially all less than the established site-wide Cs-137 background of 0.5 pCi/g. Therefore, a background investigation was not required as all gamma emitting contaminates of concern (COCs) for the on-site soil samples were at background levels.

Table 1. – Statistical Quantities from ENERCON Characterization Report

	Cs-137 (pCi/g)
Minimum Result:	-1.56E-02
Maximum Result:	6.53E-01
Mean:	1.27E-01
Median:	1.25E-01
Standard Deviation:	1.72E-01

For each survey unit, the relative shift (Δ/σ) is 3, which is within the range (i.e., 1 and 3) recommended per the MARSSIM guidance document (Ref. 3). The survey design specified fourteen (14) surface soil samples for non-parametric statistical testing.

The number of soil samples for FSS was determined in accordance with the general guidance in Section 5.5.2.3 of the MARSSIM. Based upon a review of the historical information and characterization data, the acquisition of additional judgmental surface soil samples from within this survey unit was deemed unnecessary.

ENERCON designed a randomly generated layout of the locations of the soil samples using the software program Visual Sample Plan (VSP) (Ref. 7), following the general guidance provided

in Section 5.5.2.5 of the MARSSIM. The random spatial distribution was selected for sample design, which is appropriate for Class 3 survey units.

Based upon a review of this historical information, the use of VSP and resulting number and location of the 14 soil sample locations in each survey unit resulted in a random spatial distribution that would meet the intent of the current methodology described in Figure 5.1 of Section 5.5.2 of the MARSSIM.

Sample Locations for the design are listed with the Global Positioning System (GPS) coordinates in Tables 2 and 3.

Table 2. Sample Locations with GPS Coordinates (NGFA-WST)

Designation	Northing	Easting
NGFA-WST-1	2160970.0	5949615.8
NGFA-WST-2	2160741.4	5949779.3
NGFA-WST-3	2160845.4	5949661.5
NGFA-WST-4	2160961.5	5949674.2
NGFA-WST-5	2160939.2	5949674.0
NGFA-WST-6	2160852.0	5949762.1
NGFA-WST-7	2160864.8	5949556.7
NGFA-WST-8	2160837.7	5949616.7
NGFA-WST-9	2160816.1	5949865.0
NGFA-WST-10	2160841.0	5949776.4
NGFA-WST-11	2160952.4	5949732.2
NGFA-WST-12	2160799.2	5949913.1
NGFA-WST-13	2160914.7	5949701.5
NGFA-WST-14	2160976.6	5949685.3

NOTE: See Attachment 1 for corresponding posting plot map of these sample locations.

Table 3. Sample Locations with GPS Coordinates (NGFA-EST)

Designation	Northing	Easting
NGFA-EST-1	2160973.4	5949958.8
NGFA-EST-2	2161152.3	5950033.7
NGFA-EST-3	2161039.2	5949799.7
NGFA-EST-4	2161134.6	5949893.0
NGFA-EST-5	2160940.8	5950087.6
NGFA-EST-6	2161122.1	5949880.9
NGFA-EST-7	2160996.8	5949770.7
NGFA-EST-8	2161064.9	5949781.4
NGFA-EST-9	2160993.6	5949849.1
NGFA-EST-10	2160847.3	5949997.2
NGFA-EST-11	2161009.5	5949879.2
NGFA-EST-12	2161015.8	5949770.4
NGFA-EST-13	2160977.0	5950054.9
NGFA-EST-14	2161067.5	5950022.5

NOTE: See Attachment 1 for corresponding posting plot map of these sample locations.

Table 4 and Table 5 provide a synopsis of the survey design.

Table 4. Synopsis of the Survey Design (NGFA-WST)

Feature	Design Criteria	Basis
Survey Unit Land Area	10,015 m^2	Per Geographical Information System (GIS) measurements and AutoCAD maps.
Number of Measurements	14 (Randomly selected using VSP)	Type 1 and Type 2 errors= 0.05 σ= 0.17 pCi/g LBGR = 3.95 pCi/g (50% DCGL) Relative Shift (Δ/σ) = 3.0 Relative Shift conservatively set to provide value between 1 and 3, per MARSSIM and LTP.
Grid Spacing	N/A	Class 3 Survey Unit. No grid required.
DCGL	7.90 pCi/g (Cs-137)	Per the LTP.
Soil (sediment) Investigation Level	3.95 pCi/g (Cs-137)	If activity exceeds 50% of the DCGL; per LTP (Criteria for a Class 3 survey unit).
Scan Survey Area Coverage	28% (Approximate)	The LTP requires 1- 10% of area coverage for Class 3 survey units.
Scan Investigation Level	Detectable Measurements (Exceeds Background)	Detectable above background, per the LTP for Class 3 Survey Units.

Table 5. Synopsis of the Survey Design (NGFA-EST)

Feature	Design Criteria	Basis
Survey Unit Land Area	8,821 m^2	Per Geographical Information System (GIS) measurements and AutoCAD generated maps.
Number of Measurements	14 (Randomly selected per VSP)	Type 1 and Type 2 errors= 0.05 σ=0.17 pCi/g LBGR = 3.95 pCi/g (50% DCGL) Relative Shift (Δ/σ) = 3.0 Conservatively set to provide value between 1 and 3, per MARSSIM and LTP.
Grid Spacing	N/A	Class 3 Survey Unit. No grid required.
Operational DCGL	7.90 pCi/g (Cs-137)	Per the LTP.

Table 4. Synopsis of the Survey Design (NGFA-WST)

Feature	Design Criteria	Basis
Soil (sediment) Investigation Level	3.95 pCi/g (Cs-137)	If activity exceeds 50% of the DCGL; per LTP (Criteria for a Class 3 survey unit).
Scan Survey Area Coverage	21% (Approximate)	The LTP requires 1- 10% of area coverage for Class 3 survey units
Scan Investigation Level	Detectable Measurements (Exceeds Background)	Detectable above background, per the LTP for Class 3 Survey Units.

Survey Results (NGFA-WST)

Sample Measurement Results

Field survey and sampling activities were performed on January 15 and 16, 2009.

The on-site laboratory analyzed the fourteen (14) samples using gamma spectroscopy. Gamma spectroscopy analysis was performed to the required MDCs. Cs-137 was identified as greater than the critical value in one sample collected (i.e., result was "statistically positive"; indicating the activity was greater than the two-sigma uncertainty, but less than the Minimum Detectable Activity or "MDA").

A summary of the samples collected is provided in Table 6. A map of the sample locations and Cs-137 results are provided in Attachment 1. The GEL Laboratories Analytical Result information, Chain of Custody, and Certificate of Analysis Report for each sample from survey unit NGFA-WST can be reviewed in Attachment D of Reference 2.

Table 6. Gamma Spectroscopy Results NGFA-WST

Sample Number	Cs-137 (pCi/g)	Percentage of DCGL
NGFA-WST-01	2.62E-02	0.33%
NGFA-WST-02	4.10E-02	0.52%
NGFA-WST-03	-2.72E-02	-0.34%
NGFA-WST-04	4.71E-02	0.60%
NGFA-WST-05	9.59E-03	0.12%
NGFA-WST-06	3.29E-02	0.42%
NGFA-WST-07	1.90E-02	0.24%
NGFA-WST-08	1.93E-02	0.24%
NGFA-WST-09	2.92E-02	0.37%
NGFA-WST-10	3.60E-02	0.46%
NGFA-WST-11[1]	**5.10E-02**	**0.65%**
NGFA-WST-12	-4.18E-03	-0.05%
NGFA-WST-13	2.12E-02	0.27%
NGFA-WST-14	3.39E-02	0.43%

1 – Result (in bold) was greater than the "Critical Value"; statistically positive yet less than the laboratory calculated *a posteriori* MDA.

Fixed-Point Radiation Measurements

Soil samples were used as fixed point measurements. Sample locations are provided on the posting plot maps found in Attachment 1.

Scan Data

The survey approach utilized the Sign Test from statistically random locations. Cs-137 was the principal nuclide of concern. Walk-over scanning of biasedly selected areas with a 2" x 2" NaI(Tl) scintillation detector was performed on approximately 28% of the survey unit, exceeding the minimum requirement of 1 – 10 percent listed in the LTP. See Figure 2, *NGFA Gamma Walkover Survey Map* for a representation of the areas surveyed in this unit.

Survey Unit Data Assessment (NGFA-WST)

Statistical Evaluation

The DQO sample design and data was also reviewed against current Procedure RCP FSS-14, *"Data Quality Assessment,"* for completeness and consistency. The sampling design had adequate power as indicated by the Retrospective Power Curve. The Sign Test was performed on the data and compared to the original assumptions of the DQOs. The evaluation of the Sign Test results demonstrate that the survey unit passes the unrestricted release criteria, thus, the null hypothesis is rejected.

Surveys and sample collection were consistent with the DQOs and were sufficient to ensure that the survey unit was properly designated as Class 3.

The preliminary data review consists of calculating basic statistical quantities (e.g., mean, median, standard deviation). The mean and median values are well below the DCGL. The basic statistical quantities for the statistical sample population are provided below in Table 7.

Table 7. Basic Statistical Quantities (NGFA-WST)

Statistic	Cs-137 (pCi/g)
Minimum Value:	-2.72E-02
Maximum Value:	5.10E-02
Mean:	2.39E-02
Median:	2.77E-02
Standard Deviation:	2.07E-02

An analysis of the statistics of Survey Unit NGFA-WST data was performed using the criteria and results listed in Tables 6 and 7. The range of the data is approximately 3.8 standard deviations. The difference between the mean and median was -18.2% of the standard deviation, indicating negative skewness in the data. The frequency plot indicates a negative skewness, as confirmed by the calculated skew of -1.2. However, both the mean and median values were a small fraction of the DCGL, making the skewness statistic not a relevant concern.

Graphical Evaluations

The data, assessments, and graphical representations are provided in Attachment 2.

Survey Unit Investigations and Results (NGFA-WST)

The soil and scan investigation levels were not triggered for this survey unit. Therefore, no investigations were performed for Survey Unit NGFA-WST.

Survey Results (NGFA-EST)

Sample Measurement Results

Field survey and sampling activities were performed on January 15 and 16, 2009. The on-site laboratory analyzed the fourteen (14) samples using gamma spectroscopy. Gamma spectroscopy analysis was performed to the required MDCs. Cs-137 was identified as greater than the critical value in three of the fourteen (14) samples collected (i.e., results were "statistically positive," indicating the activity was greater than the two-sigma uncertainty, and either greater than or less than the Minimum Detectable Activity or "MDA"). A summary of the samples collected in NGFA-EST is provided in Table 8. A map of the sample locations and Cs-137 results are provided in Attachment 1. The GEL Laboratories Analytical Result information, Chain of Custody, and Certificate of Analysis Report for each sample from survey unit NGFA-EST can be reviewed in Attachment D of Reference 2.

Table 8. Gamma Spectroscopy Results NGFA-EST

Sample Number	Cs-137 (pCi/g)	Percentage of DCGL
NGFA-EST-01	-6.72E-03	-0.09%
NGFA-EST-02 [1]	**1.95E-01**	**2.47%**
NGFA-EST-03	-1.43E-03	-0.02%
NGFA-EST-04	1.68E-02	0.21%
NGFA-EST-05 [1]	**9.45E-02**	**1.20%**
NGFA-EST-06	1.87E-02	0.24%
NGFA-EST-07	2.71E-02	0.34%
NGFA-EST-08	-1.36E-02	-0.17%
NGFA-EST-09	-1.05E-02	-0.13%
NGFA-EST-10 [2]	**7.15E-02**	**0.91%**
NGFA-EST-11	-2.79E-02	-0.35%
NGFA-EST-12	8.00E-03	0.10%
NGFA-EST-13	0.00E+00	0.00%
NGFA-EST-14	1.54E-02	0.20%

1 – Results were greater than the "MDA"; statistically positive at the 95% confidence level (activity greater than or equal to the two sigma uncertainty).
2 – Results were greater than the "Critical Value"; statistically positive at the 95% confidence level (activity greater than or equal to the two sigma uncertainty) yet less than the laboratory calculated *a posteriori* MDA.

