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# Closeout Radiological Survey Report For Building 729

Rocky Mountain Remediation Services, L.L.C.

Millennium Services Inc.

Revision 0

April 1999

Volume 1

**CLOSEOUT RADIOLOGICAL SURVEY REPORT  
FOR BUILDING 729**

**REVISION 0**

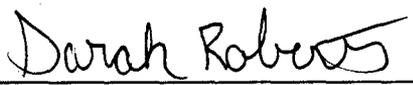
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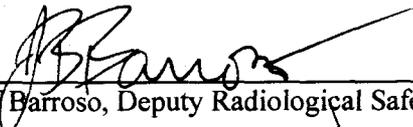
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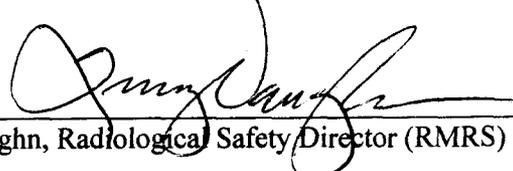
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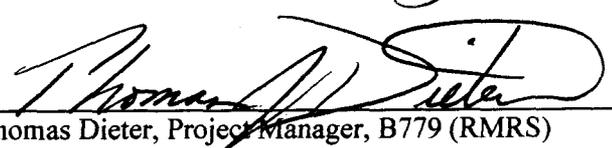
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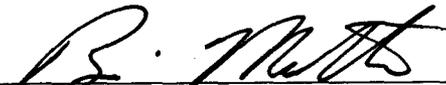
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## Acronyms

|                     |   |
|---------------------|---|
| CPM                 | Counts Per Minute   |
| CRSP                | Closeout Radiological Survey Plan                                       |
| D&D                 | Decontamination and Decommissioning                                     |
| DCGL <sub>w</sub>   | Derived Concentration Guideline Level – Wilcoxon Rank Sum test          |
| DCGL <sub>EMC</sub> | Derived Concentration Guideline Level – Elevated Measurement Comparison |
| DOE                 | U.S. Department of Energy   |
| DPM                 | Disintegration Per Minute   |
| DQA                 | Data Quality Assessment   |
| DQO                 | Data Quality Objectives   |
| FSS                 | Final Status Survey   |
| FSSP                | Final Status Survey Plan  |
| FSSR                | Final Status Survey Report  |
| HSA                 | Historical Site Assessment  |
| LBGR                | Lower Bound or the Gray Region  |
| MARSSIM             | Multi-Agency Radiation Survey and Site Investigation Manual             |
| MDA                 | Minimum Detectable Activity   |
| MDC                 | Minimum Detectable Concentration  |
| NIST                | National Institute of Standards & Technology                            |
| NORM                | Naturally Occurring Radioactive Material                                |
| PRE                 | Project Radiological Engineer   |
| PSPC                | Position Sensitive Proportional Counter                                 |
| QA                  | Quality Assurance   |
| QA/QC               | Quality Assurance/Quality Control                                       |
| QC                  | Quality Control   |
| RCT                 | Radiological Control Technician   |
| RE                  | Radiological Engineer   |
| REFS                | Radiological Engineering Field Services                                 |
| RESS                | Radiological Engineering Support Services                               |
| RFETS               | Rocky Flats Environmental Technology Site                               |
| SCM/SIMS            | Surface Contamination Monitor/Survey Information Management System      |
| SRA                 | Shonka Research Associates  |
| TSA (TSC)           | Total Surface Activity (or Total Surface Contamination)                 |
| V&V                 | Verification and Validation   |

## Abstract

Building 729 is a former support building to Building 779, a research facility involved in the handling of transuranic materials. Building 729 contained air filtration systems, and emergency power generator. Building 729 is connected to Building 779 by a bridge that contained a ventilation duct leading to the filter plenum. Three survey units were established in Building 729:

- 72901 – Plenum room, stairwell, and bridge (Class 2)
- 72902 – Diesel generator room, control room, hallway (and airlock) and lavatory (Class 3)
- 72903 – Exterior walls and roof (Class 2)

Surface contamination measurements, paint/surface media samples and removable contamination surveys were performed in each survey unit. The number of samples and removable/total surface contamination surveys taken in each area was determined using the MARSSIM statistical approach. Random and systematic locations were established for samples and removable/total surface contamination surveys. Surface scans were performed at the density of:

- Class 2 – 100% floors and wall up to 2 meters, 10% of area above 2 meters (per the Closeout Radiological Survey Plan for the 779 Cluster, the percentage was based on findings on floor and lower walls)
- Class 3 – 10% of surface area

Results of all paint/surface media samples and removable/total surface contamination surveys were all below the Derived Concentration Guideline Levels (DCGLs) established in the survey plan. In Survey Unit 72901, initial surface contamination characterization surveys identified small areas of radioactivity near or above the  $DCGL_{EMC}$  (300 dpm/100  $cm^2$ ) on the pedestal around the west pit in the plenum room, on the west end of the southwest pedestal, and on the floor and walls of the west pit. All areas were remediated prior to performing final surveys.

The galvanized roof flashing was also found to indicate elevated total activity. Sample coupons were obtained and sent to an on-site laboratory for gross alpha spectroscopy analysis. The analysis identified Polonium-210 (Po-210), a naturally occurring isotope in the uranium – radon decay chain. No transuranic isotopes or uranium isotopes were detected. However, for conservatism, the DCGLs associated with uranium were applied, with all values falling below the applicable DCGL.



**Figure 1 - Exterior of Building 729**

Survey Unit 72901, which constitutes the main plenum room, the stairwell and the bridge area, is an Impacted Class 2 Area. Impacted Class 2 Areas are areas that have or had a potential for radioactive contamination or known contamination, but are not expected to exceed the applicable contamination DCGLs. Scan surveys in Class 2 areas were performed such that 100% of the floor and walls up to 2 meters and a minimum of 10% of the area above 2 meters were surveyed. The main plenum room also contained a number of pedestals ranging from 2" to 4" above the slab, and 2 sumps. Edges of the pedestals and the walls and floors of the sumps were included in the 100% survey. All areas of the stairwell leading to the bridge area were surveyed at the density of 100% up to 2 meters, and 10% of the areas above 2 meters. Paint/Surface media samples and removable/total surface contamination surveys were obtained at systematic locations within the plenum room and bridge area. Samples and surveys were obtained in accordance with Survey Package 72901 (refer to Volume 3, Attachment H, Survey Unit 72901 Survey Package).

Survey Unit 72902, which constitutes the diesel generator room, the control room, the entrance hallway (including an airlock), and the lavatory, is an Impacted Class 3 Area. Class 3 Areas are not expected to contain residual contamination or activity at a small fraction of the applicable DCGL<sub>WS</sub>, based on knowledge of building history and previous survey information. However, insufficient documentation is present to exclude the area from survey requirements. Surface Contamination scans in Class 3 Areas included 10% of the total survey unit surface area. Paint/Surface media samples and removable/total surface contamination surveys were obtained at random locations. Samples and surveys were obtained in accordance with Survey Package 72902 (refer to Volume 3, Attachment I, Survey Unit 72902 Survey Package).

Survey Unit 72903, which is comprised of the surfaces exterior to building 729, is an Impacted Class 2 Area, thus 100% surface contamination scans were performed up to 2 meters. 10% of the surfaces above 2 meters, including the exterior surfaces of the connecting bridge between 779 and 729 was scanned. Scans of the exterior walls were performed to a level of 180 cm above the concrete footer. 100% of the concrete footer was also scanned. The height of the footer ranges from 20 cm on the west end to 65 cm above grade on the east end of building 729. Paint/Surface media samples and removable/total contamination surveys were also obtained at systematic locations on the external surfaces of the building. Samples and surveys were obtained in accordance with Survey Package 72903 (refer to Volume 3, Attachment J, Survey Unit 72903 Survey Package).

## **Scope of Work**

### **1.2.1 Paint/Surface Media Samples**

Paint/surface media samples were obtained to ensure contamination above the Building 729 DCGLs did not exist below painted surfaces or other forms of surface media such as roofing material, floor adhesive, or within the paint or roofing/adhesive material itself. Due to the fact that there was no evidence (as discovered during the historical site assessment, characterization, and final status surveys) that contamination had migrated into cinder block, concrete, or any other base material and disappeared from the surface, total surface activity measurements and surface media sampling were utilized as the detection methods for any contamination that occurred on building surfaces, and no volumetric samples were collected.

The sample collection method for coated surfaces (paint or adhesive) involved the collection of cover material to a depth where the underlying base material was exposed. For roofs, samples of all layers of base tar material under the ballast layer were collected.

The quantity of samples was determined based on MARSSIM statistical calculations to satisfy Impacted Class 2 and Impacted Class 3 survey requirements. The calculation methodology for the number of media samples is presented in the Closeout Radiological Survey Plan for the 779 Cluster (section 5.2.6.2). Based on the calculations, 15 paint/surface media samples were required for each survey unit. Calculations to determine the minimum number of media samples are included in the survey packages (Volume 3, Attachments H, I, and J).

Instrument calibration, maintenance, source check requirements, as well as data reduction and MDC equations are controlled per applicable Analytical Services Division procedures.

### **1.2.2 Removable Surface Contamination**

Removable surface contamination surveys were obtained to ensure removable contamination did not exist above the Building 779 DCGLs. The quantity of removable contamination measurements was determined based on MARSSIM statistical calculations as presented in the Closeout Radiological Survey Plan for the 779 Cluster (Section 5.2.6.2). Based on calculations, 17 removable contamination measurements were required for each survey unit. Calculations to determine the minimum quantity of removable contamination measurements are included in the survey packages (Vol. 3, Attachments H, I, & J).

Smears were counted on a Tennelec or SAC-4. Instrument calibration, maintenance, source check requirements, as well as data reduction and MDC equations are provided in 3-PRO-112-RSP-02.01, Revision 1, "Radiological Instrumentation".

### 1.2.3 Total Surface Activity

The SCM/SIMS system was credited only for the scan surveys obtained in order to prove compliance with the applicable  $DCGL_{EMC}$ . The SCM/SIMS system data is not applicable to the  $DCGL_W$ . In addition, investigations were not performed at 75% of the  $DCGL_W$ , based on SCM/SIMS data.

Total surface activity surveys were obtained to ensure total activity did not exist above the Building 779 DCGLs. The number of total surface activity surveys was also determined based on MARSSIM statistical calculations as presented in the Closeout Radiological Survey Plan for the 779 Cluster (Section 5.2.6.2). Based on the calculations, 15 total surface activity measurements were required for each survey unit. Calculations to determine the minimum number of total surface activity measurements are included in the survey packages (Volume 3, Attachments H, I, and J).

The surveys were performed with a NE Electra. The survey count time was one-minute. Local area background determinations are discussed in section 3.0. Instrument calibration, maintenance, source check requirements, as well as data reduction and MDC equations are provided in 3-PRO-112-RSP-02.01, Rev 1, "Radiological Instrumentation".

### 1.2.4 Surface Scan Surveys

Surface scan surveys were conducted using the Surface Contamination Monitor/Survey Information Management System (SCM/SIMS) developed by Shonka Research Associates, Inc. (SRA). The system consists of a position sensitive proportional counter (PSPC) coupled to a computerized data acquisition system. The PSPC is a long detector that acts as an array of many small radiation detectors. This allows the instrument to measure more area per unit time than a smaller detector and still separate out localized areas of contamination. The PSPC is mounted to a motor driven cart. The drive motor provides speed control for the unit, and a precision wheel encoder, affixed to the cart, provides travel distance input to the computer. Counts are accumulated in each 5 cm. channel every 5 cm. travel by the system. The result is data retained in 5 cm. x 5 cm. ( $25 \text{ cm}^2$ ) pixels, available for analysis and presentation via the SIMS software. Surveys were conducted at a speed of 2.5 cm/sec (approximately 1 inch/sec.). A recount detector was employed for all surveys performed with the cart-mounted detectors. Recount detectors perform a second survey of the area surveyed by the primary detector. The main purpose of the recount detector is to reduce the number of false positive results due to the low  $DCGL_W$  for alpha emitting isotopes, and the low and variable background. A few background counts occurring in a small area can result in an indication of elevated activity. The probability of background affecting both the primary and the recount detector is greatly reduced, thus reducing the need to perform verification surveys.

Detector surface areas were  $700 \text{ cm}^2$  and  $1800 \text{ cm}^2$ . Choice of detector was based on the floor space available and the interferences in the area. To complete surveys in areas that were not accessible with the standard cart mounted detectors, corner detectors were

employed. The corner detector is a similar PSPC used in a static count mode with data binned in 5 cm. increments. The corner detector accumulates data for eight seconds. The longer count time eliminated the need for recount. The output of the corner detector was formatted to allow integration into the SIMS software to complete the survey data for a survey area.

Wall surveys were performed by mounting the detectors vertically to the side of the SCM cart. All other aspects of the survey were consistent with floor monitoring. The drive wheel maintained speed control, and position sensitivity was established through the wheel encoder and the height above grade as identified by the PSPC.

Surveys were conducted in accordance with equipment operation and calibration procedures developed by SRA and incorporated in the Millennium Services, Inc. Quality Assurance Plan. Detector efficiencies were determined with a NIST traceable Plutonium-238 source with an active area of approximately 50 cm<sup>2</sup> and an alpha energy of 5.5 Mev. The energy of the source is similar to the 5.1 Mev of Plutonium-239, the principle isotope of the primary suspected contaminant. Periodic Quality Control checks were performed for each detector in use, and used to establish the efficiency for the detectors based on data that spanned the use of that detector during the survey (See section 4). All quality control checks were performed under the same operating and environmental conditions as the surveys.

MARSSIM calculations for the total number of measurements per survey unit were performed, and Electra measurements were obtained at the specified survey density to achieve compliance with the applicable DCGL<sub>w</sub> for total surface contamination. The SCM/SIMS system data is not applicable to the DCGL<sub>w</sub>. The use of the SCM/SIMS system for total surface activity measurements in order to ensure compliance with the DCGL<sub>w</sub> for the remaining buildings in the 779 Cluster is pending final approval by Kaiser Hill.

## 2.0 DCGLs

The surface contamination criteria from DOE Order 5400.5 were used as the DCGLs for the final survey. The applicable transuranic DCGL<sub>w</sub> for removable contamination, and total surface activity measured by direct surface emission are as follows:

| Removable Alpha            | DCGL <sub>w</sub> Total Alpha | DCGL <sub>EMC</sub> Total Alpha |
|----------------------------|-------------------------------|---------------------------------|
| 20 dpm/100 cm <sup>2</sup> | 100 dpm/100 cm <sup>2</sup>   | 300 dpm/100 cm <sup>2</sup>     |

The applicable transuranic DCGL<sub>w</sub> for paint/solid media samples is 100 dpm/100 cm<sup>2</sup>.

The applicable uranium DCGL<sub>w</sub> for paint/solid media samples and total surface activity attributable to uranium, and verified by isotopic analysis is 5000 dpm/100 cm<sup>2</sup>.

### 3.0 Background

Final radiological surveys of building 729 were focussed on alpha emitting isotopes, principally Plutonium-239, and Plutonium-240. Natural activity present in construction materials was not expected to contribute a significant amount to the field measurements. Historical data from other RFETS building indicates that surface emission rates from concrete, typically the material containing the highest quantities of naturally-occurring alpha-emitting isotopes, would have contributed a range of 10 to 20 dpm/100 cm<sup>2</sup> on an average. Therefore, surface scan measurements evaluated the gross activity values against the DCGL's defined in section 2.0. This approach resulted in a conservative evaluation of potential contamination due to previous operations associated with building 729.

Instrument background was considered as the only source of counts to the SCM during surface scan surveys. Inherent instrument background determination is discussed in Appendix 4. The instrument background for a 180 cm. x 10 cm. detector was determined to be 12.2 counts per minute (cpm), which resulted in a 100cm<sup>2</sup> area background of 0.677 cpm. The instrument background for a 90 cm. x 10-cm. detector was determined to be 8.0 cpm, which resulted in a 100 cm<sup>2</sup> area background was 0.941 cpm. These low values indicated that the instrument background did not impact the SCM ability to detect low activity levels. Instrument sensitivity is discussed in Appendix 4.

For total surface activity data collected with the NE Electra, an average one-minute local area background was determined and subtracted from total surface activity measurements to obtain net total surface activity results.

Paint/Surface media samples were analyzed by alpha spectroscopy methods. Individual isotopic data is contained in Volume 3, Attachments H-J. Transuranic isotopes are not present in natural radioactivity, therefore no background concerns exist. Uranium isotopes, though present in nature, are not expected to exist in significant quantities in paint /surface media samples. As in surface activity measurements, total reported activity from paint/surface media sample analyses was evaluated against the applicable uranium or transuranic DCGL<sub>w</sub> defined in Section 2.0.

Other than instrument background, which is quantified prior to analysis, background is not a factor during performance of removable contamination surveys. Reported values from the removable contamination surveys were evaluated against the applicable DCGL defined in section 2.0.

