National Aeronautics and
Space Administration

John H. Glenn Research Center
Lewis Field
Cleveland, OH 44135–3191

September 30, 2010

Reply to Attn of: QS

U.S. Nuclear Regulatory Commission
Region III
2443 Warrenville Road, Suite 210
Lisle, IL 60532-4352

Subject: License #34-00507-16, Docket #030-05626

The NASA John H. Glenn Research Center would like to expand the authorized activities associated with its Part 30 license to include tasks necessary to perform the radiological characterization of potentially impacted areas as well as related assessment and clearance surveys (e.g. Final Status Survey). These activities would include the sampling of structural materials, equipment, components, the removal of interference to support such sampling and surveys, and the analysis of the collected samples. This work will be performed using work control documents which are prepared, internally approved, and then issued for such activities. Included with this correspondence are examples of such documents, procedures, and survey requests to address concrete core boring and volumetric metals sampling. Such documents may be updated or revised as our conditions and needs change.

In concert with the previous paragraph, we also request that Condition #10, "Licensed material may be used and stored at John H. Glenn Research Center at Lewis Field, 21000 Brookpark Road, Cleveland, Ohio and may also be stored at Plum Brook Station, 6100 Columbus Avenue, Sandusky, Ohio" be modified to read "Licensed material may be used and stored at the John H. Glenn Research Center facilities at Lewis Field, 21000 Brookpark Road, Cleveland, Ohio and at Plum Brook Station, 6100 Columbus Avenue, Sandusky, Ohio." This change will enable us to take cyclotron characterization samples (i.e. byproduct material) collected at our Lewis Field facility and have them analyzed at the radiological laboratory located at our Plum Brook Station location. Said samples will be returned to the Lewis Field location following analyses. Finally, please remove Gayle Reid from Condition #11 of the license.

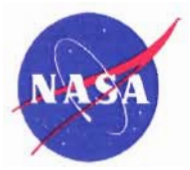
Should you have questions or require additional information, you may contact Mr. Christopher J. Blasio, Radiation Safety Officer at (216) 433-6520.

Manuel B. Dominguez
Chief Institutional Safety Officer

Keith M. Peecook
Plum Brook Decommissioning
Program Manager

5 Enclosures:
Survey Methodology to Support Radiological Characterization (CP-1)
Sample Chain of Custody Controls (CP-2)
Sample Preparation (CP-3)
Survey Request SR-5 for Metals Sampling
Survey Request SR-3 for Volumetric Concrete Sampling

Enclosure 1



SAFETY AND MISSION ASSURANCE DIRECTORATE

GRC Cyclotron Facility

Survey Methodology to Support Radiological Characterization

CP-1
(Revision 0)

NASA GRC CYCLOTRON FACILITY
ROUTING AND APPROVAL SHEET

Document Title: Survey Methodology to Support Radiological Characterization

Document Number: CP-1 **Revision Number:** 0

ROUTING

	Signature	Date
Originator	**W. Stoner /**	3/23/10
Review and Concurrence:		
Independent Technical Reviewer	**R. Case /**	3/29/10
NASA Decommissioning Program Manager	**K. Peecook /**	3/29/10

IMPLEMENTING APPROVAL: _____ / 3/29/10
Date

EFFECTIVE DATE: 3/29/10

NASA GRC CYCLOTRON FACILITY
CHANGE/CANCELLATION RECORD

DOCUMENT TITLE:	DOCUMENT NO: CP-1	REVISION NO: 0
Survey Methodology to Support Radiological Characterization		

Revision 0: Initial issue of Document

LIST OF EFFECTIVE PAGES

DOCUMENT NO: CP-1 **REVISION NO:** 0

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1.0 INTRODUCTION

1.1. Purpose

The purpose of this procedure is to provide direction for the performance of radiological surveys that support the radiological characterization of the Glenn Research Center (GRC) Cyclotron Facility.

1.2. Scope

This procedure provides specific instructions for the performance of radiological surveys and collection of samples to support radiological characterization. It applies to all personnel who perform, supervise, or direct radiological characterization activities.

2.0 REFERENCES

2.1 Applicable Documents

2.1.1 CP-2 - Sample Chain of Custody Controls

2.1.2 CP-4 - Operation of Portable Radiological Survey Instruments

2.1.3 CP-5 - Radiological Survey Documentation

2.1.4 10 CFR 61.55 - Title 10 Code of Federal Regulations, Part 61.55, "Waste Classification"

2.1.5 Characterization Plan for the GRC Cyclotron Facility

2.1.6 NASA GRC Safety Manual, Chapter 35 - Digging, Trenching, & Excavation Procedures

2.1.7 NASA GRC Safety Manual, Chapter 33 - Job Hazard Analysis

2.2 Records

2.2.1 Exhibit 1 - Survey Request Form

2.2.2 Exhibit 2 - Survey Request Continuation Sheet

2.2.3 Exhibit 3 - Survey Request Sample Analysis Sheet

2.2.4 Exhibit 7 - Quality Checking Inspection Form

2.2.5 Exhibit 9 - Survey Data Verification and Validation Form

2.3 Definitions

2.3.1 Average Background Count Rate (ABCR) - A series of static measurements (at least three) taken in low background areas of a survey area immediately before a scan measurement survey is performed. The collected measurements are averaged to obtain the ABCR.

2.3.2 Chain of Custody - An unbroken trail of accountability that ensures the physical security of samples. It refers to the identification of samples, their location, and the individuals responsible for their custody and transfer of custody. Chain of custody begins with the taking of a sample and remains intact through the analysis and final holding or disposal. Sample chain of custody controls are provided in Reference 2.1.1.

2.3.3 Characterization Survey - Radiological surveys that are performed to determine the nature and extent of contamination in an area. Characterization Surveys provide the basis for acquiring necessary technical information to develop, analyze, and select appropriate remediation techniques.

2.3.4 Non-substantive Corrections or Alterations - Document revisions that do not affect the scope, meaning or intent of the document (e.g., correction in spelling, correction of typographical errors, minor document clarifications, etc.).

2.3.5 Quality Checking - A quality control (QC) check, which includes direct observations of survey activities (i.e., survey measurements, sample collections, sample preparation and analysis).

2.3.6 Reference Coordinate Grid System - A set of intersecting lines referenced to a fixed site location or benchmark, typically arranged in a perpendicular pattern, dividing the survey locations into squares or blocks of equal size.

2.3.7 Scan Measurement - A radiological monitoring technique that is performed by moving a detector over a surface at a specified speed and distance to detect elevated areas of radioactivity. Also referred to as "Surface Scan" or "Scan Survey".

2.3.8 Site Diagrams - Maps, photographs, sketches, drawings, or Radiological Survey Forms that have been approved by the Characterization Engineer for use during survey activities.

2.3.9 Smear - An absorbent disc, approximately 1.75 inches in diameter, used to sample 100 cm^2 of an item or area for loose surface contamination by smearing or wiping.

2.3.10 Static Measurement - A radiological monitoring technique that is performed by placing a detector on or at a specified distance from the surface of interest and obtaining measurements over a discrete time interval. Also referred to as "direct measurement".

3.0 RESPONSIBILITIES

3.1 NASA Decommissioning Program Manager

The NASA Decommissioning Program Manager will be responsible for planning and directing characterization work activities and will maintain ultimate responsibility for the safe completion of all work activities performed under this procedure. The NASA Decommissioning Program Manager will serve as the primary point of contact between NASA and the characterization contractor.

3.2 NASA Radiation Safety Officer (RSO)

The NASA RSO is responsible for organizing, administering, and directing the radiation protection program at the GRC Cyclotron Facility and for providing oversight during implementation of characterization activities.

3.3 Characterization Manager

The Characterization Manager is responsible for the organization, administration, development, and implementation of the Characterization Program. He/she is also responsible for technical review and approval of Survey Request (SR) packages.

3.4 Characterization Engineer

The Characterization Engineer provides technical direction for the characterization effort, including development and closure of SR packages. The Characterization Engineer reports to the Characterization Manager.

3.5 Characterization Technicians

Characterization Technicians are responsible for performance of characterization surveys in accordance with the instructions included in this procedure and SR packages. Characterization Technicians report to the Characterization Engineer.

4.0 PROCEDURE

4.1 Prerequisites/General Requirements

4.1.1 Ensure that an approved SR Form (Exhibit 1) is available for the area to be surveyed and/or sampled. The Characterization Engineer will complete the SR in accordance with Exhibit 4.

4.1.2 Ensure that adequate site diagrams are available for the area to be surveyed and/or sampled. Static measurement and/or sample points will be labeled on diagrams and be easily identified by coordinates, landmarks, site boundaries, or reference coordinate grid system.

4.1.3 Ensure that all areas to be surveyed and/or sampled are accessible and unobstructed. Make arrangements for the movement or staging of equipment or materials, as necessary.

4.1.4 Ensure that all personnel involved in surveying and/or sampling under this procedure receive training. The Characterization Manager or designee will develop a training outline and provide the necessary training to personnel.

4.1.5 Ensure that the reference coordinate grid system has been established for the area to be surveyed and/or sampled, if required.

4.2 Performing Sampling Operations

4.2.1 General Sampling Instructions

4.2.1.1 Review and satisfy applicable prerequisites of this procedure (see Section 4.1).

4.2.1.2 Assemble the necessary equipment to obtain samples. Refer to Exhibit 6 for a listing of typical equipment that may be needed to support sampling.

4.2.1.3 All sample containers shall be labeled with an indelible marker or tag with the following information:

- Sample Identification Number (i.e., SR-XX-YY)

  Where: XX = SR Number and YY = the sequential sample number beginning with "1"

- Location where the sample was taken (use reference coordinate grid system, landmarks, survey area identification number, etc.)
- Date and time sample was obtained
- Sampler's initials

4.2.1.4 All samples obtained under a SR package shall be documented and controlled in accordance with Reference 2.1.1.

4.2.1.5 Personnel shall take the necessary precautions to prevent sample cross contamination (e.g., wear clean surgeon's gloves, change gloves between samples, clean sampling tools between samples, use only new sample containers, etc.).

4.2.1.6 Back-fill land area sampling areas/holes with surrounding material or post suitable warning signs to prevent personnel trip/fall hazards, as necessary.

4.2.1.7 A GRC Digging, Trenching, & Excavation Permit (Reference 2.1.6) is required to penetrate soil at a depth of one foot or greater on GRC property.

4.2.1.8 Sample analysis will be performed by an approved NASA or vendor laboratory.

4.2.1.9 Sections 4.2.2 through 4.2.8 provide general sampling instructions for collection of various samples. Other sampling instructions may be included within the SR package, at the discretion of the Characterization Engineer and Characterization Manager.

4.2.2 Smear Sampling

4.2.2.1 Label or number each smear for identification purposes, if necessary.

4.2.2.2 Wipe the smear over approximately 100 cm^2 (16 square inches) of the surface to be sampled.

- Apply moderate pressure.

- Exercise care on rough surfaces so as not to tear the smear.
- Exercise care on wet surfaces so as not to degrade the smear.

4.2.2.3 Ensure that surfaces are not submerged in water and that cloth smears or similar are used on wet/damp surfaces.

4.2.2.4 Place the smear samples in envelopes or use a similar technique to prevent cross contamination.

4.2.2.5 Place smear groups into a sealable plastic bags and label as described in Step 4.2.1.3.

4.2.2.6 Document smear sample results on a Radiological Survey Form in accordance with Reference 2.1.3.

4.2.3 Surface Soil Sampling

4.2.3.1 Review requirements of Section 4.2.1.

4.2.3.2 Locate the sampling point using the guidance provided by the SR package.

4.2.3.3 Remove rocks and vegetation from the sampling area.

4.2.3.4 If only rock or stone is available at the sampling point, do not proceed with sampling. Contact the Characterization Engineer for guidance.

4.2.3.5 Loosen the soil at the selected sampling site to a depth of ~15 centimeters (~6 inches) using a trowel or suitable digging tool.

4.2.3.6 Collect approximately 1/2 liter of soil for soil samples that are to be processed for 250 ml marinelli sample analysis containers. Other volumes may be obtained at the direction of the Characterization Engineer.

4.2.3.7 Place the soil sample materials into a clean sample container.

4.2.3.8 Label the sample container as described in Step 4.2.1.3.

4.2.3.9 Seal the sample container to prevent inadvertent sample loss.

4.2.4 Sediment Sampling

4.2.4.1 Review requirements of Section 4.2.1.

4.2.4.2 Locate the sampling point using the guidance provided by the SR package.

4.2.4.3 If necessary, loosen the material with a trowel, knife, chisel, or other suitable tool.

4.2.4.4 Collect approximately 1/2 liter of sediment for samples that are to be processed for 250 ml marinelli sample containers. Other volumes may be obtained at the direction of the Characterization Engineer.

4.2.4.5 Place the sediment into a clean sample container.

4.2.4.6 Label the sample container as described in Step 4.2.1.3.

4.2.4.7 Seal the sample container to prevent inadvertent sample loss.

4.2.5 Water Sampling

4.2.5.1 Review requirements of Section 4.2.1.

4.2.5.2 Locate the sampling point using the guidance provided by the SR package.

4.2.5.3 Collect approximately 1 liter of water. Other volumes may be obtained at the direction of the Characterization Engineer.

4.2.5.4 Place the water into a clean sample container.

4.2.5.5 Seal the sample container to prevent inadvertent sample loss.

4.2.5.6 Label the sample container as described in Step 4.2.1.3.

4.2.6 Core Bore Sampling

4.2.6.1 Review requirements of Section 4.2.1.

4.2.6.2 Locate the sampling point using the guidance provided by the SR package.

4.2.6.3 Perform core drilling in accordance with the core drilling press operator's manual. The core bit must be capable of collecting an approximately 3" diameter solid core sample.

