DRAFT

Los Alamos National Laboratory
Site Characterization for TA-3-141
Sampling and Testing Plan

December 14, 1995

Prepared for
Los Alamos National Laboratory
Industrial Hygiene Group
under Contract No. 9-XQ3-1432E-J
Work Release 95-0017

Prepared by
Radian Corporation
115 Longview Drive
White Rock, NM 87544
Doc. #D951128.5TT51

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Hazards Identification Prior to Demolition and Reconfiguration of TA-3-141
Sampling and Testing Plan

This plan addresses the sampling and testing criteria to be followed during building characterization activities conducted by Radian Corporation. The characterization activities will support the TA-3-141 demolition and reconfiguration to be conducted in 1996.

Reviewed and approved by:

Signature	Name/Title	Company	Date
LANL Industrial Hygiene (ESH-5)			
Signature	Name/Title	Company	Date
Radian Project Manager			
Signature	Name/Title	Company	Date
Radian Project Safety Officer			
Signature	Name/Title	Company	Date
LANL Health Physics Operating (ESH-1)			

The comments of the above reviewers have been incorporated as stipulated, or resolved with written record and copy to the respective reviewer.

Doug Allen	Radian Corporation	(423) 220-8168	
Plan Preparer Name/Signature	Company	Phone number	Date

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ACRONYMS

COC	chain-of-custody
DQO	data quality objective
HA	homogeneous area
HEPA	high-efficiency particulate air
HVAC	heating, ventilation, and air conditioning
ICP	inductively coupled plasma
LANL	Los Alamos National Laboratory
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PPE	personal protective equipment
QA	quality assurance
QAAP	Quality Assurance Administrative Procedure
QC	quality control
Radian	Radian Corporation
RPD	relative percent difference
TLV	threshold limit value

1. INTRODUCTION

Radian Corporation (Radian) has been tasked by Los Alamos National Laboratory (LANL) under Contract No. 9-XQ3-1432E-J, Work Release 95-0017, to conduct surveys of TA-3-141 located at LANL. The purpose of the survey is to identify health and safety hazards, both chemical and physical, associated with the dismantlement of TA-3-141. The primary contaminants of concern are uranium, beryllium, polychlorinated biphenyls (PCBs), lithium, thorium, thallium, and other toxic metals. Radiological contamination is also present in the building; however, the identification of radiologically contaminated areas is not part of the scope of this work. The building is being dismantled to prepare for the installation of a new beryllium processing system.

This plan constitutes the third and fourth phases of a seven phase project to be completed by Radian. The seven phases include (1) background data and information review (including historical information and personnel interviews), (2) site-specific health and safety plan preparation, (3) data quality objectives (DQOs) development, (4) sampling and testing plan preparation, (5) survey and sampling activities, (6) final report preparation, and (7) a personal monitoring report. The DQO process is presented in Sect. 2 of this plan, Sects. 3 and 4 summarize procedures for the field sampling effort, and Sect. 5 is the quality assurance (QA) plan for the sampling effort.

1.1 BACKGROUND

TA-3-141 was constructed in two parts. The first part was completed in 1959 and was used to support activities conducted in the original sigma building primarily to support the Rover Program. The Rover Program was the early development work for constructing a nuclear rocket engine for deep space use. In addition to the Rover Program, the facility was used for supporting weapons component development. In the early 1960s, an addition was constructed on the north side of the building. The additional space was needed for further support of the weapons and the Rover programs.

The facility was mainly used to produce one-of-a-kind metal parts and for initial metal product development prior to scale-up. The facility used a variety of metal powders in these efforts. Based on interviews with personnel at the facility, it was determined that most of the metal processed included uranium, beryllium, lithium, graphite, zirconium, aluminum, tungsten, nickel, thorium, and molybdenum, although numerous other metals have been processed at the facility in small quantities (usually a few pounds over a period of 35 years). Based on discussions with personnel, metals processed in small quantities include boron, thallium, lead, arsenic, cesium, cadmium, chromium, magnesium, antimony, barium, bismuth, gadolinium, europium, germanium, vanadium, rubidium, silicates, tellurium, and titanium.

Powdered metal(s) were mixed with a binder (usually furfuryl alcohol) and then either rolled or pressed with such force to cause the powder to bind together. The shape thereby produced was then usually placed into an oven and sintered. After sintering, the material would be placed in an oven at a temperature slightly below the melting point of the material, thereby causing it to bind together further, usually with greater strength than if the material had been forged through traditional techniques. Much of this work was conducted in glove boxes to control the spread of contamination and maintain product purity.

In addition to rolling or pressing metal powders, the facility also uses metal powder technology to coat or plate metal onto other metal parts through the plasma arc furnace. Therefore, the major types of equipment used at the facility are rolling mills, presses, furnaces, glove boxes, and laboratory hoods.

The Rover Program was phased out during the late 1960s. During this time and later in the 1970s and 1980s, the focus of the facility started to shift toward research and development, although much effort was still given to the weapons program. Because of the wide range of products produced at the facility, most of the metals on the periodic chart have probably been in the building. However, most metals were handled only in small quantities.

Based on discussions with personnel at the building and from visual observations, it is believed that one of the largest areas of concern for contamination is the exhaust ventilation system. There are six exhaust ventilation systems in the building that have been or are currently connected to numerous lab hoods, furnaces, and other equipment where toxic metals were/are processed. The remainder of this section discusses the various areas that the building is divided into and the types of contaminants that may be present.

In 1987, a beryllium processing area was established in rooms 136A, 139, and 141. At this time the exhaust and supply heating, ventilation, and air conditioning (HVAC) systems were replaced for these rooms. Air flowing through the dedicated exhaust system (i.e., FE-1) passes through a high-efficiency particulate air (HEPA) bank of filters located just before the stack on the east side of the building. As part of this construction, a plaster board wall was built across room 136 from east to west to divide this room into 136 and 136A. There are two supply ventilation systems, one is located on the roof and provides air for rooms 139 and 141, and the other ventilation system supplies air for all three rooms plus rooms 136 and 142.

There are five radiological areas in the building, including room 136, room 150, a flagged-off area located on the west side of room 148, and two exhaust systems. Radiological contaminants that may be located in these areas include ^{235}U, ^{238}U, and ^{232}Th. The area on the west side of room 148 is classified as radiological due to a metal rolling machine that was contaminated from rolling uranium.

Currently, this equipment is on standby. There is no exhaust ventilation system for this radiological area. The radiological area consisting of room 150 is serviced by an exhaust ventilation system (i.e., FE-6) that also services the east side of room 148 and is connected to a baghouse located on the north side of the building. The supply ventilation system for this area also supplies other rooms, including rooms 144 and 148. The radiological area consisting of room 136 is serviced by a dedicated exhaust ventilation system (i.e., FE-10), which is not filtered, although the supply system is shared with rooms 136A, 139, 141, and 142.

There are three other exhaust ventilation systems (i.e., FE-9, FE-11, and old FE-1), none of which are filtered, and three additional supply ventilation systems (i.e., total of six exhaust and six supply systems). In addition to the ventilation systems, various pipes for supplying laboratory gasses are also present. There are numerous laboratory hoods located throughout the building that were used for various experiments, usually with powdered metals. A section of the building located on the south side consisting of rooms 104, 108, and 126 are excluded from this project. Because the exhaust ventilation is under a vacuum while it is in operation, cross-contamination between building areas should not occur except within the exhaust duct work. However, if contamination could get into the HVAC systems, cross-contamination is likely.

Other equipment and components that may be contaminated with radionuclides, toxic metals, and other hazardous materials include rolling mills, glove boxes, lab hoods, presses, furnaces, compressors, storage cabinets, bus bars, shelves, and other miscellaneous equipment/components. Areas that may harbor more contaminants from historical operations include room 136 (especially along the north wall) and room 144 due to the furnaces and glove boxes that were once used in those areas.

1.2 OBJECTIVE

The objective of this project is to identify both chemical and physical hazards that may impact worker health and safety during dismantlement activities. Chemical hazards include the inhalation of metal contaminants that have the potential to be suspended in the air (especially beryllium), dermal contact with other contaminants on the surfaces of equipment and building components, and fire/explosion hazards associated with pyrophoric materials. Contaminants of concern include uranium, beryllium, thorium, lithium, lead, PCBs, cadmium, chromium, chromic acid, nickel, thallium, hydrochloric acid, zinc, and other toxic metals. In addition to chemical hazards, physical hazards such as confined spaces, faulty electrical systems, fall hazards, and laboratory gasses could be present.

1.3 SAMPLING SCOPE

The building survey may be divided into five separate tasks.

1. Beryllium and other metal survey. This task will include sampling various internal and external surfaces for contamination with beryllium powder and other transferrable metal powders. Surfaces include the external and internal areas of the ventilation systems, external and internal surfaces of equipment and cabinets, external surfaces of walls and floors, internal and external surfaces of rotating equipment, and external surfaces of various surface mounted fixtures. In addition, roofing materials will be gathered and analyzed for the presence of these contaminants. Metal wipe samples will be sent to Radian's laboratory in Austin, Texas, for analysis.

2. Perchlorate survey. This survey will consist of the completion of a questionnaire to determine the likelihood that perchloric acid, or other contact sensitive materials, was used in any of the laboratory hoods or other areas where it may have been drawn into the exhaust ventilation system.