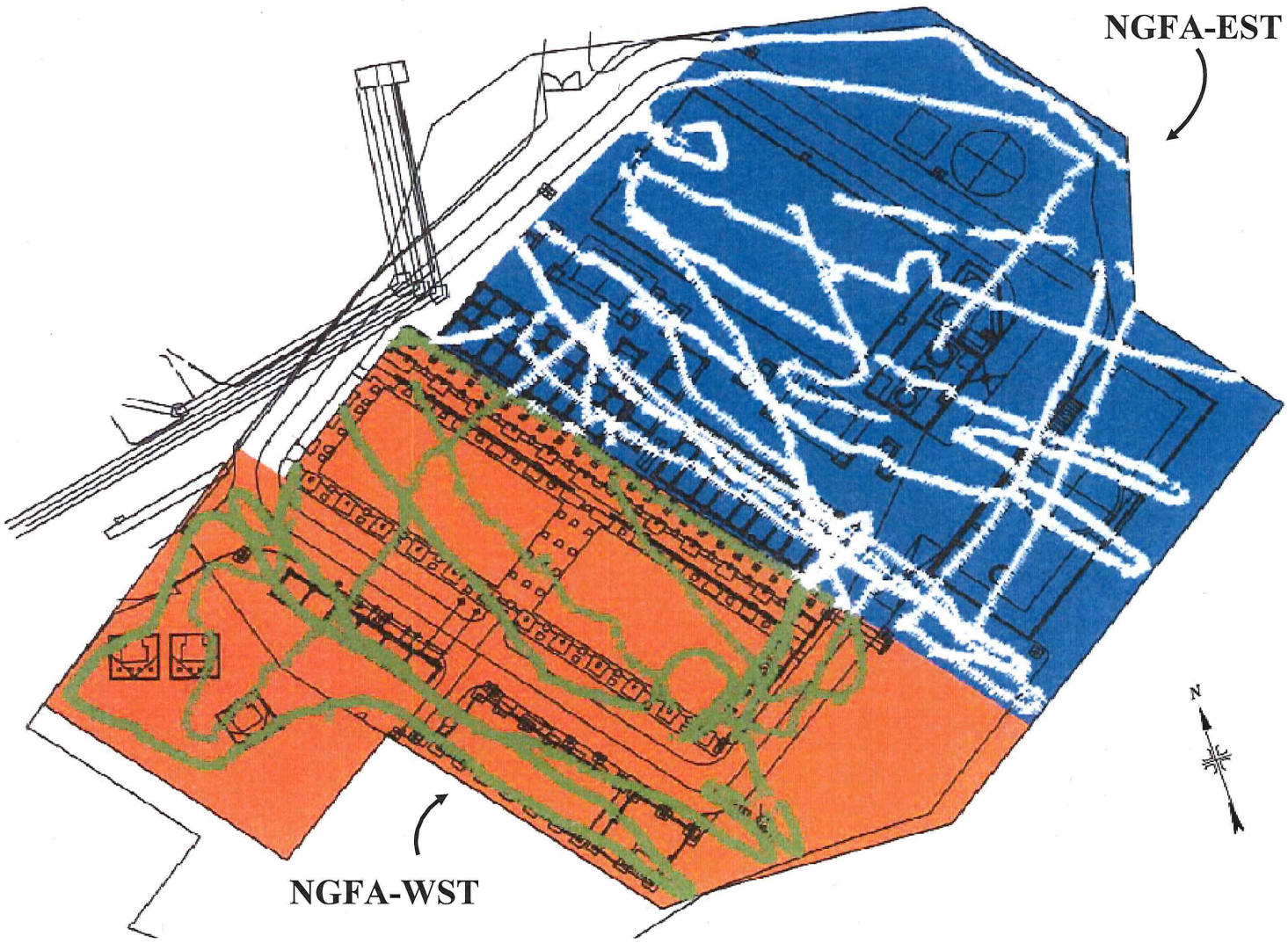
Fixed-Point Radiation Measurements

Soil samples were used as fixed point measurements. Sample locations are provided on the posting plot maps found in Attachment 1.

Scan data

The survey approach utilized the Sign Test from statistically random locations. Cs-137 was the principal nuclide of concern. Walk-over scanning of biasedly selected areas with a 2" x 2" NaI(Tl) scintillation detector was performed on approximately 21% of the survey unit, exceeding the minimum requirement of 1 – 10 percent listed in the LTP. See Figure 2, *NGFA Gamma Walkover Survey Map* for a representation of the areas surveyed in this unit.

Figure 2. New Generation Footprint Area Gamma Walkover Survey Map



Survey Unit Data Assessment (NGFA-EST)

Statistical Evaluation

The DQO sample design and data were also reviewed against the guidance provided in Appendix D of the MARSSIM for completeness and consistency. The sampling design had adequate power as indicated by the Retrospective Power Curve. The Sign Test was performed on the data and compared to the original assumptions of the DQOs. The evaluation of the Sign Test results demonstrates that the survey unit passes the unrestricted release criteria, thus, the null hypothesis is rejected.

Documentation was complete and legible. Surveys and sample collection were consistent with the DQOs and were sufficient to ensure that the survey unit was properly designated as Class 3.

The preliminary data review consisted of calculating basic statistical quantities. The mean and median values are well below the DCGL. The basic statistical quantities for the statistical sample population are provided below in Table 9.

Table 9. Basic Statistical Quantities (NGFA-EST)

Statistic	Cs-137 (pCi/g)
Minimum Value:	-2.79E-02
Maximum Value:	1.95E-01
Mean:	2.76E-02
Median:	1.17E-02
Standard Deviation:	5.83E-02

An analysis of the statistics of Survey Unit NGFA-EST data was performed using the criteria and results listed in Tables 8 and 9. The range of the data is approximately 3.8 standard deviations; not a particularly large variation. The difference between the mean and median was 27.3% of the standard deviation, indicating positive skewness in the data. The frequency plot indicates a positive skewness, as confirmed by the calculated skew of 2.1. However, both the mean and median values were a small fraction of the DCGL, making the skewness statistic not a relevant concern.

Graphical Evaluations

The data, assessments, and graphical representations are provided in Attachment 2.

Survey Unit Investigations and Results (NGFA-EST)

The soil and scan investigation levels were not triggered for this survey unit. Therefore, no investigations were performed for Survey Unit NGFA-EST.

ALARA Statement for NGFA-WST and NGFA-EST

Attachment 3 is provided in to demonstrate that it is not ALARA to remediate soil to levels below the DCGL (Ref. 8).

Changes in Initial Survey Unit Assumptions (NGFA-WST and NGFA-EST)

An implicit assumption of the MARSSIM guidance is that the turnover process is discrete such that the Final Status Survey organization has positive control of the area turned over and administers control over work activities within the area.

In this case, the implementation of work controls complicated the survey process. The contractor hired to remove the structural interferences in the New Generation area worked in concurrent areas throughout the site. The contractor did not remove all interferences prior to backfilling, (i.e. the contractor would excavate to remove one line or foundation and then backfill the excavation), preventing positive control of these areas by the Final Status Survey organization.

For each and every excavation, FSS personnel collected soil samples in order to prove that the excavated soil did not contain concentrations of Cs-137 that exceeded the DCGL. As a result of these work controls, the Final Status Survey gamma walkover scan was performed over a mix of backfill and original site materials. As noted earlier, many of these areas were walkover scanned during a previous survey (Ref. 5).

The results were typical of Class 3 survey units and the preponderance of evidence collected prior to and during the performance of FSS demonstrates that NGFA-WST and NGFA-EST meet the release criteria.

Quality Assurance and Corrective Actions (NGFA-WST and NGFA-EST)

Since the time that this survey was undertaken, PG&E has implemented a procedural process governing the conduct of Final Status Survey work. This process includes turnover requirements to determine the readiness of an area to undergo the FSS process and isolation controls needed to limit unfettered access and minimize the potential for contamination of the characterized survey unit. Otherwise, no changes in the initial survey unit assumptions were noted.

Conclusion

Survey Units NGFA-EST and NGFA-WST have met the release requirements associated with a DCGL at the screening level specified in NUREG-1757 (Ref. 4). The ALARA criteria for soils as specified in Chapter 4 of the HBPP LTP were achieved (Ref. 6).

All identified radionuclides of concern were used for statistical testing to determine the adequacy of the survey unit for FSS. The sample data passed the Sign Test for each unit and the null hypothesis was rejected. The survey units were properly designated as Class 3.

The hypothetical dose contribution from soil for survey units NGFA-EST and NGFA-WST are 0.263 mrem/yr and 0.413 mrem/yr, respectively. These values are TEDE based on the average concentration of the samples used for non-parametric statistical sampling. While not all of the concerns raised by ORISE were addressed herein, the aggregate of the radiological data provides sufficient confidence to ensure that the subject area meets the release criteria. Concerns raised by ORISE that were not addressed (Ref. 1) include:

- A copy of the preliminary FSS soil sample results were not provided by ESI;
- A request for soil samples from the characterization survey to perform an inter-laboratory comparison of the elevated soil sample results with the ESI laboratory could not be fulfilled as the samples had been disposed; and
- Final Status Survey activities should have been performed at the bottom of the excavated areas as it is not reasonable to perform FSS of backfill soil.

None of the above concerns raised by ORISE affect the radiological status and findings presented in this report for survey units NGFA-EST and NGFA-WST that subject areas meet the release criteria. Therefore, survey units NGFA-EST and NGFA-WST are acceptable for unrestricted release. To uphold the commitments in License Amendment No. 40 to DPR 7, the units are controlled to preclude recontamination from Unit 3 decommissioning activities and undergo periodic surveillance surveys in accordance with the Cross Contamination Prevention Plan.

On the basis of the analysis presented in this report, FSS data demonstrates that both subject areas associated with potentially impacted areas has met the decision criteria, specifically:

- No unexpected results or trends are evident in the data.
- The sampling and survey results demonstrate that soil residual radioactivity in the potentially impacted areas is very minimal, and essentially indistinguishable from background.
- The data quality is judged to be adequate for its intended purpose.
- The amount of data collected from each survey unit is adequate to provide the required statistical confidence needed to decide that the DCGLs were met.
- The retrospective power of the sign test, used to judge compliance, was almost 100%.

Thus, the null hypothesis – that residual radioactivity in the survey units exits in concentrations above the applicable DCGLs – should be rejected for each of the survey units in the potentially impacted area. The areas surveyed and sampled during FSS (survey units identified in this report) should be released from further radiological controls. Therefore, this FSS Report submittal supports the regulatory decision to terminate the license following completion of all FSS report submittals for the site.