4.2.6.4 The depth or length of core sample will be specified in the SR package.

4.2.6.5 Place the core sample in a clean sample container (i.e., PVC sleeve with end caps) or place in a heavy plastic bag.

4.2.6.6 Label the core sample as described in Step 4.2.1.3.

4.2.7 Sub-Surface Soil Sampling

4.2.7.1 Review requirements of Section 4.2.1.

4.2.7.2 Locate the sampling point using the guidance provided by the SR package.

4.2.7.3 Remove rocks and vegetation from the sampling area.

4.2.7.4 If only rock is available at the sampling point, do not proceed with sampling. Contact the Characterization Engineer for guidance.

4.2.7.5 If a split spoon type device (e.g., a device that collects sample material inside a collection tube or pipe) is used, perform the following:

- Drill and/or drive the sample collection tube into the ground until the required sampling depth is achieved.
- Remove the sample collection tube from the ground and expose the sample core.
- Divide the sample core over each one-foot of depth. Each one-foot section is a complete sample. Other core lengths may be specified by the Characterization Engineer.
- Place all of the material from each section into a clean sample container.

- Label the sample containers as described in Step 4.2.1.3 and include the sampling depth (e.g., 0 - 1 foot, 1 - 2 feet, etc).

4.2.7.6 If a shovel is used, perform the following:

- Remove the soil from the layer to the depth specified on the SR package.
- Place the soil into a clean sample container.
- Label the containers as described in Step 4.2.1.3 and include the sampling depth (e.g. 0 - 1 foot, 1 - 2 feet, etc.)
- Clean the shovel prior to obtaining a sample at the next layer.
- Repeat the previous steps above for each layer specified in the SR package, ensuring that soil from the higher layers do not mix with the current layer.

4.2.7.7 If a well drilling type device (e.g., a tool that pulverizes material during drilling) is used, perform the following:

- Drill to a depth of one-foot, or to the length specified by the Characterization Engineer
- Collect all of the soil that was brought to the surface from that sampling depth.
- Place the soil into a clean sample container.
- Label the sample containers as described in Step 4.2.1.3 and include the sampling depth (e.g., 0 - 1 foot, 1 - 2 feet, etc).
- Continue drilling and collecting samples for each section until the final drilling depth is reached.

4.2.8 Metals Sampling

4.2.8.1 Review requirements of Section 4.2.1.

4.2.8.2 Locate the sampling point using the guidance provided by the SR package.

4.2.8.3 Collect the necessary volume of material as specified by the SR package. Samples may be collected using any of the following methods:

- Cutting and removal of sections of metal
- Drilling or honing and collection of metal shavings
- Unbolting or removal of equipment/components
- Other method specified by the SR package

4.2.8.4 Place the material into a clean sample container or wrap in plastic.

4.2.8.5 Seal to prevent inadvertent sample loss and potential cross-contamination.

4.2.8.6 Label the sample as described in Step 4.2.1.3.

4.3 Performing Survey Operations

4.3.1 General Survey Instructions

4.3.1.1 Review and satisfy applicable prerequisites of this procedure (see Section 4.1).

4.3.1.2 Assemble the necessary instrumentation and equipment needed to perform the survey(s). Instrument and probe types will be specified in the SR package.

4.3.1.3 Ensure that building survey surfaces are reasonably dry before obtaining measurements. Debris or materials that have the potential to shield radiation (i.e., paint, rust, self-adhesive labels, etc.) shall be removed from all surfaces to be surveyed, unless otherwise directed by the Characterization Engineer or SR package.

4.3.1.4 When survey operations are interrupted before completion (e.g., due to breaks, shift change, end of workday, etc.), positively identify stopping points to assure the correct re-start location and complete coverage of the required survey area.

4.3.1.5 Ludlum 2350-1 instrumentation shall be operated in accordance with Reference 2.1.2.

4.3.1.6 Ensure that Ludlum 2350-1 instrumentation is positively controlled while performing surveys to prevent tampering and loss of data.

4.3.1.7 All scan measurements will be performed using the audible speaker. Earphones are recommended when working in high noise areas.

4.3.1.8 Radiological Surveys shall be documented in accordance with Reference 2.1.3.

4.3.1.9 If the SR package requires an Average Background Count Rate (ABCR) to be taken, perform the following:

- Locate at least three (3) low background areas throughout the survey area. The number of locations selected may vary based on survey area/area size and/or background variability.
- If a beta or alpha sensitive detector is being used, cover the entire sensitive area of the detector with approximately 3/8" (900 mg/cm2) of Plexiglas, Lucite, or other equivalent shield material.
- Place the detector at the required surveying distance from surface as specified by the SR package.
- Obtain the background count rate (BCR) measurements. Count time for Scaler Instrumentation shall be 1 minute, unless otherwise directed by the SR package.
- Calculate the ABCR using the following formula:

$$ABCR = \frac{\text{Sum Background CPM}}{\text{Number of Background Measurements}}$$

- Record the ABCR on the Radiological Survey Form in accordance with Reference 2.1.3.

4.3.1.10 Sections 4.3.2 through 4.3.6 provide general surveying instructions for the various techniques to be used during site characterization. Other surveying instructions may be included within the SR package, at the discretion of the Characterization Engineer and Characterization Manager.

4.3.2 Beta and Gamma Radiation Surveys

4.3.2.1 Monitor dose rates from the knee to head level, recording the highest level as general area dose rate on the Radiological Survey Form.

4.3.2.2 If dose rate sources are predominantly from overhead or below the knee, denote on Radiological Survey Form.

4.3.2.3 Monitor dose rates on contact (within 1") and at 30 cm from a significant radiation source. Record the 30 cm reading as a general area dose rate.

4.3.2.4 Radiation surveys shall include beta and gamma dose rates unless otherwise specified by the SR package. When obtaining beta/gamma dose rates with an ion chamber, the beta dose rate shall be determined by multiplying the difference between the open window reading (OW) and the closed window reading (CW) by the beta correction factor (BCF). A BCF of four (4) will be used, unless otherwise specified by the Characterization Engineer.

Beta Dose Rate = (OW - CW) X BCF

4.3.2.5 Document survey results on a Radiological Survey Form in accordance with Reference 2.1.3.

4.3.3 Scan Measurements for Beta/Gamma and Alpha Surface Activity

4.3.3.1 Review and satisfy applicable requirements of Section 4.3.1.

4.3.3.2 Locate the survey area or area using the guidance provided by the SR package.

4.3.3.3 Scan the surface at a slow rate. Do not exceed the "scan rate" and "detector distance from surface" requirements specified by the SR package.

4.3.3.4 If an increase in counts is observed, determine the location of the most elevated activity, allow the meter to stabilize, and obtain a measurement. If the activity exceeds the Scan Investigation Level established by the SR package, perform the following:

- Scan the immediate vicinity to determine the bounds of the elevated area.
- Mark the bounds of the elevated area using permanent marker or other method approved by the Characterization Engineer.
- Obtain representative static measurements in accordance with Section 4.3.4 within the affected area. The number of static measurements necessary to reach a conclusion will vary because of differences in affected area size and geometry. As a general rule, two to three measurements within a one square meter affected area at the highest activity locations is sufficient. Contact the Characterization Engineer for guidance, if needed.
- Convert the static measurement readings to dpm/100cm^2. If static measurements confirm that the activity is above the Static Measurement Action Level, measure the affected area using a tape measure or equivalent measuring device. The measurements taken must be sufficient so that a total affected surface area can be calculated.

4.3.3.5 Document survey results on a Radiological Survey Form in accordance with Reference 2.1.3.

4.3.4 Static Measurements for Beta/Gamma and Alpha Surface Activity

4.3.4.1 Review and satisfy requirements of Section 4.3.1.

4.3.4.2 Locate the static measurement point using the guidance provided by the SR package.

4.3.4.3 Place the detector at the required distance from surface as specified by the SR package.

4.3.4.4 For an instrument with a scaler mode, obtain the static measurement using the count time specified by the SR package.

4.3.4.5 For an instrument without a scaler mode, allow the meter to stabilize for a minimum of 15 seconds.

4.3.4.6 All static measurements will be performed in pairs of shielded and non-shielded readings, unless specifically exempted by the SR package. Shielded readings shall be taken by completely covering the detector window with approximately 3/8" (900 mg/cm2) of Plexiglas, Lucite, or other equivalent shield material.

4.3.4.7 Document survey results on a Radiological Survey Form in accordance with Reference 2.1.3.

4.3.5 Open Land Area Gamma Scan Measurements

4.3.5.1 Review and satisfy requirements of Section 4.3.1.

4.3.5.2 Locate the survey area using the guidance provided by the SR package.

4.3.5.3 Scan the surface at a slow rate. Do not exceed the "scan rate" and "detector distance from surface" requirements specified in the SR package.

4.3.5.4 If an increase in counts is observed, determine the location of the most elevated activity, allow the meter to stabilize, and obtain a measurement. If the activity exceeds the Scan Investigation Level established by the SR package, perform the following:

- Scan the immediate vicinity to determine the bounds of the elevated area.
- Mark the bounds of the elevated area using flags, rope, or other method approved by Characterization Engineer.
- Obtain representative static measurements (Section 4.3.6) within the affected area. The number of static measurements necessary to reach a conclusion will vary because of differences in affected area size and geometry. As a general rule, two to three measurements within a one square meter affected area at the highest activity locations is sufficient. Contact the Characterization Engineer for guidance, if needed.
- If static measurements confirm that the activity is above the Scan Investigation Level, measure the affected area using a tape measure or equivalent measuring device.

The measurements taken must be sufficient so that a total affected surface area can be calculated.

4.3.5.5 Document survey results on a Radiological Survey Form in accordance with Reference 2.1.3.

4.3.6 Open Land Area Static Measurements

4.3.6.1 Review and satisfy requirements of Section 4.3.1.

4.3.6.2 Locate the static measurement point using the guidance provided by the SR package.

4.3.6.3 Place the detector at the required distance from surface as specified by the SR package.

4.3.6.4 In the scaler mode, obtain the static measurement using the count time specified by the SR package.

4.3.6.5 Document survey results on a Radiological Survey Form in accordance with Reference 2.1.3.

4.4 Sample Analysis

4.4.1 When sampling is required, the Characterization Engineer will complete a Survey Request Sample Analysis Sheet (Exhibit 3) detailing the radionuclides of concern and the target minimum detectable activities (MDAs). GRC Cyclotron Facility radionuclides of concern and target MDAs for sample solids are provided in the table below.

Radionuclide	Suspect Material	Analysis Method	Target MDA (pCi/g)	
			Concrete	Soil
Ag-108m	Miscellaneous Waste/Hardware	Gamma Spectroscopy	0.1	0.1
Al-26	Magnesium	Gamma Spectroscopy	0.2	0.2
Bi-207	Miscellaneous Waste/Hardware	Gamma Spectroscopy	0.2	0.2
Co-57	Copper, Iron	Gamma Spectroscopy	0.2	0.1
Co-60	Copper, Steel, & Iron	Gamma Spectroscopy	0.3	0.2
Cs-134	Concrete	Gamma Spectroscopy	0.3	0.1
Eu-152	Concrete	Gamma Spectroscopy	1.0	0.7
Eu-154	Concrete	Gamma Spectroscopy	0.3	0.2
Fe-55	Manganese, Stainless Steel, Iron	Liquid Scintillation	10	10
H-3	Miscellaneous Waste/Hardware	Liquid Scintillation	10	10
Mn-54	Chromium, Iron, Concrete	Gamma Spectroscopy	0.1	0.1
Na-22	Aluminum	Gamma Spectroscopy	0.2	0.1
Ni-59	Nickel, Stainless Steel	x-ray	10	10
Ni-63	Nickel, Stainless Steel	Liquid Scintillation	10	10
Sb-125	Miscellaneous Waste/Hardware	Gamma Spectroscopy	0.2	0.2
Tc-99	Waste	Liquid Scintillation	0.3	0.3
Ti-44	Steel/Iron	Gamma Spectroscopy	0.2	0.2

4.4.2 When prescribing the sample analyses, consideration shall be given to each of the radionuclides listed in the table above and those radionuclides listed in 10 CFR 61.55 (Reference 2.1.4).

4.4.3 Sample solids (i.e., concrete, soil, and sediment) will be analyzed for gamma-emitting radionuclides using a Gamma Spectroscopy System, at a minimum. Hard-to-detect (HTD) radionuclide analysis (i.e., those radionuclides which cannot be quantified through gamma spectroscopy) will be performed per the requirements of Reference 2.1.5.

4.4.4 Water samples will be analyzed for gamma-emitting radionuclides and tritium, at a minimum. Sufficient MDAs will be achieved using typical laboratory count times.

4.4.5 All smear samples will be analyzed for gross beta and alpha contamination. A gamma spectroscopy composite analysis will be performed on each group of smear samples collected. Gamma spectroscopy and/or HTD radionuclide analysis may be performed on individual smear samples exhibiting contamination, at the discretion of the Characterization Manager.

4.5 Quality Assurance and Quality Control (QA/QC)

4.5.1 Quality Checking (see definition 2.3.5)

4.5.1.1 Quality checking will be performed during the characterization process. The frequency of inspections will be at the discretion of the Characterization Manager.

4.5.1.2 Quality checking inspections shall be documented on Exhibit 7 in accordance with instructions provided in Exhibit 8. Other forms may be used if approved by the Characterization Manager.

4.5.2 Quality Control Surveys and Samples

4.5.2.1 A minimum of one out of every twenty (5%) of all scan and static measurements performed under a SR package will be duplicated or repeated. In order to evaluate both operator and instrument precision, these measurements shall be performed using a different operator and different instrument.