3. PCB survey. This survey will consist of samples from three potential sources of PCBs: oil stains on floors and equipment, bulk oil in equipment or tanks, and roofing materials. PCBs in oil stains will be sampled using the immunoassay screening method. Bulk PCB samples will be sent to Radian's laboratory in Austin, Texas, for analysis.

4. Paint survey. This survey will consist of identifying and sampling for the presence of lead and chromium in the paint formulation, as well as encapsulated metal contaminants from painting over potentially contaminated areas.

5. Physical hazard assessment. An assessment will be conducted through visual observations on the general condition and configuration of the building. The types of hazards that will be addressed include those defined in the objective.

Further detail on how these tasks will be performed for the first four tasks is provided in Sect. 3 of this plan. The fifth task is described in Sect. 5.

1.4 PROJECT ORGANIZATION AND RESPONSIBILITIES

The responsibilities of the Radian project team are presented below.

Project Manager. Jeff Miller is the project manager with overall responsibility and accountability for completing the project. He will ensure that appropriate project planning, contractual compliance, technical quality assurance (QA), and status reporting and will report directly to the LANL Project Manager.

Project Engineer. Doug Allen is the project engineer and will manage the field and reporting efforts. He will ensure that work is conducted in a quality manner according to established procedures and this sampling and testing plan. He will be responsible for planning project assignments, managing day-to-day activities of the project team, and communicating with the client to ensure the quality of the work and deliverables.

Field Team Leader. Scott Anderson is the field team leader. He is responsible for preparing the Health and Safety Plan for this project and will provide support for the preparation of the other deliverables. He will organize and direct the field team's efforts and record all data that impact the team's efforts. The team leader ensures that the team complies with all site regulations and training requirements. He will report all problems or recommendations to the project engineer, although he has full authority to make field changes that will enhance the successfulness of the project in his judgement. He is responsible for ensuring that the sampling team complies with all health and safety requirements and will not allow workers to perform a task unless it can be accomplished safely. Lastly, he is responsible for the successful transfer of field data to the office for report writing efforts.

Field Team Members. David Stoetzel and Richard Sturgeon are the field team members for this project. Together with Scott Anderson they form the sampling team. They will be responsible for obtaining the samples, decontaminating equipment, completing the sample logbook and other support documentation [sample labels, chain-of-custody (COC) forms, etc.), and following all appropriate sample procedures as well as the sampling and testing plan.

Peer Review. Peer review will be provided by Dennis Murphy. He will be responsible for reviewing all deliverables to ensure the technical accuracy of their contents.

QA Officer. Steve Alvanas will provide QA support for this project. He will review the DQOs, verify the quality of the data produced, and verify compliance with the sampling and testing plan. Data quality checks include reviewing logbooks to ensure they are complete and correct, reviewing COC forms to ensure they match the sample numbers recorded in the logbook, and reviewing data received from the laboratory to ensure they correspond correctly with the COC forms and the logbooks.

1.5 SCHEDULE

The proposed schedule for this project is shown in Fig. 1.1. The start date of November 20, 1995, coincides with the Notice to Proceed for this task. A scoping meeting was held on November 22, 1995, to discuss the schedule and sequence of activities that are indicated in the figure. The schedule is subject to modification as needed with approval from Radian and LANL.

2. DATA QUALITY OBJECTIVES

DQOs are used to define the physical types of samples to gather, locations for obtaining samples, the number of samples required, and the type of chemical analysis required. In addition, DQOs are used to define how physical hazards should be identified and addressed. DQOs are defined through a seven step process:

1. State the problem,
2. Identify decisions needed to solve the problem,
3. Identify inputs to the decision,
4. Define the boundaries,
5. Develop decision rules,
6. Specify limits on decision error, and
7. Optimize design for collecting data.

2.1 PROBLEM STATEMENT

The primary objective of the characterization effort is to identify health and safety hazards, both chemical and physical, associated with the dismantlement of TA-3-141. Dismantlement will include the removal of electrical, mechanical, and structural systems and components. Health and safety hazards that may be encountered during dismantlement activities may be described in terms of chemical and physical hazards. Chemical hazards include the potential for inhalation of beryllium dust, dermal contact with PCBs, inhalation of lead-contaminated paint dust, inhalation of dust containing other metals, and fire hazards from pyrophoric metal powders. Physical hazards include confined spaces, electrical shock, fall hazards, poor lighting, falling objects, heat stress, accidents with power tools, and laboratory gasses. Potential hazards will depend on the contamination associated with the component/equipment removed and the method of removal. Table 2.1 lists equipment and components to be removed [i.e., homogeneous areas (HAs)], the likely removal method, and potential hazards associated with removal.

Table 2.1. Potential hazards during dismantlement operations

Room/ location	HA	Dismantlement method	Potential hazards and concerns
136A 139 141	Beryllium exhaust ventilation system (new FE-1)	Disconnect, remove covers, and cut into sections and remove	Inhalation of beryllium dust, spreading of beryllium dust
150, 148, 144/bo[a], 248/bo	Bag filter exhaust system radiological area (FE-6)	Disconnect, remove flanges, and cut into sections and remove	Inhalation of dust with metals, radiological contaminants, pyrophoric hazards
142, 144, 248/bo	Nonfiltered exhaust system (FE-9)	Disconnect, remove flanges, and cut into sections and remove	Inhalation of dust with metals, pyrophoric hazards
126	Nonfiltered exhaust system (FE-11)	Disconnect, remove flanges, and cut into sections and remove	Inhalation of dust with metals, pyrophoric hazards
136	Nonfiltered radiological area (FE-10)	Disconnect, remove flanges, and cut into sections and remove	Inhalation of dust with metals, radiological contaminants, pyrophoric hazards
130	Filtered exhaust system (old FE-1)	Disconnect, remove flanges, and cut into sections and remove	Inhalation of dust with metals, pyrophoric hazards
100, 102, 110, 116, 117	Supply ventilation system (HV-1)	Disconnect, remove flanges, cut away from out-of-scope area and seal off, and cut into sections and remove	Minimal contamination (radiological contaminants and possibly metals)
106, 112, 113, 130, 135, 137	Supply ventilation system (HV-5)	Disconnect, remove flanges, and cut into sections and remove	Minimal contamination (radiological contaminants and possibly metals)
136A, 136, 139, 141	Supply ventilation system (HV-2)	Disconnect, remove flanges, and cut into sections and remove	Minimal contamination (radiological contaminants and possibly metals)
133, 138, 140, 146	Supply ventilation system (HV-2)	Disconnect, remove flanges, and cut into sections and remove	Minimal contamination (radiological contaminants and possibly metals)
144, 148, 150, 248	Supply ventilation system (HV-3)	Disconnect, remove flanges, and cut into sections and remove	Minimal contamination (radiological contaminants and possibly metals)
139, 141	Supply ventilation system (HV-6)	Disconnect, remove flanges, and cut into sections and remove	Minimal contamination (radiological contaminants and possibly metals)
TBD during sampling	Paint by color	Heat gun, mechanical removal, and paint over	Inhalation of lead, possibly other metals, and radiation from dust generated

Table 2.1 (continued)

Room/ location	HA	Dismantlement method	Potential hazards and concerns
Roof	Outside roof	Mechanical removal and scraping	PCBs in tar paper, miscellaneous metals, and radiological contaminants
136A, 139, 141	Horizontal surfaces in beryllium rooms	Disconnect and remove (light fixtures, electrical enclosures, cabinets, counter tops, etc.)	Inhalation of beryllium dust, other metals, and radiological contaminants
100, 102, 110, 112, 113, 116, 117, 130, 133, 135, 138, 140, 146	Horizontal surfaces in office areas	Disconnect and remove (light fixtures, electrical enclosures, cabinets, counter tops, etc.)	Minimal contamination (radiological contaminants and possibly metals)
106, 137, 142, 144, 148, 148A, 201, 248, internal roofs	Horizontal surfaces in process areas	Disconnect and remove (light fixtures, electrical enclosures, cabinets, counter tops, etc.)	Moderate probability of contamination (radiological contaminants and metals)
136, 150	Horizontal surfaces in radiological areas	Disconnect and remove (light fixtures, electrical enclosures, cabinets, counter tops, etc.)	Moderate probability of metal contamination, radiological concerns
Same as vent exhaust systems	Rotating equipment	Disconnect and remove (motors, fans, blowers)	Same as ventilation exhaust systems
TBD during sampling	Process equipment	Rolling mills, lathes, plasma spray chamber, furnaces, glove boxes, and presses	Specific to process, possibly metals and radiological contaminants
	Cinder block wall	Mechanical breaking and removal	Inhalation of dust potentially contaminated with metals and radiological contaminants
136, 136A	Sheetrock wall	Mechanical breaking and removal	Inhalation of dust potentially contaminated with beryllium, metals, and radiological contaminants
137	Acid waste line	Disconnect, cut, and remove	Inhalation of dust contaminated with radiological contaminants, beryllium, metals, and others
	Steam lines	Disconnect, flange off, and cut and remove	Inhalation of dust contaminated with radiological contaminants, beryllium, metals, and others

Table 2.1 (continued)

Room/ location	HA	Dismantlement method	Potential hazards and concerns
	Laboratory gas pipelines	Purge system, disconnect, and cut and remove	Explosion from improperly purged lines, inhalation of dust contaminated with radiological contaminants, beryllium, metals, and others

[a]bo = blanked off.