Attachments

Attachment 1 NGFA-EST and NGFA-EST Posting Plot Maps

Attachment 2 DQA Results and Graphs

Attachment 3 ALARA Statement

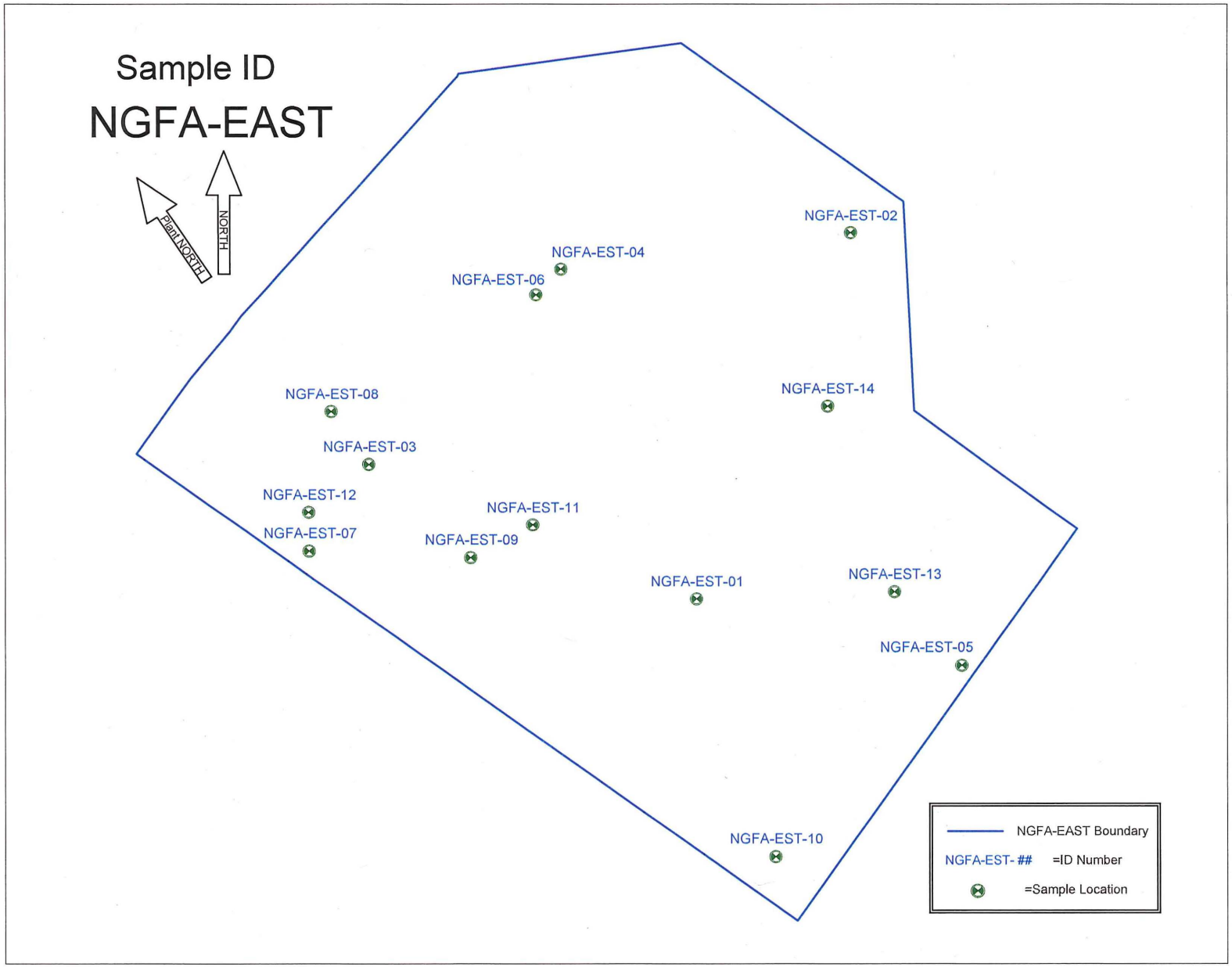
Attachment 4 License Amendment No. 40 to DPR 7

References

1. Independent Radiological Survey Report for Unit 3 New Generation Footprint Area Plant Soils at the Humboldt Bay Power Plant Eureka, CA Final, W.C. Adams (ORISE), Prepared for the U.S. Nuclear Regulatory Commission, November 2009
2. HBPP-RPT-002, Humboldt Bay Power Plant New Generation Footprint Area Radiological Characterization Report, Rev. 0, 09-01-2009, ENERCON, Murrysville, PA
3. NUREG-1575, Multi Agency Radiation Survey and Site Investigation Manual (MARSSIM), Rev. 1, August 2000
4. NUREG-1757, Consolidated Decommissioning Guidance: Decommissioning Process for Materials Licensees, Volume 1, Rev. 2, September 2006

5. DGM-08-004, "Radiological Status of the Humboldt Bay Repowering Project Soils" correspondence from ENERCON to Mr. David Sokolsky, with attachments, September 2, 2008
6. Humboldt Bay Power Plant License Termination Plan, Rev. 1
7. *Visual Sample Plan: A Tool for Design and Analysis of Environmental Sampling.* Version 4.6. Pacific Northwest National Laboratory. Richland, WA. http://vsp.pnnl.gov.
8. Generic ALARA Review for Final Status Survey of Soil at HBPP, July 8, 2013
9. Gamma Scan Detection Capabilities, Humboldt Bay Power Plant, TBD-006, October 16, 2008

Attachment 1
NGFA-EST and NGFA-WST
Posting Plot Maps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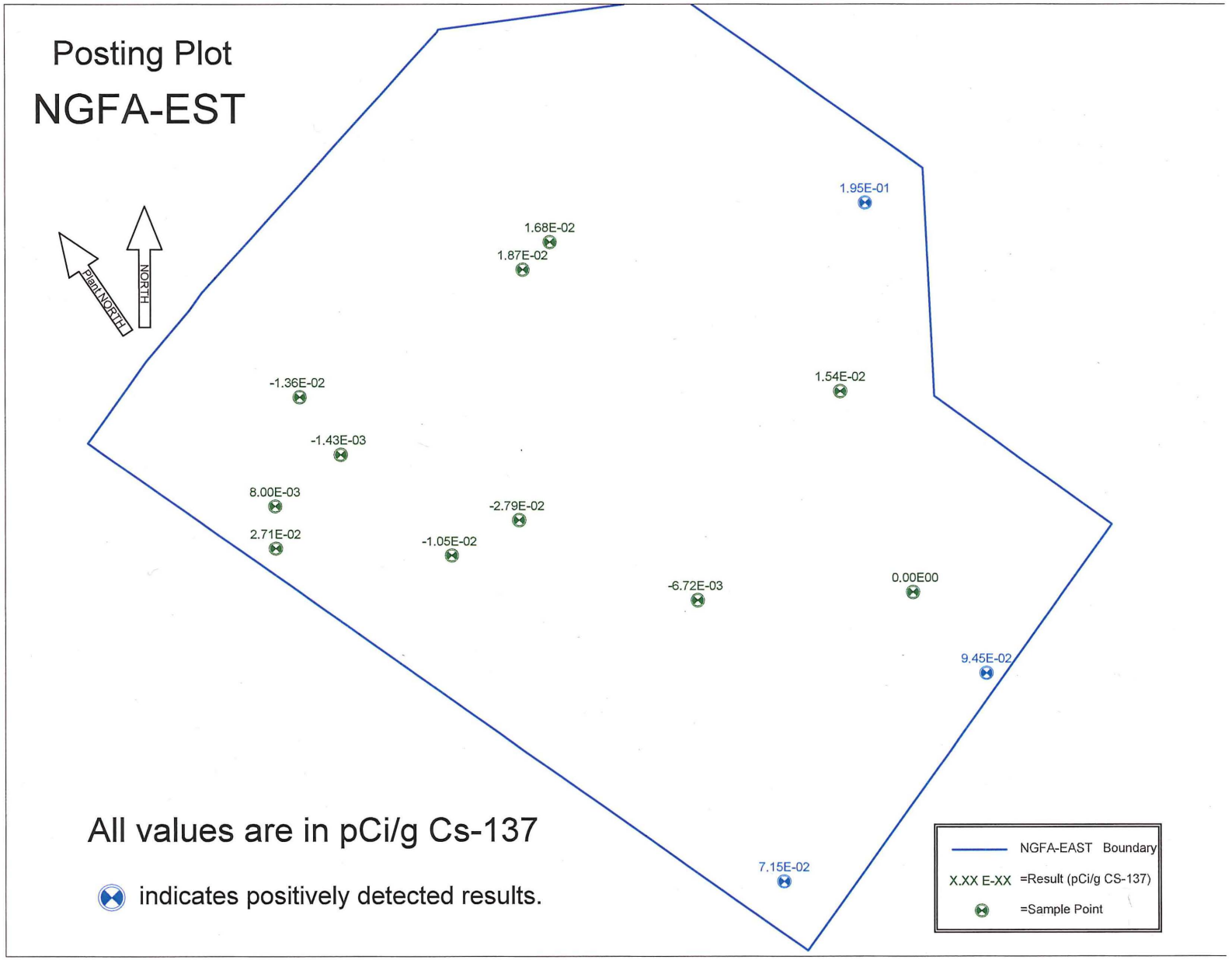
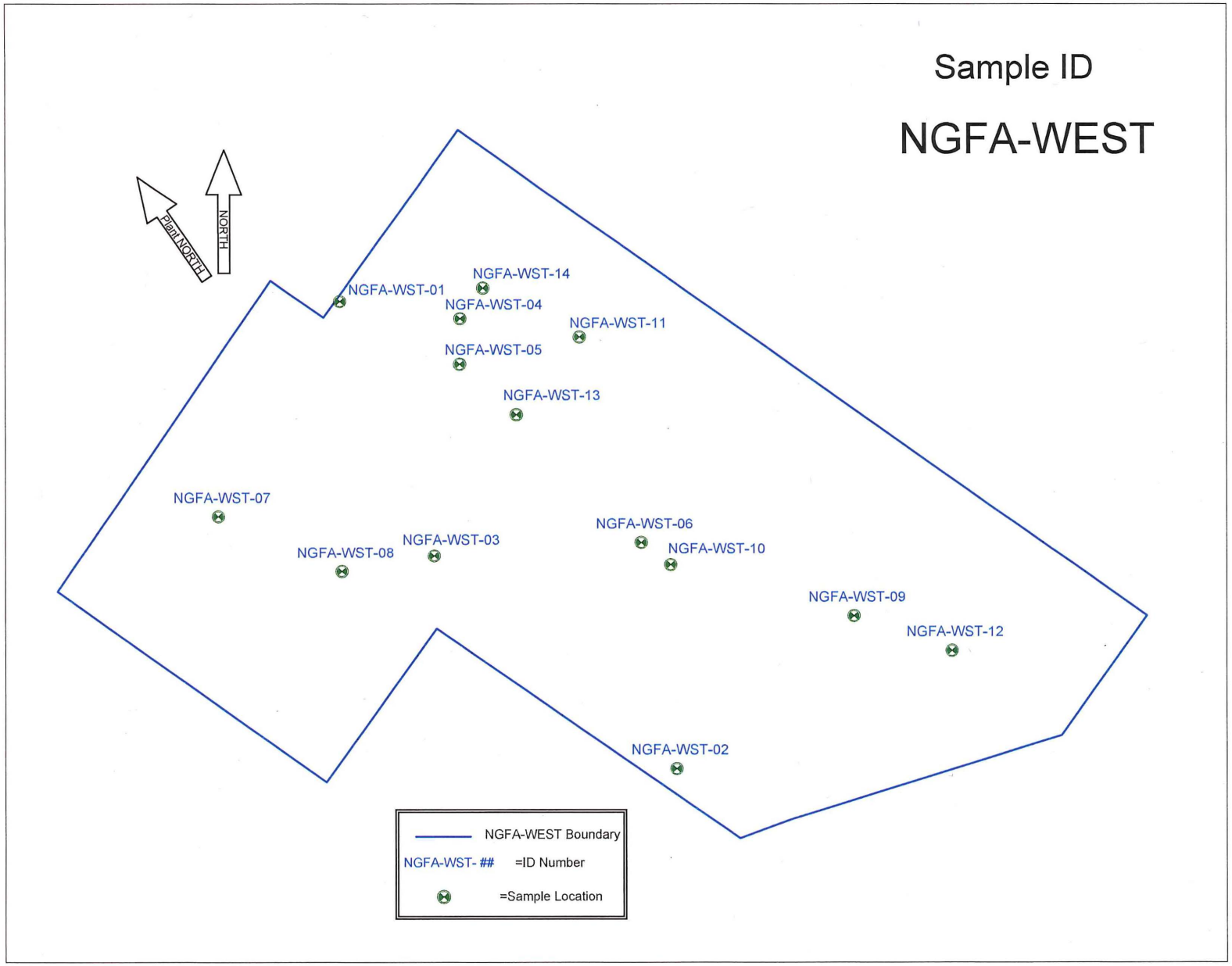
NORTH
NGFA-EST-02
NGFA-EST-04
NGFA-EST-06
NGFA-EST-08
NGFA-EST-14
NGFA-EST-03
NGFA-EST-12
NGFA-EST-11
NGFA-EST-07
NGFA-EST-09
NGFA-EST-01
NGFA-EST-13
NGFA-EST-05
NGFA-EST-10
NGFA-EAST Boundary
NGFA-EST- ## =ID Number
=Sample Location


