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1. PURPOSE

The Site Pre-Demolition Survey Plan for release of surfaces and structures incorporates guidance provided in final NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) The Pre-Demolition Survey Plan also incorporates residual surface contamination limits (total and removable) provided in DOE Order 5400.5 These limits or release criteria are based on net activity above background, due to licensed radioactive material

To determine whether a survey unit meets the stated release criteria, appropriate background values should be subtracted from the survey unit measurement data. If the background is insignificant by comparison to the limits it may be ignored. If the background is significant though, this procedure is used to quantify the background for use during the Pre-Demolition Survey.

The background values to be used for a given survey unit shall come from locations unaffected by radiological operations. In addition, background values should be obtained from locations that exhibit similar characteristics as the survey unit.

In order to justify the subtraction of background values from gross values, the background parameters must be well defined, collected via a controlled methodology and directly applicable to individual survey unit measurements. This procedure is intended to describe the process for determining background values.

2. SCOPE

This procedure applies to personnel who determine background reference areas, calculate the number of background data points, collect, document and evaluate background data for Pre Demolition Survey use.

This procedure addresses the following topics:

- Background reference area determination
- Calculation of data points
- Material selection
- Measurement/data acquisition
- Data validation and usability

The forms attached to this procedure are examples that are used in documenting survey/sampling information, however, equivalent forms may be used in lieu of the attached forms (i.e., appendices) as long as the information is equivalent to the minimum information required by the forms in this procedure.

This revision supersedes PRO-480-RSP-16 06, Revision 0 and associated forms.

3. OVERVIEW

This procedure establishes the requirements for background reference area selection criteria, material selection and the collection, analysis, documentation and use of background data for release of surfaces and structures. Background data will be collected using the same measurement techniques and instrumentation as data collected for Pre Demolition Survey. Background, as addressed in this procedure includes local area background and material background. The local area background (LAB) is the background counts seen by a detector that has a shield in place over the probe. Material background is the background seen when an unshielded detector probe is placed directly on a non-impacted surface containing naturally occurring radioactive material (NORM). The counts seen by the detector are due to the combination of NORM on the material surface and the LAB. Since alpha-emitting NORM is insignificant relative to the alpha Derived Concentration Guideline Level-Wilcoxon Rank Sum Test (DCGL_w) criteria, no material background subtraction will be required for alpha survey background determination. A conservative value of zero can be used for alpha material background determination resulting in the need to collect a LAB only for alpha. This procedure does not address laboratory instrument background applied to sample analysis results in accordance with site radiochemistry procedures.

Background values will be developed for total surface activity based on surface material type and building configuration. Background determination for exposure rates and removable activity will not be conducted as part of this procedure.

Background values will also be developed for media sampling and volumetric sampling on building materials such as paint, concrete, roofs, etc.

Background reference areas must be approved in accordance with this procedure. If necessary these areas may be onsite or offsite, however, in all cases the area must meet the criteria stated above.

4. DEFINITIONS

Background Radiation – Radiation from cosmic sources, naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material), and global fallout as it exists in the environment from the testing of nuclear explosive devices or from nuclear accidents like Chernobyl which contribute to background radiation and are not under the control of the cognizant organization. Background radiation does not include radiation from source, byproduct, or special nuclear materials regulated by the cognizant Federal or State agency.

Background Reference Area – Geographical area from which representative reference measurements are performed for comparison with measurements performed in specific survey units. A background reference area is defined as an area that has similar physical, chemical, radiological, and biological characteristics as the site area being remediated,

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but which has not been contaminated by site activities. The distribution and concentration of background radiation in the reference area should be the same as that which would be expected on the site if that site had never been contaminated.

DCGL (Derived Concentration Guideline Level) – A derived, radionuclide-specific activity concentration within a survey unit corresponding to the release criterion. The DCGL is based on the spatial distribution of the contaminant and hence is derived differently for the nonparametric statistical test (DCGL_w) and the Elevated Measurement Comparison (DCGL_{EMC}). DCGLs are derived from activity/dose relationships through various exposure pathway scenarios.

Decommission – To remove a facility or site safely from service and reduce residual radioactivity to a level that permits release of the property and termination of the license and other authorization for site operation.