Secondary objectives during dismantlement and reconfiguration are to prevent the spread of contamination during dismantlement, identify levels of concern to support waste management decisions for components that are removed from the building, provide information to ensure environmental compliance, provide input to project planning for dismantlement and reconfiguration, and identify long-term health and safety concerns for the new tenants from contaminants that may still remain after reconfiguration.

The type and extent of contaminants in and on building components/equipment will be used to define chemical hazards that may be present. The type and extent of contaminants in and on building components/equipment will be determined through process knowledge and sampling. Physical hazards will be identified through visual observation and process knowledge. Therefore, the problem to be resolved for chemical hazards identification includes the determination of:

- components/equipment to be sampled (i.e., define representative samples),
- sampling technique (i.e., ensure representative sample is collected),
- contaminants that should be analyzed, and
- detection level required for each contaminant.

The problem to be resolved for the identification of physical hazards includes determining:

- visual observations that should be recorded,
- the level of detail to be recorded from visual observations, and
- process documentation that should be reviewed.

2.2 IDENTIFY DECISIONS NEEDED TO SOLVE THE PROBLEM

Information gathered during characterization will be used to protect dismantlement personnel from chemical and physical hazards. Decisions that need to be made to ensure worker protection include:

- dismantlement methods and techniques (to minimize personnel exposure, the potential for spreading contamination, and physical hazards),
- order of dismantlement/removal of equipment and components,
- engineered barriers to be used during dismantlement activities,
- level of personal protective equipment (PPE) required by dismantlement personnel, and
- medical monitoring required for dismantlement personnel to verify minimal exposures to chemical hazards.

Solutions to these decisions will be attained through the appropriate data collection plan.

2.3 IDENTIFY INPUTS TO THE DECISION

In this step, the information/data needed to make the decisions defined above need to be identified.

Chemical Hazards

- types of contaminants that are present;
- form of contamination (fixed, transferable, solid, dust, etc.);
- location of contamination:
  - equipment,
  - infrastructure,
  - floors/walls, and
  - miscellaneous structures (cabinets, shelves, structural steel, etc.); and
- allowable quantity of contamination.

Physical Hazards

- location of confined spaces,
- location of electrical sources, and
- identification of potential for accidental falls, falling objects, and other physical hazards.

Potential sources for obtaining this information/data need to be identified. Sampling activities will be used to confirm or supplement other information sources. Other sources of information include:

- process knowledge,
- visual observations,
- building drawings,
- personnel interviews,
- radiological survey and other historical data, and
- written process operating procedures.

Presently, the portion of the building slated for reconfiguration consists of 25 rooms and 2 roof areas. Based on process knowledge, it is logical to divide the building into five areas or zones:

1. beryllium processing areas (includes rooms 136A, 139, and 141),
2. radiological areas (includes rooms 136, 150, and a small part of room 148),
3. miscellaneous laboratory and processing areas (includes rooms 130, 137, 142, 144, 148, 148A, 201, 248, and internal roof areas),
4. office areas and change rooms (includes rooms 100, 102, 110, 112, 113, 116, 117, 133, 135, 138, 140, and 146), and
5. external roof areas.

Based on process knowledge, the following contaminants have been used and therefore may be present. These contaminants are listed in Table 2.2 in an approximate decreasing order of use based on personnel interviews. The threshold limit values (TLVs) are also provided.

Table 2.2. Materials handled in decreasing order of use in TA-3-141

Material	TLV (mg/m^3)	Density (g/mL)	Comment
Uranium[a]	0.2	19.05	Not in scope of characterization effort
Beryllium	0.002	1.85	Negligible use except in beryllium areas
Lithium	0.025	0.84	Usually used as LiH
Graphite	2.0	2.25	Used extensively
Furfuryl alcohol	40.0	1.16	Used extensively as binder, may be absorbed through skin
Zirconium[ns, b]	5.0	6.49	Relatively significant use
Aluminum	10.0	2.70	Used extensively
Tungsten	5.0	19.35	Relatively significant use
Nickel	1.0	8.90	Moderate use
Thorium[ns]	0.6[c]	11.70	Moderate to small use
Boron	10.0	2.37	Small use
Thallium	0.1	11.85	Small use, may be absorbed through skin
Lead	0.15	11.34	Small use
Arsenic	0.2	5.73	Small use
Cesium[ns]	2.0	1.88	Small use (TLV based on hydroxide)
Cadmium	0.05	8.64	Small use
Chromium	0.5	7.20	Small use
Magnesium	10.0	1.74	Small use
Antimony	0.5	6.68	Negligible use
Barium	0.5	3.51	Negligible use
Bismuth	10.0	9.80	Negligible use
Gadolinium[ns]	NA	7.90	Negligible use
Europium[ns]	NA	5.24	Negligible use
Germanium[ns]	0.6	5.35	Negligible use
Vanadium	0.05	5.96	Negligible use
Rubidium[ns]	NA	1.53	Negligible use

Table 2.2 (continued)

Material	TLV (mg/m^3)	Density (g/mL)	Comment
Tellurium[ns]	0.1	6.25	Negligible use
Titanium	10.0	4.50	Negligible use
Perchloric acid	NA	V	Negligible use, concern is formation of perchlorates and explosive hazard
PCBs	0.5	V	Unknown use, may be in lubricating oil
Molybdenum	5.0	10.20	Small use (for plasma arc furnace)
Silicates	NA	NA	Small use (in the form of molydisilicate)

NA = not available
NS = non-standard analysis (not a standard ICP metal)
V = variable depending on type or strength

[a]This element may exist in the form of uranium carbide, which is more hazardous because of its pyrophoric nature.
[b]This element may exist in the form of zirconium carbide, which is more hazardous because of its pyrophoric nature.
[c]Not published, based on U assuming radioactivity controls (^{238}U is three times more radioactive than ^{232}Th).

The health and safety concern for most of the contaminants is the potential for inhalation when disturbed and suspended in air during dismantlement activities. These contaminants are normally in the form of surface contamination until some physical activity is performed, causing the contaminants to become airborne. Therefore, the sampling method chosen should be for identifying surface contamination. Three contaminants that may also be absorbed through the skin include furfuryl alcohol, thallium, and PCBs. PCBs may be found with oil in bulk form within some of the equipment. Therefore, some bulk sample analysis may be necessary for oils that may be contaminated with PCBs. In addition, some materials such as paint should be analyzed in bulk form. In paint, the primary contaminant of concern is lead, which is part of the paint matrix and not easily removed through wipe analysis. Most other surface contamination may best be estimated through wipe analysis methods.

Perchlorates should not be sampled through wipe analysis methods due to the fire hazard associated with them. Perchlorates may best be sampled by cleaning the suspect surface with water and analyzing the water for the presence of perchlorates.

Radiological contamination and asbestos are also known to be present; however, they are outside the scope of this characterization effort. The anticipated contaminants in each zone are described below.

Beryllium Processing Areas. It is believed that all contaminants listed in Table 2.2 have been in this area. However, the primary contaminant of concern in this area is beryllium. Beryllium was not handled in large quantities in this building until 1987 when the beryllium processing area was constructed.

Radiological Areas. The primary contaminants of concern for these areas include uranium and thorium. Other contaminants that have been in these areas could include all of those listed in Table 2.2.

Miscellaneous Laboratory and Processing Areas. It is believed based on interviews with personnel that all contaminants listed in Table 2.2 have been used in these areas at one time or another. However, beryllium was not used in large quantities like it has been used in the beryllium processing area.

Office Areas and Change Rooms. Because of the ventilation system, it is possible that all contaminants listed in Table 2.2 could be in these areas. However, because hazardous materials where not handled in these areas, the presence of contaminants here is considered doubtful, unless contamination is found in the HVAC system supplying these areas.

External Roof Areas. The primary contaminant of concern on the roof is PCB-contaminated tar paper. In addition, it is possible that the other contaminants, except chromic acid and hydrochloric acid, could be on the roof from the exhaust stacks.

In addition to these areas, the building is supported through five separate exhaust ventilation systems and four supply ventilation systems. The system for supporting the beryllium handling areas (FE-1) was installed in 1987 and includes a HEPA filtration system. The exhaust ventilation system servicing rooms 148 and 150 is filtered through baghouses located outside on the north side of the building at ground level. The remaining exhaust ventilation systems are not filtered.

Other process systems that cross boundaries between the areas defined above include electrical conduit, bus bars, process water piping, steam piping, and laboratory gas piping. None of these systems should act as a conduit for contamination between areas.

2.4 DEFINE THE BOUNDARIES

The boundaries for the effort include the area within the building undergoing dismantlement and reconfiguration and the roof. Components include:

- process equipment (rolling mills, presses, furnaces, glove boxes, lab hoods, blowers, and compressors),
- external surfaces of miscellaneous materials and equipment (storage cabinets, shelves, counter tops, furniture),

- building infrastructure (plumbing, electrical, ventilation systems, steam and condensate system, cooling system, gas systems),
- walls destined for removal,
- the floors and walls that remain (including supporting structures), and
- the roof to be replaced

The building may be divided into five different areas of contamination. Area 1 includes those rooms where contamination is known to exist and is fairly well documented (e.g., beryllium processing areas); Areas 2 and 3 include those rooms where contamination is likely but not documented (e.g., old processing areas); Area 4 includes those rooms where contamination is not likely (e.g., office areas and change rooms); and Area 5 includes locations where contamination is likely, especially near the exhaust vents, but not documented.