### 4.0 Quality Assurance/Quality Control

Quality control for each type of instrument utilized in the Building 729 survey is discussed in the sections below. As recommended by MARSSIM, a data quality assessment (DQA) was also performed and documented (refer to Appendix 4).

## 4.1 Scan Surveys

Quality control surveys for scans were performed with a NIST traceable Plutonium-238 source with an activity of 194400 dpm, which was obtained from the source storage area at RFETS. The source, RFETS ID# RS3911, Manufacturer's ID ER716, is a 71 mm x 71 mm (approximately 50 cm<sup>2</sup>) plated source. The source manufacturer's certificate is included in Volume 3, Attachment E, Source Certificate-NIST Traceability. Quality control surveys consisted of a minimum of three measurements of the source by the detector in the configuration used in the actual survey. SCM quality control surveys were performed with the source on the floor or wall and the detector assembly moving at the appropriate survey speed (i.e., 2.5 cm/sec). Corner detector quality control surveys consisted of measurements of the source placed on a surface and the data acquisition set for the survey time (i.e., 8 seconds).

A quality control survey was performed at the beginning and end of each detector use each day and periodically during the surveys. The response of the detector over the duration of its use became the basis for the detector's efficiency. Additionally, each survey was evaluated to ensure that it was bracketed by acceptable quality control surveys. When a quality control survey value was within 20% of the mean of all quality control surveys for each specific detector, the detector results were considered valid.

Source checks were conducted daily prior to start of survey, whenever the detector configuration is changed, and whenever any other electronic adjustments or maintenance was performed. The mean of the valid quality control surveys, determined from all acceptable results over the duration of the survey, is used to establish the efficiency for a specific detector. Appendix 2 includes the quality control charts for all detectors used during the survey.

## 4.2 Total Surface Activity Surveys

An additional 5% of total surface activity measurements were obtained for quality control purposes (refer to Volume 3, Attachments H-J). The results from these measurements were compared to the applicable DCGL<sub>w</sub> to ensure survey compliance (i.e., all QC measurements were less than DCGL<sub>w</sub>). All QC measurements were less than DCGL<sub>w</sub> (see Volume 2, Attachments A, B, and C).

## 4.3 Removable Surface Contamination

The instruments utilized for removable surface contamination analysis (Eberline SAC-4 and Oxford Tennelec) were calibrated with NIST-traceable sources. A daily background and QC check was also performed. All background and QC checks were valid.

## 4.4 Paint/Surface Media Samples

Quality control for media samples was performed per the applicable laboratory procedures. Measures of laboratory precision and accuracy were assessed per applicable laboratory procedures. All results indicated that sample results were valid (see Volume 3, Attachments H, I, and J).

## **5.0 Survey Results**

### **5.1 Paint/Surface Media Samples**

Paint/surface media samples were obtained at each grid location where paint/surface media existed, ensuring that the minimum required paint/surface media samples were obtained for each survey unit. Volume 2, Attachments A, B and C, present results and a data summary of paint/surface media sample analyses for each survey unit. Alpha spectroscopy was performed to determine the activity of Uranium-233/234, Uranium-235, Uranium-238, Plutonium-239/240, and Americium-241. Values for each isotope(s) is presented separately. All reported values for the three survey units were below the applicable total uranium and total transuranic DCGL<sub>w</sub>. Copies of data provided by Sanford Cohen & Associates, Inc. are provided in Volume 3, Attachments H, I, and J. The number of media samples obtained was verified to be adequate by re-calculating the required number of samples with the actual survey unit sample standard deviation (refer to Volume 2, Attachments A, B and C).

### **5.2 Removable Surface Contamination Surveys**

Removable contamination measurements were obtained at each accessible grid location. The minimum required removable contamination measurements were obtained for each survey unit. Removable contamination survey results are presented by survey unit in Volume 2, Attachments A, B and C. Surveys were performed at each location from which paint/surface media samples were obtained, ensuring that the minimum required number of smears was collected for each survey unit. For those points, measurements were obtained prior to and after the media sample. For those areas from which no paint/media sample was obtained, a single removable contamination measurement was obtained. The results of all samples show that the removable contamination levels met the applicable DCGL<sub>w</sub> described in Section 2.0. The number of removable activity measurements obtained was verified to be adequate by re-calculating the required number of measurements with the actual survey unit measurement standard deviation (refer to Volume 2, Attachments A, B and C).

### **5.3 Total Surface Activity Surveys**

Total surface activity measurements were obtained at each accessible grid location, ensuring that the minimum required total surface activity measurements were obtained for each survey unit. Total surface activity survey results for each survey unit are presented in Volume 2, Attachments A, B and C. Total surface activity surveys were performed at each location where paint/surface media samples were obtained. For those areas where no media sample was obtained, a single total surface activity measurement was obtained (Volume 3, Attachments H, I, J). The results of all surveys showed that all total surface activity levels were less than the applicable DCGL<sub>w</sub> described in Section 2.0. The number of total surface activity measurements obtained was verified to be adequate by re-calculating the required number of measurements with the actual survey unit measurement standard deviation (refer to Volume 2, Attachments A, B and C).

## 5.4 Scan Surveys

Scan contamination survey results are presented in Volume 2, Attachment D. Survey results are grouped by survey unit. For each individual survey SIMS automatically generates a sub-unit report. Appendix 1, SCM/SIMS Scan Survey Overlay Maps, displays the sub-unit survey area locations relative to the survey unit boundaries. Each surveyed area (colored in green or gray to distinguish between areas) is annotated with the corresponding sub-unit number. The required scan frequency for each survey unit, per the Closeout Radiological Survey Plan for the 779 Cluster, was verified.

Each auto-generated sub-unit report consists of several pages. The first three sections of the sub-unit report (i.e., INTRODUCTION, SURFACE ACTIVITY LEVELS, AND SQUARE METER DATA sections) presents the survey name, technician name, date of survey, instrument identification and efficiency, and ranges of measured data for each pixel (25 cm<sup>2</sup>) and 100 cm<sup>2</sup> area. The survey names are alpha numeric. The first five characters define the building and the survey unit, (e.g. 72901 is building 729 survey unit 1). The remaining characters are sequential, identifying the survey sub-unit within the survey unit as monitored by SCM/SIMS. Identifiers such as n, e, s, or w are typically used to denote areas such as north walls, east walls, etc.

Figures 1 and 2 of the sub-unit report present a three-dimensional display of the data, and a two dimensional color graphic display. Each of these displays provides spatial information of the radioactivity measured in a survey area. As a result of programming problems, the two-dimensional graphical representations (figure 2) do not all have scales printed out. The omission of these scales does not impact the quality of data or the ability to interpret the results.

Table 1 of the sub-unit report presents a spread sheet evaluation of each square meter area for that survey area. The x,y values for each meter are determined from the two dimension display with the origin in the lower left corner. Therefore meter 1,1 is the square meter in the lower left corner of the two dimensional display. Data presented is the maximum, mean and minimum 100 cm<sup>2</sup> area measured for the square meter area, the standard deviation of the data within that square meter, and the number of 100 cm<sup>2</sup> areas in that square meter. The "100 cm<sup>2</sup> Areas" column indicates the number of 100 cm<sup>2</sup> areas in the square meter that have data. Full square meters will contain one hundred 100 cm<sup>2</sup> areas. Areas that are along the edge of a survey area, have portions of the surface missing (windows, doors, etc.) will show less than one hundred 100 cm<sup>2</sup> areas. The mean values in these areas are averaged over the surveyed area, which is not necessarily a full square meter. Surveys that consist of a series of long thin strips, such as the edges of the concrete pedestal in the main plenum room, are portrayed with the long sides adjacent, rather than end to end, so that analysis of the average square meter data can be performed.

In some cases, the number of 100cm<sup>2</sup> areas listed in the "100cm<sup>2</sup> Areas" column of the auto-generated reports was zero. This phenomenon can occur for several reasons. First, the empty grid may have been contiguous to a surveyed grid, and therefore not surveyed. For example, the database reports data for rectangular areas, but the survey within the

rectangle may have actually been L-shaped. The grids contiguous to the L-shaped area will report zero 100cm<sup>2</sup> areas. Second, a small part of the detector may have been included in the grid, but the geometry was insufficient to contain a square 100cm<sup>2</sup> area. This second phenomenon also explains why the number of 100cm<sup>2</sup> areas equaled zero, yet radiological data was reported in the mean, maximum, minimum, and standard deviation columns. The radiological data values are likely to be zero or very low when this occurs (the maximum is the only parameter that may result in a typical value).

The "Comparison of Results with Guidelines" section of the sub-unit report compares the maximum and average scan data against the specific DCGL and identifies those square meter areas that exceed the DCGL<sub>w</sub>, if any. Figure 3 is included only for those surveys that have 100 cm<sup>2</sup> areas or square meter averages that exceed the applicable DCGL defined in section 2.0. Specific areas exceeding those DCGLs are identified on a two-dimensional display. If all measured values are less than the DCGLs, Figure 3 is not included.

Surveys performed with the SCM used in the encoder mode (moving at 2.5 cm/sec.) will generate a separate report for the primary and recount detector. For this case, the report name will be the same. The detector generating the survey information is indicated at the bottom of each page. Due to the low expected count rate and the random nature of radioactivity, a low occurrence of individual 100 cm<sup>2</sup> area false positive results are expected. The recount detector allows for a rapid evaluation of an area that indicates a higher than normal value. If one detector indicates a slightly elevated reading but the event is not confirmed by the second detector, the measurement is likely a false positive. Readings that approach a level of concern with either detector are averaged with the results from the other detector. The average value determines the need for follow up investigation.

Surveys taken with the SCM operating in the timer mode are presented as a single survey. Survey time for those detectors have been increased to minimize the probability of false positives. Timer mode surveys are performed when the cart mounted, motor driven SCM can not physically access an area due to area size, interference, or accessibility. The timer mode setting was 8 seconds, providing the same surface area measurement as the time measured by both the primary and recount operating at 2.5 cm/sec.

#### **5.4.1 SCM/SIMS Sensitivity**

SCM/SIMS data was utilized to satisfy the scan requirement only for the Building 729 survey (TSA measurements were performed with the NE Electra. The Electra MDC is verified in a radiological engineering site operations technical basis document entitled "Methods to Demonstrate Compliance with Performance Requirements for Swipe Counting and Portable Contamination Survey Instrumentation used to Evaluate Property and Waste for Unrestricted Release", dated June 7, 1995). However, due to the fact that the instrument software reports data for every 100 cm<sup>2</sup> area, and performs averaging over every one square-meter area, a discussion ensues that provides a comparison of each SCM/SIMS result to the DCGL<sub>w</sub> and the DCGL<sub>EMC</sub>. The SCM/SIMS sensitivity for the surveys performed in building 729 is presented in Appendix 4. All required instrument performance requirements are satisfied with SCM/SIMS survey methodology.

### 5.4.2 Survey Unit 72901 SCM/SIMS Data Summary

Auto-generated reports for all surveys conducted in survey unit 72901 are presented in Volume 2, Attachment D. The following table summarizes the surveys conducted in survey unit 72901:

**Table 5.1**  
**Survey Unit 72901 SCM/SIMS Data Summary**

| Survey Sub-unit | Area Description                                     | Highest 1 m <sup>2</sup> Average (dpm/100 cm <sup>2</sup> ) | Number exceeding DCGL <sub>w</sub> | Highest 100 cm <sup>2</sup> Area (dpm/100 cm <sup>2</sup> ) <sup>(1)</sup> | Number exceeding DCGL <sub>EMC</sub> | Efficiency (c/d) |
|-----------------|--|---|------------------------------------|--|--------------------------------------|------------------|
| 72901001        | Stairwell Landing Floor                              | 14  | 0                                  | 137  | 0                                    | 0.35             |
| 72901002        | Stairwell Landing Floor                              | 18  | 0                                  | 135  | 0                                    | 0.35             |
| 72901003        | Stairwell Landing South Wall                         | 18  | 0                                  | 137  | 0                                    | 0.35             |
| 72901004        | Stairwell Landing East Wall                          | 13  | 0                                  | 170  | 0                                    | 0.35             |
| 72901005        | Stairwell Landing North Wall                         | 12  | 0                                  | 137  | 0                                    | 0.35             |
| 72901006        | Stairwell Ceiling                                    | 13  | 0                                  | 137  | 0                                    | 0.35             |
| 72901007        | Stairwell East Wall > 6'                             | 8   | 0                                  | 99   | 0                                    | 0.35             |
| 72901008        | Bridge Floor Adjacent to Hole                        | 14  | 0                                  | 137  | 0                                    | 0.35             |
| 72901009        | Bridge West Wall Over Hole                           | 11  | 0                                  | 137  | 0                                    | 0.35             |
| 72901010        | Bridge South Wall                                    | 22  | 0                                  | 103  | 0                                    | 0.35             |
| 72901011        | Bridge East Wall                                     | 23  | 0                                  | 93   | 0                                    | 0.35             |
| 72901013        | Bridge West Wall Corner                              | 20  | 0                                  | 103  | 0                                    | 0.35             |
| 72901014        | Bridge East Wall Corner                              | 15  | 0                                  | 103  | 0                                    | 0.35             |
| 72901015        | Bridge Floor Corner Strips                           | 20  | 0                                  | 69   | 0                                    | 0.35             |
| 72901016        | Bridge Ceiling                                       | 50  | 0                                  | 171  | 0                                    | 0.35             |
| 72901020        | Plenum Floor – East Areas around N. Central Pedestal | 14  | 0                                  | 170  | 0                                    | 0.35             |
| 72901021        | Bridge – North Wall Adjacent to B779                 | 8   | 0                                  | 102  | 0                                    | 0.35             |
| 72901022        | East Deep Pit – Plenum Room, Walls and Floor         | 20  | 0                                  | 123  | 0                                    | 0.39             |
| 72901023        | East Pit – Plenum Room, Tray                         | 27  | 0                                  | 153  | 0                                    | 0.39             |
| 72901025        | Plenum Room East Side Floor                          | 15  | 0                                  | 192  | 0                                    | 0.35             |
| 729011c         | Plenum Room Ceiling                                  | 27  | 0                                  | 137  | 0                                    | 0.35             |
| 729011e         | Plenum Room East Wall                                | 21  | 0                                  | 220  | 0                                    | 0.35             |
| 729011f         | West Pit – Walls and Floor                           | 46  | 0                                  | 274  | 1                                    | 0.35             |
| 729011eu        | Plenum Room East Wall Upper Area                     | 16  | 0                                  | 174  | 0                                    | 0.35             |
| 729011n primary | Plenum Room North Wall                               | 21  | 0                                  | 251  | 0                                    | 0.25             |
| 729011n recount | Plenum Room North Wall                               | 22  | 0                                  | 224  | 0                                    | 0.25             |
| 729011nu        | Plenum Room North Wall Corners                       | 13  | 0                                  | 137  | 0                                    | 0.35             |
| 729011su        | Plenum Room South Wall Corners                       | 13  | 0                                  | 171  | 0                                    | 0.35             |
| 729011tc        | Plenum room trench                                   | 62  | 0                                  | 378  | 1                                    | 0.35             |
| 729011wu        | Plenum room west wall                                | 12  | 0                                  | 102  | 0                                    | 0.35             |
| 729012c         | Plenum room ceiling                                  | 30  | 0                                  | 188  | 0                                    | 0.35             |
| 729012f         | Plenum Room East Pit-Floor and Walls                 | 20  | 0                                  | 220  | 0                                    | 0.35             |