Decommissioning – The process of removing a facility or site from operation, followed by decontamination, and license termination (or termination of authorization for operation) if appropriate. The objective of decommissioning is to reduce the residual radioactivity in structures, materials, soils, groundwater, and other media at the site so that the concentration of each radionuclide contaminant that contributes to residual radioactivity is indistinguishable from the background radiation concentration for that radionuclide.

Decontamination – The removal of radiological contaminants from, or their neutralization on, a person, object or area to within levels established by governing regulatory agencies. Decontamination is sometimes used interchangeably with remediation, remedial action, and cleanup.

Direct Measurement – Radioactivity measurement obtained by placing the detector near the surface or media being surveyed. An indication of the resulting radioactivity level is read out directly.

Final Status Survey – Measurements and sampling to describe the radiological conditions of a site, following completion of decontamination activities (if any) in preparation for release. (Synonymous with Pre Demolition Survey)

Indistinguishable from Background – The detectable concentration distribution of a radionuclide that is not statistically different from the background concentration distribution of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques.

Mean – The average value obtained when the sum of individual values is divided by the number of values.

Measurement – The act of using a detector to determine the level or quantity of radioactivity on a surface or in a sample of material removed from a media being evaluated, or the quantity obtained by the act of measuring

Minimum Detectable Concentration (MDC) – The a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. When stating the detection capability of an instrument, MDC should be used. The MDC is the detection limit, L_D , multiplied by an appropriate conversion factor to give units of activity.

Minimum Detectable Count Rate (MDCR) – The a priori count rate that a specific instrument and technique can be expected to detect.

n – Number of measurements from a survey unit used to conduct a statistical test

p – The probability that a random measurement from the survey unit is less than Δ , shift

P_r – The probability that a measurement performed at a random location in the survey unit is greater than a measurement performed at a random location in the reference area

Physical Probe Area – The physical surface area assessed by a detector. The physical probe area is used to make probe area corrections in the activity calculations.

Relative Shift (Δ/σ) – Δ , shift, divided by σ , standard deviation, of the measurements

Release Criterion – A regulatory limit expressed in terms of dose or risk

Removable Activity – Surface activity that is readily removable by wiping the surface with moderate pressure and can be assessed with standard radiation detectors. It is usually expressed in units of $\text{dpm}/100 \text{ cm}^2$

Residual Radioactivity – Radioactivity from activities under the cognizant organization's control. This includes radioactivity from all sources used, but excludes background radioactivity as specified by the applicable regulation or standard. It also includes radioactive materials remaining at the site as a result of routine or accidental releases of radioactive material and previous burials at the site.

Sample – A part or selection from a medium located in a background reference area that represents the quality or quantity of a given parameter or nature of the whole area or unit.

Scanning – An evaluation technique performed by moving a detection device over a surface at a specified speed and distance above the surface to detect radiation.

Surface Contamination – Residual radioactivity found on building or equipment surfaces and expressed in units of activity per surface area (Bq/m^2 or $\text{dpm}/100 \text{ cm}^2$)

Survey – A systematic evaluation of radiological measurements with correctly calibrated instrument(s) that meet the sensitivity required by the objective of the evaluation

Survey Unit – A geographical area consisting of structures or land areas of specified size and shape at a remediated site for which a separate decision will be made whether the unit attains the site-specific reference-based cleanup standard for the designated pollution parameter. Survey units are generally formed by grouping contiguous site areas with a similar use history and the same classification of contamination potential. Survey units are established to facilitate the survey process and the statistical analysis of survey data.

5. RESPONSIBILITIES

5.1 **Radiological Engineering Manager or Radiation Safety Manager**

Reviews and signs the Background Reference Area Package Cover Sheet (see Appendix 1) indicating that the package is ready for implementation

Reviews and signs the Background Reference Area Package Cover Sheet (see Appendix 1) indicating that the package is ready for closure

Assigns Radiological Engineering personnel to review Background Reference Area survey/sampling packages

5.2 **Radiological Engineer (RE)**

Selects background reference area similar to the surfaces and structures contained within associated survey unit(s)

Determines materials and locations to be evaluated for background determination

Prepares Background Reference Area survey/sampling packages

Determines the number of sample measurement locations for background determination

Signs the Background Reference Area Survey Package Cover Sheet (see Appendix 1) indicating that the package is ready for implementation