Posting Plot
NGFA-EST
Plant NORTH
NORTH
1.95E-01
1.68E-02
1.87E-02
-1.36E-02
1.54E-02
-1.43E-03
8.00E-03
-2.79E-02
2.71E-02
-1.05E-02
-6.72E-03
0.00E00
9.45E-02
7.15E-02
All values are in pCi/g Cs-137
indicates positively detected results.
NGFA-EAST Boundary
X.XX E-XX =Result (pCi/g CS-137)
=Sample Point


Sample ID
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Plant NORTH
NORTH
NGFA-WST-01
NGFA-WST-14
NGFA-WST-04
NGFA-WST-11
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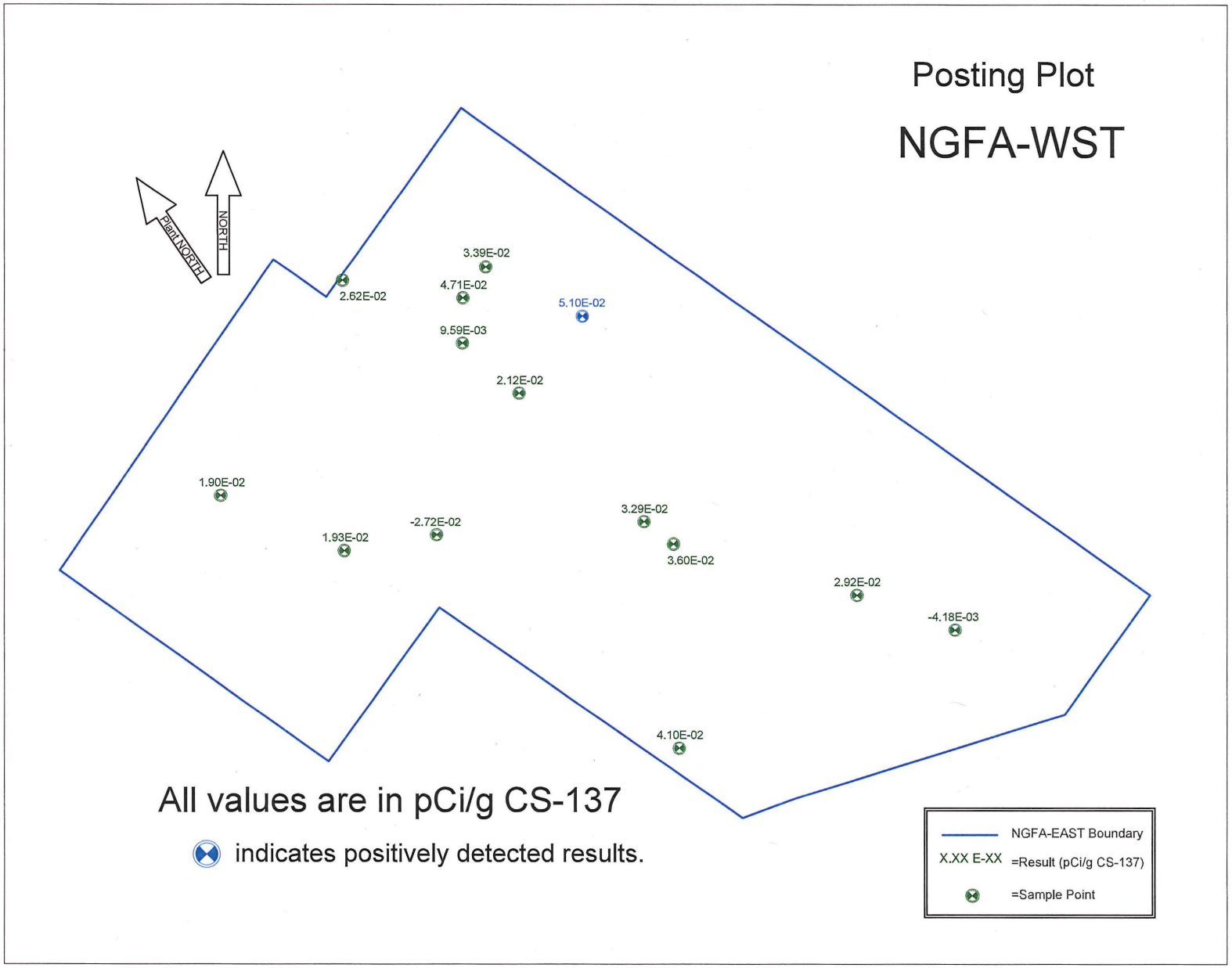
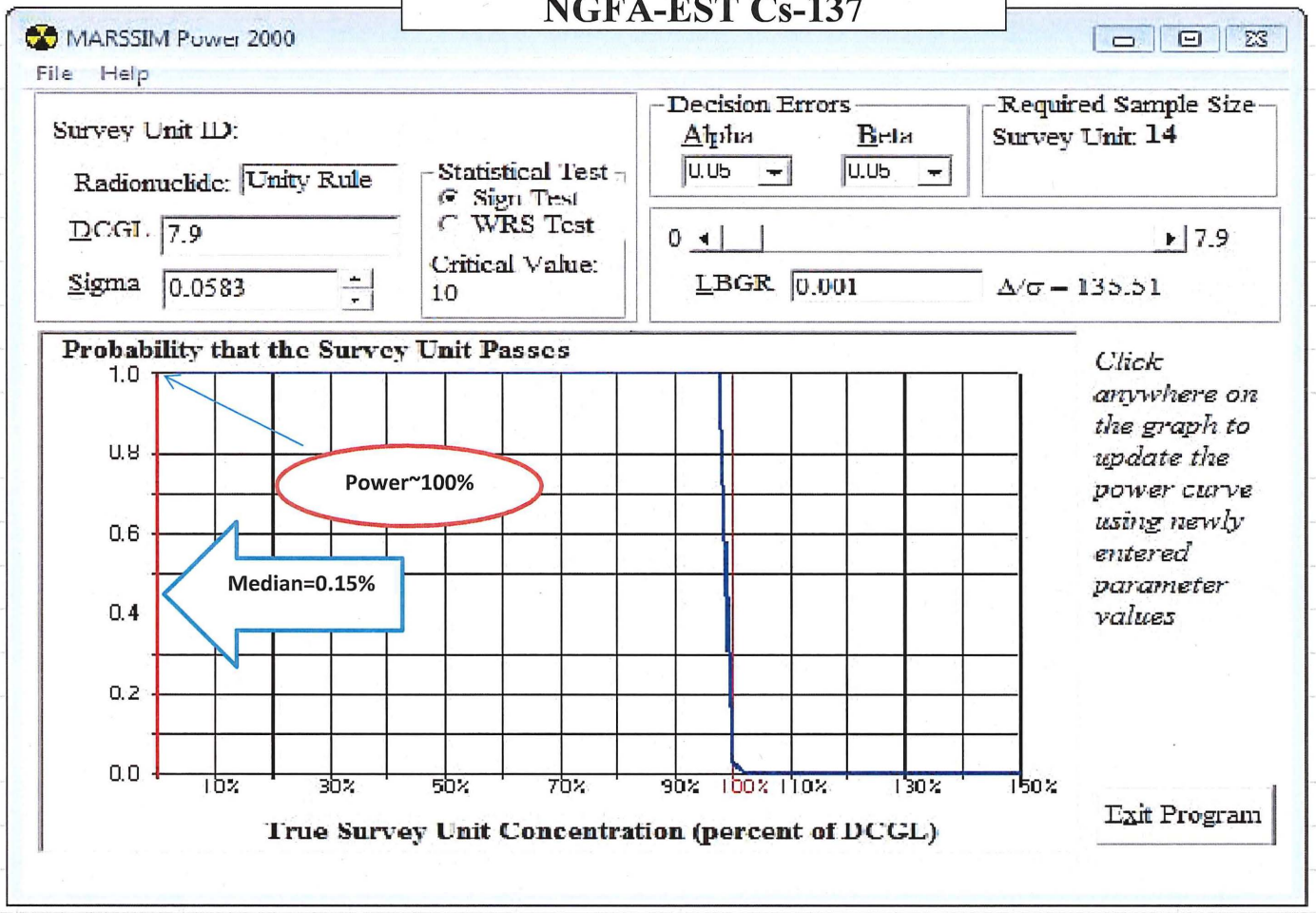
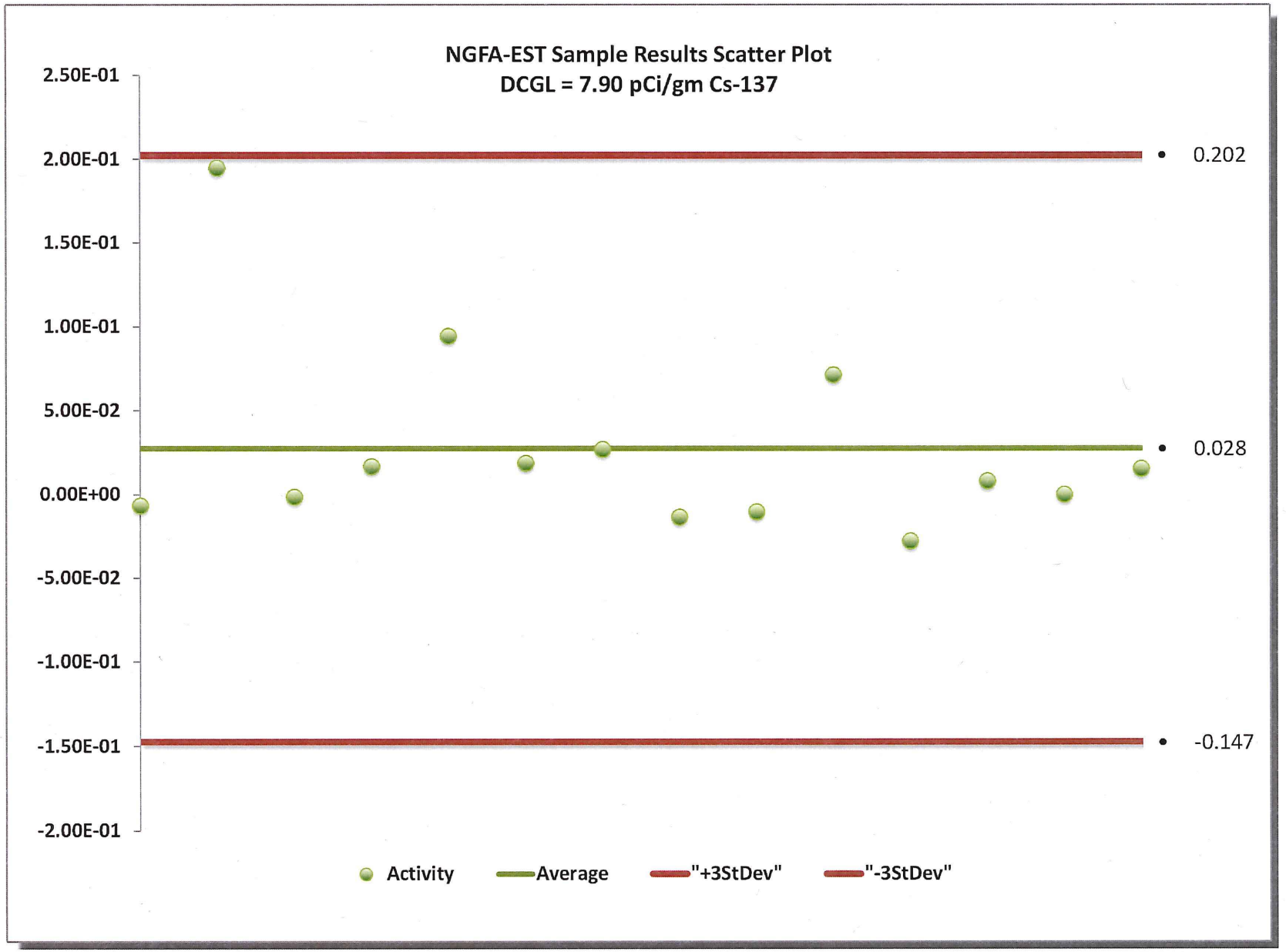
NGFA-WST-13
NGFA-WST-07
NGFA-WST-06
NGFA-WST-03
NGFA-WST-08
NGFA-WST-10
NGFA-WST-09
NGFA-WST-12
NGFA-WST-02
NGFA-WEST Boundary
NGFA-WST- ## =ID Number
=Sample Location


