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August 3, 2016

Mr. John Hickman
U.S. Nuclear Regulatory Commission
Office of Nuclear Material Safety and Safeguards
Division of Decommissioning, Uranium Recovery, and Waste Programs
Reactor Decommissioning Branch
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SUBJECT: PROJECT-SPECIFIC PLAN FOR THE CONFIRMATORY SURVEY ACTIVITIES AT THE HUMBOLDT BAY POWER PLANT EUREKA, CALIFORNIA RFTA No. 15-006, Docket No. 03004530; DCN 5272-PL-02-0

Dear Mr. Hickman:

Oak Ridge Associated Universities, operating under the Oak Ridge Institute for Science and Education contract, is pleased to provide the subject plan detailing the proposed confirmatory survey activities at the Humboldt Bay Power Plant in Eureka, California. This confirmatory survey plan was developed to support all activities under RFTA No. 15-006. Changes to this plan, and concurrence from NRC, will be noted in the site logbook

Please feel free to contact me at 865.241.8793 or Erika Bailey at 865.576.6659 if you have any comments or concerns.

Sincerely,

Nick A. Altic
Health Physicist/
Project Manager
ORAU

NAA:lw

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PROJECT-SPECIFIC PLAN FOR THE CONFIRMATORY SURVEY ACTIVITIES AT THE HUMBOLDT BAY POWER PLANT EUREKA, CALIFORNIA

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Prepared by
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August 2016

Prepared for the
U.S. Nuclear Regulatory Commission

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ORAU

PROJECT-SPECIFIC PLAN FOR THE CONFIRMATORY SURVEY ACTIVITIES AT THE HUMBOLDT BAY POWER PLANT EUREKA, CALIFORNIA

1. INTRODUCTION

The Pacific Gas & Electric Company (PG&E) operated the Humboldt Bay Power Plant (HBPP) Unit 3 nuclear reactor near Eureka, California under Atomic Energy Commission (AEC) provisional license number DPR-7. HBPP Unit 3 achieved initial criticality in February 1963 and began commercial operations in August 1963. Unit 3 was a natural circulation boiling water reactor with a direct-cycle design. Stainless steel fuel claddings were used from startup until cladding failures resulted in plant system contamination—zircaloy-clad fuel was used exclusively starting in 1965, eliminating cladding-related contamination. A number of spills and gaseous releases were reported during operations, resulting in a range of mitigation activities (ESI 2008).

In July 1973, Unit 3 was shut down for annual refueling and seismic modifications. However, by December 1980, it was concluded that completing the required upgrades and restarting Unit 3 would be cost prohibitive. PG&E decided in June of 1983 to decommission Unit 3, received a possession-only license amendment, and placed the unit into cold shutdown and safety storage (SAFSTOR). The impacted areas associated with Unit 3 are currently undergoing decommissioning. As part of the Humboldt Bay Repowering Project (HBRP), PG&E has built ten new fossil fuel units (16.3 MWe [megawatt electric] each) on the site in the vicinity of Unit 3. Decommissioning activities have also been completed on the adjacent fossil fuel Units 1 and 2, with all materials being removed to ground level (ESI 2008).

The U.S. Nuclear Regulatory Commission (NRC) has requested that ORAU, via the Oak Ridge Institute for Science and Education (ORISE) contract, perform confirmatory survey activities of the HBPP. This project-specific plan (PSP) was developed to support the confirmatory survey activities areas associated with Unit 3 operation.

2. SITE DESCRIPTION

The HBPP site, owned by PG&E, consists of 143 acres on the southern edge of Humboldt Bay four miles southwest of the town of Eureka in Humboldt County, California. Figure 2.1 provides an

arieal view of the HBPP. PG&E maintains ten new operating electric generating units at the HBPP site (in the New Generation Footprint Area) that run on fossil fuels, two non-operating fossil fuel units (Units 1 and 2), and one non-operational nuclear unit (Unit 3). Units 1 and 2, which were decommissioned to ground level, were interconnected with and west of Unit 3 (ESI 2008). The remaining property includes mostly open areas and protected wetlands.