| Survey Sub-unit  | Area Description   | Highest 1 m <sup>2</sup> Average (dpm/100 cm <sup>2</sup> ) | Number exceeding DCGL <sub>W</sub> | Highest 100 cm <sup>2</sup> Area (dpm/100 cm <sup>2</sup> ) <sup>(1)</sup> | Number exceeding DCGL <sub>EMC</sub> | Efficiency (c/d) |
|------------------|--|---|------------------------------------|--|--------------------------------------|------------------|
| 729012n          | North wall   | 12  | 0                                  | 132  | 0                                    | 0.35             |
| 729012s          | Plenum Room South Wall   | 25  | 0                                  | 171  | 0                                    | 0.35             |
| 729012w          | Plenum Room West Wall  | 16  | 0                                  | 164  | 0                                    | 0.35             |
| 7290120p         | Plenum Room Floor-Corners  | 25  | 0                                  | 241  | 0                                    | 0.35             |
| 7290121F-primary | Plenum Room East end of South Pedestal                             | 34  | 0                                  | 255  | 0                                    | 0.25             |
| 7290121F-recount | Plenum Room East end of South Pedestal                             | 36  | 0                                  | 239  | 0                                    | 0.25             |
| 729013s          | Bridge south door  | 39  | 0                                  | 166  | 0                                    | 0.39             |
| 729014e          | Bridge east door #11/729   | 36  | 0                                  | 171  | 0                                    | 0.35             |
| 729015f          | Plenum Room southeast floor  | 100 <sup>(2)</sup>  | 1                                  | 308  | 1                                    | 0.35             |
| 729015sw         | Plenum Room Floor - SW Area  | 26  | 0                                  | 171  | 0                                    | 0.35             |
| 729015n          | Stairwell Walls North  | 70  | 0                                  | 154  | 0                                    | 0.39             |
| 7290150f         | Plenum Room floor  | 30  | 0                                  | 158  | 0                                    | 0.35             |
| 7290151f         | Plenum Room floor-corners adjacent to walls and the south pedestal | 33  | 0                                  | 137  | 0                                    | 0.35             |
| 7290152w         | Plenum Room walls- 5 strips per wall                               | 20  | 0                                  | 171  | 0                                    | 0.35             |
| 7290153f         | Plenum Room Floor - NW Area  | 19  | 0                                  | 206  | 0                                    | 0.35             |
| 7290154f         | West pedestal floor adjacent to pit                                | 20  | 0                                  | 184  | 0                                    | 0.35             |
| 7290155f         | South large pedestal- west side                                    | 20  | 0                                  | 171  | 0                                    | 0.35             |
| 7290156f         | Plenum Room Floor East Side  | 33  | 0                                  | 240  | 0                                    | 0.35             |
| 729015ff         | Plenum Room Floor Adjacent to West & North Central Pedestal        | 42  | 0                                  | 129  | 0                                    | 0.35             |
| 72901604         | South wall along stairs going from ground floor to landing         | 12  | 0                                  | 137  | 0                                    | 0.35             |
| 729016f          | Plenum Room South East Pedestal                                    | 36  | 0                                  | 137  | 0                                    | 0.35             |
| 729016fc         | Plenum Room Pedestals North Central & South                        | 44  | 0                                  | 171  | 0                                    | 0.35             |
| 729018fc         | Plenum Room Floor Southwest  | 20  | 0                                  | 129  | 0                                    | 0.35             |
| 729019fc         | Plenum Room East Pedestal  | 24  | 0                                  | 171  | 0                                    | 0.35             |
| 729019ff         | Bridge Stairs-Risers and Steps                                     | 17  | 0                                  | 137  | 0                                    | 0.39             |
| 72901300-primary | Bridge Interior East Wall  | 28  | 0                                  | 310  | 1                                    | 0.25             |
| 72901300-recount | Bridge Interior East Wall  | 23  | 0                                  | 389  | 1                                    | 0.25             |
| 72901301-primary | Bridge Interior West Wall  | 30  | 0                                  | 295  | 0                                    | 0.25             |
| 72901301-recount | Bridge Interior West Wall  | 24  | 0                                  | 374  | 1                                    | 0.25             |
| 72901600         | Plenum Room Deep Pit Tray  | 12  | 0                                  | 154  | 0                                    | 0.39             |
| 72901601         | Plenum Room West Edge of South Pedestal                            | 25  | 0                                  | 154  | 0                                    | 0.39             |
| 72901602         | Plenum Room East Wall Plexiglass Window                            | 13  | 0                                  | 62   | 0                                    | 0.39             |

| Survey Sub-unit  | Area Description                     | Highest 1 m <sup>2</sup> Average (dpm/100 cm <sup>2</sup> ) | Number exceeding DCGL <sub>w</sub> | Highest 100 cm <sup>2</sup> Area (dpm/100 cm <sup>2</sup> ) <sup>(1)</sup> | Number exceeding DCGL <sub>EMC</sub> | Efficiency (c/d) |
|------------------|--------------------------------------|---|------------------------------------|--|--------------------------------------|------------------|
| 72901603         | Plenum Room Deep Pit Tray South Wall | 4   | 0                                  | 31   | 0                                    | 0.39             |
| 72901800-primary | Bridge Floor                         | 76  | 0                                  | 268  | 0                                    | 0.30             |
| 72901800-recount | Bridge Floor                         | 48  | 0                                  | 238  | 0                                    | 0.30             |

(1) Represents the maximum value within a one-square meter area. Thus, the values cited for primary and recount detectors do not typically pertain to the same location.

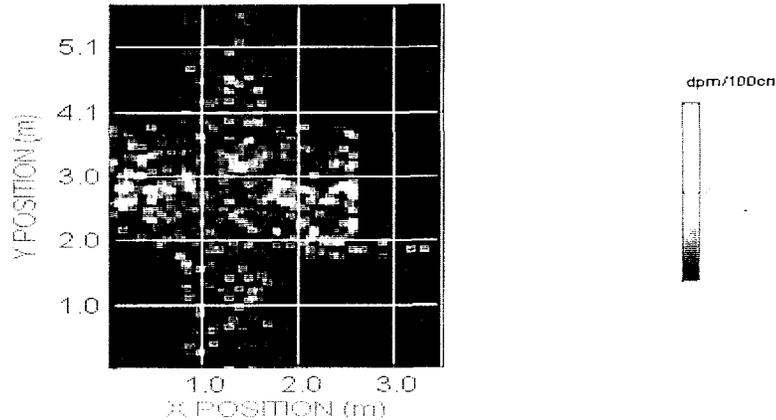
(2) Survey Sub-Unit 729015f, grid coordinate 7-12, was limited to a surface area of 100 cm<sup>2</sup> area only. Therefore, the DCGL<sub>w</sub> does not apply.

Survey Unit 72901 consisted of the main plenum room, the stairwell and the bridge area. The plenum room contained two pits and several pedestals 2" to 4" high that were the foundation for the filter plenums. The stairwell included a landing area at the midpoint of the stairs. The bridge floor included a hole in the south end, a penetration for the main ventilation duct from the bridge to the plenum room.

Initial characterization surveys of the plenum room indicated minor contamination, with a maximum value of approximately 400 dpm/100 cm<sup>2</sup> with additional spots between 250 and 300 dpm/100 cm<sup>2</sup> on the pedestal surrounding the west pit, and on the west end of the southwest pedestal. Final remediation activities in building 729 involved removal of a liner from the pit. The pedestal surrounding the pit was removed and disposed of as radioactive waste. Approximately 10 feet of the southwest pedestal was also removed and disposed of as radioactive waste. An investigative survey of the floor performed following removal of the pedestals indicated that all areas were below the DCGL<sub>EMC</sub> and DCGL<sub>w</sub> (refer to Volume 3, Attachment F).

Initial characterization surveys of the west pit also indicated low levels of activity. A single 100 cm<sup>2</sup> area on the floor of the pit was determined to be approximately 337 dpm. Areas near the top of both the east and west wall of the pit indicated radioactivity in the range of 250 to 280 dpm/100 cm<sup>2</sup> distributed over areas of approximately 30 cm x 30 cm. Figure 5.1 is the two dimensional display of the pit area. The pit is represented as if the walls were laid out, with the floor area in the middle. The view is with the north wall toward the top of the display. The maximum 100 cm<sup>2</sup> area is in meter grid (2,3). The activity on the walls can be seen in meter grids (1,3), west wall, and (3,3), east wall. The areas were surveyed with a hand held NE Electra with a Model DP6 probe. These surveys confirmed the initial scan findings. The contaminated location on the floor was determined to be approximately 70 cm from the north wall of the pit and 40 cm from the east wall. The areas found on the walls were at the approximate mid points of the wall and extended from the top of the wall down approximately 35 cm. The areas as confirmed with the Electra, were marked and subsequently remediated. A needle gun was used to remove approximately 1/8" of the surface in areas roughly 40 cm x 40 cm around each of the three areas. The surface materials removed were disposed of as radioactive waste. Subsequent final status surveys with hand held instruments indicated that the pit area was below the DCGL<sub>EMC</sub> in the remediated areas. Final survey of the west pit is presented in Volume 2, Attachment D.

The final status surveys for survey unit 72901 indicates that all areas surveyed met the  $DCGL_W$ . Several survey sub-units indicated measurements in excess of the  $225 \text{ dpm}/100\text{cm}^2$  (75% of the  $DCGL_{EMC}$ ) investigation level. These locations were investigated and dispositioned as less than the  $DCGL_{EMC}$  (refer to section 5.4.5 and Volume 3, Attachment F).



**Figure 5.1**  
**West Pit Initial Survey**

### 5.4.3 Survey Unit 72902 Summary

Auto-generated reports for all surveys conducted in survey unit 72902 are presented in Volume 2, Attachment D. The following table summarizes the surveys conducted in survey unit 72902:

**Table 5.2**  
**Survey Unit 72902 SCM/SIMS Data Summary**

| Survey Sub-unit  | Area Description                 | Highest 1 m <sup>2</sup> Average (dpm/100 cm <sup>2</sup> ) | Number exceeding $DCGL_W$ | Highest 100 cm <sup>2</sup> Area (dpm/100 cm <sup>2</sup> ) <sup>(1)</sup> | Number exceeding $g DCGL_{EMC}$ | Efficiency (c/d) |
|------------------|----------------------------------|---|---------------------------|--|---------------------------------|------------------|
| 7290250f         | diesel generator room floor      | 34  | 0                         | 171  | 0                               | 0.35             |
| 729027f          | Airlock Floor                    | 12  | 0                         | 102  | 0                               | 0.35             |
| 729027wn         | Airlock North Wall               | 11  | 0                         | 137  | 0                               | 0.35             |
| 729027ws         | Airlock South Wall               | 15  | 0                         | 137  | 0                               | 0.35             |
| 729027ww         | Airlock West Wall                | 17  | 0                         | 171  | 0                               | 0.35             |
| 729028f          | Hallway Floor                    | 11  | 0                         | 102  | 0                               | 0.35             |
| 729029f          | Lavatory Floor                   | 16  | 0                         | 137  | 0                               | 0.35             |
| 729029wn         | Lavatory North Wall              | 20  | 0                         | 171  | 0                               | 0.35             |
| 72902300 primary | Diesel Generator Room North Wall | 33  | 0                         | 323  | 1                               | 0.25             |
| 72902300 recount | Diesel Generator Room North Wall | 21  | 0                         | 222  | 0                               | 0.25             |
| 72902301 primary | Diesel Generator Room North Wall | 24  | 0                         | 330  | 1                               | 0.25             |
| 72902301 recount | Diesel Generator Room West Wall  | 27  | 0                         | 240  | 0                               | 0.25             |

|                     |                                 |    |   |     |   |      |
|---------------------|---------------------------------|----|---|-----|---|------|
| 72902302<br>primary | Diesel Generator Room East Wall | 36 | 0 | 289 | 0 | 0.25 |
| 72902302<br>recount | Diesel Generator Room East Wall | 35 | 0 | 251 | 0 | 0.25 |
| 72902303<br>primary | Control Room North Wall         | 20 | 0 | 215 | 0 | 0.25 |
| 72902303<br>recount | Control Room North Wall         | 15 | 0 | 294 | 0 | 0.25 |
| 72902304<br>primary | Control Room West Wall          | 21 | 0 | 194 | 0 | 0.25 |
| 72902304<br>recount | Control Room West Wall          | 17 | 0 | 189 | 0 | 0.25 |
| 72902305<br>primary | Control Room South Wall         | 22 | 0 | 289 | 0 | 0.25 |
| 72902305<br>recount | Control Room South Wall         | 13 | 0 | 191 | 0 | 0.25 |
| 72902306<br>primary | Control Room East Wall          | 24 | 0 | 309 | 1 | 0.25 |
| 72902306<br>recount | Control Room East Wall          | 22 | 0 | 210 | 0 | 0.25 |

(1) Represents the maximum value within a one-square meter area. Thus, the values cited for primary and recount detectors do not typically pertain to the same location.

Survey Unit 72902 consisted of the diesel generator room, control room, lavatory, hallway and airlock entrance into the plenum room. All areas surveyed showed 1 m<sup>2</sup> average activity to be below the applicable DCGL. Several survey sub-units indicated measurements in excess of the 225 dpm/100cm<sup>2</sup> (75% of the DCGL<sub>EMC</sub>) investigation level. These locations were investigated and dispositioned as less than the DCGL<sub>EMC</sub> (refer to section 5.4.5 and Volume 3, Attachment F).

#### 5.4.4 Survey Unit 72903 Summary

Auto-generated reports for all surveys conducted in survey unit 72903 are presented in Volume 2, Attachment D. The following tables summarize the surveys conducted in survey unit 72903:

**Table 5.3**  
**Survey Unit 72903 SCM/SIMS Data Summary**

| Survey Sub-unit | Area Description  | Highest 1 m <sup>2</sup> Average (dpm/100 cm <sup>2</sup> ) | Number exceeding DCGL <sub>w</sub> | Highest 100 cm <sup>2</sup> Area (dpm/100 cm <sup>2</sup> ) <sup>(1)</sup> | Number exceeding DCGL <sub>EMC</sub> | Efficiency (c/d) |
|-----------------|---|---|------------------------------------|--|--------------------------------------|------------------|
| 72903001        | exterior stairwell east wall                                    | 46  | 0                                  | 274  | 0                                    | 0.35             |
| 72903002        | exterior stairwell south wall                                   | 55  | 0                                  | 308  | 1                                    | 0.35             |
| 72903003        | exterior stairwell west wall                                    | 64  | 0                                  | 239  | 0                                    | 0.35             |
| 72903008        | exterior bridge east wall and ledge                             | 70  | 0                                  | 240  | 0                                    | 0.35             |
| 72903017        | exterior east wall  | 30  | 0                                  | 210  | 0                                    | 0.35             |
| 72903018        | Shield wall adjacent to door protruding from east exterior wall | 29  | 0                                  | 205  | 0                                    | 0.35             |
| 72903019        | East exterior foundation wall                                   | 19  | 0                                  | 171  | 0                                    | 0.35             |
| 729031w         | Exterior Wall West  | 26  | 0                                  | 214  | 0                                    | 0.35             |

|          |                                |    |   |     |   |      |
|----------|--------------------------------|----|---|-----|---|------|
| 729031na | Exterior Wall North, East Half | 36 | 0 | 257 | 0 | 0.35 |
| 729031nb | Exterior Wall North, West Half | 55 | 0 | 214 | 0 | 0.35 |
| 729032sa | Exterior Wall South, West Half | 63 | 0 | 386 | 1 | 0.35 |
| 729032sb | Exterior Wall South, East Half | 72 | 0 | 300 | 1 | 0.35 |
| 729035u  | Exterior Underside of Bridge   | 45 | 0 | 257 | 0 | 0.35 |

(1) Represents the maximum value within a one-square meter area. Thus, the values cited for primary and recount detectors do not typically pertain to the same location.

Survey Unit 72903 consists of external surfaces of the building. 100% surface surveys were performed up to two meters from grade, with a minimum of 10% of the area above two meters surveyed. The concrete block walls are supported by a concrete foundation, the height of which varies with the slope of the land around the building. In many areas, the surveyed area extended beyond the 2-meter height required. Galvanized metal roof flashing extends approximately 8 to 10 inches from the top of the exterior walls, and along the top of the bridge. The exterior of the stairwell also has flashing along the base. Surveys showed no activity above the 1 m<sup>2</sup> average activity DCGL<sub>W</sub>. Several survey sub-units indicated measurements in excess of the 225 dpm/100cm<sup>2</sup> (75% of the DCGL<sub>EMC</sub>) investigation level. These locations were investigated and dispositioned as less than the DCGL<sub>EMC</sub> (refer to section 5.4.5 and Volume 3, Attachment F).

Table 5.4 presents the flashing survey results, which are compared to the uranium DCGL<sub>W</sub> of 5,000 dpm/100cm<sup>2</sup> and DCGL<sub>EMC</sub> of 15,000 dpm/100cm<sup>2</sup> (refer to section 5.4.5 for justification).

**Table 5.4**  
**Survey Unit 72903 SCM/SIMS Data Summary for Flashing**

| Survey Sub-unit | Area Description                       | Highest 1 m <sup>2</sup> Average (dpm/100 cm <sup>2</sup> ) | Number exceeding DCGL <sub>W</sub> | Highest 100 cm <sup>2</sup> Area (dpm/100 cm <sup>2</sup> ) | Number exceeding DCGL <sub>EMC</sub> | Efficiency (c/d) |
|-----------------|--|---|------------------------------------|---|--------------------------------------|------------------|
| 72903004        | exterior stairwell east wall flashing  | 120   | 0                                  | 235   | 0                                    | 0.35             |
| 72903005        | exterior stairwell south wall flashing | 89  | 0                                  | 376   | 0                                    | 0.35             |
| 72903006        | exterior stairwell west wall flashing  | 30  | 0                                  | 274   | 0                                    | 0.35             |
| 72903009        | exterior west wall flashing            | 83  | 0                                  | 239   | 0                                    | 0.35             |
| 72903010        | exterior east wall flashing            | 125   | 0                                  | 377   | 0                                    | 0.35             |

### 5.4.5 Investigations

Follow up investigations were conducted for each measurement in excess of 75% of the DCGL<sub>W</sub> or DCGL<sub>EMC</sub>. Table 5.5 summarizes the results of the investigations. SCM survey results in excess of 225 dpm/100cm<sup>2</sup> (75% of the DCGL<sub>EMC</sub>) but less than 300 dpm/100cm<sup>2</sup> were investigated by one of two methods. The first was to average the primary and recount detector results. If the results were less than 225 dpm/100cm<sup>2</sup>, then no further investigation was required. The second method consisted of performing a survey of the flagged area with a hand held instrument, the NE Electra with a DP6 probe.