Posting Plot
NGFA-WST
Plant NORTH
NORTH
3.39E-02
4.71E-02
2.62E-02
5.10E-02
9.59E-03
2.12E-02
1.90E-02
3.29E-02
-2.72E-02
1.93E-02
3.60E-02
2.92E-02
-4.18E-03
4.10E-02
All values are in pCi/g CS-137
indicates positively detected results.
NGFA-EAST Boundary
X.XX E-XX =Result (pCi/g CS-137)
=Sample Point

Attachment 2
NGFA-EST and NGFA-WST
DQA Results and Graphs

Retrospective Power Curve
NGFA-EST Cs-137




NGFA-EST Sample Results Scatter Plot
DCGL = 7.90 pCi/gm Cs-137
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
-5.00E-02
-1.00E-01
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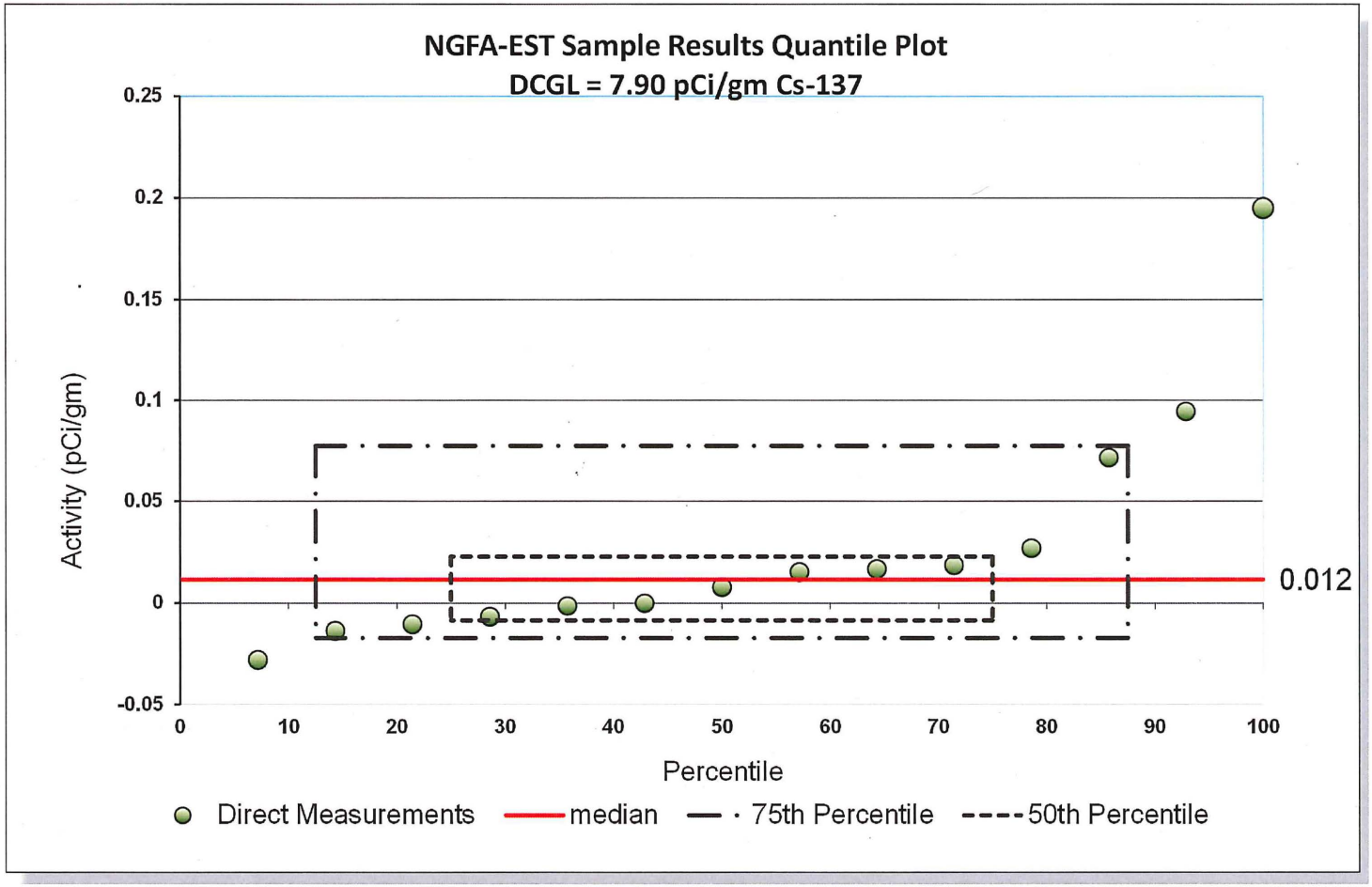
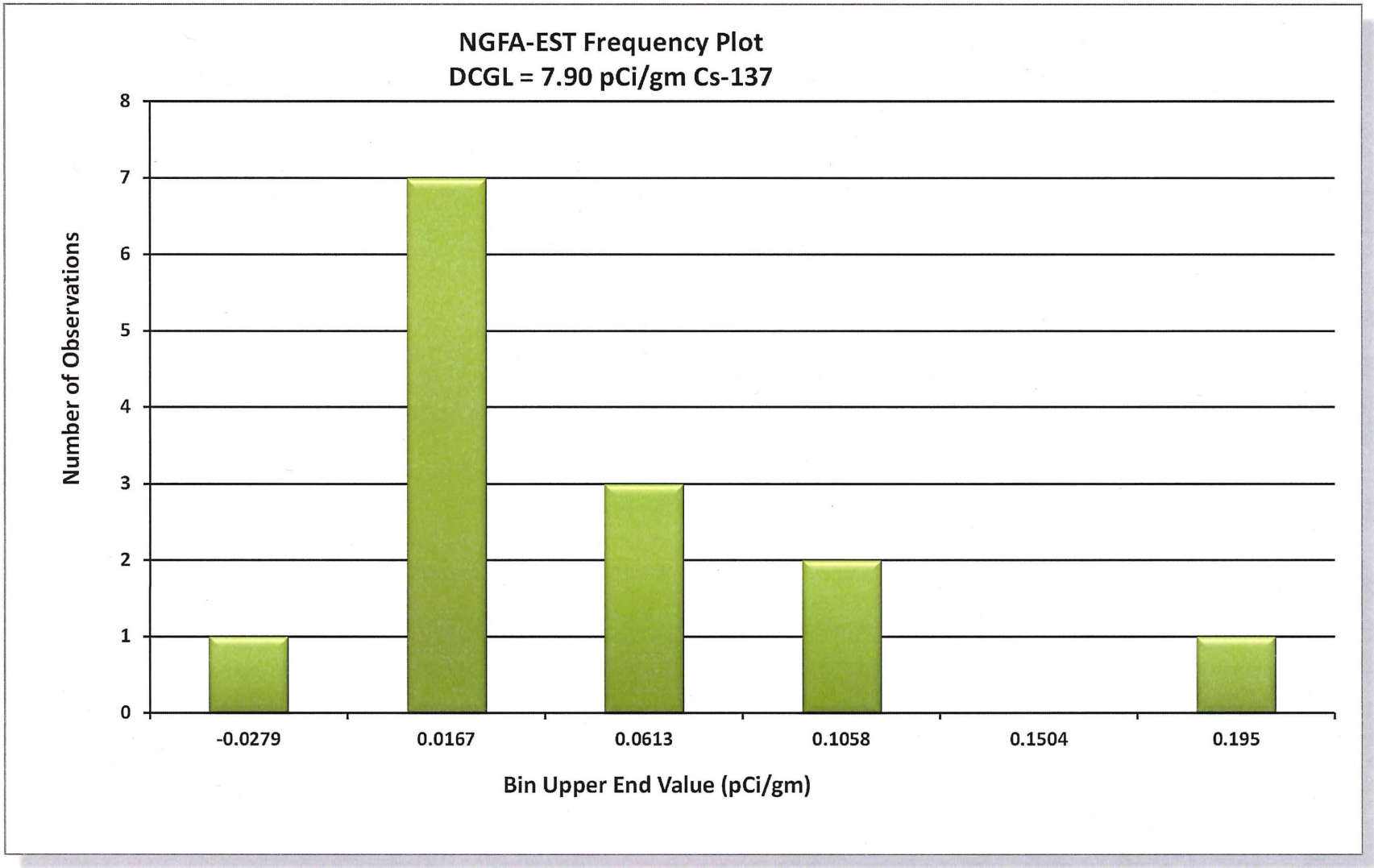
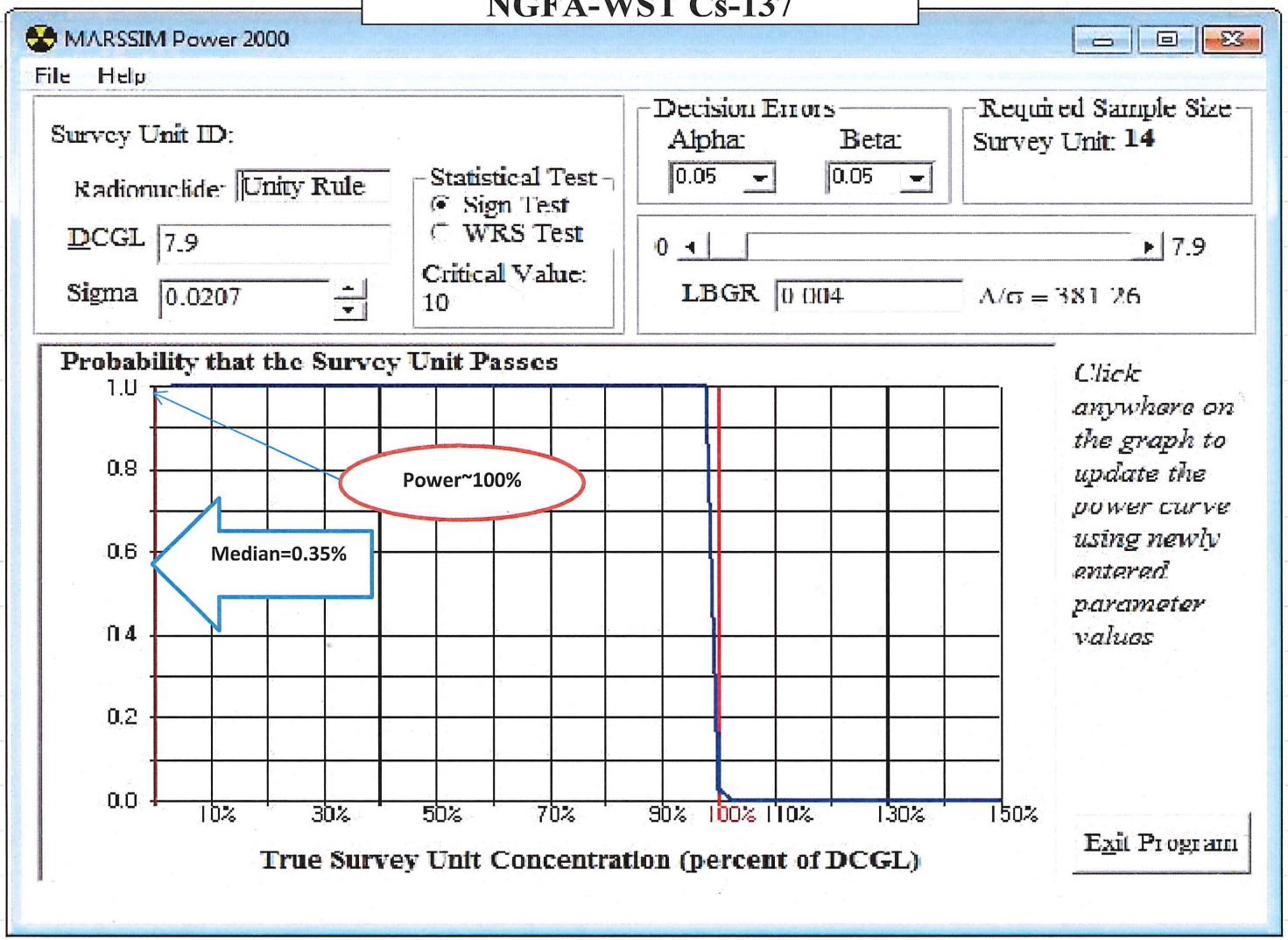
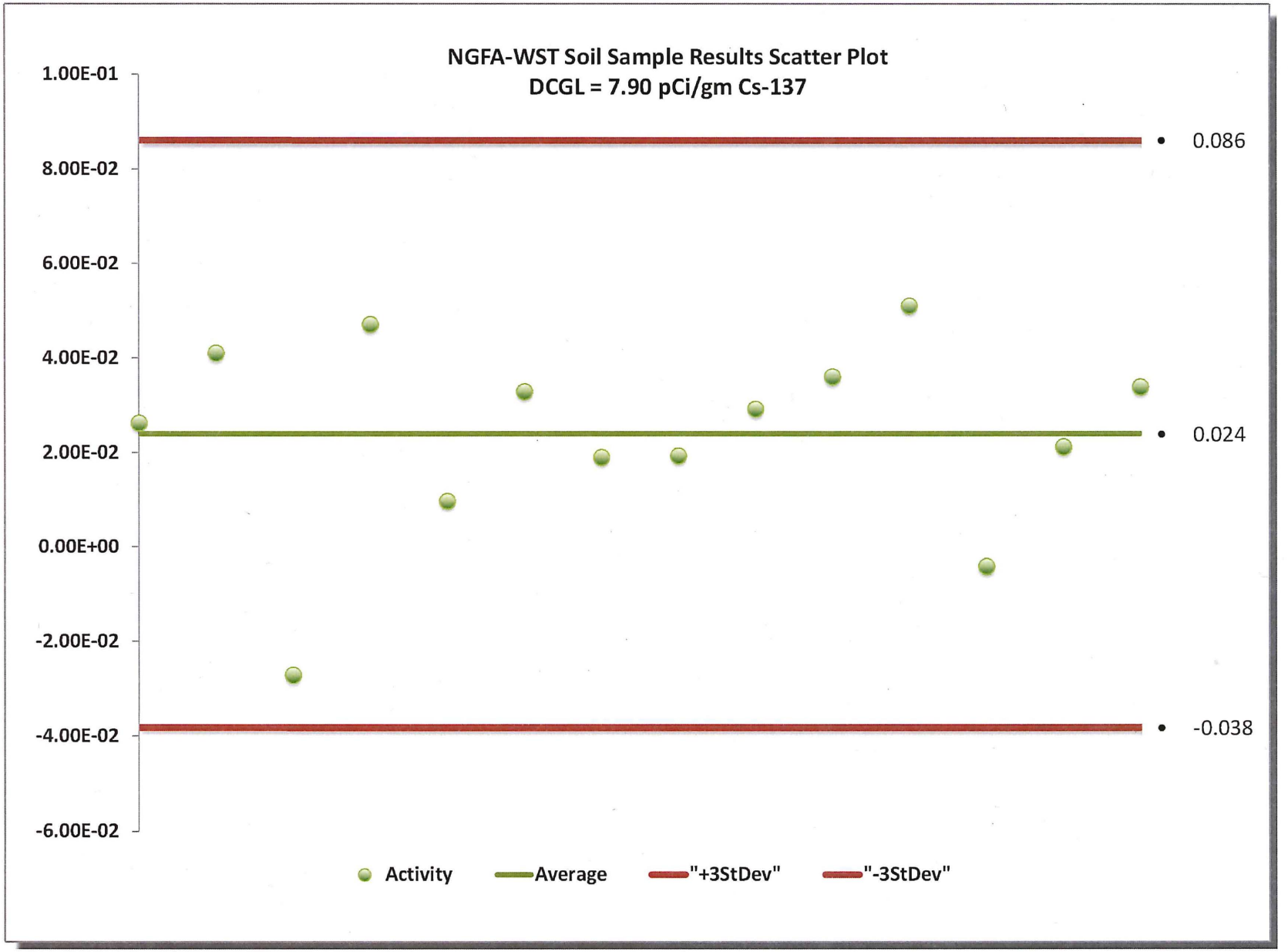
-2.00E-01
0.202
0.028
-0.147
Activity
Average
"+3StDev"
"-3StDev"