Within each area will be components and equipment with a high probability of contamination (e.g., duct work, process equipment), low probability of contamination (e.g., furniture, counter tops), and unknown probability of contamination (e.g., light fixtures, paint, walls).

Components and equipment will be placed into logical dismantlement groups. HAs within each group would then be defined. Each HA would represent an area or set of equipment assumed to have similar types and concentrations of contaminants. This forms the basis for the sampling and analysis plan.

2.5 DEVELOP DECISION RULES

The decision rules are used to resolve the decisions identified in Sect. 2.2. Considerations to be addressed when resolving these decisions include:

- guideline levels of exposure to contaminants by dismantlement personnel,
- available methods and their effectiveness for protecting dismantlement personnel from contaminants (e.g., PPE and engineered barriers),
- dispersion of contaminants (quantity and extent),
- procedures to be considered when working around physical hazards (e.g., lock-out/tag-out, confined space, hoisting and lifting, fall protection), and
- data needed to estimate potential personnel exposure from contaminants (e.g., type, form, location, dismantlement method).

The allowed levels of exposure to personnel for the contaminants that may be present are provided in Table 2.2. Exposure protection methods include PPE and engineered barriers. Gloves and Tyvek clothing effectively eliminate threats from dermal exposure, and respirators eliminate the threat from some airborne dust contamination. Engineered barriers include adequate ventilation to reduce the level of airborne contamination, negative air confinement of the work area, confinement of the object/component being removed (e.g., seal object in plastic bag), segregation of work area, and remote operations. The allowed dispersion of contaminants will depend on the confinement of the area and the form and quantity of contamination present.

Procedures to be followed to avoid physical hazards will depend on the logistics of the operation and the dismantlement method chosen. These procedures will have to be selected on a case-by-case basis. Any out of the ordinary physical hazards in the area need to be known before the appropriate dismantlement method and procedure may be selected. Ordinary physical hazards will be addressed by the subcontractor during dismantlement activities. Examples of out of the ordinary hazards that should be identified during this survey include loose electrical connections, exposed bus bars, corroded building support structures, lack of railings, poor lighting, poor ventilation, and confined spaces.

The data needed to estimate potential exposure will depend on the type, form, and quantity of contaminants that are present and the selected dismantlement technique. The primary routes of exposure for these contaminants are inhalation of particulates and absorption through the skin. Some form of physical movement of contaminated surfaces is required to waft the particulates into the air where they may be inhaled. It is very difficult to correlate surface contamination with the quantity that could be suspended into the air. Therefore, levels of concern for surface contamination need to be set conservatively. The concept of "as clean as practicable" should be applied.

To determine desired detection levels for surface wipe samples to verify "as clean as possible," an empirical comparison between surface concentrations and air concentrations was performed. This empirical comparison was based on lead data gathered at a firing range as provided below.

Average air concentration ($\mu g/m^3$)	**Average surface concentration ($\mu g/100\ cm^2$)**
158	4,457
337	16,200
90.3	983
3.5	98

If the unit $\mu g/m^3$ is adopted for air concentrations and the unit $\mu g/100\ cm^2$ is adopted for surface concentrations, then it may be stated that, on the average, the lead surface concentration is on the order of 10 times greater or more than the air concentration. Due to the poor correlation between these two units of measure, a very conservative factor of safety of 100 was applied for determining the level of concern. Therefore,

$$\textit{Level of concern } (\mu g/100\ cm^2) = TLV\ (\mu g/m^3) \times \frac{10\ (\textit{correlation factor})}{100\ (\textit{factor of safety})}$$

For example, based on the TLV for beryllium concentration in the air (i.e., 2 $\mu g/m^3$), the required detection level for beryllium surface concentration was set at 2/10 = 0.2 $\mu g/100\ cm^2$. Based on this analysis, the laboratory detection level of 0.2 $\mu g/100\ cm^2$ will be adequate for defining "as clean as practicable" for beryllium.

Table 2.3 lists the levels of concern established for the other contaminants.

Table 2.3. Surface concentration level of concern and detection level

		Detection limit ($\mu g/100\ cm^2$ unless indicated otherwise)	
Contaminant	**Level of concern**	**ICP**	**ICP trace**
Uranium	20 $\mu g/100\ cm^2$	50	—
Beryllium	0.2 $\mu g/100\ cm^2$	0.2	0.2
Lithium	2.5 $\mu g/100\ cm^2$	2	—
Graphite	200 $\mu g/100\ cm^2$	—	—
Zirconium	500 $\mu g/100\ cm^2$	—	—
Aluminum	1,000 $\mu g/100\ cm^2$	20	20
Tungsten	500 $\mu g/100\ cm^2$	10	10
Nickel	100 $\mu g/100\ cm^2$	3.0	0.3
Thorium	60 $\mu g/100\ cm^2$[a]	0.1	—
Boron	1,000 $\mu g/100\ cm^2$	60	60
Thallium	10.0 $\mu g/100\ cm^2$	10	0.5
Lead	15.0 $\mu g/100\ cm^2$	10	0.3
Arsenic	20.0 $\mu g/100\ cm^2$	30	0.4
Cesium	200 $\mu g/100\ cm^2$	—	—
Cadmium	5.0 $\mu g/100\ cm^2$	0.5	0.1
Chromium	50 $\mu g/100\ cm^2$	1.0	0.1
Magnesium	1,000 $\mu g/100\ cm^2$	30	30
Antimony	50 $\mu g/100\ cm^2$	20	0.5

Table 2.3 (continued)

Contaminant	Level of concern	Detection limit (μg/100 cm^2 unless indicated otherwise) ICP	ICP trace
Barium	50 μg/100 cm^2	1.0	1.0
Bismuth	1,000 μg/100 cm^2	—	0.2
Gadolinium	NA	—	—
Europium	NA	—	—
Germanium	60 μg/100 cm^2	—	—
Vanadium	5.0 μg/100 cm^2	2	2
Rubidium	NA	—	—
Tellurium	10.0 μg/100 cm^2	—	20
Titanium	1,000 μg/100 cm^2	5	5

[a]Based on uranium since ^{232}Th is three times less active than ^{238}U.
[b]Presence will be based on process knowledge and personnel interviews. If perchlorates could be present, then it is at a level of concern.

NA = not published

Based on this analysis, all reported detection levels are low enough to provide health-risk information except for uranium and arsenic. Because uranium is also detected through the radiological survey at much lower levels, the potential areas where this contaminant could create health-risk concerns will be known. However, the detection limit for uranium is close enough to the level of concern that it still provides useful information. Arsenic was used in small quantities, so concerns with its presence are smaller than the concerns associated with the other contaminants that were used in greater quantities. Additionally, the detection limit for arsenic is very close to the level of concern and would provide useful health-risk information. Besides, a very conservative factor of safety was used in this analysis, so the detection limit for both uranium and arsenic is most likely adequate.

Not all of the contaminants listed in Table 2.3 should be analyzed because some have been used in small quantities, are not very toxic, and/or have probably dissipated. More discussion on this is provided in Sect. 2.7.

2.6 SPECIFY LIMITS ON DECISION ERROR

The desired confidence level for determining whether any contaminants exist in the assumed clean areas should be the most conservative because protective PPE and engineering controls are less likely to be used in these areas. Therefore, enough samples should be obtained to provide a 95% confidence level that contamination does not occur above any action level in these areas. In areas that are assumed to be contaminated, less stringent confidence levels are needed. This is because protective PPE and engineering controls are more likely to be used in these areas. Therefore, enough samples to provide 65% confidence to confirm that contaminants are present should be sufficient. In areas where the level of contamination is not known, the desired confidence level will depend on whether protective PPE and engineering controls are planned. If it is planned to use this higher level of protection, then less stringent confidence limits are necessary (i.e., 65%). However, if minimal PPE and no barriers are planned, then a higher confidence level is necessary (95%).

2.7 OPTIMIZE DESIGN FOR COLLECTING DATA

2.7.1 Sampling Areas and Methods

The number of samples, sampling method, and the equipment/material to be sampled are based on the number and type of HAs that the building is divided into and the allowed error bound for that HA. Because the purpose of the sampling effort is generally to confirm the absence of contamination, a biased sampling technique is preferred. Based on process knowledge and visual observations, those areas deemed most likely to harbor contamination will be sampled. A sufficient number of samples must then be gathered to meet the limit on decision error. For an area assumed to have no contamination, it is conservative to assume that 95% of the biased areas are free from contamination. If the bound on the error is set at 5%, then the number of biased areas that must be sampled may be calculated as follows:

$$n = \frac{Npq}{[(N-1)D] + pq}$$

where:

n = required number of samples,
N = population (i.e., number of biased sample areas),
p = population portion below action limit (0.95),
q = 1-p,
D = $B^2/4$,
B = bound on error of estimation (0.05).

Based on this equation ~45 of 100 biased areas (i.e., areas suspected to have contamination based on process knowledge and visual observation) need to be sampled to verify that contamination is absent. This same equation may also be used to determine how many biased samples are needed to verify that contamination is present. In this case it may be assumed that 65% of the biased areas are contaminated and the allowed bound on the error may be set more liberally at 35%. Based on this analogy, ~7 of 100 areas suspected of being contaminated need to be sampled to verify that contamination is present. If no contamination is found in these seven samples and it is desired to verify the absence of contamination, then an additional 38 samples (i.e., 45-7) would have to be collected and analyzed. It should be noted that as the population (i.e., available sample areas) decreases, the percentage of the population that needs to be sampled to meet a specified confidence level increases.