SCM survey results in excess of 300 dpm/100cm<sup>2</sup>, or primary plus recount detector result averages greater than 225 dpm/100cm<sup>2</sup>, were investigated by utilizing a hand held instrument, a NE Electra with a DP6 probe.

Investigation surveys utilizing the NE Electra were performed by first scanning the surrounding suspect area to determine if any elevated activity areas could be identified. Following the scan, a shielded local area background measurement (one minute count) and an unshielded direct measurement (one minute count) were obtained in the area of highest activity identified during the scan. If the investigations that were performed by averaging the primary and recount detectors resulted in values less than 225 dpm/100cm<sup>2</sup>, then, no further actions were required. Each SCM measurement location investigated was documented on an investigation form (refer to Volume 3, Attachment F). If more than one elevated measurement is discovered in a given grid, separate investigation forms are included for each elevated measurement. As indicated by Table 5.5, all SCM and NE Electra investigation results were less than the DCGL<sub>EMC</sub>.

Additional NE Electra investigations were performed for survey sub-units 72903001, 72903002, 72903003, and 72903008 (refer to Volume 3, Attachment F). These investigations were initiated by Millennium Services, Inc. when consistently high one-square meter averages were observed (ranging from 40 to 50 dpm) on concrete block wall of the stairwell exteriors and the bridge east wall and ledge exteriors. All investigations were less than the DCGL<sub>w</sub>.

Survey sub-units 72903004, 72903005, 72903006, 72903009, and 72903010 (roof flashing) of survey unit 72903 indicated increased activity on the east wall flashing and the exterior stairwell south wall flashing exceeding the DCGL<sub>EMC</sub>. Two measurement locations on the flashing exceeded the DCGL<sub>w</sub>. Investigations performed by site Radiological Control Technicians using a NE Technologies Electra with a DP6 Probe confirmed the increased activity levels. Experience in other Decontamination and Decommissioning projects at RFETS has indicated that increased activity on roof flashing was due to naturally occurring Polonium-210, a daughter product in the uranium-radon decay chain, as confirmed by several roof samples collected during previous projects (Memorandum from Don Howard to Alan Parker, dated September, 1997, "Radiological Requirements for Release of the 690 and 891 Trailer Clusters" – DJH-028-97). Because Polonium-210 has an alpha energy of 5.3 MeV, comparable to the average Plutonium-239 alpha energy of 5.15 MeV, the isotopes cannot be discriminated with typical field instruments.

Confirmation of the isotopic content was performed by obtaining two coupon samples at areas of elevated activity as determined with a NE Electra instrument. The samples were submitted to the RFETS Analytical Services Division (ASD) for alpha spectroscopy. The results confirmed the presence of Polonium-210 (refer to Volume 3, Attachment F – Safe Sites Interoffice Correspondence). No plant related radionuclides, including plutonium, americium, or uranium were detected on the sample. Thus the elevated field measurements are attributed to Polonium-210.

Because an isotopic analysis was performed to confirm that transuranics were not present in the sample, and Polonium-210 is in the decay chain of Uranium-238, the measurement results were compared to the uranium DCGL<sub>w</sub> of 5000 dpm/100 cm<sup>2</sup>. This was considered an acceptable deviation from the "Closeout Radiological Survey Plan for the 779 Cluster", Revision 2, due to the fact that isotope specific laboratory analyses were performed. All measurements collected on the flashing from both the SCM and the hand held NE Electra were below the 5000 dpm/100 cm<sup>2</sup> uranium DCGL<sub>w</sub>. The sub-unit reports in Volume 2, Attachment D compare SCM measurements to uranium DCGLs.

**Table 5.5**  
**Summary of Investigation Survey Results**

| Survey Sub-Unit | Grid (X,Y) Coordinates | Original SCM/SIMS Flagged Result (dpm/100 cm <sup>2</sup> ) | SCM/SIMS Calculated Maximum (dpm/100 cm <sup>2</sup> ) <sup>(1)</sup> | Investigation Results (dpm/100 cm <sup>2</sup> ) <sup>(2)</sup> | DCGL <sub>EMC</sub> Met |
|-----------------|------------------------|---|---|---|-------------------------|
| 729011f         | 2,3                    | 274   | N/A   | 67  | Yes                     |
| 729011n         | 4,1                    | 235   | 157   | N/A   | Yes                     |
|                 | 14,1                   | 251   | 238   | 10  | Yes                     |
|                 | 12,2                   | 239   | 189   | N/A   | Yes                     |
|                 | 13,2                   | 227   | 201   | N/A   | Yes                     |
|                 | 14,2                   | 246   | 208   | N/A   | Yes                     |
| 729011tc        | 1,1                    | 257   | N/A   | 105   | Yes                     |
|                 | 1,2                    | 265   | N/A   | 87  | Yes                     |
|                 | 1,3                    | 378   | N/A   | 64  | Yes                     |
|                 | 1,4                    | 276   | N/A   | 46  | Yes                     |
|                 | 1,4                    | 276   | N/A   | 142   | Yes                     |
|                 | 1,4                    | 293   | N/A   | 96  | Yes                     |
| 7290120p        | 17,11                  | 241   | N/A   | 34  | Yes                     |
| 7290121f        | 3,2                    | 255   | 214   | N/A   | Yes                     |
|                 | 3,1                    | 244   | 166   | N/A   | Yes                     |
|                 | 5,1                    | 248   | 190   | N/A   | Yes                     |
| 729015f         | 3,5                    | 308   | N/A   | 19  | Yes                     |
| 7290156f        | 1,4                    | 240   | N/A   | 34  | Yes                     |
| 72901300        | 4,1                    | 310   | 205   | 24  | Yes                     |
|                 | 4,2                    | 389   | 290   | 24  | Yes                     |
|                 | 6,2                    | 294   | 202   | N/A   | Yes                     |
|                 | 1,2                    | 289   | 238   | 38  | Yes                     |
|                 | 2,1                    | 294   | 249   | 29  | Yes                     |
|                 | 3,2                    | 289   | 195   | N/A   | Yes                     |
|                 | 4,2                    | 389   | 290   | 19  | Yes                     |
|                 | 9,1                    | 290   | 243   | 10  | Yes                     |
|                 | 8,2                    | 242   | 177   | N/A   | Yes                     |
| 72901301        | 1,2                    | 374   | 238   | 19  | Yes                     |
|                 | 5,1                    | 309   | 195   | 24  | Yes                     |
|                 | 1,2                    | 310   | 259   | 24  | Yes                     |
|                 | 9,1                    | 273   | 231   | 38  | Yes                     |
|                 | 10,1                   | 280   | 234   | 0   | Yes                     |
|                 | 8,2                    | 294   | 238   | 24  | Yes                     |
|                 | 9,2                    | 284   | 233   | 5   | Yes                     |
| 72901800        | 1,13                   | 261,238   | 250   | 9   | Yes                     |
|                 | 1,9                    | 237   | 199   | N/A   | Yes                     |
|                 | 1,8                    | 234   | 193   | N/A   | Yes                     |
|                 | 2,2                    | 225   | 218   | N/A   | Yes                     |
|                 | 1,4                    | 265   | 208   | N/A   | Yes                     |
|                 | 2,10                   | 238   | 217   | N/A   | Yes                     |
|                 | 1,14                   | 264   | 186   | N/A   | Yes                     |
|                 | 2,14                   | 268   | 221   | N/A   | Yes                     |
| 72902300        | 2,2                    | 323, 232  | 278   | 19  | Yes                     |
|                 | 2,2                    | 256, 232  | 244   | 14  | Yes                     |
|                 | 2,2                    | 313   | 231   | 14  | Yes                     |

| Survey Sub-Unit | Grid (X,Y) Coordinates | Original SCM/SIMS Flagged Result (dpm/100 cm <sup>2</sup> ) | SCM/SIMS Calculated Maximum (dpm/100 cm <sup>2</sup> ) <sup>(1)</sup> | Investigation Results (dpm/100 cm <sup>2</sup> ) <sup>(2)</sup> | DCGL <sub>EMC</sub> Met |     |
|-----------------|------------------------|---|---|---|-------------------------|-----|
| 72902301        | 2,2                    | 330   | 214   | 24  | Yes                     |     |
|                 | 2,1                    | 240   | 148   | 5   | Yes                     |     |
| 72902302        | 2,1                    | 289   | 226   | 29  | Yes                     |     |
|                 | 3,2                    | 251   | 126   | N/A   | Yes                     |     |
|                 | 3,1                    | 249   | 165   | N/A   | Yes                     |     |
|                 | 1,1                    | 225   | 113   | N/A   | Yes                     |     |
|                 | 4,1                    | 241   | 121   | N/A   | Yes                     |     |
|                 | 4,1                    | 236   | 142   | N/A   | Yes                     |     |
| 72902303        | 2,1                    | 294   | 147   | N/A   | Yes                     |     |
| 72902305        | 1,1                    | 289   | 145   | N/A   | Yes                     |     |
| 72902306        | 1,1                    | 310   | 206   | 19  | Yes                     |     |
| 729031na        | 10,2                   | 257   | N/A   | 42  | Yes                     |     |
| 729032sa        | 2,1                    | 295   | N/A   | 9   | Yes                     |     |
|                 | 2,1                    | 257   | N/A   | 23  | Yes                     |     |
|                 | 3,1                    | 385   | N/A   | 0   | Yes                     |     |
|                 | 3,1                    | 342   | N/A   | 18  | Yes                     |     |
|                 | 3,1                    | 343   | N/A   | 23  | Yes                     |     |
|                 | 5,1                    | 257   | N/A   | 32  | Yes                     |     |
|                 | 11,1                   | 257   | N/A   | 5   | Yes                     |     |
|                 | 1,2                    | 299   | N/A   | 14  | Yes                     |     |
|                 | 2,2                    | 249   | N/A   | 18  | Yes                     |     |
|                 | 3,2                    | 257   | N/A   | 23  | Yes                     |     |
|                 | 6,2                    | 255   | N/A   | 23  | Yes                     |     |
|                 | 729032sb               | 2,1   | 257   | N/A   | 9                       | Yes |
|                 |                        | 3,1   | 257   | N/A   | 14                      | Yes |
| 4,1             |                        | 257   | N/A   | 18  | Yes                     |     |
| 5,1             |                        | 238   | N/A   | 14  | Yes                     |     |
| 7,1             |                        | 257   | N/A   | 5   | Yes                     |     |
| 3,2             |                        | 254   | N/A   | 14  | Yes                     |     |
| 8,2             |                        | 257   | N/A   | 18  | Yes                     |     |
| 8,2             |                        | 257   | N/A   | 9   | Yes                     |     |
| 8,4             |                        | 300   | N/A   | 38  | Yes                     |     |
| 8,4             |                        | 251   | N/A   | 9   | Yes                     |     |
| 729035u         | 2,1                    | 257   | N/A   | 59  | Yes                     |     |
| 72903001        | 1,2                    | 274   | N/A   | 74  | Yes                     |     |
|                 | 1,2                    | 228   | N/A   | 42  | Yes                     |     |
|                 | 1,1                    | 236   | N/A   | 46  | Yes                     |     |
| 72903002        | 5,1                    | 240   | N/A   | 55  | Yes                     |     |
|                 | 4,2                    | 308   | N/A   | 43  | Yes                     |     |
|                 | 6,2                    | 240   | N/A   | 46  | Yes                     |     |
| 72903003        | 2,2                    | 239   | N/A   | 60  | Yes                     |     |
|                 | 1,2                    | 226   | N/A   | 37  | Yes                     |     |
| 72903004        | Flashing               | 235   | N/A   | N/A   | Yes <sup>(3)</sup>      |     |
| 72903005        | Flashing               | 377   | N/A   | N/A   | Yes <sup>(3)</sup>      |     |
| 72903006        | Flashing               | 274   | N/A   | N/A   | Yes <sup>(3)</sup>      |     |
| 72903008        | 1,1                    | 240   | N/A   | 47  | Yes                     |     |
|                 | 2,1                    | 240   | N/A   | 56  | Yes                     |     |
|                 | 2,1                    | 240   | N/A   | 51  | Yes                     |     |
| 72903009        | Flashing               | 240   | N/A   | N/A   | Yes <sup>(3)</sup>      |     |
| 72903010        | Flashing               | 377   | N/A   | N/A   | Yes <sup>(3)</sup>      |     |

(1) A recount detector is not utilized with a corner detector. Thus, an average value is not calculated.

(2) An investigation is not required with the NE Electra when a single measurement is < 300 dpm/100 cm<sup>2</sup> and the average result is < 225 dpm/100 cm<sup>2</sup>.

(3) Coupon samples collected. Activity attributed to Po-210.

## 6.0 Conclusion

All survey data collected from Building 729 meets the DCGLs as defined by the Closeout Radiological Survey Plan for the 779 Cluster. Therefore, the building is suitable for unrestricted release. The estimated sanitary waste volume for Building 729 is 1,032.28 (estimated tons). This is equivalent to a total of 83.89 roll-off loads.

**APPENDIX 1**

**SCM/SIMS Scan Survey Overlay Maps**

**RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER**

Survey Area: A

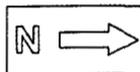
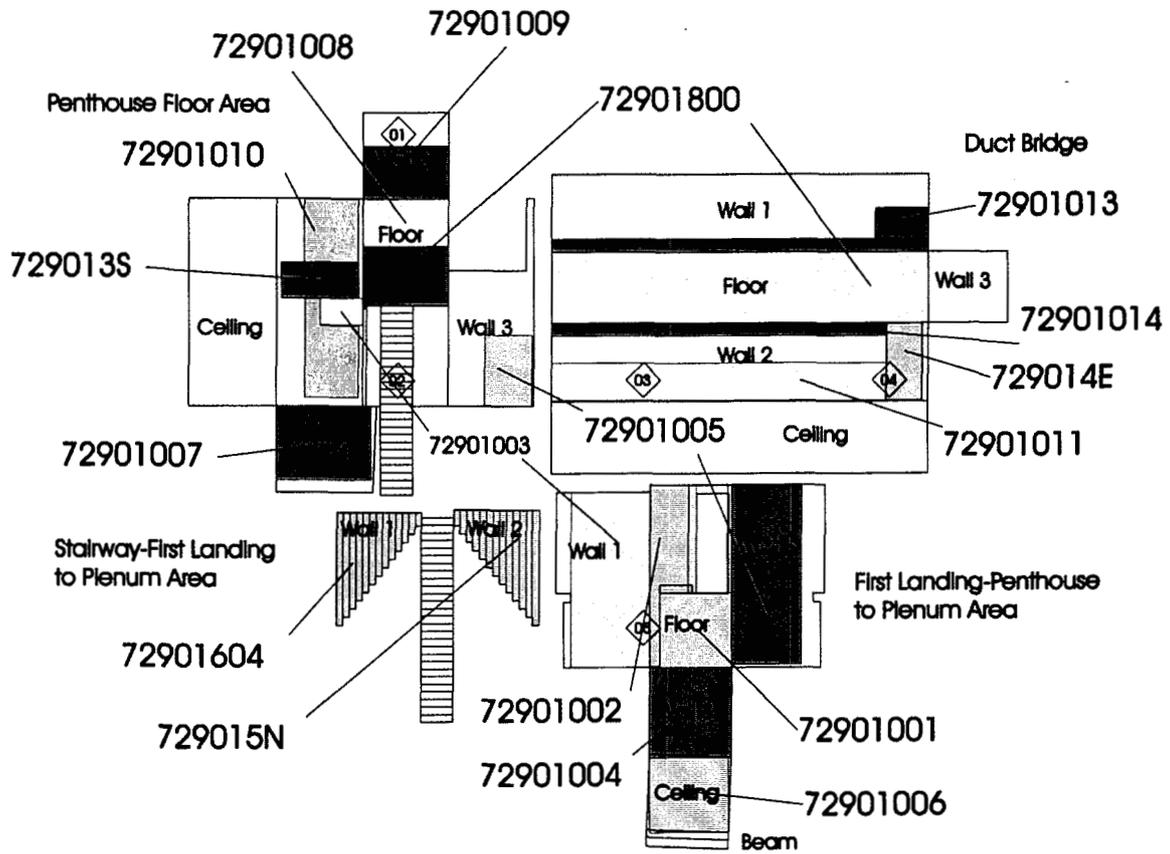
Survey Unit: 72901