NOTE

In cases where instrumentation is highly specialized or of limited quantity, the same instrument may be used. In cases where specialized training is required to operate an instrument or perform a survey, the original operator may perform the survey. All exceptions must be authorized by the Characterization Engineer.

4.5.2.2 A minimum of one out of every twenty (5%) characterization samples collected under a SR package will be reanalyzed or homogenized, split and submitted for independent analyses.

4.5.2.3 Specific instructions for the performance of QC surveys and samples will be included in the SR package.

4.5.2.4 Quality control survey and sample results are compared with the original results to verify that they are in agreement. Survey/sample results must meet the following acceptance criteria:

- Scan Measurements - The same conclusion must be obtained for both measurements (e.g., both QC and original survey results are less than the investigation level established by the SR package).

- Static Measurements - The same conclusion must be obtained for both measurements, (e.g., both QC and original survey results are less than the investigation level established by the SR package) and the relative percent difference (RPD) must be within 20%. RPD is calculated as follows:

$$RPD = \frac{|(D_1 - D_2)|}{(D_1 + D_2)/2} \times 100$$

Where: D_1 = 1st data result

D_2 = 2nd data result

- Samples - The same conclusion must be obtained for both samples, (e.g., QC and original sample results are less than the investigation level) and the guidance similar to NRC Inspection Manual 84750 (IP 84750) will be used for evaluation of replicate sample analyses. This evaluation is performed as follows:

  a. Determine the resolution for each known nuclide concentration by dividing the initial activity by its corresponding 1σ uncertainty.

  b. Determine the ratio of each nuclide concentration by dividing the duplicate sample result by the initial sample result.

  c. The results are acceptable if the agreement ratio falls within the values given in the following table for the corresponding resolution.

Resolution	Acceptable Ratio
<4	0.4-2.5
4-7	0.5-2.0
8-15	0.6-1.66
16-50	0.75-1.33
51-200	0.80-1.25
>200	0.85-1.18

4.5.2.5 When acceptance criteria is not met, an investigation is performed to determine the cause and subsequent corrective actions, which may include re-surveying, re-sampling, or other actions determined by the Characterization Engineer. Results of the investigation will be documented on Exhibit 2 during the SR package closure (see Exhibit 4).

4.5.3 Laboratory QA/QC During Sample Analyses

4.5.3.1 QA/QC during sample analyses will be performed in accordance with an approved NASA or vendor laboratory QA program, as applicable.

4.6 Administrative Control of Survey Request Packages

4.6.1 Characterization Engineers will prepare, issue, and close SR packages in accordance with instructions provided in Exhibit 4. The Characterization Manager will review and approve packages prior to issue and during closure.

4.6.2 SR package field copies will be issued to field crews to reference during surveying and sampling. Field copies will be stamped on the first page of the SR Form (Exhibit 1) in red with the words "Field Copy" and be sequentially numbered for tracking purposes. For ease of tracking, no more than two (2) field copies will be issued per SR package.

4.6.3 When a SR package is ready for closure, the Characterization Engineer will summarize the results of surveying/sampling on a SR Continuation Sheet (Exhibit 2) in accordance with instructions provided in Exhibit 4.

5.0 EXHIBITS

5.1 Exhibit 1 - Survey Request Form

5.2 Exhibit 2 - Survey Request Continuation Sheet

5.3 Exhibit 3 - Survey Request Sample Analysis Sheet

5.4 Exhibit 4 - Guidelines to Complete a Survey Request Package

5.5 Exhibit 5 - Survey Request Log

5.6 Exhibit 6 - Typical Equipment Needed to Obtain Samples

5.7 Exhibit 7 - Quality Checking Inspection Form

5.8 Exhibit 8 - Guidelines to Complete a Quality Checking Inspection Form

5.9 Exhibit 9 - Survey Data Verification and Validation Form

EXHIBIT 1

SURVEY REQUEST FORM

SR NUMBER		REVISION #		DATE ISSUED	
TYPE OF SR	☐ CHARACTERIZATION	☐ OTHER:			
AREA / LOCATION					
PURPOSE					

SAMPLE TYPE

- ☐ SURFACE SOIL SAMPLE:
- ☐ SUB-SURFACE SOIL SAMPLE:
- ☐ SMEAR SAMPLE:
- ☐ SEDIMENT SAMPLE:
- ☐ CORE SAMPLE:
- ☐ WATER SAMPLE:
- ☐ OTHER:

SURVEY TYPE

SURFACE SCAN	☐ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE		SCAN RATE & DETECTOR DISTANCE FROM SURFACE	
		PROBE TYPE			
SURFACE SCAN	☐ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE		SCAN RATE & DETECTOR DISTANCE FROM SURFACE	
		PROBE TYPE			
STATIC MEASURE-MENT	☐ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE		COUNT TIME & DETECTOR DISTANCE FROM SURFACE	
		PROBE TYPE			
STATIC MEASURE-MENT	☐ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE		COUNT TIME & DETECTOR DISTANCE FROM SURFACE	
		PROBE TYPE			
OTHER					

EXHIBIT 1 (Continued)

SURVEY REQUEST FORM					
SR NUMBER		REVISION #		AREA / LOCATION	
SPECIFIC SAMPLING & SURVEYING INSTRUCTIONS / COMMENTS					
APPROVAL SIGNATURES					
CHARACTERIZATION ENGINEER				DATE	
CHARACTERIZATION MANAGER				DATE	
SR CLOSURE					
CHARACTERIZATION ENGINEER				DATE	
CHARACTERIZATION MANAGER				DATE	

EXHIBIT 2

SURVEY REQUEST CONTINUATION SHEET					
SR NUMBER		REVISION #		AREA / LOCATION	
SPECIFIC SAMPLING & SURVEYING INSTRUCTIONS / COMMENTS					

EXHIBIT 3

SURVEY REQUEST SAMPLE ANALYSIS SHEET					
SR NUMBER		REVISION #		AREA / LOCATION	
REQUESTED SAMPLE ANALYSIS					
SAMPLE TYPE	RADIONUCLIDE	TARGET COUNTING SYSTEM MDA	COMMENTS / ADDITIONAL INSTRUCTIONS		

EXHIBIT 4

Guidelines to Complete a Survey Request Package

1. Obtain a SR Number from the SR Log (Exhibit 5). The numbering system shall be unique and be issued sequentially (e.g., SR-1, SR-2, etc.).

2. Complete a Survey Request Form (Exhibit 1) by performing the following:

   a. Enter the SR Number in the "SR Number" section of the form.

   b. Enter the revision number. When a new procedure is issued, all pages will be indicated as "Revision 0". Subsequent revisions will be number sequentially.

   c. Leave the "Date Issued" section blank. This section will be completed once the SR package is approved for issue.

   d. Check the appropriate "Type of SR".

   e. Enter the location or area to be surveyed and/or sampled in the "Area/Location" section of the form. Include building and room numbers when applicable.

   f. Enter a description of the survey to be performed in the "Purpose" section of the form.

   g. If sampling is required, identify the sample type by marking the appropriate block(s) in the "Sample Type" section of the form and complete a Survey Request Sample Analysis Sheet (Exhibit 3). An "Other" space is provided in this section which may be used to add other sampling types that are not listed on the form.

   h. If surveying is required, identify the radiation type (beta, gamma and/or alpha) by marking the appropriate block(s) in the "Survey Type" section of the form.

   i. Enter the Instrument Type (e.g., LM-2350-1) and Probe Type (e.g., 44-116), as applicable. The type of instrument selected shall be based on type of activity expected, measurement sensitivity requirements, and the objectives of the survey.

   j. Enter the detector "Scan Rate" (e.g., 3 inches/second), "Detector Distance from Surface" (e.g., within ½"), and "Count Time" (e.g., 1 minute), as applicable. Scan rates, count times, and detector distance from surface are determined based on the instrument type, instrument sensitivity, instrument response time and the established minimum detectable concentration (MDC) for the radiation of concern and may be adjusted accordingly by the Characterization Engineer. An "Other" space is provided in this section which may be used to add other survey types that are not listed on the form.

EXHIBIT 4 (Continued)

Guidelines to Complete a Survey Request Package

k. Enter detailed instructions in the "Specific Sampling and Surveying Instructions/Comments" section of the form. Use Exhibit 2, "Survey Request Continuation Sheet" if additional space is needed. Instructions may include the following:

- Survey/sample equipment needed
- Pre-job briefing requirements
- Identification of survey areas, grids, facility surfaces or systems to be surveyed/sampled (may be a site diagram)
- Anticipated support requirements needed to perform surveying/sampling (brush clearing, scaffolding to access overheads, etc.)
- Special surveying/sampling instructions
- Survey investigation or action levels
- QA/QC survey and sampling specifics
- The need for personnel to obtain ABCR measurements
- Other related information, special precautions, and comments

It is acceptable to attach vendor manuals or procedures to the SR Form to perform survey or sampling. It is also acceptable to reference sections of other approved procedures to perform work.

l. Obtain a GRC Digging, Trenching, & Excavation Permit (Reference 2.1.6) if sampling will penetrate the soil at a depth of one foot or greater on GRC property.

m. Complete a Job Hazard Analysis (JHA) (Reference 2.1.7) and attach the JHA to the SR package.

n. The Characterization Engineer shall print, sign and date the "Characterization Engineer" section of the form.

o. The Characterization Manager will review the SR package for completeness and adequacy, resolve discrepancies as necessary and print, sign and date the applicable sections of the form.

EXHIBIT 4 (Continued)

Guidelines to Complete a Survey Request Package

p. After the SR package has been approved, develop field copies for field personnel. Field copies will be stamped on the first page of the SR Form (Exhibit 1) in red with the words "Field Copy". For ease of tracking, no more than two (2) SR field copies will be issued to field crews. Field copies will be sequentially numbered.

Survey Request Revisions

1. The Characterization Engineer may revise Survey Request packages using any of the methods listed below.

   Pen & Ink Change

   a. For non-substantive corrections or alterations (see definition 2.3.4), draw a single line through the text to be altered, write the new information or instructions near the lined text, and initial and date next to the change.

   b. If the pen and ink change does not meet the definition of 2.3.4, the Characterization Manager must also initial next to the change.

   c. Ensure all Field Copies are collected and reissue the revised SR package.

   SR Package Revision

   a. Obtain the next revision number from the Survey Request Log (Exhibit 5). Record the revision in the log.

   b. Locate the most current SR package electronic copy.

   c. Change the revision number on all pages of the SR package.

   d. Make the necessary changes using the instructions provided in the "Guidelines to Complete a Survey Request Package" section above. Add additional pages using Exhibit 2, as necessary.

   e. Forward the SR package to the Characterization Manager for approval.

   f. Ensure all Field Copies are collected and reissue the revised SR package.

EXHIBIT 4 (Continued)

Guidelines to Complete a Survey Request Package

SR Package Closure

1. After surveys are performed, reviewed and approved, attach a copy of each to the SR package and all associated documentation (e.g., Field Sample Collection & Chain of Custody Forms).

2. Perform a final review to ensure that the package is complete, resolve discrepancies as necessary, and print, sign, and date the "SR Closure" section of the SR Form (Exhibit 1).

3. Summarize the results of surveying/sampling on a SR Continuation Sheet (Exhibit 2). The summary should include the following, as applicable:

   a. Number and types of samples taken

   b. Summary of sample results

   c. Summary of Scan and/or Static Measurements

   d. Problems encountered during surveying/sampling

   e. Summary of QC survey and sample results, including corrective actions taken when acceptance criteria are not met

4. Verify and validate the data by completing a Survey Data Verification and Validation Form (Exhibit 9). Answer the questions and follow the instructions on the form.

5. Submit the entire package to the Characterization Manager for final review and closure signature.

EXHIBIT 5

Survey Request Log

SR Number	Rev. #	Location	Date Issued	Date Closed	Responsible Engineer	Comments

EXHIBIT 6

Typical Equipment Needed to Obtain Samples

SAMPLE EQUIPMENT
Plastic Bags
Sample Containers
Post Hole Digger
Knife or Suitable Cutting Implements
Smears
Trowel
Concrete Core Drilling Machine
Tape Measure
Radiological Survey Instrumentation
Disposable Plastic/Rubber Gloves
Duct Tape
Plastic Sheeting
Trash Containers/Bags
OFFICE SUPPLIES
Field Sample Collection & Chain of Custody Forms
Field Use Logbook
Pens, Pencils and Indelible Markers
Labels, Tags and Tamper Resistant Seals
SAMPLING TOOL DECON SUPPLIES
Rinse Water
Scrub Brush and Bucket
Non-phosphate Containing Detergent
Paper Towels
Isopropyl Alcohol

EXHIBIT 7

QUALITY CHECKING INSPECTION FORM

AREA OBSERVED		SURVEY REQUEST #		REVISION #	

	SAMPLES	SURVEYS
WORK IN PROGRESS	☐ Surface Soil Sampling ☐ Sub-Surface Soil Sampling ☐ Sediment Sampling ☐ Core-Bore Sampling ☐ Water Sampling ☐ Concrete Sampling ☐ Smears ☐ Other _____	☐ Scan Measurements (Building) ☐ Static Measurements (Building) ☐ Scan Measurements (Land Area) ☐ Static Measurements (Land Area) ☐ Dose Rate Measurements ☐ Other _____

DATE OBSERVED		TIME		RESPONSIBLE ENGINEER	
WORK GROUP(S) & INDIVIDUAL(S) INVOLVED					

SPECIFICS OF YOUR OBSERVATION

DEFICIENCY IDENTIFIED & CORRECTIVE ACTIONS

EVALUATOR		DATE	
CHARACTERIZATION MANAGER REVIEW		DATE	

EXHIBIT 8

Guidelines to Complete a Quality Checking Inspection Form

The evaluator should have a clear understanding of the survey activity before proceeding into the field. This may be performed by communication with the Characterization Engineer or staff, attending the pre-job briefing, reviewing the Survey Request (SR) package, and reviewing procedures, as applicable. Quality Checking Inspection Forms (Exhibit 7) shall be completed in accordance with the following instructions:

1. Area Observed - Enter a detailed description of the inspection location. The description should include survey area number(s), grid number(s), elevation, and building, as applicable.