Monitors the performance of RCTs/samplers to ensure survey/sample criteria are met
Ensures that Background Reference Area survey/sampling packages are issued and tracked during collection of data

Approves technical corrections/changes to the Background Reference Area survey/sampling package

Reviews and signs the Background Reference Area Survey Package Cover Sheet (see Appendix 1) indicating that the package is ready for closure

Reviews and validates closed Background Reference Area survey/sampling packages

Performs data analysis of Background Reference Area survey results

Prepares Background Reference Area document

Updates the Survey Package Tracking Form (see PRO-475-RSP-16 01) upon survey/sampling package closure

5.3 Radiological Control Technician Technical Supervisor

Assigns Background Reference Area survey/sampling packages to Radiological Control Technicians (RCTs) for the performance of background determination

Reviews all Background Reference Area survey/sampling package survey forms for accuracy and completeness prior to technical evaluation of data

5.4 Radiological Control Technician/Sampler

Understands the instructions in the Background Reference Area survey/sampling package

Performs and documents surveys/samples in accordance with PRO-476-RSP-16 02, Pre-Demolition (Final Status) Radiological Surveys of Surfaces and Structures and PRO-477-RSP-16 03, Radiological Samples of Building Media

Provides initial review and signature of collected data

Provides complete, accurate and legible documentation

Ensures equipment and instrumentation are inspected, tested/calibrated and maintained properly prior to use

Notifies the Radiological Control Technician Technical Supervisor of any out-of-tolerance or suspect radiological condition

5.5 Procedure User

Understands, performs, and complies with the requirements of this procedure

6 PREREQUISITE ACTIONS

Procedure User

- [1] Ensure that the following is in-place prior to collecting background survey/sample data
- Survey instrumentation **SHALL** be calibrated and in working order
 - Survey/sample personnel **SHALL** be trained and qualified in the use of instrumentation
 - Survey/sample personnel **SHALL** be provided with survey/sampling instructions and a brief on the requirements of this procedure

7. INSTRUCTIONS

7.1 General

An estimate of background total surface activity, removable activity and media sample activity due to naturally occurring radionuclides in various building materials is required to support Site Pre Demolition Surveys. Measurements collected during Pre Demolition Surveys will be corrected to account for the background due to naturally occurring radionuclides in building materials such that final results reflect only activity due to radiological operations.

Measurement locations used to implement this procedure will be selected from buildings unaffected by radiological operations. The methods used to obtain measurements for background determination will be the same methods used to obtain Pre Demolition Survey measurements.

To demonstrate that the background in an area is not influenced by radiological operations, an in-situ gamma spectroscopy system may be used for qualitative analysis to verify the presence or absence of radionuclides. The presence of radionuclides associated with radiological operations identified by in-situ gamma spectroscopy should disqualify an area for determination of background.

Measurements for total surface activity and removable activity will be performed using the same instrumentation and methods described in PRO-476-RSP-16 02, Pre-Demolition (Final Status) Radiological Surveys of Surfaces and Structures. Removable activity measurements are taken to verify the absence/presence of removable activity. If removable activity is detected, the location/material may be disqualified as a background reference area or decontaminated prior to collecting subsequent measurements. Measurements for media sample activity will be performed using the same instrumentation and methods described in PRO-477-RSP-16 03, Radiological Samples of Building Media.

Background values will be established based on the data collected from this procedure and documented in Background Reference Area Survey Packages.

Due to the large amount of data to be recorded on survey/sampling package forms and the small space available, it is imperative to print neatly on all forms. If errors should occur, line through incorrect information with a single inked line that does not obliterate the error and initial and date the correction. Where applicable, data and information may be entered on survey/sampling package forms electronically.

A folder designated as the "Survey Package" should be used to keep original paperwork for each background reference area.

Initiated and implemented survey/sampling packages should be stored in a designated file cabinet when not in use (e.g. at shift change, over night, during holidays and weekends, etc.)