Figure 2.1. HBPP Ariel View

3. RESPONSIBILITY

Work described in this survey plan will be performed under the direction of Tim Vitkus, (Survey and Technical Projects Operations Director) and Erika Bailey (Survey and Technical Projects Manager). The cognizant Field Team Leader has the authority to make appropriate changes to the survey procedures as deemed necessary, after consultation with NRC personnel or ORAU project management. Changes to the scope of this survey plan or applicable procedures will be documented in the site logbook.

4. PROJECT HEALTH AND SAFETY

ORAU will adhere to all applicable regulatory requirements and participate in any required site-specific training. Confirmatory activities will be performed under the site's overall health and safety plan (HASP) and radiological protection plan during site activities. The ORAU project manager is responsible for the overall health and safety of the ORAU project personnel. The licensee is expected to inform ORAU of known and potential hazards in order to effectively apply required safety precautions. A walkdown of the project area prior to the survey will assist ORAU in evaluating any additional potential health and safety issues that are not currently addressed in ORAU survey procedures or job hazard analyses (JHAs) (ORAU 2015a). Should ORAU identify a hazard not covered in the *ORAU Survey Procedures Manual* or the site HASP, work will not be initiated or continued until it is addressed by an appropriate JHA.

5. DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) described herein are consistent with the *Guidance on Systematic Planning Using the Data Quality Objectives Process* (EPA 2006) and provide a formalized method for planning radiation surveys, improving survey efficiency and effectiveness, and ensuring that the type, quality, and quantity of data collected are adequate for the intended decision applications. The seven steps in the DQO process are outlined below:

1. State the problem
2. Identify the decision/objective
3. Identify inputs to the decision/objective

4. Define the study boundaries
5. Develop a decision rule
6. Specify limits on decision errors
7. Optimize the design for obtaining data

5.1 STATE THE PROBLEM

The first step in the DQO process defines the problem that necessitates the study. NRC has requested that ORAU perform confirmatory surveys at the HBPP. The objectives of the confirmatory surveys are to provide independent contractor document and field reviews and generate independent radiological data to assist NRC in evaluating the adequacy and accuracy of the licensee's FSS results. The problem statement is as follows:

> Perform confirmatory surveys to assess and determine the adequacy of the licensee's FSS design, implementation, and documentation for demonstrating compliance with the release criteria.

5.2 IDENTIFY THE DECISION

The second step in the DQO process identifies the principal study question (PSQ) and alternate actions (AAs), develops a decision statement, and organizes multiple decisions, as appropriate. This is done by specifying AAs that could result from a "yes" response to the PSQ and combining the PSQ and AAs into a decision statement. Table 5.1 presents the PSQ, AAs, and combined decision statement.

Table 5.1. HBPP Confirmatory Survey Decision Process	
Principal Study Question	**Alternative Actions**
In order to select "Yes" from the AAs, the subsequent questions must all be answered "Yes." • Are the results of HBPP's FSS representative of the current radiological status? • Were field and laboratory instrumentation adequate and appropriate relative to the site's ROCs? • Were the survey units/areas classified correctly?	Yes: HBPP has demonstrated compliance with the release criteria through adequate measurements, sampling, and analysis—agree with HBPP's decision to release the survey unit/area. No: HBPP has not adequately demonstrated compliance with the release criteria. ORAU will provide technical comments and NRC may alter remedial action planning to address contamination and/or documentation issues.
Decision Statement	
Determine whether HBPP has made the appropriate decision regarding the final radiological status of the survey area/unit investigated relative to the release criteria.	