2. Survey Request & Revision # - Record the SR package and revision number, which personnel are working under.

3. Work In Progress (Samples/Surveys) - Check the appropriate box(s) to reflect the type of work being evaluated. If the "Other" box is checked, record the work being evaluated.

4. Date & Time Observed - Record the date and time of inspection.

5. Responsible Engineer - Record the responsible Characterization Engineer's name.

6. Work Group(s) & Individual's Involved - Record name(s) and work group(s) of personnel being evaluated.

7. Specifics of Your Evaluation - Provide a detailed description of what you observed during the inspection.

8. Deficiency Identified & Corrective Actions - If a deficiency is identified during your inspection, provide a description of the deficiency. Include the reference document number(s) and procedural step(s) that were violated, as applicable. Evaluators should take immediate corrective actions to rectify the deficiency (i.e., inform personnel of the deficiency, notify supervision, etc.). Document corrective actions in this section of the form.

9. Evaluator - The evaluator shall print and sign his/her name and enter the date. Submit the form to the Characterization Manager for review.

10. Characterization Manager Review - The Characterization Manager shall review the form for completeness and adequacy, resolve discrepancies with the evaluator, print and sign name, and enter the date of review.

EXHIBIT 9

SURVEY DATA VERIFICATION AND VALIDATION FORM

Survey Location/Description		SR Number	

Check the appropriate answer for each question below.	Yes	No	N/A
1. Was each radiological instrument capable of detecting the radiation of interest at or below the investigation level? If not, acceptable compensatory measures have been taken.			
2. Did each radiological instrument have a current calibration traceable to NIST standards?			
3. Were radiological instruments source checked daily (before and after use) and did the instruments successfully pass?			
4. Were survey team personnel properly trained in the applicable survey techniques and was the training adequately documented?			
5. Were the MDCs and the assumptions used to develop them appropriate for the instruments and survey methods used to collect the data?			
6. Were the survey methods appropriate for the media and types of radiation being measured?			
7. Were the samples adequately tracked from their collection point and through the analysis process in accordance with the sample chain-of-custody requirements?			
8. Were the samples/surveys collected in accordance with the Survey Request (SR) package?			
9. Were the samples and/or surveys representative of current site conditions?			
10. If SR package investigation levels were exceeded, was appropriate action taken?			
11. Were at least 5% of all survey and/or sample points re-sampled and/or re-surveyed using identical methodology contained in the SR package?			
12. Were the samples analyzed in accordance with requirements contained in the SR Sample Analysis Sheet (Exhibit 3) and did the analyses meet the required MDAs?			
13. Were all static and scan measurement data and sample point locations properly documented?			
14. Has a summary of surveying/sampling results been developed?			

NOTE: If the question does not apply to the SR, check the N/A (not applicable) box. If a "No" answer is obtained above, the Characterization Engineer should initiate corrective action in accordance with site procedures. Document actions taken and/or justifications in the "Comments" section below. Attach additional sheets as necessary.

Comments:

Characterization Engineer (print/sign)		Date	

Enclosure 2

SAFETY AND MISSION ASSURANCE DIRECTORATE

GRC Cyclotron Facility

Sample Chain of Custody Controls

CP-2
(Revision 0)

NASA GRC CYCLOTRON FACILITY
ROUTING AND APPROVAL SHEET

Document Title: Sample Chain of Custody Controls

Document Number: CP-2 **Revision Number:** 0

ROUTING

	Signature	Date
Originator	**W. Stoner /**	3/26/10
Review and Concurrence:		
Independent Technical Reviewer	**R. Case /**	3/29/10
NASA Decommissioning Program Manager	**K. Peecook /**	3/29/10

IMPLEMENTING APPROVAL: _____ / 3/29/10
Date

EFFECTIVE DATE: 3/29/10

NASA GRC CYCLOTRON FACILITY CHANGE/CANCELLATION RECORD		
DOCUMENT TITLE: Sample Chain of Custody Controls	**DOCUMENT NO:** CP-2	**REVISION NO:** 0
Revision 0: Initial issue of Document		

LIST OF EFFECTIVE PAGES

DOCUMENT NO: CP-2 **REVISION NO:** 0

Page No.	Revision Level	Page No.	Revision Level	Page No.	Revision Level
Cover Page	0				
Routing Page	0				
Change Page	0				
LOEP	0				
Pages 1 thru 6	0				
Exhibit 1 Page 1 of 1	0				
Exhibit 2 Page 1of 1	0				
Exhibit 3 Page 1of 1	0				
Exhibit 4 Page 1 of 1	0				

1.0 INTRODUCTION

1.1 Purpose

This procedure provides direction for the control of samples collected under procedure CP-1 (Reference 2.1.1) in support of radiological characterization of the Glenn Research Center (GRC) Cyclotron Facility.

1.2 Scope

This procedure establishes a system for sample chain of custody (COC), including the identification, retention, storage, and transfer of radiological samples collected during characterization of the facility. It applies to all personnel who are involved in sample collection, processing, transferring, and shipping of samples to a NASA or Vendor Laboratory.

2.0 REFERENCES

2.1 Applicable Documents

2.1.1 CP-1 - Survey Methodology to Support Radiological Characterization

2.1.2 CP-6 - Radioactive Material Packaging and Transportation

2.2 Records

2.2.1 Exhibit 1 - Field Sample Collection & Chain of Custody Form

2.2.2 Exhibit 2 - Field Sample Collection & Chain of Custody Log

2.2.3 Exhibit 3 - Vendor Laboratory Shipment Log

2.2.4 Exhibit 4 - Vendor Laboratory Chain of Custody Form

2.3 Definitions

2.3.1 Characterization Survey - Radiological surveys that are performed to determine the nature and extent of contamination in an area.

2.3.2 Chain of Custody (COC) - An unbroken trail of accountability that ensures the physical security of samples. It refers to the identification of samples, their location, and the individuals responsible for their custody and transfer of custody. Chain of custody begins with the taking of a sample and remains intact through the analysis and final holding or disposal.

2.3.3 NASA Laboratory - A radiological laboratory owned and operated by NASA.

2.3.4 Vendor Laboratory - A laboratory under contract or sub-contract to NASA whose program has been approved for the purpose of performing radiological analysis of samples for the GRC Cyclotron Facility.

2.3.5 Qualified Individual - An individual who is not a qualified Characterization Technician, but has received documented training to handle and control samples in accordance with the requirements of this procedure.

2.3.6 Survey Request (SR) - A work instruction document that provides specific instructions for collection of surveys and samples. Refer to Reference 2.1.1.

3.0 RESPONSIBILITIES

3.1 Characterization Manager

The Characterization Manager is responsible for overall management of the Sample Chain of Custody Program.

3.2 Characterization Engineer

The Characterization Engineer is responsible for direct supervision of personnel involved in sample chain of custody to assure compliance with the requirements of this procedure. He/she is responsible for direct control of the Field Sample Collection & Chain of Custody Log (Exhibit 2) and Vendor Laboratory Shipment Log (Exhibit 3).

3.3 Characterization Technicians

Characterization Technicians are responsible for obtaining samples in accordance with Reference 2.1.1 and for maintaining chain of custody in accordance with the requirements of this procedure.

3.4 Qualified Individuals

Qualified Individuals are responsible for maintaining sample chain of custody in accordance with the requirements of this procedure.

4.0 PROCEDURE

4.1 Prerequisites / General Requirements

4.1.1 Sample collection shall be performed in accordance with procedure CP-1 (Reference 2.1.1).

4.1.2 Samples shall either be under the direct control of a Characterization Technician or Qualified Individual or locked in a secure location.

4.1.3 Ensure that all long-term storage locations have been approved by the Characterization Manager and are capable of being locked. Keys to these areas will be controlled by the Characterization Engineer.

4.2 Completion of a Field Sample Collection & Chain of Custody Form

4.2.1 A Field Sample Collection & Chain of Custody Form (Exhibit 1) shall be completed upon collection of characterization samples obtained under procedure CP-1 (Reference 2.1.1). The form shall accompany the sample(s) from the time of collection through the entire sample analytical process. Subsequent sample transfers shall be fully documented.

4.2.2 Field Sample Collection & Chain of Custody Forms (Exhibit 1) shall be completed in accordance with the following instructions:

4.2.2.1 SR Number: Record the Survey Request number under which the samples were collected.

4.2.2.2 COC Sheet Number: Obtain the next sequential number from the Field Sample Collection & Chain of Custody Form Log (Exhibit 2) and record on the form. COC Sheet Numbers shall be recorded in sequential order beginning with "1" (e.g., 1, 2, 3, etc.). Ensure all information is recorded in the log (Exhibit 2).

4.2.2.3 Samples Collected By: Record the printed name of the Characterization Technician(s) that collected the sample.

4.2.2.4 Sample Number: Assign a sample number to each sample and record in the block. Sample numbers shall be numbered similar to SR-23-#, where "SR-23" is the Survey Request number and "#" is the next sequential sample number beginning with "1".

4.2.2.5 Sample Location/Description: Record the location/description of the sample (e.g., Location C-15, Vault Floor, in pit).

4.2.2.6 Sample Matrix: Provide a description of the sample material (e.g., concrete core, surface soil, etc.).

4.2.2.7 Date & Time Collected: Record the date and time of sample collection.

4.2.2.8 Volume or Weight: Record the estimated sample volume (e.g., 1-liter) or weight (e.g., 383 grams).

4.2.2.9 Comments: May be used to provide additional information regarding the sample.

4.2.2.10 Relinquished By: To transfer samples to another individual, the current possessor shall print and sign his/her name.

4.2.2.11 Received By: The individual taking custody of the samples shall print and sign his/her name.

4.2.2.12 Date & Time: Record the date and time samples were transferred.

4.2.2.13 Location Transferred To: If the samples were transferred to a specific location (i.e., Sample Processing Facility), record the specific location.

4.2.3 It is common practice to list multiple samples on a Field Sample Collection & Chain of Custody Form. In cases where it is necessary to transfer some of the samples listed on a form to another location, perform the following steps:

4.2.3.1 Obtain a blank Field Sample Collection & Chain of Custody Form (Exhibit 1).

4.2.3.2 Complete the Sample Information section of the blank form for samples being transferred. Follow applicable steps within Section 4.2.2 above.

NOTE: When completing the Sample Information section, a new COC Sheet Number will be assigned to this new form and logged into the Field Sample Collection & Chain of Custody Log (Exhibit 2).

4.2.3.3 Insert a general statement within the comments section of the original Field Sample Collection & Chain of Custody Form

noting the sample transfer to the new form. (i.e. "Custody transferred to COC Sheet Number 5").

4.2.3.4 Insert a general statement within the comments section of the new Field Sample Collection & Chain of Custody Form noting the sample transfer (i.e. "Custody transferred from COC Sheet Number 4").

4.2.3.5 Subsequent transfers of these samples will be recorded under the new form.

4.3 Shipment of Samples to a Vendor Laboratory

4.3.1 Samples selected for analysis at a Vendor Laboratory will have custody transferred to a Vendor Laboratory Chain of Custody (VL-COC) Form (Exhibit 4) in accordance with the following instructions:

4.3.1.1 Company Name: Record the business name (e.g., NASA).

4.3.1.2 Project Name: Record the project name or project description (e.g., GRC Cyclotron Facility).

4.3.1.3 Contract Number: Record the contract number assigned to the Vendor Laboratory.

4.3.1.4 Project Contact: Record the name of the individual responsible for receiving sample results.

4.3.1.5 Telephone Number: Record the telephone number for the Project Contact.

4.3.1.6 Carrier Name/Tracking Number: Record the name of the carrier to be used to ship the samples (e.g., FedEx®) and carrier tracking number(s) assigned to the shipment.

4.3.1.7 Sample ID Number: Record the sample identification numbers for each sample (e.g., SR-23-15).

4.3.1.8 Sample Date & Time: Record the sample collection date and time.

4.3.1.9 Analysis Requested: Check the appropriate analysis requested (Gamma Spec, Fe-55, H-3, etc.). Additional space is included to note any analysis not listed on the form.

4.3.1.10 Vendor Laboratory Shipment Number (VLS #): Obtain the next available number from the Vendor laboratory Shipment Log (Exhibit 3) and record in the block. VLS numbers will be formatted as VLS-#, where "#"is the next sequential number obtained from the log beginning with "1". Complete the applicable sections of the log.

4.3.1.11 Comments: Used to provide additional information regarding the sample or analysis, if necessary.

4.3.1.12 Samples Relinquished By: The individual responsible for packaging and shipping the samples will print and sign his/her name and record the date and time of transfer.

4.3.1.13 Samples Received at Lab By: The individual receiving the samples at the Vendor Laboratory will print and sign his/her name and record the date and time of receipt.

4.3.1.14 Package Condition Upon Arrival: Used by the Vendor Laboratory to provide information on the condition of the package(s) and sample(s) upon receipt and inspection.

4.3.2 Package and ship the samples in accordance with procedure CP-6 (Reference 2.1.2).

4.3.3 The Vendor Laboratory will acknowledge receipt of samples by signing the VL-COC Form (Exhibit 4). The vendor will then forward the original or a copy back to the project for retention.