7.2 Background Reference Area Design

RE

[1] Record the below information on Background Reference Area Design Form (see Appendix 2)

- Location – Criteria for selecting building locations include similar geological, physical, chemical, and radiological characteristics to the location where Pre Demolition Survey is being conducted. Specifics include
 - Similar material type
 - Date of construction
 - Similar use history
 - No history of radiological operations
 - No impact due to radiological operations
- Material – The material selected for determination of background values **should** include, but is not limited to the following
 - Concrete
 - Wood
 - Metal
 - Brick
 - Cinder Block
 - Roofing Materials
 - Asphalt
 - Ceramic Tile
 - Carpet
 - Vinyl Flooring
 - Dry Wall
- Survey/Sample Type – The survey/sample selected for determination of background values **should** include, but is not limited to the following
 - Total Surface Activity (α and/or β/γ)
 - Removable Activity (α and/or β/γ)
 - Media Samples
 - Volumetric Samples
 - Gamma Spectroscopy
 - Alpha Spectroscopy
- Justification – The reason for selecting a Background Reference Area is documented here

7.3 Determining Number of Survey/Sample Points

RE

[1] Record the below information on Background Reference Area Calculation Data Sheet (see Appendix 3)

- Location
- Material
- Description

[2] To calculate the number of Sample/Survey Points, perform the following

- Calculate the Relative Shift, $\Delta/\sigma_s = (DCGL-LBGR)/\sigma_s$

The value of σ_s may be obtained from earlier surveys or a reasonable estimate in accordance with MARRSIM Section 5 5 2 2

- Determine Sign p using the calculated relative shift and Table 1
- Determine Decision Error Percentiles for $Z_{1-\alpha}$ and $Z_{1-\beta}$

Typical (α) and (β) values used at RFETS are 0 05 and 0 05 respectively
This yields a $Z_{1-\alpha}$ and $Z_{1-\beta}$ value of 1 645 and 1 645 respectively

Table 1.
Values of Sign p for Given Values of the Relative Shift, Δ/σ

Δ/σ	Sign p	Δ/σ	Sign p
0 1	0 539828	1 2	0 884930
0 2	0 579260	1 3	0 903199
0 3	0 617911	1 4	0 919243
0 4	0 655422	1 5	0 933193
0 5	0 691462	1 6	0 945201
0 6	0 725747	1 7	0 955435
0 7	0 758036	1 8	0 964070
0 8	0 788145	1 9	0 971284
0 9	0 815940	2 0	0 977250
1 0	0 841345	2 5	0 993790
1 1	0 864334	3 0	0 998650

If $\Delta/\sigma > 3 0$, use Sign p = 1 000000

- Calculate Number of Data Points (N) for Sign p test using the following equation

$$N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(\text{Sign } p - 0.5)^2}$$

- Increase the number of data points by 20% to ensure sufficient power of the tests and to allow for possible data losses
- [3] Record calculation on Background Reference Area Calculation Data Sheet (see Appendix 3)

7.4 Determining Survey/Sample Locations

RE

- [1] Input computer-generated maps (i.e., MS Word, MS Excel, MS Powerpoint, GIS, etc.) on Background Reference Area Survey Map (see Appendix 4)

Also enter the following information on Background Reference Area Survey Map (see Appendix 4)

- Location
 - Material
 - Description
 - Floor Area (m²)
 - Total Area (m²)
- [2] Prepare a scale drawing of the survey unit with an overlying grid system on Background Reference Area Survey Map (see Appendix 4)
- [3] Generate a random starting point
- [4] Locate desired number of data points using random numbers
- [5] **IF** identified points fall outside the survey unit or locations cannot be surveyed, **THEN** additional points are determined using the random process until the desired total number of points is identified

7 5 Background Reference Area Survey/Sample Package Preparation

RE

- [1] Enter the following information on Background Reference Area Survey Package Cover Sheet (see Appendix 1)
- Package I D
 - Location
 - Description
 - Special Support Requirements
 - Special Safety Requirements
 - Isolation Controls
- [2] Enter the following information on Background Reference Area Survey/Sampling Instructions (see Appendix 5)
- Location
 - Description
 - Material
 - Number – For each measurement, enter the number of required measurements
 - Comments – Provide information pertinent to the person performing the survey or collecting the samples
 - Survey/Sampling Instructions – Provide explicit step by step instructions to RCTs and Samplers to meet the requirements of this procedure
- [3] *Ensure the following forms have been prepared in accordance PRO-476-RSP-16 02, Pre-Demolition (Final Status) Radiological Surveys of Surfaces and Structures prior to implementation of the Background Reference Area Survey/Sampling Package*
- Total Surface Activity Data Sheet (see PRO-476-RSP-16 02)
 - Removable Activity Data Sheet (see PRO-476-RSP-16 02)