Classification: 2

Building: 729

Survey Unit Description: Bldg. 729 Penthouse & Duct Bridge

SURVEY UNIT 72901-MAP 1 OF 2



**SURVEY MAP LEGEND**

-  Smear Only Location
-  Sample & Smear Location
-  Open Area

**RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER**

Survey Area: A

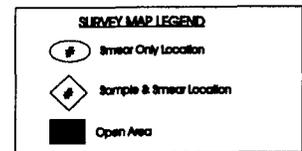
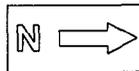
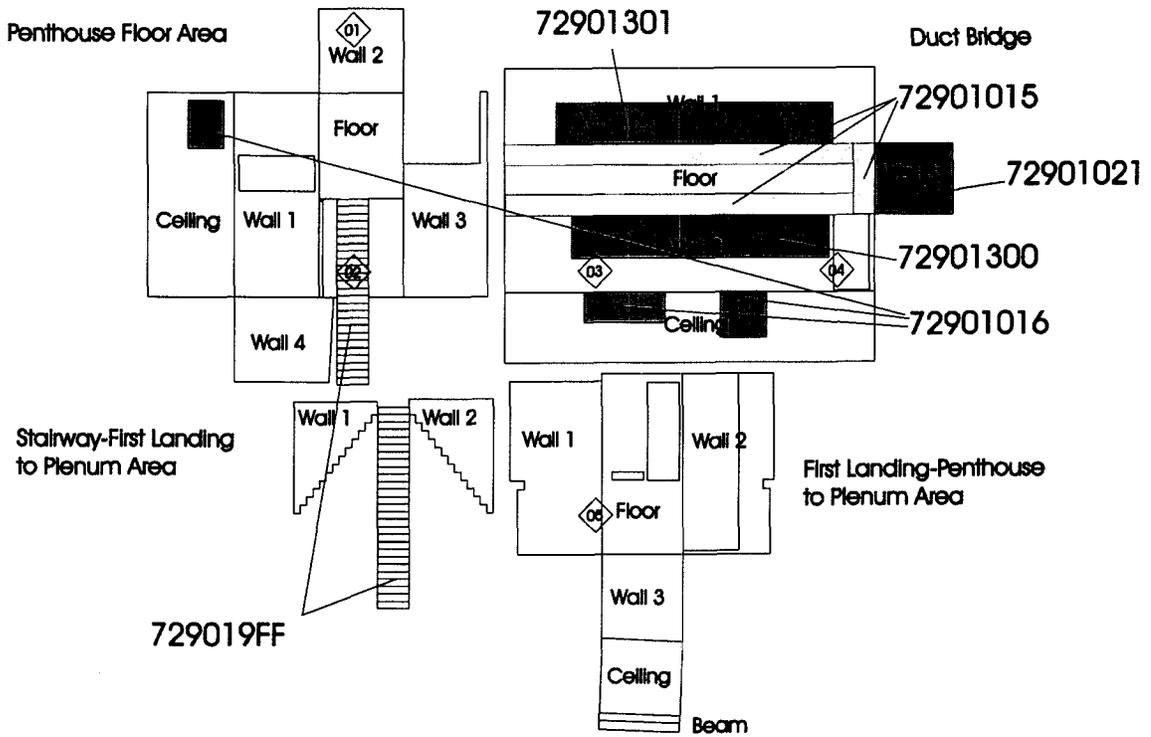
Survey Unit: 72901

Classification: 2

Building: 729

Survey Unit Description: Bldg. 729 Penthouse & Duct Bridge

**SURVEY UNIT 72901-MAP 1 OF 2**



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**RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER**

Survey Area: A

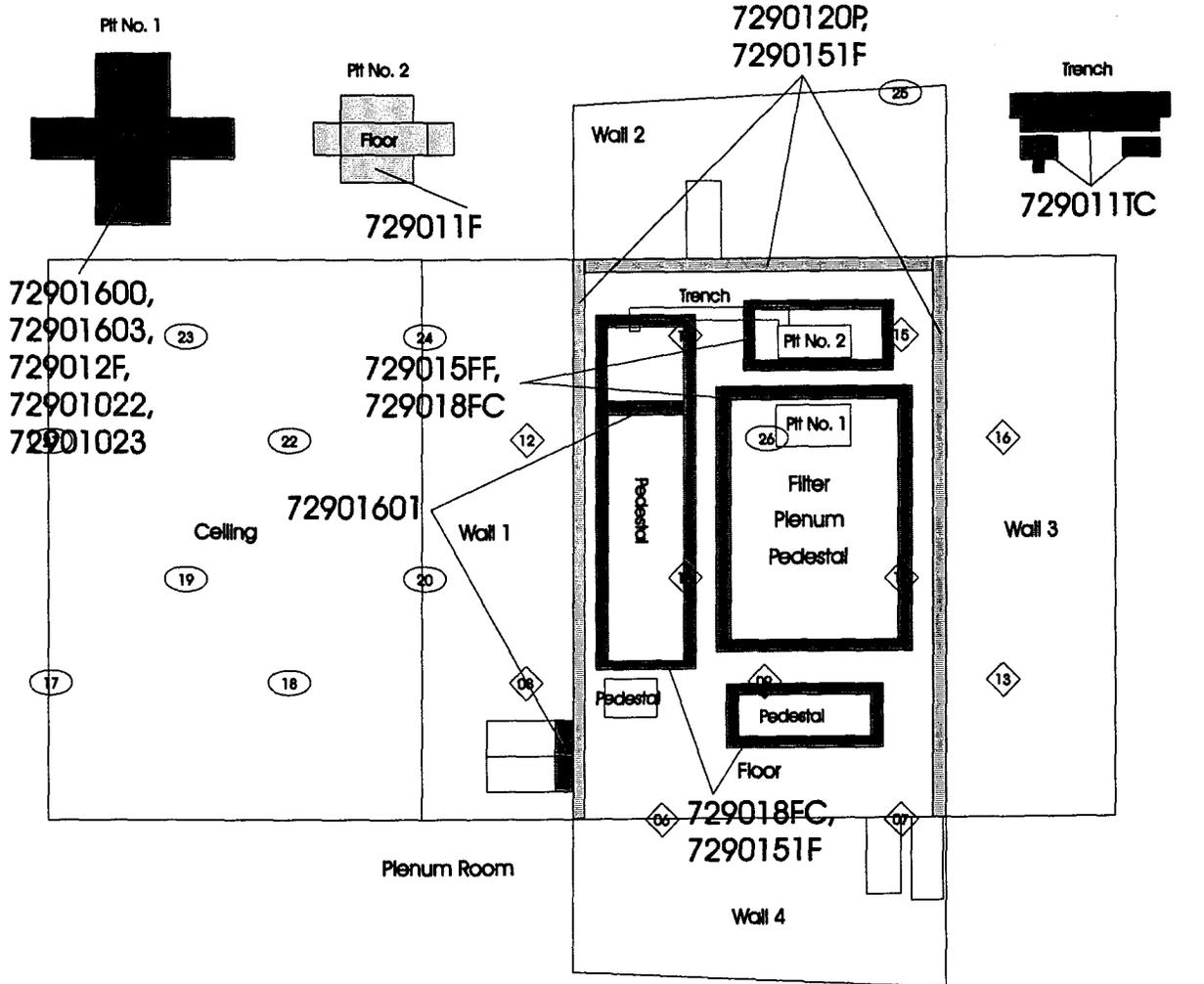
Survey Unit: 72901

Classification: 2

Building: 729

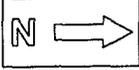
Survey Unit Description: Bldg. 729 Plenum Area

**SURVEY UNIT 72901-MAP 2 OF 2**



**SURVEY MAP LEGEND**

- Smear Only Location
- Sample & Smear Location
- Open/Inaccessible Area



29

**RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER**

Survey Area: A

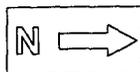
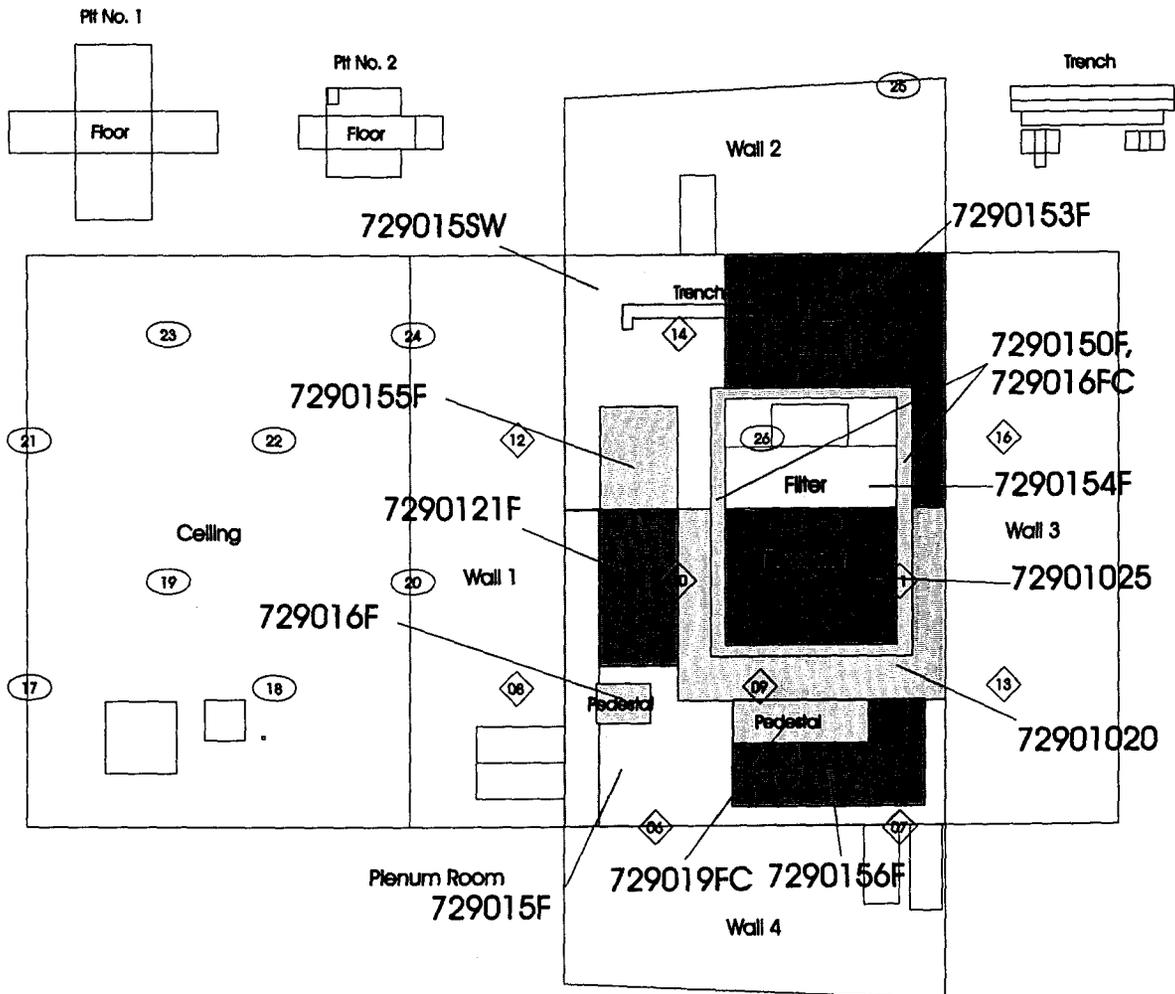
Survey Unit: 72901

Classification: 2

Building: 729

Survey Unit Description: Bldg. 729 Plenum Area

**SURVEY UNIT 72901-MAP 2 OF 2**



**SURVEY MAP LEGEND**

- Smear Only Location
- Sample & Smear Location
- Open/Inaccessible Area

**RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER**

Survey Area: A

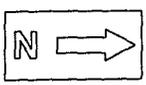
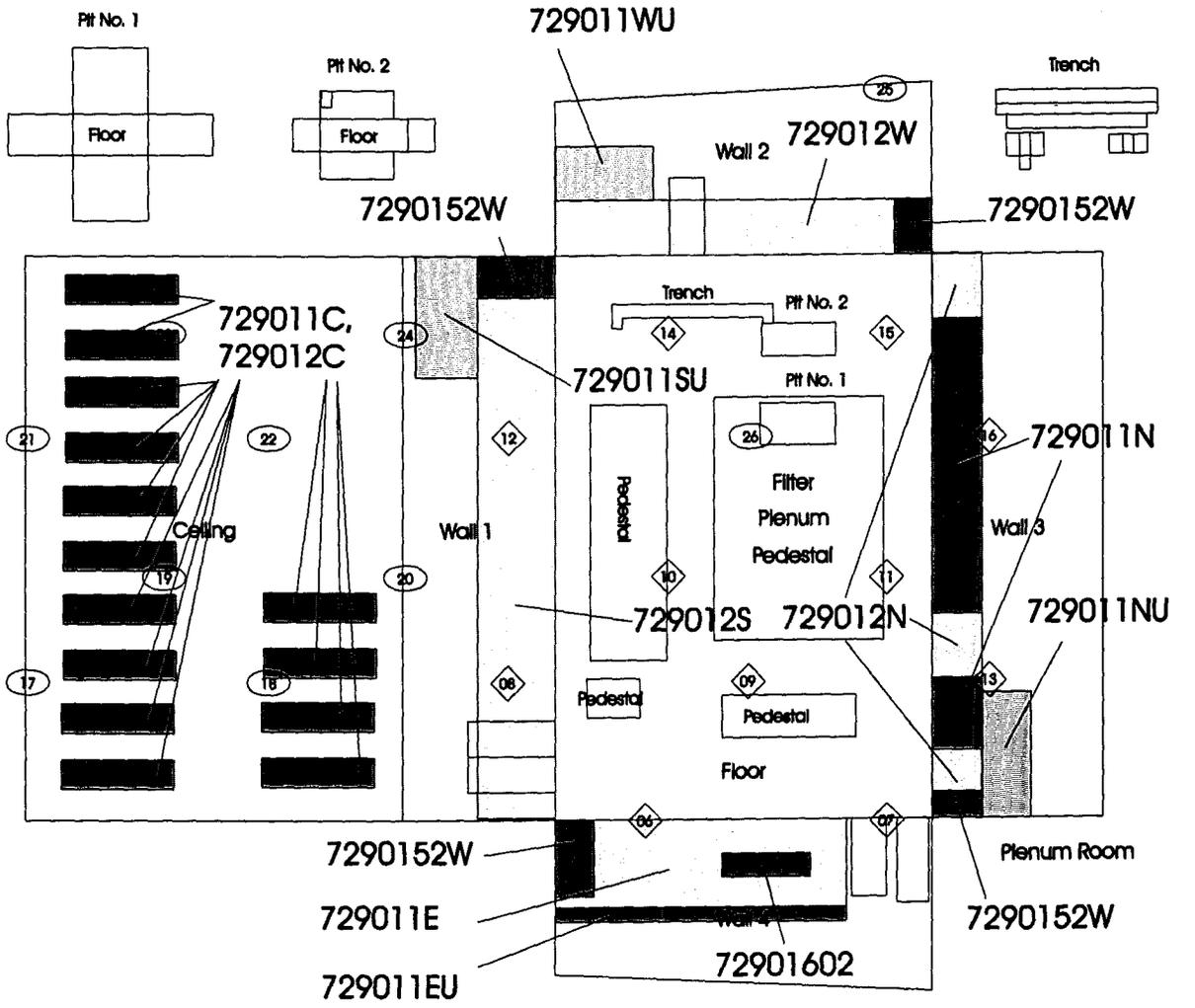
Survey Unit: 72901

Classification: 2

Building: 729

Survey Unit Description: Bldg. 729 Plenum Area

**SURVEY UNIT 72901-MAP 2 OF 2**



**SURVEY MAP LEGEND**

- # Insear Only Location
- Sample & Insear Location
- Open/Inaccessible Area

**RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER**

Survey Area: A

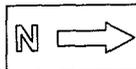
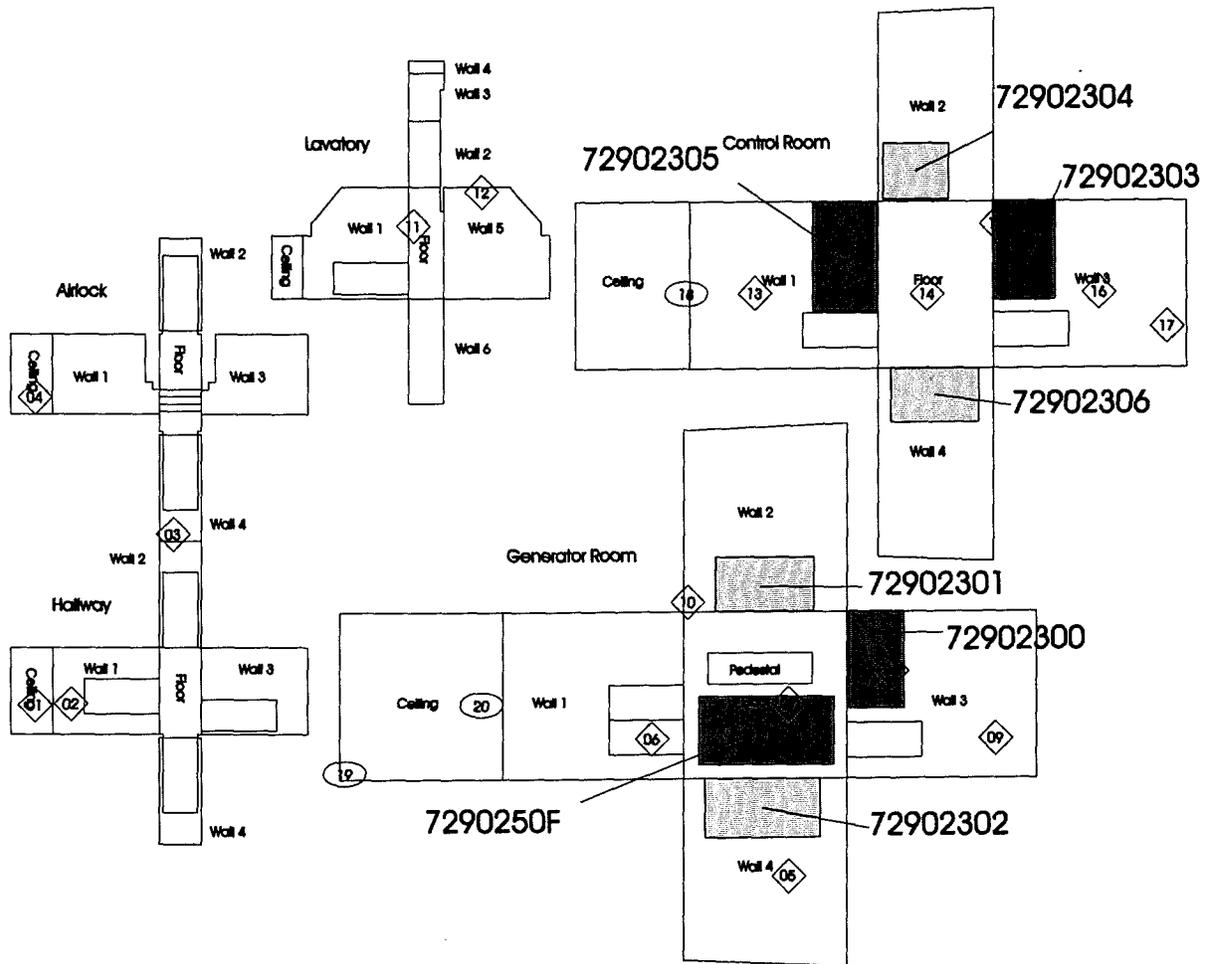
Survey Unit: 72902