5.0 EXHIBITS

5.1 Exhibit 1 - Field Sample Collection & Chain of Custody Form

5.2 Exhibit 2 - Field Sample Collection & Chain of Custody Log

5.3 Exhibit 3 - Vendor Laboratory Shipment Log

5.4 Exhibit 4 - Vendor Laboratory Chain of Custody Form (Example)

EXHIBIT 1

Field Sample Collection & Chain of Custody Form

Sample Information

SR Number		COC Sheet Number		Samples Collected By	

Sample Number	Sample Location/Description	Sample Matrix	Date Collected	Time Collected	Volume or Weight	Comments

Sample Transfers

Relinquished By (Print/Sign)	Received By (Print/Sign)	Date	Time	Location Transferred To (as applicable)

EXHIBIT 2

Field Sample Collection & Chain of Custody Log

Survey Request Number				
COC Sheet Number	Date Issued	Sample Numbers	Samples Collected By	Comments

EXHIBIT 3

Vendor Laboratory Shipment Log

VLS #	SR Number	COC Sheet Number(s)	Sample ID Number(s)	Date Package Shipped	Vendor Laboratory Transferred To	Date Samples Returned
VLS-						
VLS-						
VLS-						
VLS-						
VLS-						
VLS-						
VLS-						
VLS-						
VLS-						
VLS-						
VLS-						
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VLS-						
VLS-						
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VLS-						
VLS-						
VLS-						
VLS-						
VLS-						
VLS-						
VLS-						

Exhibit 4

Vendor Laboratory Chain of Custody Form (Example)

Company Name		Analysis Requested											VLS #	
Project Name		Gamma Spec	Fe-55	H-3	Ni-59	Ni-63	Tc-99							
Contract #														
Project Contact													Comments	
Telephone #														
Carrier Name/Tracking #														
Sample ID #	Sample Date	Sample Time												
Samples Relinquished By (Print/Sign)	Date/Time	Samples Received at Lab By (Print/Sign)											Date/Time	Package Condition Upon Arrival
														☐ Satisfactory ☐ Unsatisfactory Remarks:

Enclosure 3

SAFETY AND MISSION ASSURANCE DIRECTORATE

GRC Cyclotron Facility

Sample Preparation

CP-3
(Revision 0)

NASA GRC CYCLOTRON FACILITY
ROUTING AND APPROVAL SHEET

Document Title: Sample Preparation

Document Number: CP-3 **Revision Number:** 0

ROUTING

	Signature	Date
Originator	**W. Stoner /**	2/19/10
Review and Concurrence:		
Independent Technical Reviewer	**R. Case /**	3/29/10
NASA Decommissioning Program Manager	**K. Peecook /**	3/29/10

IMPLEMENTING APPROVAL: _____ / 3/29/10
Date

EFFECTIVE DATE: 3/29/10

NASA GRC CYCLOTRON FACILITY
CHANGE/CANCELLATION RECORD

DOCUMENT TITLE:	DOCUMENT NO: CP-3	REVISION NO: 0
Sample Preparation		

Revision 0: Initial issue of Document

LIST OF EFFECTIVE PAGES

DOCUMENT NO: CP-3 **REVISION NO:** 0

Page No.	Revision Level	Page No.	Revision Level	Page No.	Revision Level
Cover Page	0				
Routing Page	0				
Change Page	0				
LOEP	0				
Pages 1 thru 6	0				
Exhibit 1 Page 1 of 1	0				
Exhibit 2 Page 1of 1	0				

1.0 INTRODUCTION

1.1 Purpose

The purpose of this procedure is to provide instructions for preparing samples of soil, sediment, concrete, liquid, and other similar materials for radiological analysis in support of characterization of the Glenn Research Center (GRC) Cyclotron Facility.

1.2 Scope

1.2.1 This procedure applies to all project personnel who prepare or process samples collected under procedure CP-1 (Reference 2.1.1). Unprocessed samples forwarded to a vendor laboratory will be processed under the vendor's program.

1.2.2 The sample processing steps may be performed in any sequence necessary to achieve a final pre-analysis product that is consistent with the attributes of this procedure.

2.0 REFERENCES

2.1 Applicable Documents

2.1.1 CP-1 - Survey Methodology to Support Radiological Characterization

2.1.2 CP-2 - Sample Chain of Custody Controls

2.2 Records

2.2.1 Exhibit 2 - Sample Processing Log

2.3 Definitions

2.3.1 Batch - At least two samples consisting of the same or similar type (e.g., five soil samples) that will be processed as a group or at the same time.

2.3.2 Blank Samples - An analytical control sample, usually verified clean water or sand, used to demonstrate that reported analytical results are not the result of Count Room or sample processing area contamination. Blank samples are used to evaluate the entire analytical procedure (sample processing and analysis).

2.3.3 Container - For the purposes of this procedure, a receptacle (i.e., plastic, glass or metal bottle, pan, bucket, or plastic bag) that is used to hold a sample during processing or analysis.

2.3.4 NASA Laboratory - A radiological laboratory owned and operated by NASA.

2.3.5 Vendor Laboratory - A laboratory under contract or sub-contract to NASA whose program has been approved for the purpose of performing radiological analysis of samples for the GRC Cyclotron Facility.

3.0 RESPONSIBILITIES

3.1 Characterization Manager

The Characterization Manager is responsible for overall administration of this procedure.

3.2 Characterization Engineer

The Characterization Engineer is responsible for supervising sample processing.

3.3 Characterization Technicians

Characterization Technicians are responsible for the preparation of samples in accordance with the requirements of this procedure.

4.0 PROCEDURE

4.1 Prerequisites

4.1.1 Prior to preparation of samples, assemble the necessary equipment for the processing of the planned samples. Exhibit 1 of this procedure provides a list of the typical equipment needed.

4.1.2 All samples requiring processing must be recorded on a Sample Processing Log shown in Exhibit 2 of this procedure or on an electronic spreadsheet containing the same information. All applicable data listed on the form must be completed during sample processing. If a sample requires no processing, it may be delivered directly to the laboratory.

4.1.3 All necessary precautions shall be taken to prevent sample cross contamination (i.e. change gloves between samples, clean processing equipment between samples, monitor to ensure sample processing area and equipment remains clean, use new or verified clean sample containers, etc.).

4.1.4 Personnel who perform sample processing must receive documented training on the requirements of this procedure.

4.1.5 Sample processing shall be performed in an area specifically approved by the Characterization Manager.

4.1.6 Ensure that sample chain-of-custody is applied during the processing, analysis and shipping of samples. Refer to procedure CP-2 (Reference 2.1.2)

4.1.7 For soil and sediment samples, a minimum of one blank sample shall be prepared with each batch. Blank samples shall be prepared using identical methodology that was used to process the batch.

4.1.8 Laboratory balances used to obtain sample weights must have current calibration.

4.1.9 If a sample contains hazardous materials, such as polychlorinated biphenyl (PCB) or asbestos, notify the Characterization Engineer before performing any processing. Special training outside the guidelines of this procedure may be necessary.

4.2 Processing of Soil or Sediment Samples

4.2.1 Place the entire soil or sediment sample into a clean sample-drying pan(s), such as a disposable aluminum pan, as appropriate.

4.2.2 Remove large rocks, vegetation and foreign material. Break the sample into small clumps, as appropriate, to aid the drying process.

NOTE: The length of drying time will be determined by the initial amount of moisture in the sample and the type of drying oven. Typical drying times may vary from 6 to 12 hours.

4.2.3 Dry the sample, using a drying oven or other available method until all traces of moisture are removed.

4.2.4 Break the entire dried soil or sediment sample into a fine mixture.

4.2.5 Sieve the sample through a screen $\leq$ ¼ inch.

4.2.6 Thoroughly blend the sample material to ensure a homogeneous mixture.

4.2.7 If sufficient material is available, transfer approximately 250 ml of sample to the counting container, leaving approximately 3/8 inch of headspace at the top of the container, and replace the lid on the container.

4.2.8 If there is not sufficient sample material to fill a 250 ml marinelli, transfer the sampler material to a smaller, approved container (e.g. 125 ml container) or contact the Characterization Engineer for guidance.

4.2.9 Tape the lid with electrical tape or equivalent to secure the lid and prevent spillage.

4.2.10 Obtain the sample net weight.

4.2.11 Label the container with the following data:

- Sample Number
- Location where sample was taken (e.g. grid location, landmarks, etc.)
- Date and time sample was taken
- Sample net weight
- Sampler's Initials

4.3 Sample Processing for liquid samples

4.3.1 Place/pour an appropriate volume of sample liquid into a clean container.

4.3.2 Install the lid on the container.

4.3.3 Tape the lid with electrical tape or equivalent to secure the lid and prevent spillage.

4.3.4 Obtain the sample net weight.

4.3.5 Label the container with the following data:

- Sample Number
- Location where sample was taken (e.g. grid location, landmarks, etc.)
- Date and time sample was taken
- Sample net weight
- Sampler's Initials

4.4 Sample Processing for concrete core bore samples

4.4.1 Using a masonry saw, obtain approximately ½ inch core sample disk as follows:

NOTE: Use extreme caution when working with the masonry saw. Keep hands clear of the blade during operation. Ensure power is secured before performing any machine maintenance.

4.4.2 Connect the saw to a 110-volt power source. Ensure power source is ground fault protected.

4.4.3 Supply the saw with radiologically clean cooling/lubricating water in accordance with the manufacturer's technical manual.

4.4.4 Pull the slide table back away from the blade.

4.4.5 Insert the desired core sample end into the clamp fixture device fully against the stop. Insure the stop is set for a ½ inch sample cut-off length.

4.4.6 Tighten the clamp securely to the core bore sample.

4.4.7 Lock saw pivot arm into the full down position.

4.4.8 Don a face shield and other appropriate personnel safety gear (i.e., work gloves), as required.

4.4.9 Verify that the saw blade is not touching the core disk.

4.4.10 Turn the saw power switch "ON", and verify an adequate supply of water to the saw blade.

4.4.11 Push the saw table with core disk slowly into the blade.

4.4.12 Turn the saw power switch "OFF" when the cut is complete.

4.4.13 Wait until the blade has stopped rotating then pull the saw table back away from the core sample.

4.4.14 Remove the ½ inch core sample disk.

4.4.15 Loosen the clamp fixture device to remove the core sample or to reposition the core if additional samples are needed.

4.4.16 Pat the disk dry with a clean towel or dry in a sample-drying oven.

4.4.17 Obtain the sample net weight.

4.4.18 Label the disk or disk container with the following data:

- Sample Number
- Slice Number
- Location where sample was taken (e.g. grid location, landmarks, etc.)
- Date and time sample was taken
- Sample net weight
- Sampler's Initials

4.4.19 If the disk geometry has been adversely affected during saw cutting, notify the Characterization Engineer. Otherwise, place the disk in an approved container.

4.4.20 Repeat the above steps until all required core sample disks are obtained from the core bore sample.

5.0 EXHIBITS

5.1 Exhibit 1 - Typical Sample Processing Equipment

5.2 Exhibit 2 - Sample Processing Log

EXHIBIT 1

Typical Sample Processing Equipment

The following is a list of some of the basic items typically needed during sample preparation activities:

- Sample Containers
- ¼ -inch Sieve
- Drying Oven
- Laboratory Balance
- Plastic Sheeting
- Plastic Bags
- Metal Drying Pans
- Water and Towels
- Tape
- Permanent Markers
- Tags/Labels
- Analysis/Counting Containers
- Shipping Containers
- Packing Materials

EXHIBIT 2

Sample Processing Log

Sample ID Number	Sample Date/Time	Date & Time Processing Started	Technician(s) Processing Sample (Initials)	Sample Net Weight	Sample Transferred To: (Location/Individual)	Transfer Date/Time	Comments

Characterization Engineer Review: _____

Print/Sign Date

Enclosure 4

SURVEY REQUEST FORM

SR NUMBER	SR-5	REVISION #	0	DATE ISSUED	6/17/10
TYPE OF SR	☒ CHARACTERIZATION ☐ OTHER:				
AREA / LOCATION	Buildings 49 and 140				
PURPOSE	Metals Sampling				

SAMPLE TYPE

- ☐ SURFACE SOIL SAMPLE: N/A
- ☐ SUB-SURFACE SOIL SAMPLE: N/A
- ☐ SMEAR SAMPLE: N/A
- ☐ SEDIMENT SAMPLE: N/A
- ☐ CORE SAMPLE: See instructions
- ☐ WATER SAMPLE: N/A
- ☒ OTHER: Metals Samples – see instructions

SURVEY TYPE

SURFACE SCAN	☒ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE	Ludlum 2350-1	SCAN RATE & DETECTOR DISTANCE FROM SURFACE	Detector shall be held ≤ ½" from the surface and moved at a speed not to exceed 2 detector widths/second.
		PROBE TYPE	44-116		
SURFACE SCAN	☒ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE	Ludlum 2350-1	SCAN RATE & DETECTOR DISTANCE FROM SURFACE	Detector shall be held ≤ ¼" from the surface and moved at a speed not to exceed 2 detector widths/second.
		PROBE TYPE	43-90		
STATIC MEASURE-MENT	☒ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE	Ludlum 2350-1	COUNT TIME & DETECTOR DISTANCE FROM SURFACE	Detector shall be held ≤ ½" from the surface. Count time shall be 1 minute.
		PROBE TYPE	44-116		
STATIC MEASURE-MENT	☐ BETA ☐ GAMMA ☒ ALPHA	INST. TYPE	Ludlum 2350-1	COUNT TIME & DETECTOR DISTANCE FROM SURFACE	Detector shall be held ≤ ¼"" from the surface. Count time shall be 1 minute.
		PROBE TYPE	43-90		
OTHER					

SURVEY REQUEST FORM					
SR NUMBER	SR-5	REVISION #	0	AREA / LOCATION	Buildings 49/140

SPECIFIC SAMPLING & SURVEYING INSTRUCTIONS / COMMENTS

Prerequisites and General Requirements

1. An initial pre-job briefing is required with Characterization Technicians and the Characterization Engineer/Supervisor prior to the start of surveying/sampling. Subsequent briefings will be at the discretion of the Characterization Engineer/Supervisor.
2. Review the Job Hazard Analysis (JHA) and adhere to all precautionary requirements.
3. All section numbers refer to Procedure CP-1, "Survey Methodology to Support Radiological Characterization."
4. All LM 2350-1 scan measurements shall be performed using the audible speaker.
5. 44-116 and 43-90 scan measurements shall be performed in accordance with section 4.3.3.
6. 44-116 and 43-90 static measurements shall be performed in accordance with section 4.3.4.
7. Ensure that surfaces to be surveyed are relatively clean and dry prior to performing the survey.
8. All sample and survey data shall be recorded on an approved Characterization Survey Form.
9. Anomalies, obstructions or other problems encountered in performing the survey shall be documented on a Survey Request Continuation Sheet.
10. Additional surveying and sampling may be performed at the discretion of the Characterization Manager provided the surveys are performed and /or samples are collected in accordance with instructions provided by this Survey Request (SR).