5.3 IDENTIFY INPUTS TO THE DECISION

The third step in the DQO process identifies both the information needed and the sources of this information, determines the basis for action levels, and identifies sampling and analytical methods that will meet data requirements. For this effort, information inputs include the following:

- HBPP characterization data
- HBPP Geographic Information System and Visual Sample Plan files, for survey unit boundaries
- HBPP's FSS data and supporting documentation, if available
- ORAU soil sample analytical results
- ORAU surface activity measurements

5.3.1 Radionuclides of Concern

The primary radionuclides of concern (ROCs) identified for the HBPP are beta-gamma emitters—fission and activation products—resulting from reactor operation. The HBPP derived concentration guideline levels (DCGLs) for soils and building surfaces are presented in Table 5.2 and Table 5.3, respectively (PGE 2014).

Table 5.2. HBPP Soil DCGLs					
ROC[a]	**DCGL (pCi/g)[a]**	**ROC**	**DCGL (pCi/g)**	**ROC**	**DCGL (pCi/g)**
Am-241	25	Cs-137	7.9	Np-237	1.1
C-14	6.3	Eu-152	10	Pu-238	29
Cm-243	29	Eu-154	9.4	Pu-239	26
Cm-244	48	H-3	680	Pu-240	26
Cm-245	17	Nb-94	19,000	Pu-241	860
Cm-246	25	Ni-59	63,000,000	Sr-90	1.5
Co-60	3.8	Ni-63	24,000,000	Tc-99	12

[a]pCi/g = picocuries per gram

Table 5.3. HBPP Surface Activity DCGLs					
ROC[a]	**DCGL (dpm/100 cm²)[a]**	**ROC**	**DCGL (dpm/100 cm²)**	**ROC**	**DCGL (dpm/100 cm²)**
Am-241	3.00E+03	Cs-137	4.60E+04	Np-237	2.40E+03
C-14	7.00E+06	Eu-152	2.70E+04	Pu-238	3.40E+03
Cm-243	4.30E+03	Eu-154	2.50E+04	Pu-239	3.10E+03
Cm-244	5.50E+03	H-3	1.80E+08	Pu-240	3.10E+03
Cm-245	2.20E+03	Nb-94	1.90E+04	Pu-241	1.40E+05
Cm-245	2.70E+03	Ni-59	6.30E+07	Sr-90	9.70E+04
Co-60	1.30E+04	Ni-63	2.40E+07	Tc-99	9.60E+06

[a]dpm/100cm² = disintegrations per minute per 100 square centimeters

Each scaled radionuclide-specific $DCGL_W$ represents the concentration above background of a residual radionuclide that would result in a radiological dose of 25 millirem per year (mrem/yr) to the average member of the critical group. Because each of the individual $DCGL_W$ represents 25 mrem/yr, the sum-of-fractions (SOF) approach is used to demonstrate compliance with the dose limit. SOF calculations are performed as follows:

$$SOF_{TOTAL} = \sum_{j=0}^{n} SOF_j = \sum_{j=0}^{n} \frac{C_j}{DCGL_{W,j}}$$

Where C_j is the concentration of ROC "j," and $DCGL_{W,j}$ is the $DCGL_W$ for ROC "j." Note that gross concentrations are considered here for conservatism.

5.4 DEFINE THE STUDY BOUNDARIES

The fourth step in the DQO process defines target populations and spatial boundaries, determines the timeframe for collecting data and making decisions, addresses practical constraints, and determines the smallest subpopulations, area, volume, and time for which separate decisions must be made. NRC will inform ORAU of the specific survey units/areas that will be subject to the confirmatory survey scope detailed in this plan. Multiple survey units may be combined into a single confirmatory unit based on like conditions and contamination potential. Dates for individual survey trips are to be determined and will be provided by NRC.

ORAU will review the licensee's final status survey plans, associated procedures, and available release survey data—as requested by NRC staff. Reviews will be performed to assess the adequacy of the licensee's documentation, while taking into account NUREG-1757, *Consolidated NMSS Decommissioning Guidance* (NRC 2006), and NUREG-1575, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* guidance (NRC 2000). Additionally, should the licensee utilize *in situ* gamma spectroscopy measurement techniques, ORAU may request to be provided with the associated procedures and data results for independent evaluation.