In areas where the level of contamination is not known, it is recommended that enough samples be taken initially to provide a 65% confidence level that contamination is present. If the analysis of these samples shows any results above the level of concern, then no more sampling is necessary. A higher level of PPE and engineering controls will be necessary. However, if none of the samples have results above the level of concern, more samples could be obtained to provide a 95% confidence that this is true.

The type of sample gathered will depend on the contaminant of interest, its location, and form. As previously described, the primary type of sample will be wipes of areas suspected of being contaminated. Other types of samples to be gathered include (1) bulk roofing samples to identify potential PCB contamination in the roofing materials, (2) bulk paint samples to identify lead content and perhaps other contaminants encapsulated by the paint, (3) bulk dust samples where large quantities have accumulated, and (4) bulk samples of oils that may be contaminated with PCBs.

The rationale for sample locations, type, and quantity is provided in Sect. 3. Based on this rationale, a summary of the number of samples and the areas that they will be collected in is given in Tables 2.4 and 2.5. The numbers in these tables do not include duplicate samples. To verify accuracy of the sampling techniques and laboratory analysis, duplicate samples should be collected for every 10 normal samples. Therefore, in addition to the numbers presented in these two tables, an additional 15 samples will be gathered as duplicates. If it is necessary to verify the absence of contamination in the other areas, as many as 10 more duplicate samples could be necessary.

Table 2.4. Estimated number of wipe samples for beryllium and other metals survey

HAs	Beryllium areas	Radiological and miscellaneous laboratory areas	Office areas	Roof areas	Total
Exhaust ventilation system	7	8	NA	3 (bulk)	18
Supply ventilation system	6 (4)	10 (22)	12	3 (bulk)	31 (26)
Walls	6 (4)	7	10	NA	23 (4)
Rotating equipment	6	8 (10)	NA	NA	14 (10)
Misc. horizontal surfaces	8	8 (37)[a]	21	NA	37 (37)
Total	33 (8)	41 (69)	43	6	123 (77)

Note: The number shown in parenthesis is the additional number of samples that would be needed to verify that contamination was absent for a given HA within a given area.

The sample numbers shown in this table are estimates only. More samples will be taken if deemed necessary by the sampling team leader. The number of samples include duplicates.

[a]These extra samples will not be gathered during the initial sampling activities.

Table 2.5. Summary of PCBs, paint survey, and other bulk samples

Sample	Type	Number	Analysis
Oil stains	wipe	5	immunoassay
Oil stains	wipe	1	GC
Bulk oil	bulk	5	GC
Roof	bulk	5	GC
Paint	bulk	11	ICP
Bulk dust	bulk	6	ICP
Total		33	

As mentioned earlier, additional samples will be taken to verify the absence of contamination if the first sample set does not verify the presence of contamination (i.e., no contamination found in first set of samples). Although the additional samples will not be analyzed initially, it is prudent to collect the additional samples during the initial field effort to save time and to save costs associated with mobilization and demobilization. Therefore in these situations, the extra samples will be collected but not analyzed pending the analysis results for the first set of samples. However, this strategy will not be followed if it is believed that contamination is probably present in some of the HAs. In this situation, the extra samples will not be collected during the initial field sampling effort. Based on these thoughts, the following sample collection scheme will be used.

Exhaust Ventilation System. It is believed that some areas of the exhaust ventilation system are contaminated. Therefore, no extra samples will be collected during the initial field effort to verify the absence of contamination.

Supply Ventilation System. It is believed that none of the supply ventilation system is contaminated. Therefore, all extra samples needed to verify the absence of contamination will be collected during the initial field sampling effort. These extra samples will only be analyzed if no contamination is found in the initial set of samples.

Rotating Equipment. It is believed that most of the rotating equipment is free from contamination. Therefore, all extra samples needed to verify the absence of contamination will be collected during the initial sampling effort. These extra samples will only be analyzed if no contamination is found in the initial set of samples.

Miscellaneous Horizontal Surfaces. It is believed that many of the horizontal surfaces are not contaminated. However, it is relatively easy to collect these samples at a later time with minimal mobilization and demobilization costs. Therefore, none of the extra samples needed to verify the absence of contamination will be collected during the initial sampling effort. These extra samples will be collected at a later date using local personnel if necessary based on the analysis results from the initial set of samples collected. Horizontal surfaces to be sampled during the initial sampling effort include top surfaces of light fixtures, top surfaces of ducts, counter tops, top surfaces of equipment, floor areas, top surfaces of bus bars, and top surfaces of process piping. However, additional samples will be taken if deemed necessary by the Field Team Leader.

2.7.2 Sample Analysis

When selecting the appropriate sample analysis method, the potential that the contaminant is present, the degree of hazard associated with a potential contaminant, and the analysis cost needs to be considered. There are over 30 contaminants that may be present based on their use at the facility. However, the majority of these potential contaminants were used in small to very small quantities (see Table 2.2). Therefore, it is doubted that they will be detected.

The most hazardous potential contaminants that have been present in the facility in the greatest quantities include lithium, uranium, beryllium, nickel, graphite, zirconium carbide, uranium carbide, thorium, thallium, and PCBs. These contaminants constitute the greatest potential for concern. The hazards associated with these contaminants include toxic effects from potential inhalation, toxic effects from absorption through the skin, and pyrophoric hazards. PCBs and thallium may be absorbed through the skin, and uranium carbide and zirconium carbide could ignite under the appropriate circumstances. The concern with the other contaminants is the potential for inhalation should they become suspended airborne. Other materials have been used in the facility that are hazardous, but need not be analyzed routinely because they were used in such small quantities (e.g., a few pounds over 35 years).

Some of the materials listed in Table 2.2 are costly to analyze, and in most cases, the analysis of the more costly analytes provides little added information regarding health and safety concerns. This is due to their low volume use at the facility and their relatively small health and safety risk. Contaminants with TLVs above 5 mg/m^3 are generally no more hazardous than many forms of nuisance dust. Therefore, the analysis of these analytes does not add a great deal of additional information.

Most of the contaminants with a potential for concern may be analyzed relatively inexpensively through inductively coupled plasma (ICP) analysis. Exceptions include thorium, uranium carbide, zirconium carbide, and graphite. Hazards associated with thorium include the potential for its inhalation should it become airborne. Therefore, its presence should be determined for all HAs where it was used, including the beryllium, radiological, and miscellaneous laboratory areas.

The main concern with uranium carbide and zirconium carbide is their pyrophoric hazards. To be pyrophoric, they need to be present in sufficient quantities to ignite. It is believed that the only HA where these contaminants could exist in sufficient quantity is the exhaust ventilation system. It is costly to analyze for uranium carbide and zirconium carbide, but their hazard (i.e., ignitability) is a relatively inexpensive analysis. Based on these considerations, the ignitability of bulk dust samples collected from the exhaust ventilation system will be measured.

Graphite is another contaminant that cannot be easily analyzed. However, if the major form of carbon in the dust samples collected is graphite, then its concentration may be approximated through total organic/inorganic carbon analyses. Graphite is relatively non-toxic but was used in large quantities. Therefore, it is prudent to measure for its possible presence in locations where large quantities of dust may have collected, such as the exhaust ventilation system. Based on these considerations, the total organic/inorganic carbon content of bulk dust samples collected from the exhaust ventilation system will be analyzed.

Based on this knowledge, it is recommended that wipe samples be analyzed for uranium, beryllium, lithium, nickel, and thallium. In addition, it would be prudent to sample a subset of the wipes for the other potential contaminants to verify their absence. This subset should be from samples gathered in areas where these materials were most likely handled. Based on process knowledge and personnel interviews, these areas would most likely include the exhaust duct work located in rooms 136 and 144. From the rationale presented in Sect. 3, approximately 15 samples would meet this requirement and should be analyzed for all ICP metals.

Table 2.6 was created to summarize the samples that will be collected, the analyses to be performed for the collected samples, and the areas where samples will be collected based on:

- potential presence and hazard of contaminant,
- desire to verify the presence or absence of contamination,
- analytical ability to measure contamination, and
- cost of analysis.

It may be desirable to meet some of the secondary objectives presented in Sect. 2.1 if it can be accomplished at little extra cost. Additional information that would help decisions for preventing the spread of contamination and waste management includes the concentration of contaminants within the dust at various areas in the building. Wipe samples are designed to provide surface contamination information, not mass concentrations. However, by weighing the wipe just before and just after sample collection, the mass quantity of dust picked up by the wipe may be estimated. Therefore, it is recommended that representative samples from each HA be collected in this manner.