Quality Control (QC) Measurements

A minimum of 5% of all scan and static measurements will be duplicated or repeated using identical methodology contained in this SR IAW Section 4.5.2.

APPROVAL SIGNATURES

CHARACTERIZATION ENGINEER	J. Graham	DATE	6/16/10
CHARACTERIZATION MANAGER	R. Case	DATE	6/17/10

SR CLOSURE

CHARACTERIZATION ENGINEER		DATE	
CHARACTERIZATION MANAGER		DATE	

SURVEY REQUEST CONTINUATION SHEET					
SR NUMBER	SR-5	REVISION #	0	AREA / LOCATION	Buildings 49/140

SPECIFIC SAMPLING & SURVEYING INSTRUCTIONS / COMMENTS

Metals Sampling

1. The following steps refer to tables and figures contained in Appendix J of the **Characterization Plan for the GRC Cyclotron Facility**. A copy of Appendix J is attached to this SR for reference.
2. Ensure that systems are drained and/or de-energized prior to sampling.
3. Collect a metal sample from each location listed in Table J-1. Refer to Figure J-1 for photographs of each sample location. Collecting these samples may require destructive techniques. Contact the laboratory analyzing the samples for guidance on sample size and preparation.
4. Perform beta and alpha surveys on each sample.
5. Perform gamma spectroscopy analysis on each sample.
6. Perform hard-to-detect radionuclide analysis of selected samples exhibiting cyclotron produced radioactivity. The Characterization Manager shall be involved in the selection process.
7. Maintain sample chain-of-custody from the point of collection through the determination of the final results.
8. Record sample locations and survey results on a Characterization Survey Form(s).

SURVEY REQUEST SAMPLE ANALYSIS SHEET					
SR NUMBER	SR-5	REVISION #	0	AREA / LOCATION	Buildings 49/140

REQUESTED SAMPLE ANALYSIS			
SAMPLE TYPE	RADIONUCLIDE	TARGET COUNTING SYSTEM MDA	COMMENTS / ADDITIONAL INSTRUCTIONS
Metal sample	Ag-108m	0.1 pCi/g	1) Radionuclide and MDA Values taken from Table 5.2 of the *Characterization Plan for the GRC Cyclotron Facility*.
	Al-26	0.2 pCi/g	
	Bi-207	0.2 pCi/g	2) Additionally, hard-to-detect (HTD) and other analyses may be performed as directed by the Characterization Manager.
	Co-57	0.2 pCi/g	
	Co-60	0.3 pCi/g	
	Cs-134	0.3 pCi/g	
	Eu-152	1.0 pCi/g	
	Eu-154	0.3 pCi/g	
	Mn-54	0.1 pCi/g	
	Na-22	0.2 pCi/g	
	Sb-125	0.2 pCi/g	
	Ti-44	0.2 pCi/g	

APPENDIX J

Metals Sampling

The following instructions provide general information for collecting metals samples. Specific instructions will be incorporated into survey packages.

1. Ensure that systems are drained and/or de-energized prior to sampling.

2. Collect a metal sample from each location listed in Table J-1. Refer to Figure J-1 for photographs of each sample location. Collecting these samples may require destructive techniques. Contact the laboratory analyzing the samples for guidance on sample size and preparation.

3. Perform beta and alpha surveys on each sample. Record survey results on a Characterization Survey Form(s).

4. Perform gamma spectroscopy analysis on each sample.

5. Perform hard-to-detect radionuclide analysis on selected samples exhibiting cyclotron produced radioactivity. The Characterization Manager shall be involved in the selection process.

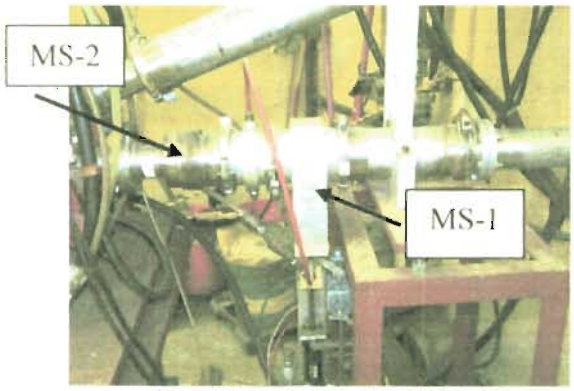
6. Maintain sample chain-of-custody from the point of collection through the determination of the final results.

Table J-1 - Metal Sample Locations (Building 140)

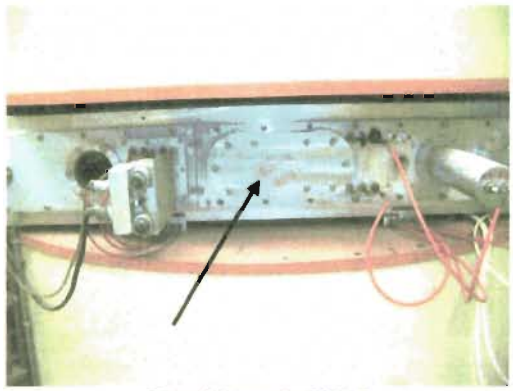
Location #	Room #	Location	Sample Description
MS-1	002	Vault Room	Aluminum Beam Stop Assembly
MS-2	002	Vault Room	Stainless Steel Beam Stop Connector Assembly
MS-3	002	Vault Room	Copper Internals (DEE) Behind Plate
MS-4	002	Vault Room	Iron North Support Column Centerline @49"
MS-5	002	Vault Room	Copper Pipe Under Beam Tube
MS-6	001	NTR	Metal Target Sleeve On Vertical Unit
MS-7	001	NTR	Metal Target Sleeve On Horizontal Unit
MS-8 thru XX	Any	Any	Other metals where radioactivity is identified, at the discretion of the Characterization Manager

APPENDIX J

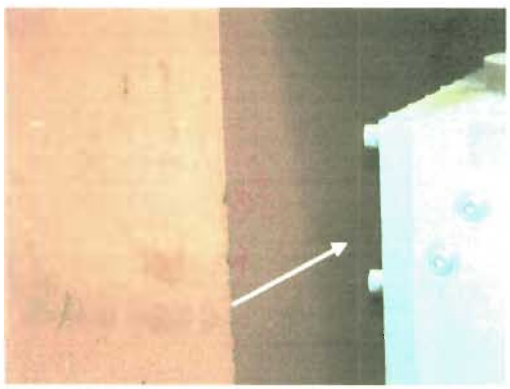
Figure J-1 - Photos of Sample Locations for Metals in Building 140



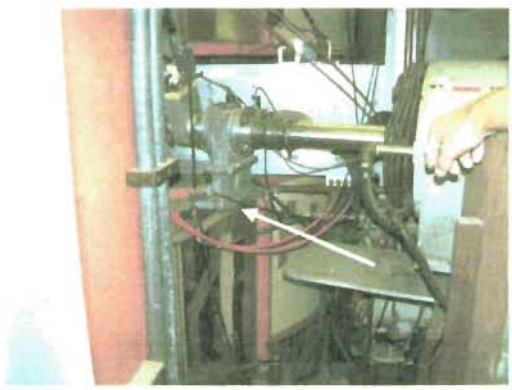
Metal Sample MS-1 and MS-2



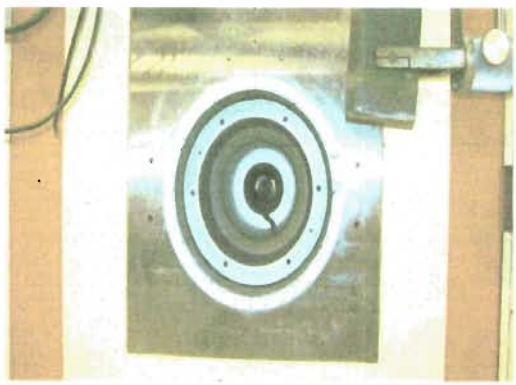
Metal Sample MS-3



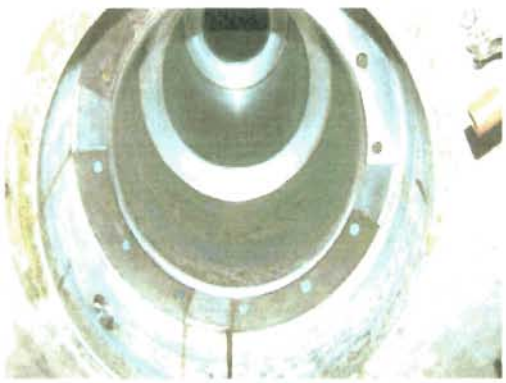
Metal Sample MS-4



Metal Sample MS-5



Metal Sample MS-6



Metal Sample MS-7

	3.1 General Preparation		
	Job Steps	**Potential Hazard**	**Critical Actions**
1	Mobilize to work site	Traffic accident.	Compliance with GRC Safety Manual Chapter 19 and assurance of valid driver's license, seat belt use, routine vehicle inspections, no cell phone use while driving.
2	Movement of equipment and materials, performance of material surveys.	Lifting (musculoskeletal injuries) hazards.	Compliance with GRC Safety Manual Chapter 14. If equipment is to be moved, an evaluation of potential pinch points and/or weight strain shall be conducted. Clear area of all unnecessary equipment and slip/trip hazards. Additional help shall be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lbs or has to be moved by maneuvering through awkward positioning.
		Temperature stress.	If temperature is above 80°F or below 40°F, administrative controls shall be implemented (cooled or warmed drinks, routine breaks in heated or shaded area, provisions for emergency heating or cooling).
		Pinch points.	Heavy work gloves will be worn when handling materials that could cause abrasion or laceration injuries to the hands. Objects that could result in pinch injuries shall be handled with work gloves and set on blocking to prevent pinches
		Falls from elevated surface (≥6')	Compliance with GRC Safety Manual Chapter 34, Fall Protection, for working from elevated surfaces ≥ 6 ft. above next lower level. Prior to the use of fall protection, a Fall Protection Plan shall be submitted to SHED for review and concurrence.
		Unauthorized personnel entering work zone	Entrance to the cyclotron vault will be posted for Authorized Entry Only
		Head Injury	Hard hats will be worn when any overhead work or material movement is in progress
		Exposure to Radionuclides	Site-specific Radiation Worker Training as required by PBRF or GRC Field screening of sample materials, equipment, and personnel Administrative controls (radiation safety procedures) Radiation Work Permit requirements will be followed at all times Field screening conducted by qualified Radiation Control Technician Comply with all GRC Radiological Postings

ACTIVITY HAZARD ANALYSIS

Work Activity: 3.4 Volumetric Material Sampling		
Personal Protective Equipment (PPE)	**Selected**	**Comments**
Safety Shoes	X	
Hard Hat	X	If overhead hazards
Safety Glasses With Side Shields	X	
Fire Resistant Clothing		
Face Shields	X	Within 15 feet of core drill rig
Goggles		
Lifeline/Body Harness	X	If working on elevated scaffold. Prior to the use of fall protection, a Fall Protection Plan shall be submitted to SHED for review and concurrence.
Hearing Protection	X	When operating core drill
Air Purifying Respirator		
Supplied Air Respirator – SCBA		
Welding Hood		
Welding/Pipe Clothing		
Welding Mask/Goggles		
Personal Floatation Device		If within 6 feet of unguarded water 3 feet or more in depth
Gloves	X	Nitrile or PVC for potentially contaminated material. Heavy duty work gloves for material handling. Leather gloves when cutting or filing metal
Dust Control	X	Keep drill area wetted, use a HEPA Vacuum for air capture, and wear dust mask to prevent inhalation of dust and exposure to silica
Safety Cones/Barricades		
Safety Vest		
Knee Pads		
Caution/Danger Tape	X	As needed, to exclude unauthorized personnel