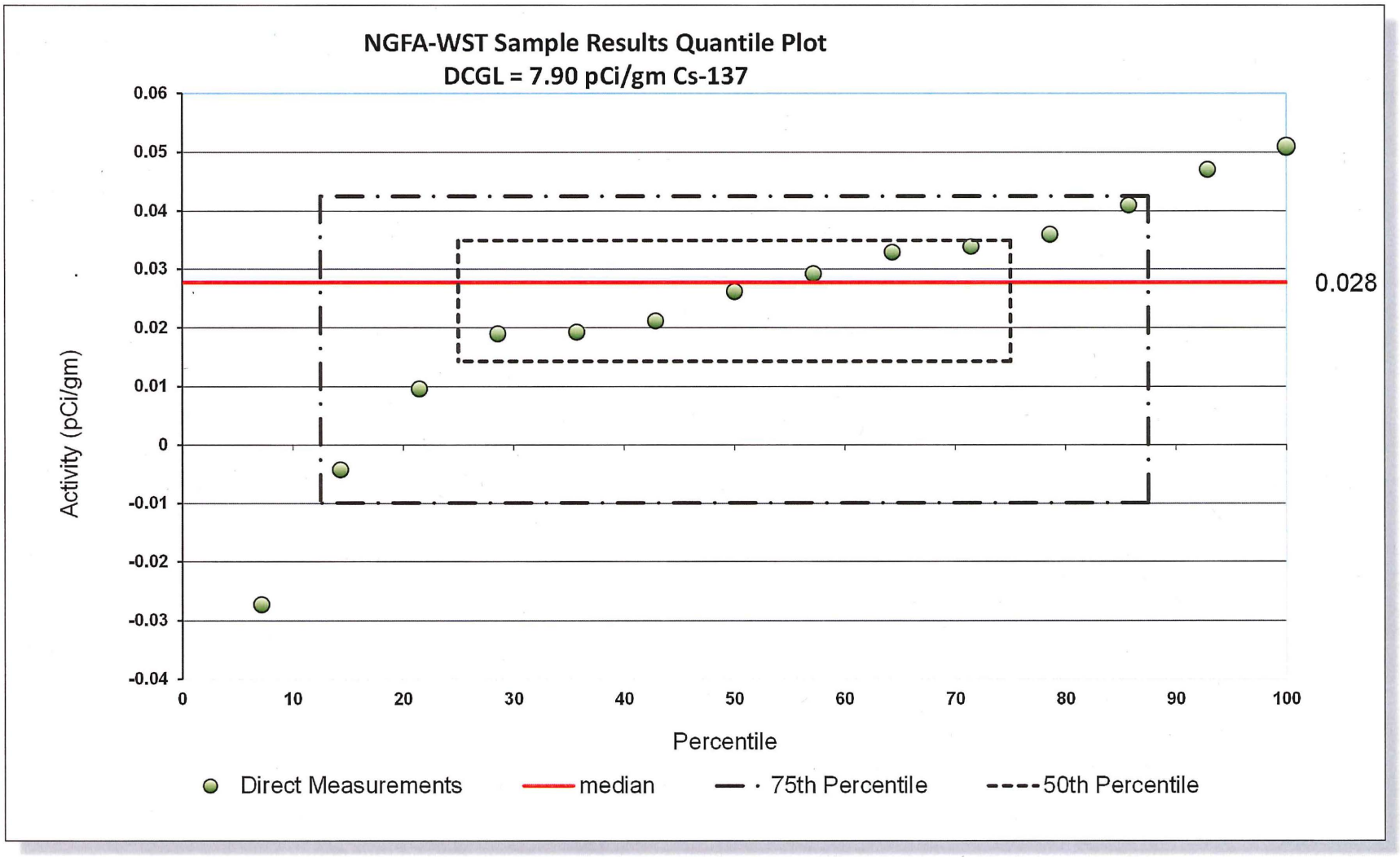

NGFA-EST Sample Results Quantile Plot
DCGL = 7.90 pCi/gm Cs-137
Activity (pCi/gm)
0.25
0.2
0.15
0.1
0.05
0
-0.05
0.012
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile


NGFA-EST Frequency Plot
DCGL = 7.90 pCi/gm Cs-137
Number of Observations
0
1
2
3
4
5
6
7
8
-0.0279
0.0167
0.0613
0.1058
0.1504
0.195
Bin Upper End Value (pCi/gm)