Table 2.6. Chemical analyses for each sample area and type

Building area	HA	Sample type	Number of samples	Number of duplicates	Analyses requested	Min. sample size
Office areas	Walls	wipe	9	1	standard suite	1-wipe
	Supply vent	wipe	10	2	standard suite	1-wipe
	Misc. horiz. surfaces	wipe	19	2	standard suite	1-wipe
Beryllium areas	Exhaust vent	wipe	6	1	standard suite	1-wipe
	Walls	wipe	5 (4)	1	standard suite	1-wipe
	Supply vent	wipe	5 (4)	1	standard suite	1-wipe
	Rotating equipment	wipe	5	1	standard suite	1-wipe
	Misc. horiz. surfaces	wipe	7	1	standard suite	1-wipe
Misc. Lab Areas	Exhaust vent	wipe	7	1	full suite	1-wipe
	Exhaust vent dust	bulk (split 2 ways)	5 5	1 1	full suite + TOC/TC + ignitability thorium	4g + 20mL 100 g
	Walls	wipe	6	1	standard suite	1-wipe
	Supply vent	wipe	7 (22)	3	standard suite	1-wipe
	Rotating equipment	wipe	6 (10)	2	standard suite	1-wipe
	Misc. horiz. surfaces	wipe	5	1	standard suite	1-wipe
	Misc. horiz. surfaces	wipe (split 2 ways)	2 2		standard suite thorium	1-wipe 1-wipe
Roof Areas	Near exhaust vent	bulk (split 3 ways)	3 3 3	 1 	full suite PCB - GC thorium	5 g 30 g 10 g
	Near supply vent	bulk	1	1	standard suite	5 g
	Near supply vent	bulk (split 2 ways)	1 1		standard suite PCB - GC	5 g 30 g
Paint	N/A	bulk	10	1	expanded suite	2 g
PCBs	Stains	wipe	4		immunoassay	1-wipe
	Stains	wipe (split 2 ways)	1 1		immunoassay PCB - GC	1-wipe 1-wipe
	Bulk oil	bulk	4	1	PCB - GC	20 mL

[a]Number in ( ) includes additional samples needed to verify the absence of contamination.
[b]Standard Suite includes ICP analysis for uranium, beryllium, lithium, nickel, and thallium.
[c]Expanded Suite includes ICP analysis for uranium, beryllium, lithium, nickel, thallium, lead, and chromium.
[d]Full Suite includes analysis for all ICP metals.
[e]Duplicates may be taken adjacent to or split with one of the regular samples.

3. SAMPLING AND FIELD SCREENING PROCEDURES

The primary objective of the sampling and testing plan is to detail the methods and strategies for data acquisition, which will provide sufficient information to satisfy the project DQOs. The overall sampling strategy and statistical significance to the approach is provided in Sect. 2. Sample handling, COC, and laboratory analytical procedures are presented in Sect. 5.

There are 5 analytes that will be sampled routinely in TA-3-141 (uranium, beryllium, lithium, nickel, and thallium) plus an additional 22 analytes (ICP metals) that will be sampled as a small subset (~5) of the other samples. Although radiological contamination is also present, it is outside the scope of this project. Each of these analytes is discussed below, including proposed sample locations, sampling procedures, and sample documentation. The appropriate sample containers and preservation and holding times are presented in Sect. 5. Since sampling methods are similar for beryllium, cadmium, nickel, thallium, and zinc, these analytes are discussed in the beryllium section.

The survey of the facility will be accomplished through five different tasks.

Section	Task name
3.1	Beryllium and other metals survey
3.2	Perchlorate survey
3.3	PCB survey
3.4	Paint survey
4	Physical hazards assessment

3.1 BERYLLIUM AND OTHER METALS SURVEY

Beryllium is anticipated to be the analyte of greatest concern from a health and safety standpoint in the beryllium process areas (rooms 136A, 139, and 141). The other metal analytes are a concern in the other process areas. The beryllium and other metals sampling approach is to gather wipe samples from surfaces with the greatest potential for contamination. Surfaces with the greatest potential for contamination are identified through process knowledge. Equipment may have to be partially dismantled to gather some of the samples depending on their location. The major equipment that will require partial dismantlement will probably be the duct work for the exhaust ventilation system.

It should be noted that paint samples will also be taken in bulk form and analyzed for other metals. The sampling locations and procedures for these samples are discussed in the paint survey section (Sect. 3.4). Paint samples will be analyzed for lead and chromium, which are common metals found in earlier paint formulations, and for other metals to determine whether any were encapsulated into the paint. In addition, bulk roof samples will be gathered and analyzed for the presence of PCBs and other contaminants.

3.1.1 Sampling Locations

Sampling locations are defined in terms of HAs. HAs consist of similar media within a contamination zone. Contamination zones are defined according to their likelihood for harboring contaminants. The building has been divided into five contamination areas: (1) beryllium processing areas, (2) radiological areas, (3) miscellaneous laboratory and processing areas, (4) office areas, and (5) external roof. It is anticipated that the radiological areas and the miscellaneous laboratory areas harbor similar contaminants except for radiological species. Therefore, for the purposes of determining sample locations and numbers of samples, they are addressed together. The number of samples that should be collected described in the remainder of this section does not include duplicate samples. At least one duplicate sample will be collected for every 10 regular samples gathered for analysis.

Beryllium Process Areas. HAs within the beryllium process area include the exhaust ventilation system, supply ventilation system, walls, rotating equipment, and miscellaneous horizontal surfaces. Miscellaneous horizontal surfaces include exterior surfaces of light fixtures, process piping, electrical conduits, tops of cabinets, inside surfaces of cabinets, counter tops, and other equipment.

The exhaust ventilation system probably has the highest potential for beryllium contamination. Dust tends to accumulate in "dead" areas within the system, the vents, and near the blower. From the drawings there appears to be about 30 biased sample areas where contamination is expected to occur. To verify the presence of contamination, six samples will be required.

The supply ventilation system should not have any beryllium or other metal contamination associated with it. However, because it is in a beryllium area, contamination is possible. It is suggested that it be sampled with a 65% confidence interval initially. This sampling should also include the exterior surfaces of the ducts. If these results are negative, it may be desirable to gather additional samples to meet the 95% confidence limit. There appears to be 10 biased areas for sampling. To meet the 65% confidence limit, five samples should be gathered. If further sampling is required to meet the 95% confidence limit, four additional samples should be obtained.

Biased areas on the walls will be identified in the field. If it is assumed that 10 areas are identified, 5 samples are needed to verify the presence of contamination. If the absence of contamination needs to be determined, an additional four samples should be gathered.

Assuming there are less than 10 pieces of rotating equipment, 5 samples should be sufficient to verify the presence of contamination. The number of suspect areas for miscellaneous horizontal surfaces is harder to ascertain. Assuming 50 such locations can be identified, 7 samples of these areas should be taken to verify the presence of contamination.

The actual sample locations will be determined by the sampling team leader after the building has been inspected. Justification for selecting the locations will be documented.

Radiological and Miscellaneous Laboratory and Processing Areas. Documentation or other evidence for beryllium use in these areas has not been found. Therefore, the focus for sampling these areas will be for other metals. Various other processes with powdered metals have been conducted in these areas, including rolling, pressing, spraying (within enclosures), sintering, and forming. The HAs for these areas are the same as those defined for the beryllium areas.

To minimize the number of samples necessary to characterize these areas, verification for the presence of contamination will be conducted first. If no contamination is found, then it may be desirable to obtain additional samples to verify the absence of contamination. The exhaust ventilation system probably has the highest propensity for metal contamination. Dust tends to accumulate in "dead" areas within the system, the vents, and near the blower. From the drawings there appears to be about 40 biased sample areas where contamination is expected to occur. To verify the presence of contamination, 7 samples will be required, and to verify the absence of contamination, an additional 22 samples will be necessary.

The supply ventilation system should not have any metal contamination associated with it. However, initial sampling will be performed to verify that contaminants are present followed by additional samples, if necessary, to verify the absence of contamination. From the drawings, there appears to be 46 areas for sampling. To verify the presence of contamination, 7 samples will be necessary, and to verify the absence of contamination, an additional 22 samples will be necessary.

Wall sample areas will be identified in the field. It is assumed that only six biased sample areas will be identified. All six of these areas will be analyzed to verify the absence of contamination with 95% confidence.

Assuming there are less than 20 pieces of rotating equipment, 6 samples will be needed to verify the presence of beryllium and other metal contamination and an additional 10 samples will be needed to verify the absence of contamination. The number of suspect areas for miscellaneous horizontal surfaces is harder to ascertain due to the large number of objects that fall into this category. Typical areas to be sampled include top surfaces of light fixtures, top surfaces of ducts, counter tops, top surfaces of equipment, floor areas, top surfaces of bus bars, and top surfaces of process piping. Assuming 100 such locations can be identified, 7 samples of these areas should be taken. If no significant contamination is found and it is desirable to verify the absence of contamination, an additional 37 samples will be necessary.

The actual sample locations will be determined by the sampling team leader after the building has been inspected. Justification for selecting the locations will be documented.

Office Areas and Change Rooms. It is not anticipated that metal contamination will be found in the office areas. The HAs that have been identified for these areas include the supply ventilation system, walls, and miscellaneous horizontal surfaces. Because no contamination is anticipated in these areas, they will be sampled at the 95% confidence level to ensure no contamination is present.

From examining the drawings, there appears to be about 12 internal biased areas for sampling the ventilation system. Therefore, a total of 10 wipe samples should be gathered from this system. It is assumed that approximately 10 biased samples will be identified on the walls. This will require nine samples to verify the absence of contamination. Additionally, it is anticipated that another 25 biased sample locations will be identified on miscellaneous horizontal surfaces in these areas. This will require 19 samples to verify the absence of contamination.

