Smith, James

From:	Bailey, Erika <Erika.Bailey@orau.org>
Sent:	Saturday, May 19, 2018 11:46 AM
To:	Smith, James
Cc:	Learn, Matthew; Lin, Bill; Faraz, Yawar; Kunowski, Michael; Carter, Ted; Altic, Nick; Roberts, Sarah; Cox, John; Brown, Teresa; Engel, Kaitlin; Hagemeyer, Derek
Subject:	[External_Sender] Final Centrus confirmatory survey plan
Attachments:	5326-PL-01-0 Centrus Confirmatory Survey PSP.pdf

Jim –

The survey plan is attached for you records.

Erika N. Bailey
Survey and Technical Projects Group Manager
ORAU
(865) 576-6659 (office)
(865) 310-0274 (cell)
Erika.Bailey@orau.org

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

May 18, 2017

James Smith, Health Physicist
U.S. Nuclear Regulatory Commission
Office of Nuclear Materials and Safeguards
Division of Decommissioning, Uranium Recovery, and Waste Programs
Materials Decommissioning Branch
TWFN Mail Stop T-8F5
Rockville, MD 20852

SUBJECT: CONTRACT NO. DE-SC0014664
PROJECT-SPECIFIC PLAN FOR THE CONFIRMATORY SURVEY ACTIVITIES AT THE AMERICAN CENTRIFUGE LEAD CASCADE FACILITY, PIKETON, OHIO
RFTA No. 18-006; DCN 5326-PL-01-0

Dear Mr. Smith:

The Oak Ridge Institute for Science and Education (ORISE) is pleased to provide the subject plan detailing the proposed confirmatory survey activities at the American Centrifuge Lead Cascade in Piketon, Ohio. This confirmatory survey plan was developed to support all activities under RFTA No. 18-006. NRC comments on the plan were addressed in this final version.

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

Sincerely,

Erika N. Bailey
Survey Projects Manager
ORISE

ENB:lw

Attachment

electronic distribution:

T. Carter, NRC	Y. Faraz, NRC
M. Learn, NRC	B. Lin, NRC
M. Kunowski, NRC	N. Altic, ORISE
D. Hagemeyer, ORISE	S. Roberts, ORISE
File/5326	

Distribution approval and concurrence:	Initials
Group Manager/Technical Review	

PROJECT-SPECIFIC PLAN FOR THE CONFIRMATORY SURVEY ACTIVITIES AT THE AMERICAN CENTRIFUGE LEAD CASCADE FACILITY, PIKETON, OHIO

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

Prepared by
Erika N. Bailey
ORISE

May 2018

FINAL PLAN

Prepared for the
U.S. Nuclear Regulatory Commission

This document was prepared for the U.S. Nuclear Regulatory Commission (NRC) by the Oak Ridge Institute for Science and Education (ORISE) through an interagency agreement (NRC FIN No. F-1244) between the NRC and the U.S. Department of Energy (DOE). ORISE is managed by Oak Ridge Associated Universities under DOE contract number DE-SC0014664.

OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION

PROJECT-SPECIFIC PLAN FOR THE CONFIRMATORY SURVEY ACTIVITIES AT THE AMERICAN CENTRIFUGE LEAD CASCADE FACILITY, PIKETON, OHIO

1. INTRODUCTION

The American Centrifuge Lead Cascade Facility (Lead Cascade) was a test loop of the American Centrifuge Plant (ACP) located in Piketon, Ohio. The Lead Cascade demonstrated the effectiveness of the centrifuge design and equipment by processing uranium in a closed loop. After the demonstration was completed, the facility made a financial decision to cease uranium enrichment operations in February 2016, followed by removal of uranium gas from the centrifuges and process piping, dismantling of process equipment, and other actions needed to ultimately decommission the facility.