7.6 Background Reference Area Survey/Sample Package Release

NOTE *The order of the survey package review and approval by the RE Manager or Radiation Safety Manager (RSM) may be altered as necessary to simplify or expedite the process*

RE

- [1] **WHEN** the preparation of the survey package forms has been completed, **THEN** assemble the survey package ensuring that it contains the minimum documentation in the following order
- Background Reference Area Survey Package Cover Sheet (see Appendix 1)
 - Background Reference Area Design Form (see Appendix 2)
 - Background Reference Area Survey/Sampling Instructions (see Appendix 5)
 - Total Surface Activity Data Sheet (see PRO-476-RSP-16 02)
 - Removable Activity Data Sheet (see PRO-476-RSP-16 02)
 - Background Reference Area Calculation Data Sheet (see Appendix 3)
 - Background Reference Area Survey Map (see Appendix 4)
- [2] Print name, employee number, sign and date the Background Reference Area Survey Package Cover Sheet (see Appendix 1) indicating the survey package is ready for implementation
- [3] Forward the survey package to the RE Manager or Radiation Safety Manager (RSM) for review and approval

RE Manager or RSM

- [4] Review the survey package prior to implementation and verify that all survey package information is complete and correct
- [5] After completion of review, print name, employee number, sign and date the Background Reference Area Survey Package Cover Sheet (see Appendix 1) indicating the survey package is ready for implementation
- [6] Forward the survey package to the RE

7.7 Background Reference Area Survey/Sample Package Implementation

RE

- [1] Prior to implementing a survey package, interface with facility personnel, to ensure that special support requirements and safety precautions are in place
- [2] Before issuing a survey package inspect the area and verify that special support requirements and safety precautions are in place

- [3] **IF** the area is not ready for the performance of a survey,
THEN notify the appropriate authority to commence corrective actions
- [4] Assign survey packages to RCTs to perform Background Reference Area surveys in accordance with PRO-476-RSP-16 02, Pre-Demolition (Final Status) Radiological Surveys of Surfaces and Structures, and PRO-477-RSP-16 03, Radiological Samples of Building Media

7.8 Survey Data Review

RCT

- [1] Complete all survey forms in accordance with PRO-476-RSP-16 02, Pre-Demolition (Final Status) Radiological Surveys of Surfaces and Structures, and PRO-477-RSP-16 03, Radiological Samples of Building Media
- [2] Forward the survey package to the Radiological Control Technician Technical Supervisor

Radiological Control Technician Technical Supervisor

- [3] Review all documentation for completion and ensure all surveys and samples are accounted for
- [4] Forward the survey package to the Radiological Engineer

7.9 Radiochemistry Sample Results

NOTE *Radiochemistry data packages received through Analytical Services Division (ASD) are subjected to an independent assessment to determine data quality. Data quality assessments are performed in accordance with ASD Data Verification & Validation Guidelines (DA-GR01-VI)*

RE

- [1] Include the radiochemistry sample results in the survey package for data analysis

7.10 Determination of Total Surface Activity in Building Materials

Total Surface Activity background measurements are collected and documented in accordance with PRO-476-RSP-16 02, Pre-Demolition (Final Status) Radiological Surveys of Surfaces and Structures

7.11 Determination of Media Sample Activity in Building Materials

Media Sample background measurements are collected and documented in accordance with PRO-477-RSP-16 03, Radiological Samples of Building Media

7.12 Statistical Analysis of Background Measurements

RE

[1] For each set of measurements collected, calculate the following on Background Reference Area Statistics Data Sheet (see Appendix 6)

- The mean in accordance with the following equation

$$\bar{x} = \frac{\sum x_i}{N}$$

where

\bar{x} = mean value of the measurements
 x_i = individual measurement result
 N = number of measurements

- The standard deviation in accordance with the following equation

$$s_x = \sqrt{\frac{\sum (x_i - \bar{x})^2}{N - 1}}$$

where

s_x = standard deviation of the measurement results
 \bar{x} = mean value of the measurements
 x_i = individual measurement result
 N = number of measurements

[2] After statistics are performed on raw data, the activity due to naturally occurring radioactivity may be subtracted from Pre Demolition Survey measurements such that survey results reflect only radioactivity due to radiological operations