Classification: 3

Building: 729

Survey Unit Description: Bldg. 729 Generator Room, Control Room, Airlock/Hallway & Lavatory

**SURVEY UNIT 72902-MAP 1 OF 1**



**SURVEY MAP LEGEND**

- Smear Only Location
- Sample & Smear Location
- Open Area

**RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER**

Survey Area: A

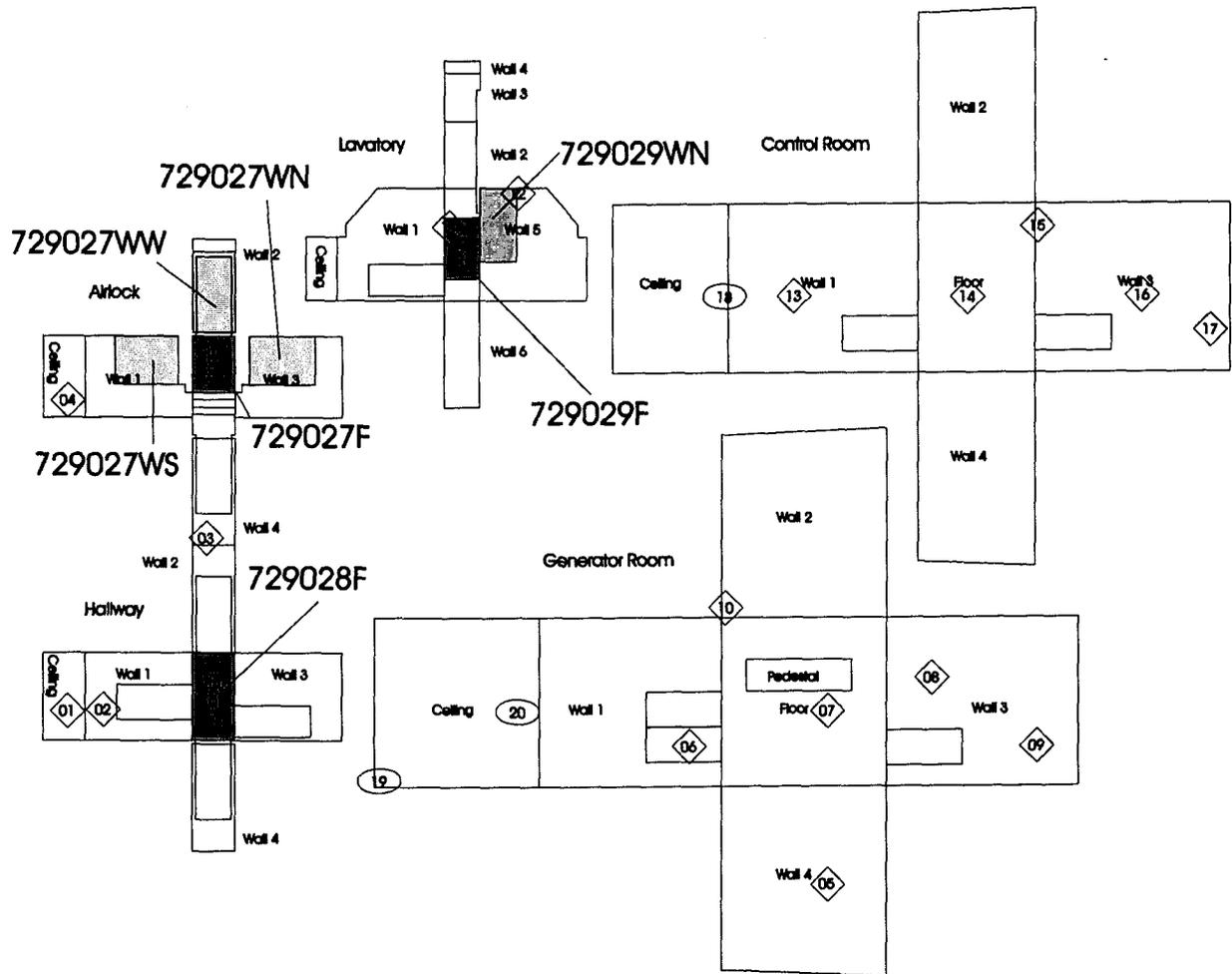
Survey Unit: 72902

Classification: 3

Building: 729

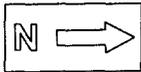
Survey Unit Description: Bldg. 729 Generator Room, Control Room, Airlock/Hallway & Lavatory

**SURVEY UNIT 72902-MAP 1 OF 1**



**SURVEY MAP LEGEND**

- # Smear Only Location
- ◇ # Sample & Smear Location
- Open Area



**RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER**

Survey Area: A

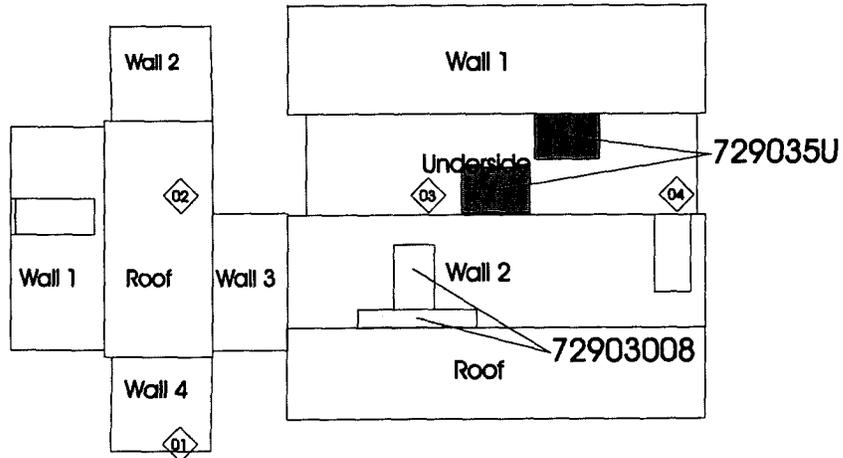
Survey Unit: 72903

Classification: 2

Building: 729

Survey Unit Description: Bldg. 729 Outside Walls, Roof & Duct Bridge

**SURVEY UNIT 72903-MAP 1 OF 2**



**RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER**

Survey Area: A

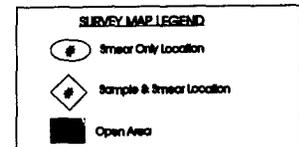
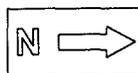
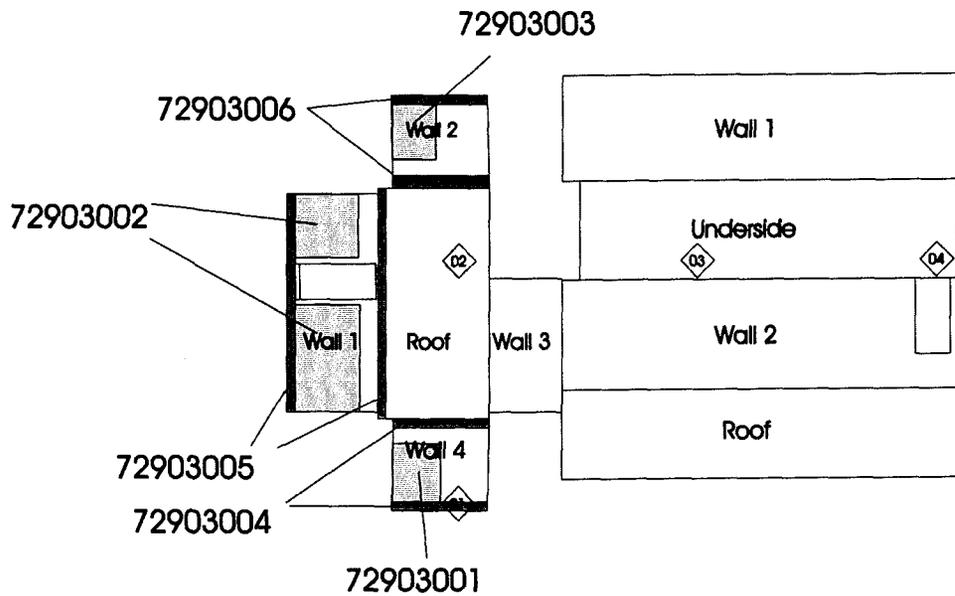
Survey Unit: 72903

Classification: 2

Building: 729

Survey Unit Description: Bldg. 729 Outside Walls, Roof & Duct Bridge

**SURVEY UNIT 72903-MAP 1 OF 2**



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RADIOLOGICAL CLOSEOUT SURVEY PLAN FOR THE 779 CLUSTER

Survey Area: A

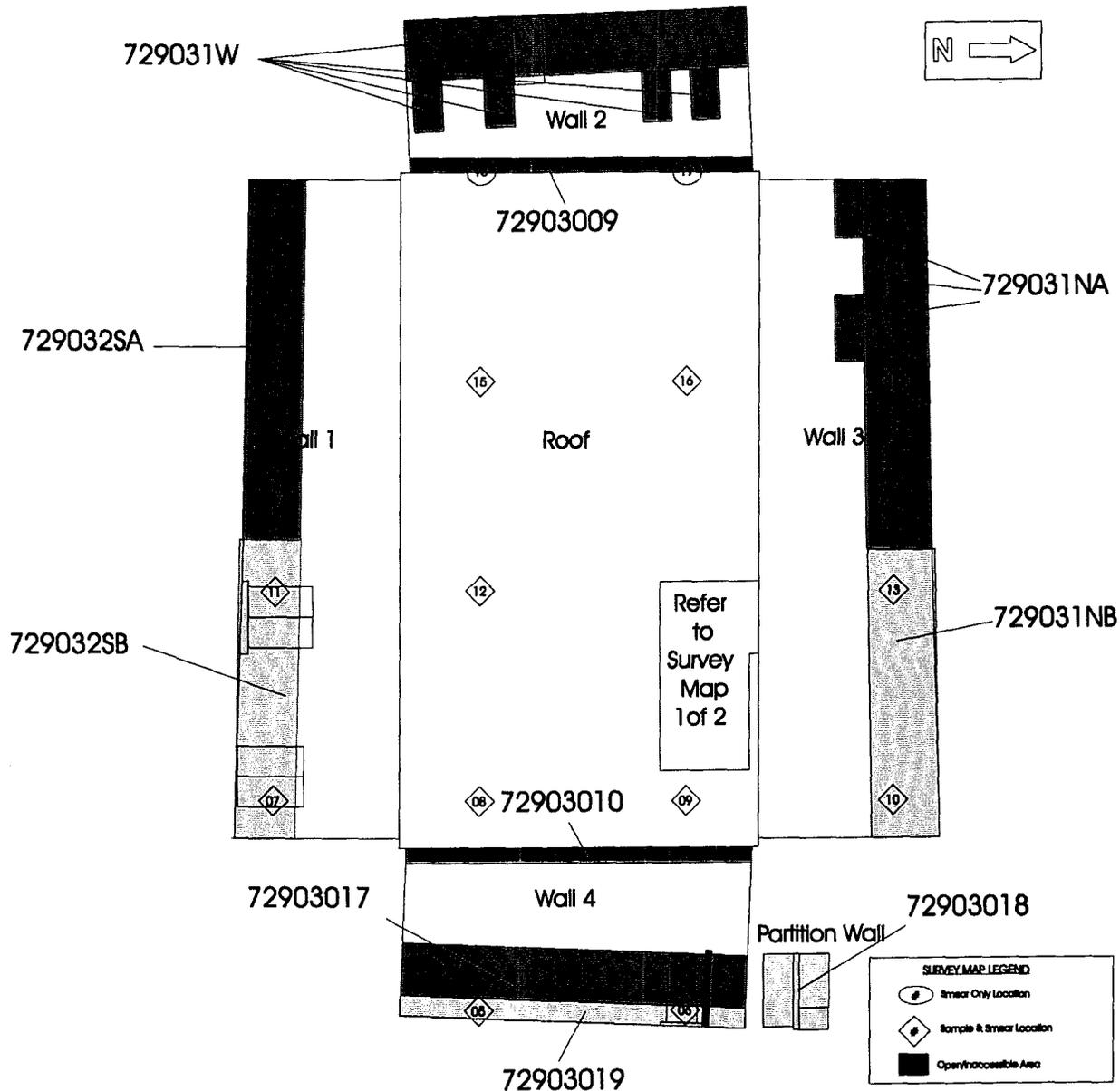
Survey Unit: 72903

Classification: 2

Building: 729

Survey Unit Description: Bldg. 729 Outside Walls, Roof, and Duct Bridge

SURVEY UNIT 72903-MAP 2 OF 2



## QC Control Charts

The QC control charts follow. The QC survey is to be distinguished from the daily source check. The daily source check allows the survey technician to determine that the instrument is responding within acceptable values for voltage and total background subtracted counts using a radioactive source. The QC survey is used to continuously update the control charts. The control charts are used to determine the efficiency of each detector assembly, verify adequate system performance, and to observe trends that may indicate monitoring system problems.

The control chart plots a mean of the Pu-238 source measurements (source strength = 194,400 dpm, reference Attachment E, Source Certificate, NIST Traceability). It also shows the range of plus and minus 20% from the mean value. A typical QC survey contains at least six measurements (or twelve, if a recount assembly is used), which consist of at least three before and three after the radiological survey. Additionally, every three hours, three (or six) more measurements are obtained during the survey.

In a few cases, values have fallen outside of 20% from the mean. Singular events outside the range are not considered failures in the measurement process provided that the other values are within the acceptable range. Single events outside the range are treated as normal statistical occurrences. Therefore, the following charts show no trends that would require resurvey of the Final Status Surveys.

There have been cases during the Building 779 survey where the QC control charts indicated a malfunctioning detector. These surveys were not published as Final Status Surveys. New surveys as well as QC surveys were performed. The problems in this case were due to inadequate gas flow to the detector due to a kink in the gas supply hose.

**APPENDIX 3**  
**Data Quality Assessment**

## DATA QUALITY ASSESSMENT

Data used in making management decisions for waste management remedial actions must be of adequate quality to support the decisions. Adequate data quality for decision-making is required by applicable RMRS and K-H corporate policies (RMRS, 1998, §6.4 and K-H, 1997, §7.1.4 and 7.2.2), as well as by the customer (DOE, RFFO; Order O 414.1, Quality Assurance, §4.b.(2)(b)). Regulators and the public also expect decisions and data that are technically and legally defensible. Verification and validation of the data ensure that data used in decisions resulting from the FSS are usable and defensible.