Competent Person	Rod Case
Subcontractor	TBD

	Work Activity: 3.4 Volumetric Material Sampling		
	Job Steps	**Potential Hazard**	**Critical Actions**
1	Mobilize to work site	Traffic accident.	Compliance with GRC Safety Manual Chapter 19 and assurance of valid driver's license, seat belt use, routine vehicle inspections, no cell phone use while driving.
2	Core Drilling	Electric shock	Portable electrical tools and all portable electrical equipment shall be connected through ground fault circuit interrupters.
		Noise	Hearing protection required within 25 feet of operating core drill
		Temperature stress.	If temperature is above 80°F or below 40°F, administrative controls shall be implemented (cooled or warmed drinks, routine breaks in heated or shaded area, provisions for emergency heating or cooling).
		Lifting (musculoskeletal injuries) hazards.	Compliance with GRC Safety Manual Chapter 14. If equipment is to be moved, an evaluation of potential pinch points and/or weight strain shall be conducted. Clear area of all unnecessary equipment and slip/trip hazards. Additional help shall be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lbs or has to be moved by maneuvering through awkward positioning.
		Dust Exposure	Wear dust masks when drilling and keep core area wetted down to minimize dust
		Slips and Falls	When wetting area, keep water mopped or collected to prevent slips and falls on wet floors. Wear rubber soled foot wear to alleviate slip hazard.
		Eye Injury	Wear a face shield or goggles when operating or near the core drill in operation.
		Pinch Points	Be aware of pinch points between pipe opening and cables associated with instruments. Wear gloves to protect hands and exercise caution when inserting/withdrawing instruments
		Exposure to Radionuclides	Site-specific Radiation Worker Training from PBRF or GRC Field screening of sample materials, equipment, and personnel Administrative controls (radiation safety procedures) Radiation Work Permit requirements will be followed Field screening conducted by qualified Radiation Control Technician Comply with all GRC Radiological Postings
		Silica exposure	Use wetting to suppress concrete dust to prevent silica exposure. If wetting is not possible industrial ventilation may be used to prevent dust from entering worker breathing zone. If engineering controls not practicable disposable respirators may be used to control worker exposure. Medical release and fit test required for respirator use.
		Lead based paint exposure	Dust from drilling/cutting through potentially lead based paint will be controlled by wetting and use of HEPA vacuum cleaner.
3	Metal and Pipe Sampling	Exposure to metal filings	Wear work gloves to protect against cuts/lacerations.
		Lead based paint exposure	Painted pipe will not be flame cut. When saw cutting, a HEPA Vacuum will be used to collect filings and to prevent airborne lead from lead based paints

Enclosure 5

SURVEY REQUEST FORM

SR NUMBER	SR-3	REVISION #	0	DATE ISSUED	6-14-10
TYPE OF SR	☒ CHARACTERIZATION ☐ OTHER:				
AREA / LOCATION	Buildings 49 and 140				
PURPOSE	Volumetric Concrete Sampling				

SAMPLE TYPE

- ☐ SURFACE SOIL SAMPLE: N/A
- ☐ SUB-SURFACE SOIL SAMPLE: N/A
- ☐ SMEAR SAMPLE: N/A
- ☐ SEDIMENT SAMPLE: N/A
- ☒ CORE SAMPLE: See instructions
- ☐ WATER SAMPLE: N/A
- ☐ OTHER:

SURVEY TYPE

SURFACE SCAN	☐ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE	N/A	SCAN RATE & DETECTOR DISTANCE FROM SURFACE	N/A
		PROBE TYPE	N/A		
SURFACE SCAN	☐ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE	N/A	SCAN RATE & DETECTOR DISTANCE FROM SURFACE	N/A
		PROBE TYPE	N/A		
STATIC MEASURE-MENT	☒ BETA ☐ GAMMA ☐ ALPHA	INST. TYPE	Ludlum 2350-1	COUNT TIME & DETECTOR DISTANCE FROM SURFACE	Detector shall be held ≤ ½" from the surface. Count time shall be 1 minute.
		PROBE TYPE	44-116		
STATIC MEASURE-MENT	☐ BETA ☐ GAMMA ☒ ALPHA	INST. TYPE	Ludlum 2350-1	COUNT TIME & DETECTOR DISTANCE FROM SURFACE	Detector shall be held ≤ ¼"" from the surface. Count time shall be 1 minute.
		PROBE TYPE	43-90		
OTHER					

SURVEY REQUEST FORM					
SR NUMBER	**SR-3**	**REVISION #**	**0**	**AREA / LOCATION**	**Buildings 49/140**

SPECIFIC SAMPLING & SURVEYING INSTRUCTIONS / COMMENTS

Prerequisites and General Requirements

1. An initial pre-job briefing is required with Characterization Technicians and the Characterization Engineer/Supervisor prior to the start of surveying/sampling. Subsequent briefings will be at the discretion of the Characterization Engineer/Supervisor.
2. Review the Job Hazard Analysis (JHA) and adhere to all precautionary requirements.
3. All section numbers refer to Procedure CP-1, "Survey Methodology to Support Radiological Characterization."
4. 44-116 and 43-90 static measurements shall be performed in accordance with section 4.3.4.
5. Ensure that surfaces to be surveyed are relatively clean and dry prior to performing the survey.
6. All sample and survey data shall be recorded on an approved Characterization Survey Form.
7. Anomalies, obstructions or other problems encountered in performing the survey shall be documented on a Survey Request Continuation Sheet.
8. Additional surveying and sampling may be performed at the discretion of the Characterization Manager provided the surveys are performed and /or samples are collected in accordance with instructions provided by this Survey Request (SR).

Quality Control (QC) Measurements

A minimum of 5% of all static measurements will be duplicated or repeated using identical methodology contained in this SR IAW Section 4.5.2.

APPROVAL SIGNATURES

CHARACTERIZATION ENGINEER	J. Graham	**DATE**	6/11/10
CHARACTERIZATION MANAGER	R. Case	**DATE**	6/14/10

SR CLOSURE

CHARACTERIZATION ENGINEER		**DATE**	
CHARACTERIZATION MANAGER		**DATE**	

SURVEY REQUEST CONTINUATION SHEET					
SR NUMBER	**SR-3**	**REVISION #**	**0**	**AREA / LOCATION**	**Buildings 49/140**

SPECIFIC SAMPLING & SURVEYING INSTRUCTIONS / COMMENTS

Volumetric Concrete Sampling

1. The following steps refer to tables and figures contained in Appendix F of the **Characterization Plan for the GRC Cyclotron Facility**. A copy of Appendix F is attached to this SR for reference.
2. Collect a 3" diameter core bore sample at each location identified in Table F-1. Refer to Figures F-1 through F-4 for diagrams and photographs of each sample location.

   NOTE: Other locations may be selected for sampling based on results of scan and static measurements, at the discretion of the Characterization Manager.
3. Process the samples by slicing the core bores into ½ inch disks.
4. Perform beta and alpha contact static measurements on each side of each disk.

   NOTE: Other locations may be selected for sampling based on results of scan and static measurements, at the discretion of the Characterization Manager
5. Perform gamma spectroscopy analysis on each disk.

   NOTE: It may not be necessary to analyze all disks within a core sample. The number of disks to be analyzed will be determined by the Characterization Manager.
6. Perform hard-to-detect radionuclide analysis of selected samples exhibiting cyclotron produced radioactivity. The Characterization Manager shall be involved in the selection process.
7. Maintain sample chain-of-custody from the point of collection through the determination of the final results.
8. Record sample locations and survey results on a Characterization Survey Form(s).

SURVEY REQUEST SAMPLE ANALYSIS SHEET					
SR NUMBER	**SR-3**	**REVISION #**	**0**	**AREA / LOCATION**	**Buildings 49/140**

REQUESTED SAMPLE ANALYSIS

SAMPLE TYPE	RADIONUCLIDE	TARGET COUNTING SYSTEM MDA	COMMENTS / ADDITIONAL INSTRUCTIONS
Concrete Core bore	Ag-108m	0.1 pCi/g	1) Radionuclide and MDA Values taken from Table 5.2 of the *Characterization Plan for the GRC Cyclotron Facility.*
	Al-26	0.2 pCi/g	
	Bi-207	0.2 pCi/g	2) Additionally, hard-to-detect (HTD) and other analyses may be performed as directed by the Characterization Manager.
	Co-57	0.2 pCi/g	
	Co-60	0.3 pCi/g	
	Cs-134	0.3 pCi/g	
	Eu-152	1.0 pCi/g	
	Eu-154	0.3 pCi/g	
	Mn-54	0.1 pCi/g	
	Na-22	0.2 pCi/g	
	Sb-125	0.2 pCi/g	
	Ti-44	0.2 pCi/g	

APPENDIX F

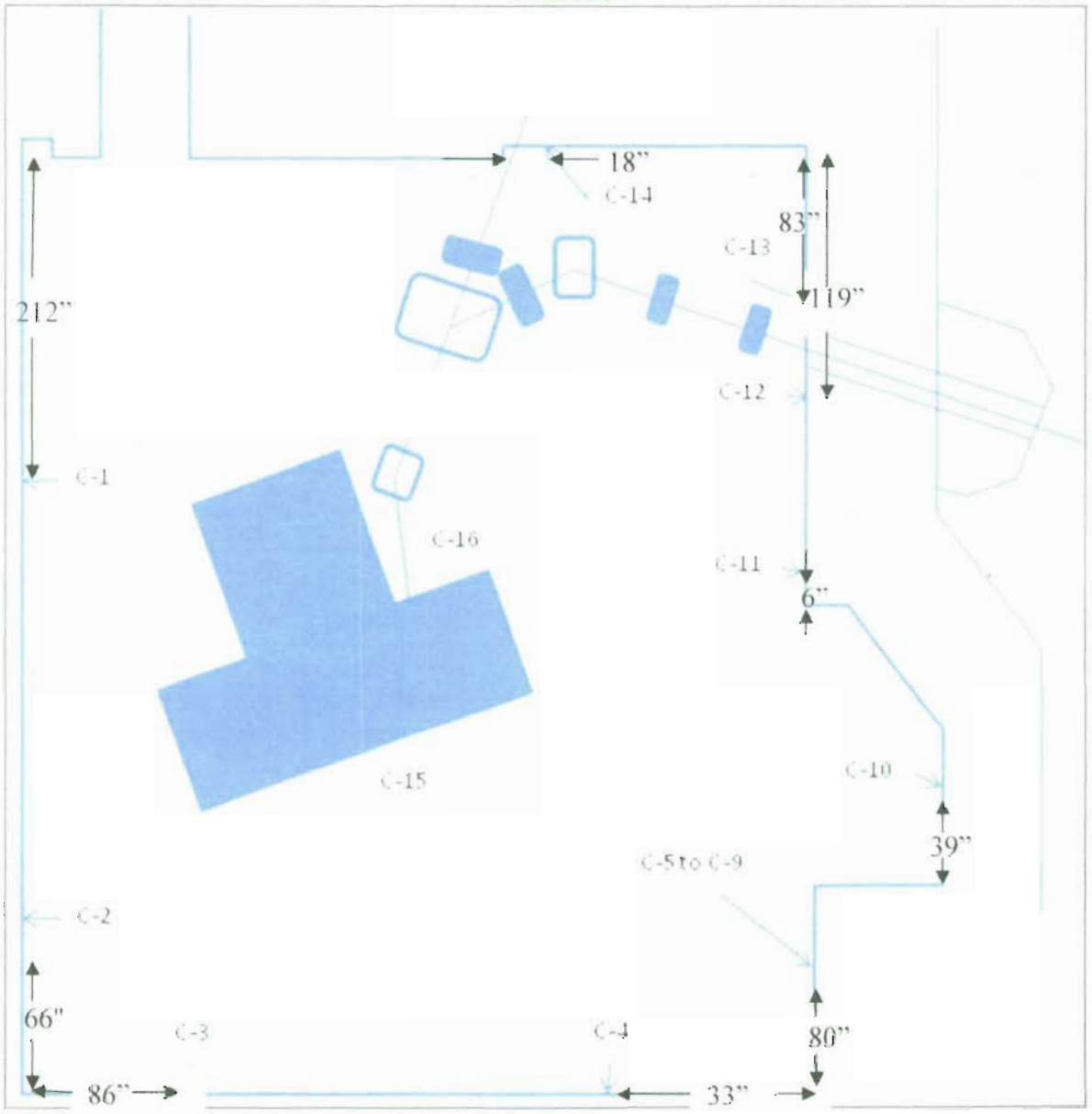
Table F-1 - Building 140 Volumetric Concrete Sampling Locations

Location Number	Room	Location	Sample Depth
C-1	Vault Room	49" (from floor) on N wall & 212" (from E wall)	6 inches
C-2	Vault Room	49" (from floor) on N wall & 66" (from W wall)	6 inches
C-3	Vault Room	49" (from floor) on W wall & 86" (from N wall)	6 inches
C-4	Vault Room	49" (from floor) on W wall & 33" (from S wall)	6 inches
C-5	Vault Room	25" (from floor) on S wall & 80" (from W wall)	6 inches
C-6	Vault Room	37" (from floor) on S wall & 80" (from W wall)	6 inches
C-7	Vault Room	49" (from floor) on S wall & 80" (from W wall)	6 inches
C-8	Vault Room	61" (from floor) on S wall & 80" (from W wall)	6 inches
C-9	Vault Room	73" (from floor) on S wall & 80" (from W wall)	6 inches
C-10	Vault Room	49" (from floor) on S wall & 39" (from W wall)	5' Through Wall
C-11	Vault Room	49" (from floor) on S wall & 6" (from corner)	5' Through Wall
C-12	Vault Room	49" (from floor) on S wall & 119" (from E wall)	5' Through Wall
C-13	Vault Room	77" (from floor) on S wall & 83" (from E wall)	5' Through Wall
C-14	Vault Room	49" (from floor) on E wall & 18" (from door edge)	6 inches
C-15	Vault Room	On floor in pit	6 inches
C-16	Vault Room	In pit under beam tube	6 inches
C-17	Therapy Room	Floor @ C/L under vertical beam	6 inches
C-18	Skylight Room	Background in skylight room @49"	6 inches
C-19	Mechanical Equipment Room	On floor @ beam tube penetration	6 inches
C-20	Vault Room	Ceiling @ Centerline above cyclotron	4 inches
C-21 thru C-XX	Any	Areas Exceeding the Scan Investigation Level	Per Characterization Engineer

Note: Refer to diagrams in Figures F-1 and F-2 and photographs in Figure F-3 for additional detail of sample locations.