8. POST-PERFORMANCE ACTIVITY

NOTE *The following steps pertain to final validation and closure of the Background Reference Area Survey/Sample Package*

RE

- [1] Forward the completed survey package to the designated reviewer for final validation and closure

RE (Peer Review)

- [2] Verify that all data satisfies final status survey acceptance criteria in PRO-478-RSP-16 04, Radiological Survey/Sample Data Quality Analysis for Final Status Survey and quality assurance requirements of MARSSIM
- [3] Print name, employee number, sign and date the Background Reference Area Survey Package Cover Sheet (see Appendix 1) indicating the survey package is ready for closure
- [4] Forward the survey package to the RE Manager or Radiation Safety Manager (RSM)

RE Manager or RSM

- [5] Verify that all data is satisfactory, print name, employee number, sign and date the Background Reference Area Survey Package Cover Sheet (see Appendix 1) indicating the survey package is ready for closure
- [6] Forward the completed survey package to the Radiological Engineer

RE

- [7] Ensure that the closed survey package contains the minimum documentation in the following order
 - 1 Background Reference Area Survey Package Cover Sheet (see Appendix 1)
 - 2 Background Reference Area Design Form (see Appendix 2)
 - 3 Background Reference Area Survey/Sampling Instructions (see Appendix 5)
 - 4 Total Surface Activity Data Sheet (see PRO-476-RSP-16 02)
 - 5 Removable Activity Data Sheet (see PRO-476-RSP-16 02)
 - 6 Background Reference Area Calculation Data Sheet (see Appendix 3)
 - 7 Background Reference Area Survey Map (See Appendix 4)
- [8] Store the closed survey package with Project Record files

9. RECORD PROCESSING INSTRUCTIONS

The following records generated as a result of this procedure should be maintained and processed as given in the table below

Record Identification	Record Type	Protection/Storage	Processing Instructions
<p>In process Appendix 1, Background Reference Area Survey Package Cover Sheet, or equivalent</p> <p>Appendix 2, Background Reference Area Design Form, or equivalent</p> <p>Appendix 3, Background Reference Area Calculation Data Sheet, or equivalent</p> <p>Appendix 4, Background Reference Area Survey Map, or equivalent</p> <p>Appendix 5, Background Reference Area Survey/Sampling Instructions, or equivalent</p> <p>Appendix 6, Background Reference Area Statistics Data Sheet, or equivalent</p> <p>And other <u>supporting documents</u>¹</p>	<p>In process QA Record</p>	<p>Responsible Manager SHALL implement a reasonable level of protection for in-process QA records to prevent loss or degradation Records SHALL be stored in standard office filing systems</p>	<p>Continued prescribed processing of documents Upon completion of processing, approval and authentication records WILL be transmitted to appropriate Records Center (e g , Project Records) in accordance with 1-V41-RM-001, Records Management Guidance for Records Sources</p>
<p>Completed Same as forms above</p>	<p>Completed QA Record</p>	<p>Responsible Manager SHALL implement a reasonable level of protection for QA records to prevent loss or degradation in conjunction with Site Records Management organization to assure reasonable level of controls are being implemented</p>	<p>When inactive, as defined in 1-V41-RM-001, Records Management Guidance for Records Sources, transfer to Site Records Management for archiving in accordance with 1-V41-RM-001</p>

¹ Supporting documents such as the forms generated as result of performing RSP-16 02 and RSP-16 03 as applicable

10. REFERENCES

The following documents are either directly referenced or used in the development of this procedure

ASD Data Verification & Validation Guidelines (DA-GR01-V1)

Decommissioning Program Plan

DOE Order 5400 5, Radiation Protection of the Public and the Environment

MAN-077-DDCP, Decontamination and Decommissioning Characterization Protocol

MAN-127-PDSP, Pre-Demolition Survey Plan (also referred to as Site PDSP)

NRC Reg Guide 1 86, Termination of Operating Licenses for Nuclear Reactors

NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)

PRO-475-RSP-16 01, Radiological Survey/Sampling Package Design, Preparation Control, Implementation and Closure

PRO-476-RSP-16 02, Pre-Demolition (Final Status) Radiological Surveys of Surfaces and Structures