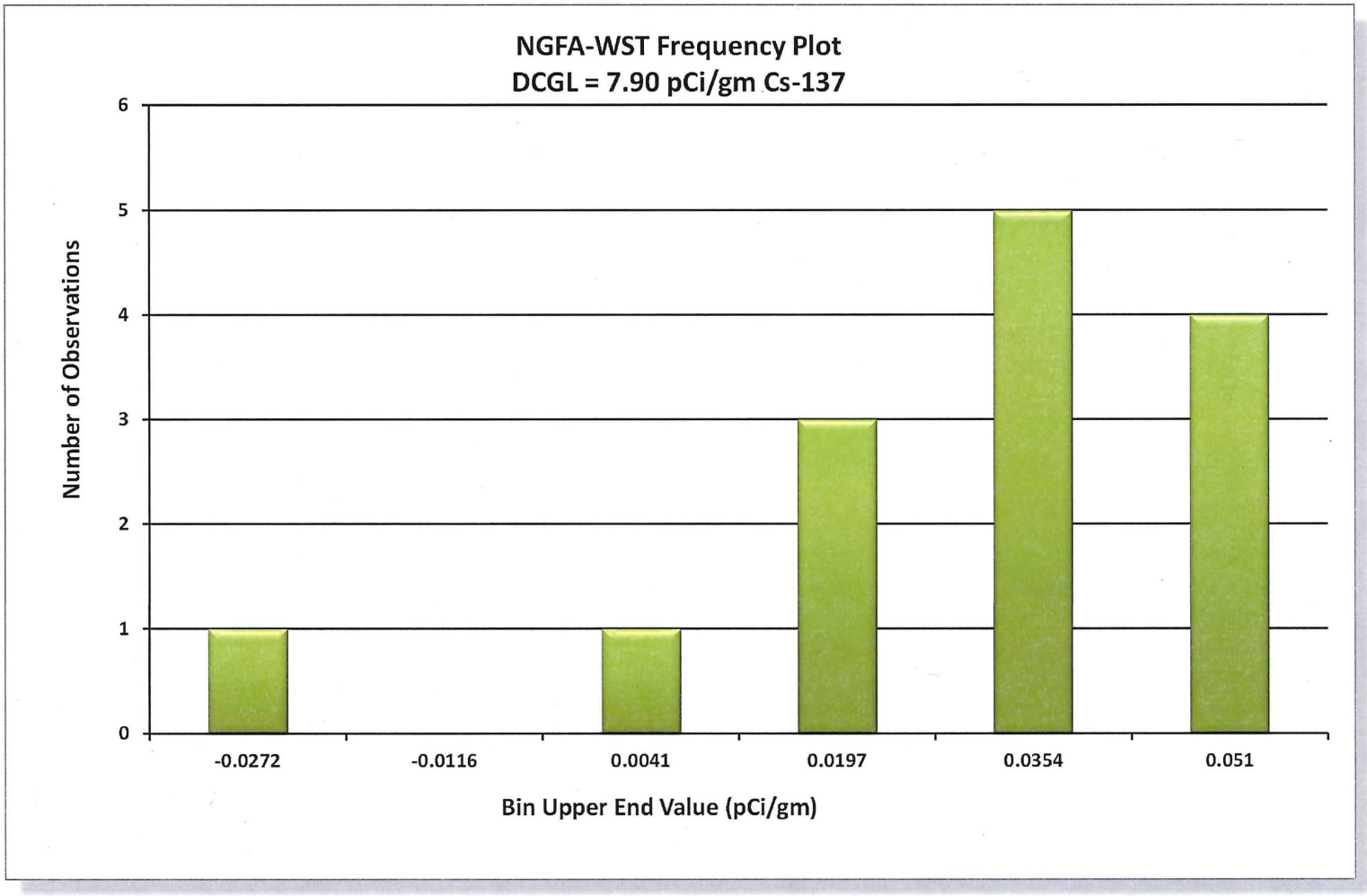
Retrospective Power Curve
NGFA-WST Cs-137




NGFA-WST Soil Sample Results Scatter Plot
DCGL = 7.90 pCi/gm Cs-137
1.00E-01
8.00E-02
6.00E-02
4.00E-02
2.00E-02
0.00E+00
-2.00E-02
-4.00E-02
-6.00E-02
0.086
0.024
-0.038
Activity
Average
"+3StDev"
"-3StDev"


NGFA-WST Sample Results Quantile Plot
DCGL = 7.90 pCi/gm Cs-137
Activity (pCi/gm)
0.06
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
0.028
0
10
20
30
40
50
60
70
80
90
100
Percentile
Direct Measurements
median
75th Percentile
50th Percentile

Number of Bins:	6



Attachment 3
ALARA Statement

Pacific Gas and Electric Company®

Generic ALARA Review for Final Status Survey of Soil at HBPP

July, 08, 2013
Martin C. Erickson

Reviewed By: Larry Watkins **Date:** 7/10/2013

Approved By: M A Barley **Date:** 8/1/13

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Executive Summary

In addition to the requirement to limit the dose from residual, plant-related radioactivity in soil to members of the critical group to 25 mrem in any year, the License Termination Plan (LTP) requires an evaluation demonstrating that these levels are as low as reasonably achievable (ALARA). If compliance with the ALARA criterion cannot be demonstrated, remediation of the soil is required, even though this would further reduce the otherwise acceptable exposure to the critical group to levels below those required. This report is intended to provide a generic ALARA review to bound the conditions under which no further remediation is necessary for soils. Calculations were performed using LTP equations and conservative assumptions. The conclusion is that it is not cost-beneficial to remediate soil in which the levels of residual, plant-related radioactivity are below LTP release criteria.

1.0 Introduction

Section 4.4 of the LTP [1] states that a generic ALARA evaluation for soils may be developed to determine if the clean up of soils beyond the DCGLs will be cost-beneficial for HBPP. Section 4.5 of the LTP provides equations and default values for this calculation. This process will be followed, assuming that the soil is at the DCGL and using conservative estimates of costs, distances and other inputs that the worksheet requires. The equation will calculate an action level (AL) that represents the ratio of concentration to the DCGL that would be cost-beneficial to remediate. If that ratio is greater than 1, remediation is not cost-beneficial.

This calculation is meant to apply to areas of any MARSSIM class and any size. In a Class 1 area, where values of residual contamination may exceed the $DCGL_W$ in limited areas, the mean concentration may never exceed the $DCGL_W$. Since it is assumed that the entire volume of soil removed is at $DCGL_W$, the assumed mean will be at $DCGL_W$. Therefore, the assumed case will be bounding.

2.0 Discussion

The total cost ($Cost_T$) will be calculated using LTP equation in Section 4.4.1):

$$Cost_T = Cost_R + Cost_{WD} + Cost_{ACC} + Cost_{TF} + Cost_{WDose} + Cost_{PDose} + Cost_{other}$$

These terms are defined and their values calculated as follows:

2.1 Cost of performing remediation work ($Cost_R$):

- Initially it will be assumed that the job is big enough to require earthmoving equipment. At a minimum, this would be either an excavator or a loader and truck. This turns out not to be a constraint, as explained later.

- To come up with a conservative scenario, the cost of remediating one square meter from a larger project is calculated. Any smaller job by, itself, would have planning and administration costs that would be dominant. Factors contributing to $Cost_R$ are identified in Attachment 1. The initial estimate for $Cost_R$ is based on a job to remediate 2000 square meters of soil, but to make it comparable to the other costs, that value is adjusted to reflect the cost of 1 square meter.

- The adjusted value of $Cost_R$ is \$7.32 to remediate 1 square meter of soil.
- Rounding down to the dollar, $Cost_R$ = \$7

Note: The value of $Cost_R$ calculated above bounds the cost of a smaller excavation, e.g., one that doesn't require earthmoving equipment. For example, two workers who take an hour to dig up some soil and bring it back

in wheelbarrow, with no work order or other formal planning, would cost the project about $100 in labor costs (assuming the cost to the project is $50/hr). So, the constraint that this only applies to jobs big enough to require earthmoving equipment can be removed.

2.2 Cost of waste disposal ($Cost_{WD}$):

- As above, it will be assumed that one square meter of surface soil is to be remediated. Surface soil is considered to be the top 15 cm. The estimated waste volume will therefore be 15 cm times the area of 1 m^2. This comes to 0.15 m^3.
- The current cost of waste disposal for radiologically contaminated soil is $100 per cubic meter. This includes burial fees and shipping.
- Rounding down to the dollar, $Cost_{WD}$ = $15

2.3 Cost of workplace accident ($Cost_{ACC}$):

- $Cost_{ACC}$ = ($3,000,000)x(4.2E-8/h)x(Time to perform remediation) .
- $3,000,000 is the monetary value of a fatality equivalent to $2000 per person-rem.
- 4.2E-8 is the workplace fatality rate, in fatalities per hour worked.
- For a 1 square meter excavation, this would not be more than a few person-hours. (Assume Time = 1.62 hr)
- ($3,000,000) x (4.2E-8/h) x (1.62 h) = $0.20
- Rounding down to the dollar, $Cost_{ACC}$ = $0

2.4 Cost of traffic fatality ($Cost_{TF}$):

- $Cost_{TF}$ = ($3,000,000)x(3.8E-8/km)x(Volume)x(Distance)/(Volume/shipment) .
- Round trip distance from HBPP to Grand View, ID: 2292 km/shipment ... (from Google Maps)
- Waste volume per shipment: 13.6 m^3/shpmt ... (default in LTP, Section 4.5.1.7.
- ($3,000,000)x(3.8E-8/km)x(0.15 m^3)(2292 km/shpmt)/(13.6 m^3/shpmt) = $2.88
- Rounding down to the dollar, $Cost_{TF}$ = $2

2.5 Cost of worker dose ($Cost_{WDose}$):

- $Cost_{WDose}$ = ($2000/person-rem)x(Worker dose rate)x(Time) .
- Dose rates would be insignificant. (Assume dose rate = 0.1 mrem/h = 1E-4 rem/h)

- ($2000/person-rem) x (1E-4 rem/h) x (1.62 h) = $0.32
- Rounding down to the dollar, $Cost_{WDose}$ = $0

2.6 Cost of Dose to the Public ($Cost_{PDose}$):

- $Cost_{DP}$ is assumed to be no more than the $Cost_{WD}$.
- Assumed $Cost_{PDose}$ = $0

2.7 Other costs associated with this situation ($Cost_{other}$)

There are no other costs associated with this remediation.

3.0 Calculation

ALARA Action Level (AL):

$$AL = \frac{Conc}{DCGL_W} = \frac{Cost_T}{\$2{,}000 \times P_D \times 0.025 \times F \times A} \times \frac{r+\lambda}{1-e^{-(r+\lambda)N}}$$

where:

- $Cost_T$ has been calculated above
- $2000 is the monetary value of one person-rem (Table 4-1, LTP)
- F = removable fraction = 1 ... (most conservative possible)
- 0.025 is the annual dose in rem to an average member of critical group from residual radioactivity.
- r = monetary discount rate = 0.03/y ... (Table 4-1, LTP)
- N = Number of years over which the collective dose is calculated = 1000 y ... (Table 4-1, LTP)
- PD = Population density for the critical group = 0.0001 people/m^2. (Table 4-1, LTP)
- A = Area being evaluated = 1 m^2
- Most conservative nuclide of concern is that with the longest half-life, Tc-99, with a half-life of 2.13E5 years (Table 6-1, LTP) and a decay constant (λ) of 3.254E-6 y^{-1} (Note: With the values for other variables used for this calculation, the 1-e... term equals 1 for any value of λ. Therefore, the smallest AL, which is the most conservative, will occur when λ, in the top of the equation, is smallest.)

Applying these values to the equation:

$$AL = \frac{24}{2000 \times 0.0001 \times 0.025 \times 1 \times 1} \times \frac{0.03 + 3.254E-06}{1 - e^{-(0.03+3.254E-6)*1000}}$$

AL = 144

If Tc-99 were at DCGL:
- Sum of DCGL Fractions = 1

Since AL is greater than the Sum of DCGL Fractions, remediation is not cost-beneficial. In fact, remediation would not be cost-beneficial unless the concentration of any LTP nuclide in soil were at least 144 times the DCGL.

4.0 Conclusions

Based upon the results of this ALARA evaluation, it is not cost-beneficial to remediate soil in which the levels of residual, plant-related radioactivity are below LTP release criteria.