APPENDIX F

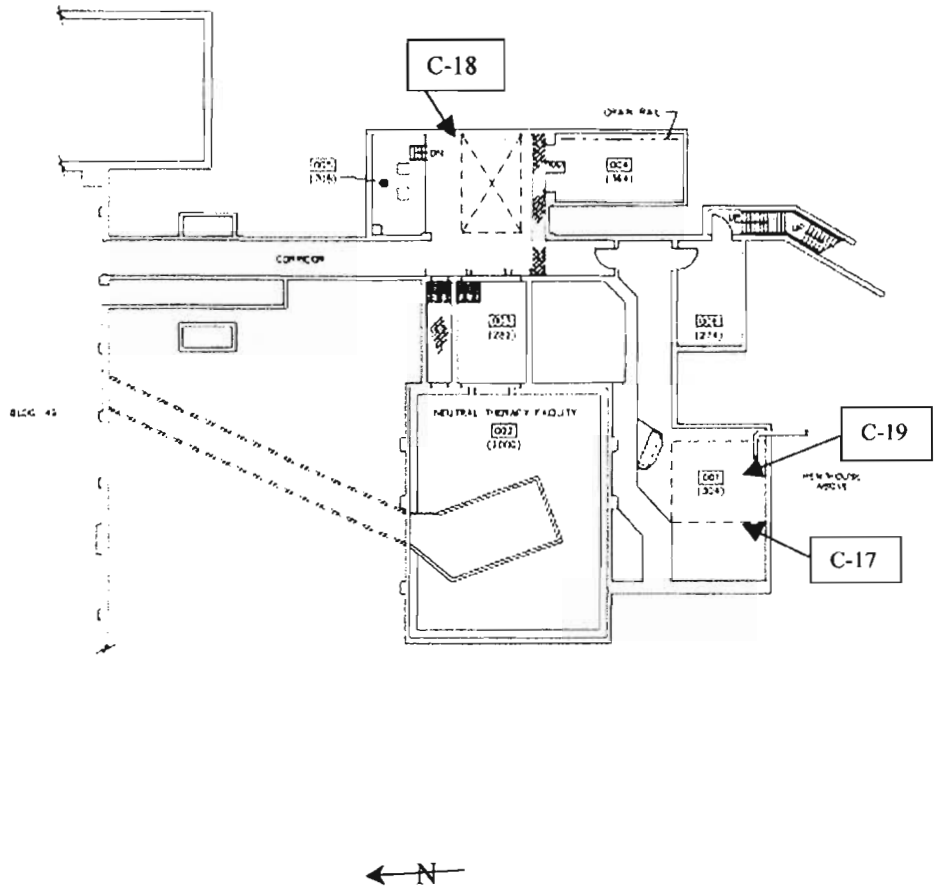
Figure F-1 - Diagram of Concrete Core Locations



for Vault Room

APPENDIX F

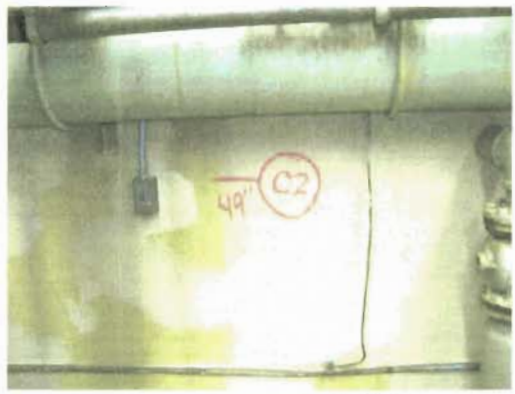
Figure F-2 - Diagram of Concrete Core Locations for Neutron Therapy & Skylight Rooms



APPENDIX F

Figure F-3 - Photos of Concrete Core Locations for Vault Room

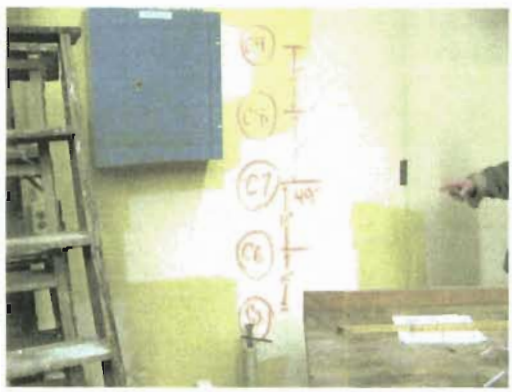
Core Sample C- 1



Core Sample C- 2

Core Sample C- 3

Core Sample C- 4



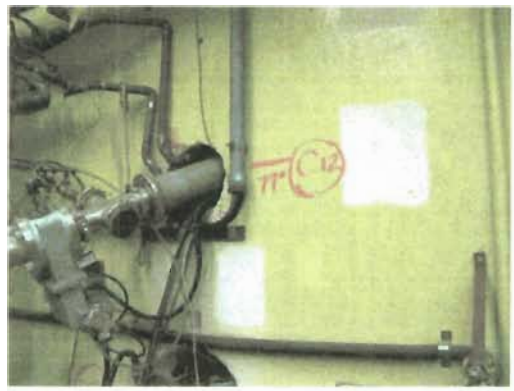
Core Sample C-5 to C-9

Core Sample C-10

APPENDIX F

Figure F-3 - Photos of Concrete Core Locations for Vault Room (continued)

Core Sample C-11



Core Sample C-12

Core Sample C-13

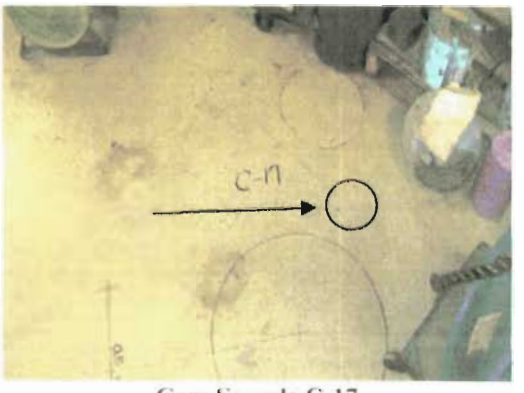
Core Sample C-14

Core Sample C-15

Core Sample C-16

APPENDIX F

Figure F-4 - Photos of Concrete Core Locations for Neutron Therapy & Skylight Rooms



Core Sample C-17

Core Sample C-18

Core Sample C-19

Activity Hazard Analysis		
Work Activity: 3.1 General Preparation		
Personal Protective Equipment (PPE)	**Selected**	**Comments**
Safety Shoes	X	
Hard Hat	X	Whenever work activities or movement material in overhead areas is in progress
Safety Glasses With Side Shields	X	
Fire Resistant Clothing		
Face Shields		
Goggles		
Lifeline/Body Harness		
Hearing Protection		
Air Purifying Respirator		
Supplied Air Respirator – SCBA		
Welding Hood		
Welding/Pipe Clothing		
Welding Mask/Goggles		
Personal Floatation Device		
Gloves	X	Nitrile or PVC for potentially contaminated material. Heavy duty work gloves for material handling.
Other		
Fall restraint/arrest PPE	X	If working from elevated surface ≥ 6 ft. above next lower level. Prior to the use of fall protection, a Fall Protection Plan shall be submitted to SHED for review and concurrence.
Safety Cones/Barricades		
Safety Vest		
Knee Pads		
Caution/Danger Tape	X	As needed, to exclude unauthorized personnel when moving equipment/materials

Competent Person	Rod Case
Subcontractor	TBD

	3.1 General Preparation		
	Job Steps	**Potential Hazard**	**Critical Actions**
1	Mobilize to work site	Traffic accident.	Compliance with GRC Safety Manual Chapter 19 and assurance of valid driver's license, seat belt use, routine vehicle inspections, no cell phone use while driving.
2	Movement of equipment and materials, performance of material surveys.	Lifting (musculoskeletal injuries) hazards.	Compliance with GRC Safety Manual Chapter 14. If equipment is to be moved, an evaluation of potential pinch points and/or weight strain shall be conducted. Clear area of all unnecessary equipment and slip/trip hazards. Additional help shall be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lbs or has to be moved by maneuvering through awkward positioning.
		Temperature stress.	If temperature is above 80°F or below 40°F, administrative controls shall be implemented (cooled or warmed drinks, routine breaks in heated or shaded area, provisions for emergency heating or cooling).
		Pinch points.	Heavy work gloves will be worn when handling materials that could cause abrasion or laceration injuries to the hands. Objects that could result in pinch injuries shall be handled with work gloves and set on blocking to prevent pinches
		Falls from elevated surface (≥6')	Compliance with GRC Safety Manual Chapter 34, Fall Protection, for working from elevated surfaces ≥ 6 ft. above next lower level. Prior to the use of fall protection, a Fall Protection Plan shall be submitted to SHED for review and concurrence.
		Unauthorized personnel entering work zone	Entrance to the cyclotron vault will be posted for Authorized Entry Only
		Head Injury	Hard hats will be worn when any overhead work or material movement is in progress
		Exposure to Radionuclides	Site-specific Radiation Worker Training as required by PBRF or GRC Field screening of sample materials, equipment, and personnel Administrative controls (radiation safety procedures) Radiation Work Permit requirements will be followed at all times Field screening conducted by qualified Radiation Control Technician Comply with all GRC Radiological Postings

ACTIVITY HAZARD ANALYSIS

Work Activity: 3.4 Volumetric Material Sampling		
Personal Protective Equipment (PPE)	**Selected**	**Comments**
Safety Shoes	X	
Hard Hat	X	If overhead hazards
Safety Glasses With Side Shields	X	
Fire Resistant Clothing		
Face Shields	X	Within 15 feet of core drill rig
Goggles		
Lifeline/Body Harness	X	If working on elevated scaffold. Prior to the use of fall protection, a Fall Protection Plan shall be submitted to SHED for review and concurrence.
Hearing Protection	X	When operating core drill
Air Purifying Respirator		
Supplied Air Respirator – SCBA		
Welding Hood		
Welding/Pipe Clothing		
Welding Mask/Goggles		
Personal Floatation Device		If within 6 feet of unguarded water 3 feet or more in depth
Gloves	X	Nitrile or PVC for potentially contaminated material. Heavy duty work gloves for material handling. Leather gloves when cutting or filing metal
Dust Control	X	Keep drill area wetted, use a HEPA Vacuum for air capture, and wear dust mask to prevent inhalation of dust and exposure to silica
Safety Cones/Barricades		
Safety Vest		
Knee Pads		
Caution/Danger Tape	X	As needed, to exclude unauthorized personnel

Competent Person	Rod Case
Subcontractor	TBD

	Work Activity: 3.4 Volumetric Material Sampling		
	Job Steps	**Potential Hazard**	**Critical Actions**
1	Mobilize to work site	Traffic accident.	Compliance with GRC Safety Manual Chapter 19 and assurance of valid driver's license, seat belt use, routine vehicle inspections, no cell phone use while driving.
2	Core Drilling	Electric shock	Portable electrical tools and all portable electrical equipment shall be connected through ground fault circuit interrupters.
		Noise	Hearing protection required within 25 feet of operating core drill
		Temperature stress.	If temperature is above 80°F or below 40°F, administrative controls shall be implemented (cooled or warmed drinks, routine breaks in heated or shaded area, provisions for emergency heating or cooling).
		Lifting (musculoskeletal injuries) hazards.	Compliance with GRC Safety Manual Chapter 14. If equipment is to be moved, an evaluation of potential pinch points and/or weight strain shall be conducted. Clear area of all unnecessary equipment and slip/trip hazards. Additional help shall be obtained by workers or mechanical assistance used on-site if equipment to be moved is unwieldy, has a weight >50 lbs or has to be moved by maneuvering through awkward positioning.
		Dust Exposure	Wear dust masks when drilling and keep core area wetted down to minimize dust
		Slips and Falls	When wetting area, keep water mopped or collected to prevent slips and falls on wet floors. Wear rubber soled foot wear to alleviate slip hazard.
		Eye Injury	Wear a face shield or goggles when operating or near the core drill in operation.
		Pinch Points	Be aware of pinch points between pipe opening and cables associated with instruments. Wear gloves to protect hands and exercise caution when inserting/withdrawing instruments
		Exposure to Radionuclides	Site-specific Radiation Worker Training from PBRF or GRC Field screening of sample materials, equipment, and personnel Administrative controls (radiation safety procedures) Radiation Work Permit requirements will be followed Field screening conducted by qualified Radiation Control Technician Comply with all GRC Radiological Postings
		Silica exposure	Use wetting to suppress concrete dust to prevent silica exposure. If wetting is not possible industrial ventilation may be used to prevent dust from entering worker breathing zone. If engineering controls not practicable disposable respirators may be used to control worker exposure. Medical release and fit test required for respirator use.
		Lead based paint exposure	Dust from drilling/cutting through potentially lead based paint will be controlled by wetting and use of HEPA vacuum cleaner.
3	Metal and Pipe Sampling	Exposure to metal filings	Wear work gloves to protect against cuts/lacerations.
		Lead based paint exposure	Painted pipe will not be flame cut. When saw cutting, a HEPA Vacuum will be used to collect filings and to prevent airborne lead from lead based paints

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