In March 2016, American Centrifuge Operating, LLC (ACO) notified the U.S. Nuclear Regulatory Commission (NRC) of Centrus Energy Corporation's decision to cease operations at the Lead Cascade and to terminate the Lead Cascade's Materials license (SNM-7003). In May, ACO submitted a proposed amendment to the license to downgrade licensed activities at the Lead Cascade to "limited operations" and to remove the regulatory permission to enrich uranium. NRC issued an approval to the license amendment in December 2016 (NRC 2017).

2. SITE DESCRIPTION

The footprint of the Lead Cascade is located within the U.S. Department of Energy's (DOE's) 3,777-acre federal reservation in a rural area of Pike County, Ohio, approximately 20 miles north of Portsmouth, Ohio. Figure 2.1 depicts the portion of the reservation associated with the American Centrifuge Program. The Lead Cascade facilities were leased from the DOE and are being prepared for return to the DOE to meet unrestricted use per lease requirements (ACO 2018a).

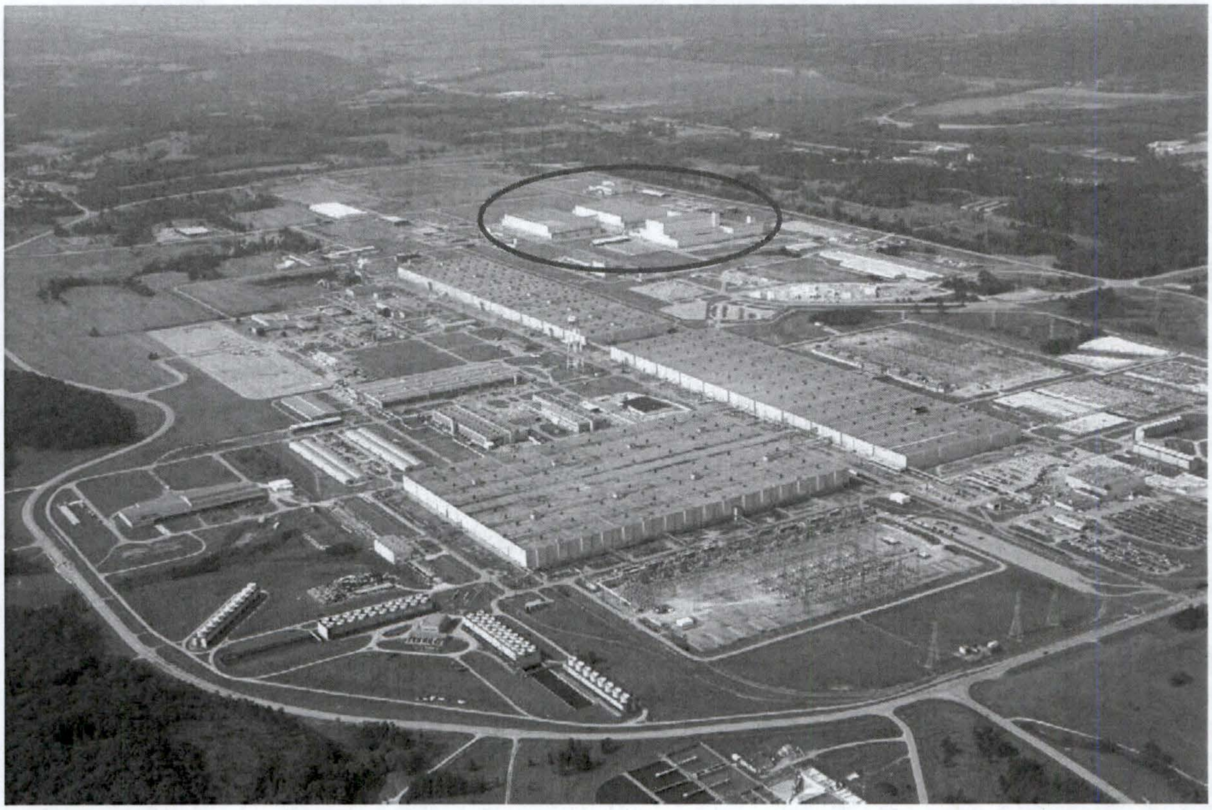

Figure 2.1. DOE Reservation and Footprint of the Lead Cascade (circled in red) (ACO 2018a)