PRO-477-RSP-16 03, Radiological Samples of Building Media

PRO-478-RSP-16 04, Radiological Survey/Sample Data Quality Analysis for Final Status Survey

Rocky Flats Cleanup Agreement (RFCA)

1-V41-RM-001, Records Management Guidance for Records Sources

3-PRO-165-RSP-07 02, Contamination Monitoring Requirements

APPENDIX 1
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BACKGROUND REFERENCE AREA SURVEY PACKAGE COVER SHEET

Package ID			
Location			
Description			
Special Support Requirements			
Special Safety Requirements			
Isolation Controls			
Survey Package Implementation			
EXAMPLE			
<i>Radiological Engineer Printed Name</i>	<i>Employee #</i>	<i>Radiological Engineer Signature</i>	<i>Date</i>
<i>Radiological Engineer Printed Name</i>	<i>Employee #</i>	<i>Radiological Engineer Signature</i>	<i>Date</i>
<i>RE Manager or RSM Printed Name</i>	<i>Employee #</i>	<i>RE Manager or RSM Signature</i>	<i>Date</i>
Survey Package Closure			
<i>Radiological Engineer Printed Name</i>	<i>Employee #</i>	<i>Radiological Engineer Signature</i>	<i>Date</i>
<i>Radiological Engineer Printed Name</i>	<i>Employee #</i>	<i>Radiological Engineer Signature</i>	<i>Date</i>
<i>RE Manager or RSM Printed Name</i>	<i>Employee #</i>	<i>RE Manager or RSM Signature</i>	<i>Date</i>

APPENDIX 2

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BACKGROUND REFERENCE AREA DESIGN FORM

Location
Material: <p style="text-align: center;">EXAMPLE</p>
Survey/Sample Type:
Justification

APPENDIX 3
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BACKGROUND REFERENCE AREA CALCULATION DATA SHEET

Location
Material
Description
Number of Survey/Sample Points
<p>Step 1 Calculate the relative shift Δ/σ_s $\Delta/\sigma_s = (DCGL-LBGR)/\sigma_s$ $\Delta/\sigma_s =$</p> <p>where Δ/σ_s DCGL LBGR σ_s</p> <p style="text-align: center; font-size: 48pt; font-weight: bold;">EXAMPLE</p>
<p>Step 2 Determine Sign p using the calculated relative shift and Table 1 Sign p is the estimated probability that a random measurement from the survey unit will be less than the $DCGL_w$ when the survey unit median is actually at the LBGR</p>
<p>Step 3 Determine Decision Error Percentiles for $Z_{1-\alpha}$ and $Z_{1-\beta}$ and the selected decision error levels α and β Typical (α) and (β) values used at RFETS are 0.05 and 0.05 respectively This yields a $Z_{1-\alpha}$ and $Z_{1-\beta}$ value of 1.645 and 1.645 respectively</p>
<p>Step 4 Calculate Number of Data Points (N) for Sign Test using the following equation</p> $N = \frac{(Z_{1-\alpha} + Z_{1-\beta})^2}{4(\text{Sign } p - 0.5)^2}$
<p>Step 5 Increase the number of data points by 20% to ensure sufficient power of the tests and to allow for possible data losses</p>
Conclusion

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APPENDIX 4

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BACKGROUND REFERENCE AREA SURVEY MAP

Location	
Material	
Description	
Floor Area (m ²)	Total Area (m ²)
<h1>EXAMPLE</h1>	

APPENDIX 5
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BACKGROUND REFERENCE AREA SURVEY/SAMPLING INSTRUCTIONS

Location		
Material		
Description.		
Survey/Sampling Measurement Requirements		
Measurement	Number	Comments
Total Surface Activity		
Removable Activity		
Media/Volumetric Samples		
Isotopic Gamma Scans		
Survey/Sampling Instructions		
<h1>EXAMPLE</h1>		

APPENDIX 6

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BACKGROUND REFERENCE AREA STATISTICAL DATA SHEET

Sample Mean:

$$\sum x_i =$$
$$N =$$
$$\bar{x} = \frac{\sum x_i}{N}$$
$$\bar{x} =$$

EXAMPLE

Sample Standard Deviation:

$$\sum (x_i - \bar{x})^2 =$$
$$N =$$
$$s_x = \sqrt{\frac{\sum (x_i - \bar{x})^2}{N-1}}$$
$$s_x =$$

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