5.5 DEVELOP A DECISION RULE

The fifth step in the DQO process specifies appropriate population parameters (e.g., mean, median), confirms action levels are above detection limits, and develops an if…then… decision rule statement. For this survey effort, the parameter of interest is the mean sum of fractions (SOF) for the survey unit/area. The decision rule can be stated as:

> If the average SOF as determined by ORAU is within the respective error of HBPP's average SOF for the investigated survey unit/area, all results are below the respective guidelines, and project documentation is complete then recommend acceptance; if insufficient, then perform further evaluations and provide technical comments/recommendations.

For survey units/areas that are small in size and have a low potential for residual contamination, judgmental only measurements may be collected to validate the licensee's classification.

5.6 SPECIFY LIMITS ON DECISION ERRORS

The sixth step in the DQO process specifies the decision maker's limits on decision errors, which are then used to establish performance goals for the survey. Two orders of control will be implemented to confirm that HBPP's FSS data are acceptable and accurate.

The first order of control is the degree to which the SOFs reported by ORAU and HBPP should agree. The 95% confidence interval of each mean will be determined. If the two confidence intervals overlap, then HBPP's and confirmatory survey results are considered to be in agreement. A disagreement may not indicate that HBPP's results are inadequate. Class 3 survey units/areas, by definition, will have little to no residual ROC concentration. In these situations, comparing data populations where results are likely to be near or below the method minimum detectable concentrations (MDCs) with large relative uncertainties can be inconclusive. Furthermore, when the action level is substantially greater than the MDCs, comparison of the population parameters may be unnecessary. Any anomalies identified while performing surveys or following data assessment will be fully investigated and discussed with NRC staff.

The second order of control will be to optimize the MDCs of analyses performed by ORAU, both for field and laboratory measurements. Measurement MDCs will be, at a minimum, equal to 50% of the guidelines presented in Section 5.3.1.

5.7 OPTIMIZE THE DESIGN FOR OBTAINING DATA

The seventh step in the DQO process is used to review DQO outputs, develop data collection design alternatives, formulate mathematical expressions for each design, select the sample size to satisfy DQOs, decide on the most resource-effective design of agreed alternatives, and document requisite details. Specific survey procedures are presented in Section 6.

6. PROCEDURES

The ORAU survey team will perform visual inspections, measurements, and sampling activities within the accessible survey areas specifically requested by the NRC. Survey activities will be conducted in accordance with the *ORAU Survey Procedures Manual* and the *ORAU Environmental Services Quality Program Manual* (ORAU 2015a and 2015b). During survey activities, ORAU will immediately inform NRC of any findings and/or recommendations. ORAU will prepare and submit a survey report to the NRC summarizing the independent in-process inspections and confirmatory survey activities and results.

6.1 REFERENCE SYSTEM

ORAU will reference confirmatory measurement/sampling locations to the licensee's reference system, global positioning system (GPS) coordinates, and/or specific X, Y coordinates from the southwest corner of the respective SU floor or lower left corner of walls of buildings. Other prominent site features may also be referenced. Measurement and sampling locations will be documented on detailed survey maps. Specific areas may also be digitally photographed.

6.2 SURFACE SCANS

Surface scans of land areas will be performed with Ludlum Model 44-10 NaI scintillation detectors coupled to ratemeter-scalers with audible indicators. Scan coverage will be dependent on the survey unit classification and will be commensurate with the potential for residual radioactivity. Detectors will also be coupled to GPS systems that enable real-time gamma count rate and spatial data capture. Locations of elevated direct radiation, suggesting the presence of residual contamination, will be marked and identified for further investigation.