3. PROJECT HEALTH AND SAFETY

ORISE staff 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 ORISE project manager is responsible for the overall health and safety of the ORISE project personnel. The site staff is expected to inform ORISE of known and potential hazards in order to effectively apply required safety precautions. A walk-down of the project area prior to the survey will assist ORISE in evaluating any additional potential health and safety issues that are not currently addressed in ORISE survey procedures or job hazard analyses (JHAs) (ORAU 2016a). Should ORISE identify a hazard not covered in the *ORAU Radiological and Environmental Survey Procedures Manual* or the site HASP, work will not be initiated or continued until it is addressed by an appropriate JHA.

4. 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 as follows:

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

4.1 STEP 1 – STATE THE PROBLEM

The first step in the DQO process defines the problem that necessitates the study, identifies the planning team, and examines the project budget and schedule. The Gas Centrifuge Enrichment Plant (GCEP) lease agreement between the DOE and the United States Enrichment Corporation states in part that prior to returning GCEP Leased Facilities residual radiological contamination levels shall comply with the U.S. Nuclear Regulatory Commission's (NRC's) radiological criteria for unrestricted used, as specified in Title 10 of the Code of Federal Regulations 20.1402 (ACO 2018a), which states:

> "A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent to an average member of the critical group that does not exceed 25 mrem per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)."

NRC has requested that ORISE perform confirmatory surveys of the Lead Cascade to provide independent contractor documentation and field reviews and generate independent radiological data to assist the NRC in evaluating the adequacy and accuracy of ACO's final status survey (FSS) results. Therefore, the problem statement is as follows:

> Independent confirmatory surveys are necessary to assist the NRC in their assessment and determination of the adequacy of the FSS design, implementation, and results for demonstrating compliance with the release criteria.

4.1.1 Project Responsibility

Work described in this survey plan will be performed under the direction of Erika Bailey (Survey and Technical Projects [STP] Group 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 ORISE project management. Changes to the scope of this survey plan or applicable procedures will be documented in the site logbook. ORISE and NRC project stakeholders are outlined in Table 4.1.

Table 4.1. Key Project Personnel

Name	Organization	Role
James Smith	NRC – Headquarters	Project Manager
Matthew Learn	NRC – Region III	Inspector
Bill Lin	NRC – Region III	Inspector
Erika Bailey	ORISE	STP Group Manager/Project Manager
Mark Berkheimer	ORISE ES&H	Industrial Hygienist
Chuck Scott	ORISE ES&H	Radiation Safety Officer
Tom Wantland	ORISE ES&H	Environmental Safety and Health Director
Forrest Smith	ORISE Lab	Senior Chemist

4.1.2 Project Budget and Schedule

Project requirements are outlined in NRC's Request for Technical Assistance (RFTA) 18-006. ORISE prepared a cost estimate to meet the requirements of RFTA 18-006. The project budget is outlined in the NRC-approved spend plan provided by ORISE and is not discussed in this project-specific plan (PSP). The confirmatory survey is expected to last five days. ORISE will prepare and submit a draft report to NRC summarizing survey results and conclusions within 20 business days of the receipt of final lab data. The final survey report will be submitted to NRC within 15 business days after the receipt of all NRC comments.

4.2 STEP 2 – IDENTIFY THE DECISION

The second step in the DQO process identifies the principal study questions (PSQs) 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 PSQs and combining the PSQs and AAs into a decision statement. PSQs, AAs, and combined decision statements (DS) are organized based on the survey unit type (i.e. the associated FSS methodology) and presented in Table 4.2.

Table 4.2. LACBWR Confirmatory Survey Decision Process

Principal Study Questions	Alternative Actions
PSQ: Do the FSS results adequately and accurately support the decision regarding the final radiological status of the Lead Cascade?	**Yes**: Confirmatory survey results support the final radiological survey data for the Lead Cascade—compile confirmatory survey data and present the results to NRC. **No**: Confirmatory survey results refute the final radiological survey data for the Lead Cascade—summarize the discrepancies and provide technical comments to NRC.
Decision Statements	
The FSS results for the Lead Cascade do/do not adequately and accurately represent final radiological conditions.	