5.0 References

1. HBPP License Termination Plan
2. U.S. Nuclear Regulatory Commission, NUREG-1530, "Reassessment of NRC's Dollar per Person-Rem Conversion Factor Policy," December 1995

Attachment 1
Cost estimate basis

Cost estimate for remediation work ($Cost_R$)

Assume larger project, to dilute fixed costs: 2000 m^2, removing the top 15 cm of soil

	Time (hr)	Rate ($/hr)	Cost
Const. Planner, Rad Engineer	50	$100	$5000
Supervision/management	1	$200	$200
Resurvey	50	$50	$2500
Additional off-site analysis			$2400
Additional on-site analysis			$1500
Equip + Operators	10	$250	$2500
RP Coverage	10	$50	$500
Total for 2000 m^2			$14,640
Cost per m^2			$7.32

Attachment 4
License Amendment No. 40 to DPR 7

September 11, 2007

Mr. John S. Keenan
Senior Vice President – Generation and Chief Nuclear Officer
Pacific Gas and Electric Company
PO Box 770000
Mail Code B32
San Francisco, CA 94177-0001

SUBJECT: HUMBOLDT BAY POWER PLANT UNIT 3 - ISSUANCE OF AMENDMENT REGARDING NEW LICENSE CONDITION 2.C.4 (TAC NO. J00325)

Dear Mr. Keenan:

The U.S. Nuclear Regulatory Commission has issued the enclosed Amendment No. 40 to Facility Operating License No. DPR-7 for the Humboldt Bay Power Plant, Unit 3. The amendment consists of changes to the License in response to your application dated April 4, 2007.

The amendment revises the license to allow the results of near-term surveys, performed on a portion of the plant site, to be included in the eventual Final Status Survey for license termination.

A copy of our related Safety Evaluation is also enclosed. The Notice of Issuance will be included in the Commission's next biweekly *Federal Register* notice.

Sincerely,

/RA/

John B. Hickman, Project Manager
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Docket No.: 50-133

Enclosures:
1. Amendment No. 40 to DPR-7
2. Safety Evaluation

cc w/encls: See next page

Humboldt Bay Power Plant, Unit 3 Service List

cc:

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PACIFIC GAS AND ELECTRIC COMPANY

DOCKET NO. 50-133

HUMBOLDT BAY POWER PLANT, UNIT 3

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 40
License No. DPR-7

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Pacific Gas and Electric Company (the licensee), dated April 4, 2007, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations set forth in 10 CFR Chapter I;

   B. The facility will be maintained in conformity with the license, as amended, the provisions of the Act, and the applicable rules and regulations of the Commission;

   C. There is reasonable assurance: 1) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public; and 2) that such activities will be conducted in compliance with applicable portions of the Commission's regulations;

   D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is hereby amended by changes to Possession Only License No. DPR-7 as follows:

   Paragraph 2.C.4. is added to read as follows:

   To demonstrate compliance with the NRC License Termination Rule, the Final Status Survey for Humboldt Bay Power Plant, Unit No. 3 license termination may utilize the results of the licensee's surveys of the area underlying the new fossil generation facility, referred to as the Humboldt Bay Repowering Project, provided a cross contamination prevention and monitoring plan is maintained.

Enclosure 1

3. This license amendment is effective as of the date of its issuance and shall be implemented when a cross contamination prevention and monitoring plan is implemented.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

Keith I. McConnell, Deputy Director
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Attachment: Revised License Pages

Date of Issuance: September 11, 2007

ATTACHMENT TO LICENSE AMENDMENT NO. 40

POSSESSION ONLY LICENSE NO. DPR-7

DOCKET NO. 50-133

Replace the following pages of the License with the attached revised pages. The revised pages are identified by amendment number and contain marginal lines indicating the areas of change.

REMOVE	INSERT
- 3 -	- 3 -
-	- 4 -

Attachment

5. Pursuant to the Act and Title 10, CFR, Chapter I, Parts 30 and 70, to possess, but not to separate, such by product and special nuclear materials which were produced by operation of the reactor. Amndt #39 4/17/07

C. This license shall be deemed to contain and is subject to the conditions specified in Part 20, Section 30.34 of Part 30, Section 40.41 of Part 40, Section 50.54 and 50.59 of Part 50, and Section 70.32 of Part 70 of the Commission's regulations, and is subject to all applicable regulations and orders of the Commission now or hereafter in effect, and is subject to the additional conditions specified or incorporated below.

1. The licensee shall fully implement and maintain in effect all provisions of the physical security plan previously approved by the Commission and all amendments and revisions made pursuant to the authority of 10 CFR Part 50.90 and 10 CFR Part 50.54(p). The plan, which contains Safeguards Information protected under 10 CFR Part 73.21, is entitled: "Humboldt Bay Power Plant, Unit No. 3, Physical Security Plan," with revisions submitted through November 17, 1986. The Guard Training and Qualification Plan and the Safeguards Contingency Plan are incorporated into the Physical Security Plan as Chapters 6 and 9, respectively.

2. Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 38, are hereby incorporated in the license. Pacific Gas and Electric Company shall maintain the facility in accordance with the Technical Specifications.

3. With respect to changes to the facility or procedures described in the Decommissioning Plan, or changes to the Decommissioning Plan, and the conduct of tests and experiments not described in the Decommissioning Plan, the provisions of 10 CFR 50.59 shall apply. Added per Amdt. #29 7-7-95

4. To demonstrate compliance with the NRC License Termination Rule, the Final Status Survey for Humboldt Bay Power Plant, Unit No. 3 license termination may utilize the results of the licensee's surveys of the area underlying the new fossil generation facility, referred to as the Humboldt Bay Repowering Project, provided a cross contamination prevention and monitoring plan is maintained. Added per Amndt. #40 9-11-07

D. This license amendment is effective as of the date of issuance and shall expire at midnight, November 9, 2015.

FOR THE NUCLEAR REGULATORY COMMISSION

Lester S. Rubenstein, Acting Director
Standardization and Non-Power
Reactor Project Directorate
Division of Reactor Projects III, IV,
V and Special Projects
Office of Nuclear Reactor Regulation

Enclosure:
Appendix A - Technical
Specifications

Date of Issuance: July 19, 1988

SAFETY EVALUATION BY OFFICE OF FEDERAL AND STATE MATERIALS

AND ENVIRONMENTAL MANAGEMENT PROGRAMS

RELATED TO AMENDMENT NO. 40 TO FACILITY OPERATING LICENSE NO. DPR-7

PACIFIC GAS AND ELECTRIC COMPANY

HUMBOLDT BAY POWER PLANT, UNIT 3

DOCKET NO. 50-133

1.0 INTRODUCTION

By letter dated April 4, 2007, Pacific Gas and Electric Company (PG&E, the licensee) submitted a request for an amendment to Facility Operating License No. DPR-7 that would add a new license condition 2.C.4 which would allow the results of near-term surveys, performed on a portion of the plant site, to be included in the eventual Final Status Survey (FSS) for license termination.

2.0 BACKGROUND

Humboldt Bay Power Plant (HBPP) Unit 3 was permanently shut down in July 1976, and, until recently, was in safe storage condition (SAFSTOR). SAFSTOR is the decommissioning method in which a nuclear facility is placed and maintained in a condition that allows the safe storage of radioactive components of the nuclear plant and subsequent decontamination to levels that permit license termination. A Decommissioning Plan (DP) was approved in July 1988. Subsequent to the 1996 License Termination rule, the licensee converted its DP into its Defueled Safety Analysis Report which is updated every two years. A Post Shutdown Decommissioning Activities Report was issued by the licensee in February 1998. The licensee is now engaged in some incremental decommissioning activities. In December 2003, PG&E formally submitted a license application to the U.S. Nuclear Regulatory Commission (NRC) for approval of a dry-cask Independent Spent Fuel Storage Installation (ISFSI) at the Humboldt Bay site. A license and safety evaluation report for the Humboldt Bay ISFSI were issued on November 17, 2005.

Currently, there are two fossil steam units (HBPP Units 1 and 2) and two combustion turbines, all approximately 50 years old, operating in close proximity to Unit 3 and within the licensed site area. Due to the age of the existing units and continuing power needs for the area, PG&E plans to begin construction in early 2008 of a new fossil generation plant to replace the existing Units 1 and 2 and the two combustion turbines. Due to the difficulty in siting new generating units, the new fossil generating plant will be located within the existing licensed site area. Full scale decommissioning of Units 1, 2, and 3 will begin after the replacement generating units are in service.

Enclosure 2

10 CFR 50.82(a)(9) states in part:

> All power reactor licensees must submit an application for termination of license. The application for termination of license must be accompanied or preceded by a license termination plan to be submitted for NRC approval.

10 CFR 50.82(a)(11) states in part:

> The Commission shall terminate the license if it determines that--
> (ii) The final radiation survey and associated documentation, including an assessment of dose contributions associated with parts released for use before approval of the license termination plan, demonstrate that the facility and site have met the criteria for decommissioning in 10 CFR part 20, subpart E.

3.0 TECHNICAL EVALUATION

The construction of the new fossil generating plant on a portion of the licensed site area will require removal of old buildings and remediation of an impacted area. The licensee plans on performing radiological surveys of the site of the new generating plant site before construction begins to verify adequate radiological cleanup. To ensure that the radiological surveys performed are adequate to meet the Final Status Survey (FSS) requirements for NRC license termination, the licensee is proposing to implement a cross contamination prevention and monitoring plan. The licensee has proposed a new license condition to address this proposal. The proposed License Condition 2.C.4. would read:

> "To demonstrate compliance with the NRC License Termination Rule, the Final Status Survey for Humboldt Bay Power Plant, Unit No. 3 license termination may utilize the results of the licensee's surveys of the area underlying the new fossil generation facility, referred to as the Humboldt Bay Repowering Project, provided a cross contamination prevention and monitoring plan is maintained."

Typically, licensees conduct a FSS following decommissioning of a nuclear facility in preparation for license termination. The FSS provides assurance that the area being released meets the NRC radiological requirements to ensure projected doses to people are within regulatory limits. The proposed change is intended to alleviate the need for additional surveys under the new facility as access to that area will be impractical once the new unit is constructed. The NRC has previously accepted the use of surveys performed prior to construction of new facilities on plant sites (i.e. for ISFSIs) to meet FSS requirements for license termination. Additionally, in this case, the licensee will be implementing a cross contamination prevention and monitoring plan which should provide reasonable assurance that the results of the surveys performed prior to Unit 3 decommissioning, will remain a valid characterization of radiological conditions existing in the area of the new generating plant.

Based on the prior NRC acceptance of radiological surveys performed before the completion of decommissioning to satisfy FSS requirements, and the implementation of a contamination prevention and monitoring program to limit and detect cross contamination of the surveyed area, the NRC has determined that the licensees request and proposed license condition are acceptable.

4.0 SUMMARY

The changes proposed by this license amendment request will allow the results of near-term surveys, performed on a portion of the plant site, to be included in the eventual Final Status Survey (FSS) for license termination. The NRC staff has reviewed the request and concluded that the licensee's request is consistent with established NRC policy and is therefore, acceptable.

5.0 STATE CONSULTATION

In accordance with the Commission's regulations, the State of California was notified of the proposed issuance of the amendment. The State had no comments.

6.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to an inspection and surveillance requirement. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration, and there has been no public comment on such finding (72 FR 41787) . Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

7.0 CONCLUSION

The staff has concluded, based on the considerations discussed above, that: 1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and; 2) such activities will be conducted in compliance with the Commission's regulations, and the issuance of the amendment will not be inimical to the common defense and security nor to the health and safety of the public.

Principal Contributor: John Hickman

Date: September 11, 2007