Verification and validation (V&V) of this RCSR are the primary components of the DQA. V&V constitutes the cornerstone of the DQA because statistical tests and background determinations relative to decision-making for radiological survey units were not implemented nor required per the approved RCSP for the 779 Cluster. Instead, measurement results were compared, on a one-to-one basis, with free-release criteria given in DOE Order 5400.5. The FSS results could, theoretically, be used to conduct Sign Tests for decisions, but because all individual measurements were less than the DCGLs, the survey units meet release criteria without further data reduction. The DQA presented in this Appendix supports conclusions in the report through implementation of the guidelines taken from the following MARSSIM sections:

- §4.9, Quality Control
- §8.2, Data Quality Assessment
- §9.0, Quality Assurance & Quality Control
- Appendix E, Assessment Phase of the Data Life Cycle
- Appendix N, Data Validation using Data Descriptors

## VERIFICATION OF RESULTS

Verification ensures that data produced and used by the project are documented and traceable per quality requirements. Verification consisted of reviewing the project's data relative to three subsets: 1) radiological surveys for removable and total contamination, 2) scan surveys, and 3) radiochemical data resulting from samples taken and subsequently analyzed via alpha spectrometry. Verification confirmed that

- Chain-of-Custody was intact from initial sampling through transport and final analysis;
- preservation and hold-times were within tolerance
- format and content of the data are clearly presented relative to goals of the project, i.e., to determine, with at least 95% confidence, that the Survey Units of interest (Building 729) are adequate for radiological free release.

Verification of the Building 729 FSS data also confirmed Quality records representing implementation of the following quality controls:

- calibrations (radiochemistry & surveys), for accuracy
- laboratory control samples (LCS -- radiochemistry), for accuracy
- blanks (radiochemistry), for accuracy
- duplicate measurements (radiochemistry & surveys), for precision
- chemical yield (radiochemistry), for accuracy
- count times (radiochemistry & surveys), for sensitivity
- sensor efficiencies (radiochemistry & surveys), for accuracy
- sample preparations (radiochemistry), for accuracy, representativeness

In summary, the verification confirmed that documentation and quality records are intact for the project, which in turn corroborates implementation of the required technical quality controls and administrative requirements, particularly verification of those documents and records that will ultimately support the CERCLA Administrative Record. All relevant Quality records associated with the Building 729 D&D final status survey decisions will be submitted to the RMRS Records Center for permanent storage within 30 days of approval of the RCSR.

#### VALIDATION OF RESULTS

Validation consists of a technical review of all data that directly support the FSS decisions, so that any limitations of the data relative to project goals are delineated, and the associated data are qualified (caveated) accordingly. Data were validated relative to

- 1) the DQOs of the project as defined in the RCSP for the 779 Cluster (i.e., did the final data achieve the initial DQOs of the project?), and
- 2) quality criteria discussed throughout various sections in the MARSSIM (sections noted previously).

MARSSIM criteria for the broad topic of "data quality assessment" used in final status surveys generally falls within the generic categories of quality assurance, quality control, data validation, and data assessment (including verification and validation). Table A3-1 provides a "crosswalk" that lists the primary MARSSIM sections and generic data quality criteria (at top) and their corresponding implementation via the RCSP, RCSR, and project files.

All of the significant MARSSIM criteria listed in Table xx-1 are summarily discussed within the "PARCC Parameters" section. PARCC parameters are congruent with "data descriptors" in the MARSSIM parlance and address characteristics of the data that must be defined for scientific integrity and defensibility. The next section, which addresses the PARCC parameters -- Precision, Accuracy, Representativeness, Comparability, and Completeness, will also include discussion on bias and sensitivity, two more data descriptors emphasized in MARSSIM.

Validation of data to K-H contractual requirements (K-H Statements of Work is currently performed on a site-wide basis at ~25% frequency by the K-H Analytical Services Division. Satisfactory validation at this frequency indicates that subcontracted labs are operating competently relative to industry-wide standards, and more specifically, that sample custody and analytical procedures are implemented under defined quality controls on a sitewide programmatic basis. Sitewide data validation coupled with annual lab audits provides the inference that all analytical and radiochemical results not *specifically* validated, are represented by the percentage that is validated. Radiochemistry performed for this FSS were verified as meeting K-H contractual requirements -- Module RC01-B.3 for alpha spectrometry (4/24/98 and Module 9, 7/6/98).

## PARCC Parameters PRECISION

A general, or "robust", V&V of the project's reproducibility, relative to data reduction and decisions, is provided in Section 5.4, and Appendices 2 and 4, which documents the Independent Verification Contractor's final position on the report and any qualifications to the project's methodology and /or conclusions.

### Radiological Surveys

Precision of the radiological instrumentation was satisfactory based on tolerance charting of daily source measurements for each individual sensor used on the project, which includes all measurement types (scans and static measures for total contamination, swipes for removable). Adequate precision was established through instrument performance within a  $\pm 20\%$  range as defined by measurement results compared to a standard source value. Based on standard protocol (*Radiological Safety Practices*) any measurement exceeding the defined tolerance limits required corrective action (repair or replacement) prior to the instrument's use in measurement of real samples.

Duplicate measurements were also periodically acquired ( $\geq 5\%$  frequency of real surveys) on the MARSSIM survey grids; all duplicate measurements were within tolerance based on the acceptance criterion that both results be below DCGL<sub>w</sub>.

### Radiochemistry

Results from laboratory duplicates indicate adequate reproducibility based on duplicate results within statistical tolerance values ( $>90\%$  confidence of equivalency between the original sample and the duplicate). Although blind duplicate samples were not acquired for determination of overall project precision, agreement between the multiple samples to within a range less than the DCGL<sub>w</sub> indicate that reproducibility is adequate for project decisions.

## ACCURACY (and Bias) Radiological Surveys

Accuracy of radiological surveys is satisfactory based on RFETS-programmatic annual calibrations that establish instrument efficiencies and sensitivities for all instrumentation used on this project. Daily source checks also provided periodic checks to ensure that all sensors are within tolerance during daily operations. Calibration and calibration check results were within the RFETS and industry-standard requirement of 20% of the applicable reference standard values.

Distance measurements recorded by the SCM/SIMS are within 3% of actual distances for mapping and location purposes.

No biases were noted in either radiological surveys or radiochemistry data that would cause data to be qualified or rejected.

### Radiochemistry

Accuracies of radiochemical results were within tolerance and acceptable based on the associated results of LCS and calibrations at the lab. Preparation blanks also confirmed that no significant cross-contamination occurred in the analysis process. Uncertainties of the radiochemical results are quantified for each sample by both 2-sigma error (probabilistic) and

Total error (systematic + probabilistic). Uncertainties associated with the alpha-spec analyses were within standard industry magnitudes and did not adversely impact project decisions.

### REPRESENTATIVENESS

Samples and surveys are representative based on the following criteria:

- familiarity with facilities -- multiple walk-downs and collaborations by and within the sampling team;
- implementation of industry-standard Chain-of-Custody protocols;
- compliance with sample preservation and hold times;
- documented and (site) approved methods:
  - radiochemistry - alpha spectrometry via K-H Module RC01-B.3 (4/24/98)
  - radiological surveys – 3-PRO-112-RSP-02.01
- compliance with the RCSP (RMRS, March 1999) -- reviewed & approved by technical and management consensus prior to implementation

### COMPLETENESS

The data set for this project is complete, with respect to both samples acquired and associated quality records ("data packages") resulting from the characterization process. The following table summarizes the minimum required number of samples or surveys, the actual quantity of samples or surveys to date, and the remaining number of samples required for successful completion of the characterization.

| Rad Measurement Type                                  | Required # of Samples/ Surveys     | Actual # of Samples/ Surveys        | Outstanding # of samples b/f completion | Comments     |
|---|------------------------------------|-------------------------------------|---|--------------|
| <b>Survey Unit 72901</b>                              |                                    |                                     |   |              |
| Shonka: SCM/SIMS (total)                              | >10% areal coverage <sup>2,3</sup> | >>10% areal coverage <sup>2,3</sup> | 0                                       | DQO achieved |
| NE Electra (total) <sup>1</sup>                       | 13                                 | 26                                  | 0                                       | DQO achieved |
| Eberline SAC-4 and Tennelec: (removable) <sup>1</sup> | 13                                 | 26                                  | 0                                       | DQO achieved |
| Radiochemical   | 13                                 | 16                                  | 0                                       | DQO achieved |
| <b>Survey Unit 72902</b>                              |                                    |                                     |   |              |
| Shonka: SCM/SIMS (total)                              | >10% areal coverage <sup>2,3</sup> | >>10% areal coverage <sup>2,3</sup> | 0                                       | DQO achieved |
| NE Electra (total) <sup>1</sup>                       | 13                                 | 16                                  | 0                                       | DQO achieved |
| Eberline SAC-4 and Tennelec: (removable) <sup>1</sup> | 13                                 | 18                                  | 0                                       | DQO achieved |
| Radiochemical   | 13                                 | 16                                  | 0                                       | DQO achieved |
| <b>Survey Unit 72903</b>                              |                                    |                                     |   |              |
| Shonka: SCM/SIMS (total)                              | >10% areal coverage <sup>2,3</sup> | >>10% areal coverage <sup>2,3</sup> | 0                                       | DQO achieved |
| NE Electra (total) <sup>1</sup>                       | 13                                 | 17                                  | 0                                       | DQO achieved |
| Eberline SAC-4 and Tennelec: (removable) <sup>1</sup> | 13                                 | 19                                  | 0                                       | DQO achieved |
| Radiochemical   | 13                                 | 17                                  | 0                                       | DQO achieved |

<sup>1</sup>see data summaries for additional "Post-media" surveys, i.e., following paint scrapes

<sup>2</sup>MARSSIM guidelines are 10% to 100% for Class 2 units; Radiological Engineering professional judgement (stated in the RCSP) yielded ~100% coverage for floors and walls to 2m height; 10% of remaining room surface areas.

<sup>3</sup>Required scan frequencies were verified and documented in the project history file.

Consistent with EPA's G-4 DQO process, the sampling design was optimized through back-calculating actual measurement results (acquired during final status survey) and comparing model output with original estimates. Use of actual sample- / survey (result) variances in MARSSIM's DQO model provided confirmation that an adequate number of samples/surveys had been acquired. Inputs required for decision-making, as stated in the original (planning) DQOs, were acquired, including coverage of originally-planned 3-dimensional boundaries of the structure. All radiological results are valid without qualification, and form data sets with adequate quantities and quality of data for free-release decisions on the three Survey Units of interest.

#### COMPARABILITY

All results presented are comparable with radiological survey and radiochemistry data on a site- and DOE-complex wide basis. This comparability is based on

- use of standardized engineering units in the reporting of measurement results
- consistent sensitivities of measurements at  $\leq 50\%$  DCGLs
- use of site-approved procedures (RSPs)
- systematic quality controls
- thorough documentation of the planning, sampling/analysis process, and data reduction into formats designed for making decisions posed from the project's original data quality objectives.

#### SENSITIVITY

Adequate sensitivities, in units of dpm/100<sup>2</sup> cm, were attained for all surveys and radiochemical methods implemented based on MDAs at 50% of the transuranic DCGLs. The nominal sensitivities for each survey and radiochemical method are summarized as follows:

- SCM/SIMS - scan surveys:  $\sim < 150$  dpm/100cm<sup>2</sup>
- Surveys (Eberline SAC-4) - removable contamination: 4 dpm/100cm<sup>2</sup>
- Surveys (NE Electra) - total contamination: 50 dpm/100cm<sup>2</sup>
- Radiochemistry (alpha spec) - total contamination:  $< 1$  dpm/100cm<sup>2</sup>

#### 4.3.7 Summary

In summary, the data presented in this report have been verified and are qualified as valid and complete for comparison with free-release criteria (action levels) as stated in the original DQOs. All media sampled and surveyed, relative to both total and removable alpha activities, yielded results less than action levels for the associated contaminants of concern. Therefore, the Survey Units in question meet the free-release criteria with the confidences stated in this section and throughout the report.

#### OTHER QA ELEMENTS

All personnel performing quality-affecting activities within the FSS project were qualified to perform their specific tasks. Suitable training and qualification documentation for personnel performing the work, from the laborers to technical professionals to management, is documented in several ways. T&Q status for personnel is included in the *Building 779 Cluster Closure Project Health & Safety Plan* (Rev. 6, 18 August 1998) and personnel dossiers controlled by company-specific Human Resource departments.

over a 1800 cm<sup>2</sup> detector surface. The SCM, surveying at 2.5 cm/sec, would survey a square meter in 22.2 seconds. Thus, the instrument background was calculated as 4.5 counts. Use of this inherent instrument background, and an average efficiency of 30% (mid-range for the detectors utilized) in the MDC formula presented in NUREG-1507 (section 3, Table 3.1, reference Strom & Stansbury 1992) results in *a priori* MDC values for a square meter of approximately 100 dpm. This value equates to an average of 1 dpm/100 cm<sup>2</sup>. This value is below the instrument performance goal established for this survey.

Similarly, the instrument background for the 90 cm. x 10 cm. detector was determined to be 8.0 cpm. A one m<sup>2</sup> survey would result in an inherent instrument background of 5.9 counts. A 90 cm. x 10 cm. detector would complete the survey in 44.4 seconds. The efficiency of the 90 cm. x 10 cm. detectors range from 30% to 39%. The mid-range for the detectors utilized, 34.5% is used. The 34.5% efficiency and the stated background are used in the Strom & Stansbury MDC equation with a resultant MDC of 61.1 dpm. This value equates to an average of less than 1 dpm/100 cm<sup>2</sup>.

The results provided are established for detectors operated in the encoder mode. Corner detectors would result in lower MDCs because they are used with longer count times, and because the efficiencies are higher than those for rolling detectors.

The attached spreadsheets use equation 1-1 (Strom & Stansbury) to determine MDC. For a detector background of 12.2 cpm for the 180 cm. x 10 cm. detector, and 8.0 cpm for the 90 cm. x 10 cm. detector, and a 30% detector efficiency. The count time of 22.2 seconds for the 180 cm. x 10 cm. detector yields a square meter MDC of 100.7 dpm. This equates to a 100 cm<sup>2</sup> average over the square meter of 1.007 dpm. The count time of 44.4 seconds for the 90 cm. x 10 cm. detector yields a square meter MDC of 66.1 dpm. This equates to a 100 cm<sup>2</sup> average over the square meter of 0.661 dpm.

$$MDC = \frac{3 + 3.29 \sqrt{R_b t_g \left(1 + \frac{t_g}{t_b}\right)}}{(Efficiency)(t_g)} \quad (1-1)$$

where:

R<sub>b</sub> = background count rate  
t<sub>g</sub> = gross count time  
t<sub>b</sub> = background count time

Field survey results confirm that the inherent instrument background was well below the total counts accumulated during actual surveys of painted concrete surfaces within building 729 (approximately 300 counts in a one m<sup>2</sup> area). The measured value on uncontaminated painted concrete surfaces equated to an activity level of 10 dpm/100 cm<sup>2</sup> averaged over a square meter. This is well above the detection limit and shows that the system is responding to natural radioactivity in the surface or fallout bearing radon progeny (dust) on the surface.

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Analysis of expected values from naturally-occurring radioactive materials in various surfaces at the Rocky Flats Environmental Technology Site (RFETS) indicates that a mean value of 10 to 20 dpm/100 cm<sup>2</sup> on painted concrete surfaces can be expected. This site data is based on measurements obtained at various non-impacted site buildings including buildings 111, 112, and 443. Evaluation of the data obtained from surveys within building 123 and reported in the final survey report also show actual measurements with an average 100 cm<sup>2</sup> activity over 1 m<sup>2</sup> areas of approximately 10 dpm. The measured values are consistent with those reported for concrete in NUREG 1507, Section 5.3.2. This data provides further evidence that SCM/SIMS reported measurements of average one m<sup>2</sup> values of approximately 10 dpm/100cm<sup>2</sup> are valid measurements.

Therefore, the values measured provide true indication of the SCM/SIMS sensitivity and average 1 m<sup>2</sup> sensitivity of less than 10 dpm/100 cm<sup>2</sup> can be asserted. This value establishes that SCM/SIMS can detect radioactivity at the naturally occurring radioactivity level. This value is well below 50% of the DCGL<sub>w</sub>, the system sensitivity required for this survey. The asserted sensitivity is consistent with that established in the Technical Basis Document developed and approved at RFETS for the use of SCM/SIMS as a final survey instrument for building 123 ("Qualification of SRA/Millennium Services, Inc. Data for Use in Building 123 Final Survey" – RLM-004-98).