Roof Area. The roof area may be divided into three HAs: exhaust ventilation stacks, supply ventilation intakes, and the roof area itself. There are three non-filtered exhaust vents on the roof. To verify that contamination is present, all three will be sampled. From the drawings, there appears to be two intakes for the supply ventilation system. To verify contamination is absent, both of these areas will be sampled. The most likely areas where contamination may be found on the roof itself would probably be near the exhaust vents. Therefore, it is recommended that samples be gathered near all exhaust vents on the roof. From the drawing, this would require three samples plus one more as a duplicate.

3.1.2 Wipe Sampling Procedures

Surfaces suspected of being contaminated with beryllium and other metals (e.g., surfaces with visible dust and surfaces associated with metals processing) will be analyzed by gathering of wipe samples. The wipe samples will be gathered in accordance with Technical Procedure 50-65-IH-057, *Wipe Sampling for Beryllium*. In addition, the area to be sampled will be checked with hand-held monitoring equipment to check for radioactive contamination before any sampling activity begins. This is performed to ensure the samples will meet radiological shipping requirements.

To estimate the quantity of dust picked up by a wipe, the wipe will be weighed immediately before and immediately after the sample is collected for approximately five of the samples. Balances available in TA-3-141 will be used for this purpose. This technique will be used in areas where substantial quantities of dust have accumulated within representative areas of the building.

Sample preservation and container selection will be conducted in accordance with TP-ESP-701, *Sample Preservation and Container Materials*. Samples will be placed in a glass, plastic jar or petri dish, labeled, and placed into a sealable plastic bag for shipment. Labeling will include a unique sample identification number (which is also recorded in the sample logbook), the sampler's initials, the time and date of sample, and the analysis requested. Further knowledge is not placed on the label to minimize the laboratory's knowledge regarding the type/location of the sample. The samples will then be placed into a cooler with blue ice packs, sealed with evidence tape and shipping tape, and shipped to the laboratory through an overnight commercial delivery service.

COC protocol will be followed in accordance with TP-ESP-501, *Manual Chain-of-Custody*. If any changes to the sampling procedures are necessary in the judgement of the sampling team leader, the team leader has the authority to make such changes. All field changes will be documented using the Field Change Request form (see Sect. 5).

It is important to provide thorough documentation on observations made by the sampling team when gathering samples. To assist with ensuring thorough documentation, a sampling form has been developed for this project (see Fig. 3.1). These sample forms will be maintained in a logbook that will remain with the sample team during sampling activities. In addition to the sample logbook, all biased sample areas considered by the sampling team leader will be documented. A brief statement explaining why a particular area was considered biased (i.e., higher potential for contamination than surrounding areas) will be provided. The biased sample areas that are chosen for sampling will be left to the judgement of the sampling team leader. However, in general, the sampling team leader will pick the sample areas that are most likely to harbor contamination in his judgement.

3.1.3 Bulk Sampling Procedure

The only bulk samples that are anticipated for metals analysis are paint, dust, and roofing samples. The procedure for gathering paint samples is presented in Sect. 3.4, and the sampling method for roofing material is presented in Sect. 3.3. Dust samples will be gathered by scraping a small quantity onto a plastic spatula or spoon and placing the material into a glass jar. Sample preservation, labeling, transporting, and other requirements are the same as those described for wipe samples.

3.2 PERCHLORATE SURVEY

Perchlorate crystals sometimes form in exhaust ventilation systems that support laboratory hoods where perchloric acid was used. This is a shock sensitive material that if not handled appropriately can cause physical injury to the sampler. Therefore, it is very important to determine

PAGE:______

Sample Collection Log

HA No:____________________________________
(ductwork, horizontal surfaces, PCBs wipe or bulk, roof, paint)

Sample No:__________

Sampling Date:__________

Location Sketch

Sampling Time:__________

Samplers:__________

____

C.O.C. #:__________

Room No:__________

Elevation:__________

Equipment/Component Description: ____

____

Test Kit/Equipment ID: ____

Optical Density Difference of Duplicate Standards ______________________(PCB Only)

Tare Weight:____________ Sample Result: ______________

Sample Weight:____________ PCB Containing: __________(PCB Only)

Analyses Requested: ____
(ICP, PCBs, Other)

Comments:____

____

____

____

____.

Fig. 3.1. Logbook Sample Form.

whether it could be present based on process knowledge. The questionnaire contained in Fig. 3.2 will be used for this purpose.

If a possibility for perchlorate contamination is established, these areas will not be sampled for any analyte until the absence of perchlorates can be confirmed. The sampling technique for perchlorates involves a water wash over the suspect area followed by analysis of the water with a specific ion electrode. This sampling effort is beyond the scope of this sampling plan. Another firm specializing in perchlorate sampling will be used if the potential for perchlorate contamination is determined.

3.3 PCB SURVEY

PCBs are often associated with oil and lubricants; dielectric fluids in transformers, capacitors, and some switches; and roofing materials. Sampling for these materials will be completed by three separate methods. The initial sampling will be for oil stains and will be accomplished using immunoassay wipes, which is a field sampling kit that provides both qualitative and quantitative results in a relatively short time. For verification, 10% of the wipes will be analyzed in a laboratory. The second method requires taking bulk oil samples for analysis of the PCB content, and the third method requires cutting away portions of the roof to obtain samples of the roofing material. For all three methods, the area to be sampled will be checked with hand-held monitoring equipment to check for radioactive contamination before any sampling activity begins. This is performed to ensure the samples will meet radiological shipping requirements.

3.3.1 Sample Locations

Locations for wipe sampling for PCBs are associated with stains on the floors, walls, and equipment. Bulk oil samples will be gathered from equipment and components that are noted to contain oil. Roof samples for PCBs will be obtained near the exhaust vents. The actual locations for obtaining these samples will be determined by the sampling team leader through visual observations.

It is estimated that oil stains will be identified at 10 locations, bulk oil samples will be identified in 5 areas, and 4 roof samples will be gathered. Because it is believed that oils will contain some PCBs, these locations will be sampled to verify the presence of contamination. Therefore, five wipe samples and three bulk oil samples are anticipated.

3.3.2 Sampling Procedures

Industrial Hygiene Evaluation of Laboratory Hood for Perchloric Acid

BUILDING   ROOM NUMBER   DATE

BUILDING SUPERVISOR ______________________________

HOOD EVALUATION:

1. Washdown capabilities: **Yes**_____ **No**_____
2. Currently use Perchloric Acid: **Yes**_____ **No**_____
   a. If so, how is Perchloric Acid used: **Hot**_____ **Cold**_____
   b. Frequency and Comments: ______________________________

   ____
3. Used Perchloric Acid in past: **Yes**_____ **No**_____ **Suspect**_____
   a. If so, how was Perchloric Acid used: **Hot**_____ **Cold**_____
   b. Comments: ______________________________

   ____
4. Does hood have drains: **Yes**_____ **No**_____

   Unknown_____ **Process**_____ **Sanitary**_____ **Storm**_____ **"Hot"**_____
5. Visible crystals present: **Yes**_____ **No**_____
6. Perchloric Acid sign present: **Yes**_____ **No**_____
7. General Comments: ______________________________

SOURCE OF INFORMATION: ______________________________

DUCT EVALUATION:

1. Perchloric Acid sign present: **Yes**_____ **No**_____
2. Duct present: **Yes**_____ **No**_____
3. Fan present: **Yes**_____ **No**_____
4.

Comments: ______________________________

INVESTIGATOR: ______________________________

Fig. 3.2. Perchloric Acid Questionnaire

As mentioned previously, three sampling methods are to be used for this work: wipe samples, bulk oil samples, and roof samples. Confirmatory analysis will be collected on at least one area where the immunoassay method indicated < 10 $\mu g/100\ cm^2$ of PCBs or at least one area where this method indicated > 10 $\mu g/100\ cm^2$ of PCBs if possible. If larger numbers of wipe samples are necessary, confirmatory samples will be taken for 10% of all samples taken. Standard sampling protocol will be followed by sampling techniques. This protocol includes placing the sample into a glass jar, labeling the jar, sealing the jar in a plastic bag, placing the jar into a cooler for shipment to the laboratory (except for immunoassay wipes), transporting the sample through an overnight commercial delivery service, and analysis at the laboratory through gas chromatography. Labeling will include a unique sample identification number (which is also recorded in the sample logbook), the sampler's initials, the time and date of sample, and the analysis requested. Further knowledge is not placed on the label to minimize the laboratory's knowledge regarding the type/location of the sample. The cooler will contain blue ice packs and will be sealed with evidence tape and shipping tape.

COC protocol will be followed in accordance with TP-ESP-501, *Manual Chain-of-Custody*. If any changes to the sampling procedures are necessary in the judgement of the sampling team leader, the team leader has the authority to make such changes. All field changes will be documented using the Field Change Request form (see Sect. 5).

Wipe Samples. Surfaces suspected of being contaminated with PCBs (i.e., visible oil stains) will be analyzed in the field for the presence of PCBs. Analysis will be performed on-site using the immunoassay field sampling kits. The wipe samples will be collected and analyzed in accordance with TP-307-9, *Immunoassay Screening Test for PCBs, PCPs, and PAHs*. Confirmatory analysis will be conducted by gathering a wipe sample adjacent to the sample analyzed through the immunoassay technique.

It is important to provide thorough documentation on observations made by the sampling team when gathering samples. To assist with ensuring thorough documentation, a sampling form has been developed for this project (see Fig. 3.1). These sample forms will be maintained in a logbook that will be taken with the sample team during sampling activities.