4.3 STEP 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:

- Applicable instrumentation and survey and sampling procedures, method procedures, and data management procedures (ORAU 2016a)
- The ORAU Environmental Services and Radiation Training Quality Program Manual (ORAU 2016b)
- Applicable laboratory equipment and procedures (ORAU 2017)
- ACO's final status survey report and associated data (ACO 2018a)

- ORISE confirmatory survey results including: surface radiation scans, direct surface activity measurements, and removable gross alpha/beta activity

All project personnel must be qualified and experienced in the project task(s) for which they are responsible. Training will be conducted per the procedures documented in the *ORAU Radiological and Environmental Survey Procedures Manual* (ORAU 2016a). The ORISE survey projects manager will be responsible for determining if any additional training requirements should be implemented to execute this plan.

4.3.1 Radionuclides of Concern

The radiological contaminants of concern are uranium isotopes U-234, U-235, and U-238 from the UF_6 feed. In order to demonstrate compliance with the 25 mrem/yr release criterion, a site-specific derived concentration guideline level ($DCGL_W$) was developed and presented in the site's Decommissioning Plan, DP-2605-001. Using RESRAD-Build, the $DCGL_W$ was determined to be 39,200 disintegrations per minute per one hundred square centimeters (dpm/100 cm^2). However, ACO noted in their FSS report that the Lead Cascade license application limits are more restrictive and limit total contamination levels for unrestricted release and ALARA purposes. The more restrictive surface contamination limits are presented in the licensee's decommissioning plan and are reproduced in Table 4.3 below (ACO 2018b). This lower value will be applied by ACO to demonstrate compliance with NRC's dose criterion and also for ALARA purposes.

Table 4.3. Lead Cascade License Application Contamination Levels [a]

Radionuclide	Removable (dpm/100 cm2)	Total (dpm/100 cm2)[b]
U-natural, U-235, U-238, and associated decay products. Transuranics ≤ 2 percent by alpha activity, Tc-99 and beta-gamma emitters.	1,000	5,000

[a]Table source: ACO 2018b

[b]The levels may be averaged over one square meter provided the maximum surface activity in any area of 100 cm^2 is less than three times the total value. For the purposes of averaging, any square meter of the surface is considered to be above the total surface activity limit if: 1) the average of measurements from a representative number of n sections are above the total limits; or 2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 exceeds three times the total limit.

4.4 STEP 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.

Figure 2.1 presents the area of the site associated with the Lead Cascade. The FSS report presents data from five buildings including X-3001, X-3012, X-7725, X-7726, and X-7727H. Limited confirmatory survey activities will be performed in each of the buildings during the five days onsite, which constitutes the temporal boundary of the study. ORISE imported ACO's FSS summary data into a spreadsheet and ranked the survey units (SUs) by highest alpha sum-of-fractions values (SOFs). Four SUs have been specifically selected with the highest alpha SOF, two of which also have the highest beta SOFs. Additional SUs may also be selected for full confirmatory survey activities as time permits.

4.5 STEP 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 uranium surface activity in an individual SU. The mean surface activity in an SU will be compared to the mean surface activity reported in ACO's FSS report via a two-sample hypothesis test. Hypothesis testing adopts a scientific approach where the survey data are used to select between the baseline condition (the null hypothesis, H_0) and an alternative condition. The specific statistical test selected will be dependent on the distribution of the two samples sets, i.e., whether the data are parametric or non-parametric. Likely candidates for the statistical test are the students-t test for parametric data or the Wilcoxon Ranked Sum test for non-parametric data sets.