Evaluation of SCM/SIMS sensitivity against the survey performance goal of 50% of the DCGL<sub>EMC</sub> can be performed in a similar manner (refer to equation 1-1). Since only inherent instrument background is considered when determining the MDC, the backgrounds determined with particle board placed over the detector can be applied. The 180 cm. x 10 cm. detector background for any 100 cm<sup>2</sup> area is 12.2 cpm/18 = 0.677 cpm. Eighteen represents the number of 100 cm<sup>2</sup> areas in the probe area. For the 90 cm. x 10 cm. detector, the background is 8.0 cpm/9 = 0.889 cpm (nine represents the number of 100cm<sup>2</sup> areas in the probe area). These background values and the detector efficiency of 30% are used in the Strom & Stansbury MDC equation, with results again highlighted in the attached spreadsheets. The appropriate count time for either size detector is 4 seconds for the SCM used in the encoder (rolling) mode, and 8 seconds for the timer (corner detector) mode. The resultant maximum 100 cm<sup>2</sup> MDCs are:

|                                   |                               |
|-----------------------------------|-------------------------------|
| 180 cm. x 10 cm. 4 second rolling | 186.1 dpm/100 cm <sup>2</sup> |
| 90 cm. x 10 cm. 4 second rolling  | 166.4 dpm/100 cm <sup>2</sup> |
| 180 cm. x 10 cm. 8 second corner  | 101.3 dpm/100 cm <sup>2</sup> |
| 90 cm. x 10 cm. 8 second corner   | 104.9 dpm/100 cm <sup>2</sup> |

The MDCs for detectors used in the encoder (rolling) mode range from 55% to 65% of the instrument performance goal for the DCGL<sub>EMC</sub>. The SCM/SIMS used in the encoder mode includes a recount detector that performs a second survey of the area. Although this data is normally not averaged with the primary detector unless areas of specific interest are identified, the recount data provides opportunities to reduce the MDC if necessary. The MDCs for detectors used in the encoder mode are below the 225 dpm/100 cm<sup>2</sup>



RF/RMRS-99-358.UN

# **Closeout Radiological Survey Report**

## **For Building 729**

**Rocky Mountain Remediation Services, L.L.C.**

**Millennium Services Inc.**

**Revision 0**

**April 1999**

**Volume 2**

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## Introduction

Survey 72901020 was conducted on April 23, 1999 by STANLEY/PILKINGTON as part of the 78201 survey. Data was gathered using SRA Surface Contamination Monitor, SCM2. The Position Sensitive Proportional Counter was operating with an efficiency of 35%. The SRA Survey Information Management System was used to provide visual imaging and analysis of the survey data and to generate this report.

## Surface Activity Levels

The SCM measures and records activity in  $25 \text{ cm}^2$  areas called pixels. Each square meter contains 400 individual pixels. These pixels are summed into  $100 \text{ cm}^2$  areas for comparison to the DCGLs. To evaluate the measured activity levels against the DCGLs, consecutive  $100 \text{ cm}^2$  sums are offset by  $25 \text{ cm}^2$  pixels, thus ensuring that all possible  $100 \text{ cm}^2$  combinations of the data are considered.

Total measured activity for 72901020 ranged from 0 to 69 dpm/pixel.  $100 \text{ cm}^2$  data ranged from 0 to 171 dpm/ $100 \text{ cm}^2$ . An interpolated surface plot of the data is provided in Figure 1. A light source is simulated to add definition via shadows to the artifacts in the image.

## Square Meter Data

Conventional statistics are provided by SIMS. The survey is divided into meter grids. Table 1 reports the  $100 \text{ cm}^2$  data for mean, min, max, and standard deviation for each grid. Table 1 also reports the number of  $100 \text{ cm}^2$  areas containing data for each grid. Figure 2 shows the grid pattern. Bold text denotes grids which exceed either DCGL.

# COMPARISON OF RESULTS WITH GUIDELINES

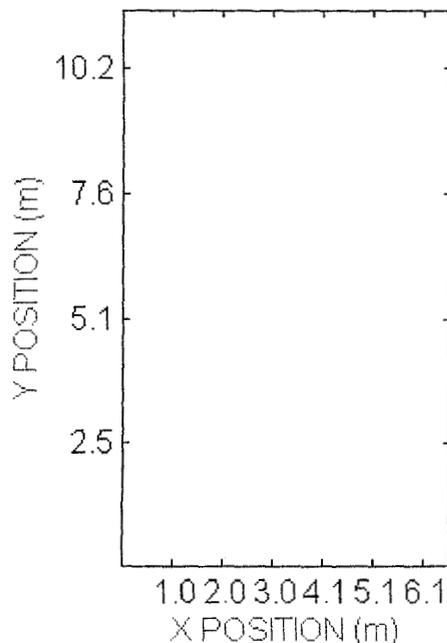
The survey data provided by the SRA Surface Contamination Monitor, serial number SCM2, was compared to the following criteria. The DCGLs were calculated by adding an observed background of 0 dpm/100 cm<sup>2</sup> to the survey criteria.

**DOE Order 5400.5 Criteria**  
100 dpm/100 cm<sup>2</sup>, averaged over 1m<sup>2</sup>  
300 dpm/100 cm<sup>2</sup>, maximum in 100 cm<sup>2</sup>

**Total Activity Limits**  
DCGL<sub>W</sub> = 100 dpm/100 cm<sup>2</sup>, averaged over 1m<sup>2</sup>  
DCGL<sub>BMC</sub> = 300 dpm/100 cm<sup>2</sup>, maximum in 100 cm<sup>2</sup>

The survey results indicate that surface activity levels averaged over one square meter were below the DCGL<sub>W</sub>.

The survey results indicate that the maximum surface activity levels in the 100 square centimeter zones were above the DCGL<sub>BMC</sub>. Figure 3 details which zones were above the DCGL<sub>BMC</sub>:



**Figure 3** Yellow pixels correspond to the upper left coordinate of a 100cm<sup>2</sup> area exceeding the DCGL<sub>BMC</sub>.

# COMPARISON OF RESULTS WITH GUIDELINES

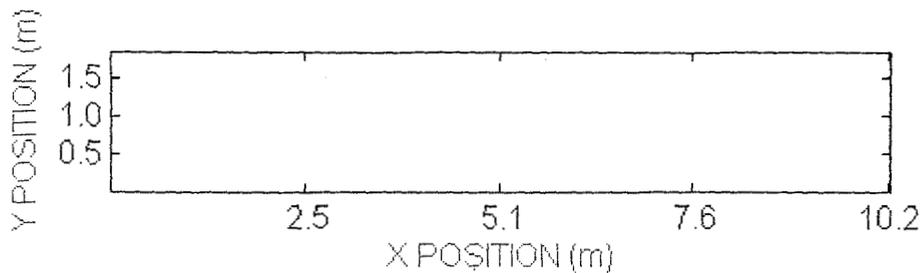
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DCGL<sub>w</sub> = 100 dpm/100 cm<sup>2</sup>, averaged over 1m<sup>2</sup>  
DCGL<sub>EMC</sub> = 300 dpm/100 cm<sup>2</sup>, maximum in 100 cm<sup>2</sup>

The survey results indicate that surface activity levels averaged over one square meter were below the DCGL<sub>w</sub>.

The survey results indicate that the maximum surface activity levels in the 100 square centimeter zones were above the DCGL<sub>EMC</sub>. Figure 3 details which zones were the DCGL<sub>EMC</sub>:



**Figure 3** Yellow pixels correspond to the upper left coordinate of a 100cm<sup>2</sup> area exceeding the DCGL<sub>EMC</sub>.

# COMPARISON OF RESULTS WITH GUIDELINES

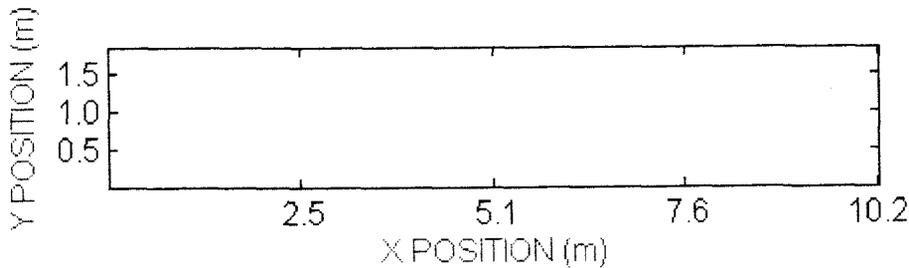
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**Figure 3** Yellow pixels correspond to the upper left coordinate of a 100cm<sup>2</sup> area exceeding the DCGL<sub>EMC</sub>.

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# COMPARISON OF RESULTS WITH GUIDELINES

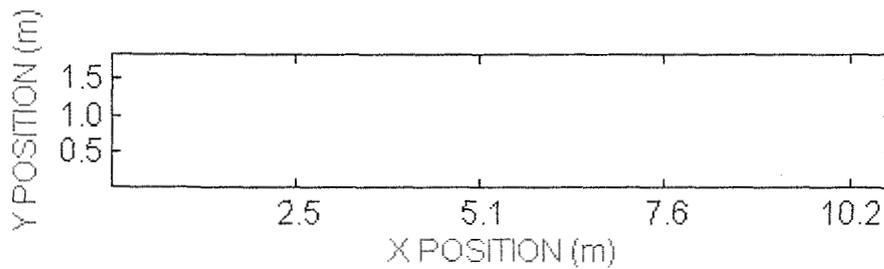
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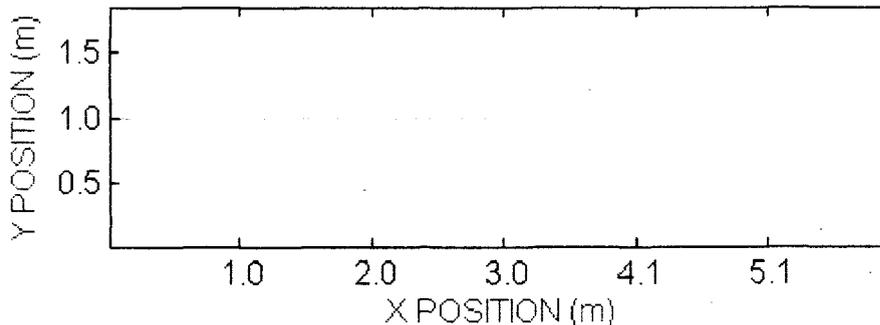
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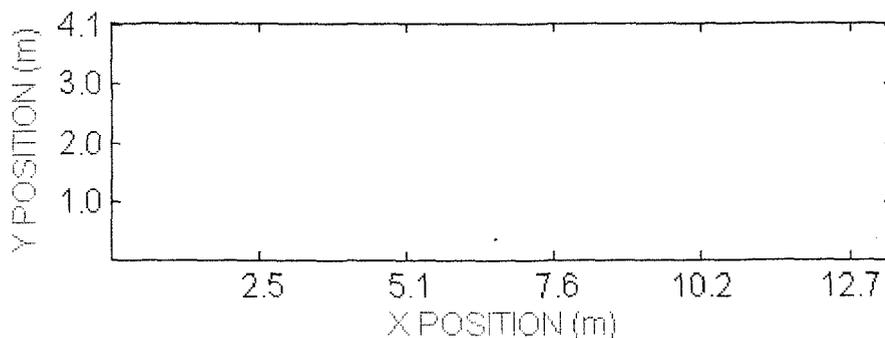


Figure 3. Yellow pixels correspond to the upper left coordinate of a 100cm<sup>2</sup> area exceeding the DCGL<sub>EMC</sub>.



Rocky Mountain  
Remediation Services, L.L.C  
*... protecting the environment*

RF/RMRS-99-358.UN

# **Closeout Radiological Survey Report**

## **For Building 729**

**Rocky Mountain Remediation Services, L.L.C.**

**Millennium Services Inc.**

**Revision 0**

**April 1999**

**Volume 3**

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### VOLUME 2

|              |  |
|--------------|--|
| Attachment A | Survey Unit 72901 Media/Contamination Results and Maps |
| Attachment B | Survey Unit 72902 Media/Contamination Results and Maps |
| Attachment C | Survey Unit 72903 Media/Contamination Results and Maps |
| Attachment D | SCM/SIMS Surface Contamination Survey Results and Maps |

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VOLUME 3

- Attachment E Source Certificate – NIST Traceability
- Attachment F Survey Investigation Results
- Attachment G 779 Cluster Final Survey Breakdown Structure
- Attachment H Survey Unit 72901 Survey Package
- Attachment I Survey Unit 72902 Survey Package
- Attachment J Survey Unit 72903 Survey Package
- Attachment K Technical Basis Document for SRA/Millennium Services, Inc. Data Qualification

**Summary of Changes to 729 Report**

| <b>Comment Originator</b> | <b>Comment</b>  | <b>Response</b>  | <b>Affected Pages</b>          |
|---------------------------|---|--|--------------------------------|
| EPA                       | ".....Please reword removing "779 Cluster" and adding "Building 729....."   | The last sentence of section 1.1 was reworded as follows: "Each survey area and survey unit for Building 729 is accounted for on Attachment G..."  | Volume 1<br>p. 5               |
| IVC                       | Comment 2<br>Change "972901" to "72901"   | Corrected.   | Volume 1<br>p. 5               |
| IVC                       | Comment 5<br>Change "...Building 779 DCGLs" to "Building 779 Cluster DCGLs."  | Corrected.   | Volume 1<br>p. 7               |
| IVC                       | Comment 7<br>Change "...Building 779 DCGLs" to "Building 779 Cluster DCGLs."  | Corrected.   | Volume 1<br>p. 8               |
| IVC                       | Comment 9<br>Add the word "background" between "of" and "counts".   | Added.   | Volume 1<br>p. 10              |
| IVC                       | Comment 10<br>Reword statement.   | Statement reworded as follows...."These low values indicated that the instrument background had an insignificant impact on the SCM ability to...." | Volume 1<br>p. 10              |
| IVC                       | Comment 17<br>Reword/clarify "level of concern."  | Reworded as "investigation level."   | Volume 1<br>p. 14              |
| IVC                       | Comment 34<br>Change title to "Radiological Closeout Survey for the 779 Cluster" on each map.<br><br>Correct map numbering. | Corrected.   | Volume 1<br>Appendix 1         |
| IVC                       | Comment 37  | The reference to "voltage" was deleted.  | Volume 1<br>Appendix 2         |
| IVC                       | Comment 43<br>Change RCSR to CRSR and RCSP to CRSP.   | Corrected.   | Volume 1<br>Appendix 3<br>p. 1 |
| IVC                       | Comment 47<br>Change RCSR to CRSR and RCSP to CRSP.   | Corrected.   | Volume 1<br>Appendix 3<br>p. 2 |
| IVC                       | Comment 51  | - Deleted incorrect references to section 5.4 and Appendix 4.<br>- Deleted statement on IVC position.  | Volume 1<br>Appendix 3<br>p. 3 |
| IVC                       | Comment 54  | Corrected statement to reflect the following: if   | Volume 1<br>Appendix 3         |

|     |  |   |                                |
|-----|--|---|--------------------------------|
|     |  | first performance check fails, the next 2 (i.e. 2 of 3) must pass the criteria for continued use of the instrument. If 2 of 3 fail, the instrument is labeled and removed from service until repairs are effected.        | p. 3                           |
| IVC | Comment 55<br>The third paragraph states that duplicate measurements were acquired of "real surveys." What is a "real survey"?                         | Changed to "total surface activity surveys."  | Volume 1<br>Appendix 3<br>p. 3 |
| IVC | Comment 56<br>There is no evidence provided in the report of any duplicates for smear surveys. If they were not done, this needs to be stated.         | Clarified. (see response to comment 55).  | Volume 1<br>Appendix 3<br>p. 3 |
| IVC | Comment 60   | Modified text to explain that full-scale calibrations comply with the +/- 10% specification, whereas periodic performance checks, which are not as rigorous as full-scale calibrations, comply with the +/- 20% standard. | Volume 1<br>Appendix 3<br>p. 3 |
| IVC | Comment 62   | Retracted "no biases" statement. Acknowledged bias, but explained that the bias does not affect the conclusion of the final survey.   | Volume 1<br>Appendix 3<br>p. 3 |
| IVC | Comment 65<br>Should be reworded since this report is not for a characterization survey.   | Changed to "final status survey."   | Volume 1<br>Appendix 3<br>p. 4 |
| IVC | Comment 66<br>Change RCSP to CRSP.   | Corrected.  | Volume 1<br>Appendix 3<br>p. 4 |
| IVC | Comment 69<br>Comment 71   | Reworded the statement to represent that instrument sensitivities were consistently not < 50% of the DCGLs.   | Volume 1<br>Appendix 3<br>p. 5 |
| IVC | Comment 73<br>In the second paragraph, the MDC for the 90 cm detector is given as 61.1 dpm/100 cm <sup>2</sup> . The table on page seven gives the MDC | Corrected.  | Volume 1<br>Appendix 4<br>p. 3 |

|       |   |   |                                       |
|-------|---|---|---------------------------------------|
|       | for this detector as 53.1 dpm/100 cm <sup>2</sup> .   |   |                                       |
| IVC   | Comment 74<br>"...It goes on to state that the MDC for the 90 cm detector is calculated as 66.1 dpm/100 cm <sup>2</sup> , however in the second paragraph it gives an MDC of 61.1 dpm/100 cm <sup>2</sup> , and in the table on page seven it gives an MDC of 53.1 dpm/100 cm <sup>2</sup> ." | Corrected.  | Volume 1<br>Appendix 4<br>p. 3        |
| IVC   | Comment 75<br>In the third paragraph, the MDC for the 90 cm corner detector is given as 104.9 dpm/100 cm <sup>2</sup> , but in the table on page nine it gives an MDC for this detector of 91.4 dpm/100 cm <sup>2</sup> ."  | Corrected   | Volume 1<br>Appendix 4<br>p. 4        |
| CDPHE | (p. 72901020-1) states "survey 72901020 was conducted....as part of the 78201 survey." Is "78201" correct?  | Corrected.  | Volume 2<br>72901020-1 subunit report |
| CDPHE | ....The grid on page 5 (of 7299015f) does not show their location.  | These faded out figures were replaced as necessary. | Volume 2<br>729015f subunit report    |

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