Surface scans of structures will be performed using Ludlum Model 43-68 gas-flow proportional detectors for direct alpha-plus-beta radiation coupled to Ludlum Model 2221 ratemeter-scalers. The detectors may also be coupled to dataloggers to electronically record all scanning data points. Scan coverage will be dependent on the survey unit classification and will be commensurate with the potential for residual radioactivity. Scans will be focused in areas with the highest likelihood of contamination potential. Locations of elevated direct radiation, suggesting the presence of residual contamination nearing the $DCGL_{GA}$, will be marked and identified for further investigation.

6.3 SURFACE ACTIVITY MEASUREMENTS

Construction material-specific background measurements may be collected—as deemed necessary—from non-impacted area or area with the lowest observed background. The material-specific background will be used for correcting gross activity measurements performed on structural surfaces. Total surface activity measurements will be performed with Ludlum Model 43-68 gas-flow proportional detectors coupled to Ludlum Model 2221 ratemeter-scalers. A mylar thickness of 3.8 mg/cm^2 will be used to shield any alpha component for the beta measurements.

Direct measurements for total beta and alpha activity will, at a minimum, be collected from judgmentally selected locations based on surface scans. The total number of direct measurements will be dependent on findings as the survey progresses. For survey units that have a higher potential for contamination, a random or systematic measurement protocol will be used. The number of random or systematic measurements will be determined using the licensee's FSS data. If the licensee's FSS data is unavailable, the measurements will be determined using a default relative shift of 1.7 as in input to Table 5.5 from the MARSSIM.

Smear samples, to determine removable alpha and beta activity levels, will be collected from direct measurement locations that exhibit elevated surface activity levels.

6.4 SOIL SAMPLING

A ranked set sampling (RSS) process, following U.S. Environmental Protection Agency (EPA) guidance, will be used to generate the random locations from which the soil samples will be collected (EPA 2006). The process combines random sampling with the use of professional judgment to select sampling locations. One-minute static gamma measurements collected from a population of random locations will provide the measurable field screening method. Gamma measurements will be performed at the surface of the RSS locations. The count data will then be ranked (high, medium, or low) to determine which location is sampled and submitted for laboratory analysis. Samples will be collected at a depth of 0–15 cm from the remediated surface. Additional samples will be collected from locations of elevated direct gamma radiation detected during surface scans or if field investigations indicate the potential for subsurface contamination. The total number and types (random vs. judgmental) of samples will be based upon the findings as the survey

progresses but is planned for up to 15 per survey unit/area. If the licensee's analytical FSS and/or characterization soil results are available prior to the confirmatory surveys, they will be used as inputs to determine the number of random sample locations. The number of soil samples collected from each survey unit will be such that the mean concentration estimated will fall within 0.25 of the predicted mean SOF at the, one-sided, 95% confidence level. If the licensee's FSS data is unavailable, nine confirmatory samples will be collected from 27 field ranking locations.

7. SAMPLE ANALYSIS AND DATA INTERPRETATION

Samples and data collected on site will be returned to the ORAU/ORISE facility for analysis and interpretation. Sample custody will transferred to the Radiological and Environmental Analytical Laboratory in Oak Ridge, Tennessee. Sample analyses will be performed in accordance with the *ORAU Radiological and Environmental Analytical Laboratory Procedures Manual* (ORAU/ORISE 2015). Soil samples will be analyzed by gamma spectroscopy for gamma-emitting fission and activation products; results will be reported in units of picocuries per gram (pCi/g). Smear samples will be analyzed for alpha/beta activity using a low-background proportional counter. Smear sample and direct measurement results will be reported in units of disintegrations per minute per one hundred square centimeters (dpm/100 cm^2).

Results of confirmatory survey activities will be presented in a report and provided to NRC for review and comment. Data collected as part of this survey will be archived by ORAU. Surplus soil and miscellaneous material samples will be returned to the site for disposal.

8. REFERENCES

EPA 2006. *Data Quality Assessment: Statistical Methods for Practitioners.* EPA QA/G-9S. U.S. Environmental Protection Agency Washington, DC. February.

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