The null and alternative hypotheses can be stated as:

H_o: The mean uranium surface activity in a SU as determined by ORISE (μ_{ORISE}) is greater than or equal to the mean uranium surface activity determined by ACO (μ_{ACO}) plus a substantial difference (S). Mathematically, H_o is formulated as:

$$\mu_{ORISE} > \mu_{ACO} + S$$

H_A: The mean uranium surface activity in a SU as determined by ORISE is less than or equal to the mean uranium surface activity determined by ACO plus a substantial difference. Similarly, H_A is formulated as:

$$\mu_{ORISE} \leq \mu_{ACO} + S$$

In the hypotheses, the substantial difference is a limit on how much the ORISE-determined mean can vary before one concludes that the two sample sets were collected from different populations. For this study the substantial difference is equal to two times the standard error of the ACO-determined mean surface activity.

Individual sample results must also be evaluated against a single pass/fail criterion. The criterion used for individual data points will be the three times the total surface activity limit—specified in the footnote of Table 4.3, which is 15,000 dpm/100 cm^2 total activity. The decision rule can be stated as:

> If the null hypothesis is rejected and surface activity, averages, maximums, and removable are less than the release limits, then recommend acceptance of ACO's FSS data; otherwise, perform further evaluation(s) and provide technical comments and recommendations to NRC.

4.6 STEP 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. There are two types of decision errors to consider: Type I (typically designated as alpha or α) and Type II (typically designated as beta or β). A Type I error occurs when the null hypothesis is rejected when it should not be, also known as a false positive, and reflects the confidence level in the decision. A Type II error is incorrectly failing to reject the null hypothesis when the alternative hypothesis is true. This is also known as a false negative. Two orders of control will be implemented to minimize decision errors regarding the decision statement introduced in Table 4.2.

The first order of control will be to select decision error rates that are conservative yet still allow for the project to be completed within the study boundaries. The Type I error rate will be set to α=0.05, that is, there is a 5% chance of incorrectly rejecting the null hypothesis. The power of the statistical test, or the probability of the test to correctly reject the null hypothesis when it is false, is denoted as the quantity (1-β). Typically a prospective power is defined by selecting a Type II error rate that is acceptable while not requiring an overly burdensome sample size. A prospective Type II error rate will not be specified, as ORISE does not have influence over ACO's sample size. The prospective or actual power achieved by the statistical test is a function of the variability in the SU and the number of samples collected by ORISE and ACO. It should be noted that due to the manner in which the hypotheses are stated, the sample size only impacts the power of the test and not the Type I error rate, which is more detrimental than committing a Type II error.

Failing to reject the null hypothesis may not indicate that ACO's results are inadequate. For example, 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 minimum detectable concentrations (MDCs) and have large relative uncertainties can be inconclusive. Furthermore, when the action level [total surface activity limit] is substantially greater than the MDCs, comparison of the population parameters may be unnecessary. Any anomalies identified while performing the surveys or subsequent data assessment will be fully investigated to determine if the survey unit was appropriately classified or otherwise satisfies an elevated measurement comparison and discussed with NRC staff.

The second order of control will be to optimize the confirmatory field measurement detection sensitivities and ensure that laboratory analytical MDCs are sufficient for decision making. The nominal analytical MDCs are less than 10% of the DCGLs. Field instrumentation MDCs are optimized by following the survey procedures outlined in Section 5.

4.7 STEP 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. Survey design and laboratory analyses will be optimized by implementing the procedures presented in Section 5.

5. PROCEDURES

The ORISE survey team will perform visual inspections, measurements, and sampling activities within select SUs. ORISE will also perform any additional surveys and/or sampling activities as directed by the NRC. Survey activities will be conducted in accordance with the *ORAU Radiological and Environmental Survey Procedures Manual* and the *ORAU Environmental Services and Radiation Training Quality Program Manual* (ORAU 2016a and ORAU 2016b). During survey activities, ORISE will immediately inform NRC of any findings and/or recommendations.

5.1 REFERENCE SYSTEM

ORISE will reference confirmatory measurement/sampling locations to the site's reference system. Other prominent site features may also be referenced. Measurement and sampling locations will be documented on detailed survey maps.

5.2 SURFACE SCANS

ORISE will use Ludlum Model 43-37 gas-flow proportional floor monitors coupled to Ludlum model 2221 rate-meter scalers to scan building floors to identify elevated alpha and/or beta radiation. These surveys are qualitative (scan MDCs are not calculated), but ORISE experience is that floor monitors are effective at, and efficient for, identifying low levels of surface contamination that can be quantitatively investigated using other hand-held instruments. For the SUs that have been specifically selected for confirmatory survey average surface activity determination, the scan coverage will be high density. Scan coverage will be lower density throughout the balance of the buildings and will focus on other judgmentally selected areas based on the potential for material accumulation, material pathways (such as ventilation access points or drain openings), and/or other indication of residual contamination. Ratemeter-scalers may be coupled to hand-held data loggers for electronically recording the count-rate data. Locations of elevated direct gamma radiation, as indicated by an increase in audible output from the ratemeter-scaler, will be marked for further investigation.

5.3 NUMBER AND LOCATION OF CONFIRMATORY MEASUREMENTS

The confirmatory measurement locations to determine the average concentration for a SU will be randomly selected. The number of measurements will be determined using Visual Sample Plan (VSP), version. 7.7a. ACO's final status survey data will be used as VSP inputs to determine the required number of measurements with a Type I decision error rate of 5%. Additional judgmental measurements will be collected from any locations identified during the surface scans where the release limits could be exceeded.

Ludlum Model 2221 ratemeter-scalers with audible output paired with Ludlum Model 43-68 gas proportional detectors (or equivalent) with a 0.8 mg/cm^2-thick Mylar window for alpha-only measurements and 3.8 mg/cm^2-thick Mylar window for beta-only measurements will be used for surface activity measurements. A weighted efficiency will be established assuming natural uranium abundances for alpha surface activity measurements. For planning purposes, weighted efficiencies for beta surface activity measurements will conservatively assume 10 percent enriched uranium (enriched in U-235 by weight). The beta weighted efficiencies may be modified to represent actual contamination conditions. Weighted efficiency calculation methods are presented in NUREG-1507 (NRC 1998), the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (NRC 2000), ORAU Survey Protocol C.21 ("Scan MDC Determination for Surface Activity") (ORAU 2016a), and site- and instrument-specific inputs will be used, as available.

Material-specific background measurements will be collected as necessary from non-impacted materials that are, to the extent possible, of similar construction to the target materials. These background measurements will be used for correcting gross measurement counts for the conversion to surface activity levels in units of dpm/100 cm^2. Example action levels presented in Table 5.1 have been back-calculated to estimate the net and gross detector response, in cpm, that corresponds to 5,000 dpm/100cm^2.

Table 5.1. Example Gas Proportional Action Levels						
Gross Activity	Typical Bkg (cpm)	Typical Total Eff.	Detector Area (cm^2)	Static MDC[a] (dpm/100 cm^2)	Action Level (cpm)	
					Net	Gross
Alpha only	2	0.11	126	69	693	695
Beta only	350	0.037	126	1,930	233	583

[a]Static MDC = $\frac{3+4.65\sqrt{Bkg}}{\varepsilon_t \times \frac{Probe\ Area}{100\ \text{cm}^2}}$

5.4 STRUCTURAL SURFACE REMOVABLE ACTIVITY MEASUREMENTS

Dry smear samples, for determining removable gross alpha/beta activity levels, will be collected from each direct measurement location. Smears will be returned to the Radiological and Environmental Analytical Laboratory in Oak Ridge, Tennessee, for analysis. Smears will be analyzed for removable gross alpha/beta activity using a low-background gas proportional counter. Smear data and direct measurements for surface activity will be converted to units of dpm/100 cm^2 for comparison against the removable limit. Table 5.2 presents radiation measurement capabilities for gross and nuclide-specific contaminants, as applicable.

Table 5.2. Example Instrument Specifications		
Gross Activity	MDC (dpm/100 cm^2)	Removable Surface Activity Limit (dpm/100 cm^2)
Gross alpha	12–14	1,000
Gross beta	12–14	1,000

MDC = minimum detectable concentration

6. REFERENCES

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