Bulk Oil Samples. Oil will be collected from machinery that contains lubricating oil and from other equipment or tanks that contain oil. If there is a valve or other means of draining the oil directly into the sample container, the sample will be collected in that manner. If necessary, a "thief" or tube sampler will be used to withdraw an aliquot of oil and transfer it directly into the sample container. The tube sampler will be decontaminated between individual collections in accordance with TP-ESP-900, *Cleaning and Decontaminating Sample Containers and Sampling Devices*.

Roof Samples. Roof samples will be gathered from at least four areas located near unfiltered exhaust ventilation stacks. The sample will be removed using knives, chisels, and a hammer. The area effected will be a few square inches. Disposable latex gloves will be worn during all sampling activities to ensure no cross-contamination of the sample occurs. The top portion of the roof sample will be separated, if possible, from the rest of the sample and placed into a separate glass jar. This is done because the top portion is more likely to harbor particulate contaminants from the ventilation exhaust vents. The lower portion will be placed in a glass jar and labeled also. All tools used during the sampling activity will be decontaminated between individual collections in accordance with TP-ESP-900, *Cleaning and Decontaminating Sample Containers and Sampling Devices*. After sampling has been completed, the hole left from the sampling activity will be filled with roofing tar as a temporary repair.

3.4 PAINT SURVEY

It is anticipated that most of the paint in this building will contain lead and chromium. In addition, it is anticipated that other metals may be found in the paint from encapsulation when potentially contaminated surfaces were painted. The lead content for a given color of paint should be consistent if painted during the same time frame. However, yellow paint that is used for caution strips and signs is applied more frequently than other paints and is, therefore, more likely to be made of different formulations. The content of other metals encapsulated from painting over contaminated surfaces will vary for a particular color of paint.

3.4.1 Sampling Locations

There are a limited number of paint colors and type of surface in the building. Each color/surface combination will be considered an HA, and a representative sample will be gathered. It is assumed that there are 10 HAs for paint. All 10 HAs will be sampled plus one duplicate sample.

Additional paint samples may be taken if results from the paint survey and the beryllium and other metals survey indicate that some contaminants may have been encapsulated in the paint. If any of the paint samples show elevated levels of other metals, duplicate samples may be collected near the area of the original sample if desired by the client. In addition, if any grossly contaminated areas are identified during the beryllium and other metals survey, paint samples near these areas may also be collected for analysis.

3.4.2 Sampling Procedures

There are four methods that may be used to collect paint from a surface. The type of surface, condition of the paint, age, and type of paint dictates what method is used to remove the paint from the surface. The principal methods considered are punching, cutting, scraping, and heating. Regardless of which method is used, the sample will be identified in the field logbook with a sample number, sampler's initials, location of sample, date and time, sample collection method, description of painted surface, and any unusual occurrences during sampling. The area to be sampled will be checked with hand-held monitoring equipment to check for radioactive contamination before any sampling activity begins. This is performed to ensure the samples will meet radiological shipping requirements.

Sample preservation and container selection will be conducted in accordance with TP-ESP-701, *Sample Preservation and Container Materials*. Samples will be placed in a glass jar, labeled, and placed into a sealable plastic bag for shipment. Labeling will include a unique sample identification number (which is also recorded in the sample logbook), the sampler's initials, the time and date of sample, and the analysis requested. Further knowledge is not placed on the label to minimize the laboratory's knowledge regarding the type/location of the sample. The samples will then be placed into a cooler with blue ice packs, sealed with evidence tape and shipping tape, and shipped to the laboratory through an overnight commercial delivery service.

COC protocol will be followed in accordance with TP-ESP-501, *Manual Chain-of-Custody*. If any changes to the sampling procedures are necessary in the judgement of the sampling team leader, the team leader has the authority to make such changes. All field changes will be documented using the Field Change Request form (see Sect. 5).

4. PHYSICAL HAZARDS ASSESSMENT

This section describes how physical hazards anticipated by decontamination and demolition teams during the reconfiguration of TA-3-141 will be identified and summarized. Each room (small rooms may be grouped with larger) will be evaluated for physical hazards using a standardized checklist. The checklist will be used by the sample team to help identify the types of physical hazards anticipated in TA-3-141. The checklist is not necessarily inclusive of all potential hazards but helps bring consistency to the survey between sample team members.

4.1 TYPES OF HAZARDS

Common physical hazards that may be present in TA-3-141 are discussed below.

4.1.1 Confined Spaces

Confined spaces will be identified. The information gathered will include the Occupational Safety and Health Administration (OSHA) criteria for classifying the space as confined, requiring a permit for entry. The location of the confined space will be noted on the building drawing. OSHA defines a confined apace as a space that contains the following attributes:

- not designed for continuous human occupancy,
- contains a hazard such as toxic atmosphere or entrapment hazard, and
- has limited means of ingress and egress.

4.1.2 Electrical

Visible and obvious electrical hazards will be identified. These hazards will include open electrical boxes, loose or absent conduit, and other noted hazards. Attempts will be made to identify electrical conduits and equipment that will interfere with removing equipment during the proposed renovation.

4.1.3 Fall Hazards

Fall hazards include areas where trips and falls are more likely to occur. Types of fall hazards that may be identified include unlevel floors and areas where unguarded openings may occur when equipment or walls are removed. Fall hazards will be identified and classified as currently present or anticipated.

4.1.4 Heat Stress

Situations where heat stress may occur during renovation activities will be identified. Types of anticipated renovation activities that could lead to heat stress concerns that will be identified include small areas with poor ventilation and areas where ladders will be required to remove overhead conduits (high physical activity).

4.1.5 Pressurized Systems

These systems primarily consist of the gas delivery systems in the building. These systems will be identified by gas type, active or inactive, and physical attributes such as locations for valving/blanking the system and locations to support purging of the system.

4.1.6 Elevated Work Areas

During the renovation, work will need to be performed on elevated areas, including removing and installing ductwork, electrical conduits, and lighting fixtures. Elevated work areas will be identified and classified as currently accessible using existing fixed equipment or areas that will require temporary structures (e.g., scaffolding) for access during the renovation.

4.2 DOCUMENTATION OF HAZARDS

Physical hazards will be documented through a visual assessment of each room using the standardized checklist shown in Fig. 4.1.

Physical Hazard Assessment
for TA-3-141

ROOM NUMBER DIMENSIONS DATE

ROOM FUNCTION: ______________________

ROOM OCCUPANCY: ______________________

GENERAL HOUSEKEEPING: ______________________

ROOM LAYOUT

HAZARDS:

A. Confined Spaces: **Name** **Location**

Name	Location

☐ not designed for human occupancy

☐ limited ingress and egress

☐ contains hazard(s)

OVER

Fig. 4.1. Physical Hazard Assessment Form

B. Electrical Hazards:

- ☐ open/damaged conduit
- ☐ open/damaged busbar
- ☐ other deficiency: ______________________________
- ☐ electrical renovation hazard: ______________________________

C. Fall Hazards:

- ☐ unlevel floors
- ☐ missing or unacceptable guardrail/handrail
- ☐ deficient ladders
- ☐ poor lighting
- ☐ other deficiency: ______________________________
- ☐ fall hazard during renovation: ______________________________

D. Heat Stress:

- ☐ hot work areas/poorly ventilated areas
- ☐ other deficiency: ______________________________
- ☐ heat stress during renovation: ______________________________

E. Elevated Work Areas:

- ☐ elevated objects to be removed: ______________________________
  ____
  ____
  ____
  ____
- ☐ elevated work concerns during renovation:
  ____

F. Other Physical Hazards:

- ☐ pressurized systems (laboratory gas lines): ______________________________
- ☐ lockout/tagout concerns: ______________________________
- ☐ current hazards: ______________________________
- ☐ hazards during renovation: ______________________________

Fig. 4.1. continued

5. QUALITY ASSURANCE AND QUALITY CONTROL

5.1 CHAIN-OF-CUSTODY

5.1.1 Sample Handling

Samples will be handled in accordance with TP-ESP-701 and TP-ESP-800. COC procedures will be as detailed in TP-ESP-501 and will be followed to trace possession of the samples from sample collection until data from the samples are recorded. A sample will be considered under custody if it is (1) in the possession of the sampling team, (2) in view of the sampling team, or (3) transferred to a secure area. An area is considered secure only when it is locked and access is controlled.

The sampling team leader is responsible for custody of the collected samples in the field until they have been properly packaged, documented, and transferred to a courier or directly to the laboratory. If samples are not immediately transported to the analytical laboratory, they are to remain in the custody of the team leader. A COC record such as the one shown on Fig. 5.1 will be used for this characterization. The original COC record will accompany samples submitted to an off-site laboratory for analysis. The laboratory will follow its own internal COC procedures, which must include the items listed below.

- All COC forms accompanying the samples must be signed and dated upon receipt.
- Copies of the forms must be maintained as part of the final data package.
- The laboratory must maintain an internal sample tracking system for the samples so that custody of the samples is traceable from the time samples are received by the laboratory until the samples have been discarded.

5.1.2 Sample Labels and Seals

Sample labels will be affixed to all sample containers prior to or at the time of sampling. Sample seals will be used to detect tampering of individual samples shipped off-site or to sample shipping containers carried to the on-site laboratory, following sample collection. The seal will be attached in such a way that it is necessary to break the seal in order to open the sample container. Sample labels and seals shall include the information specified in TP-ESP-501. As an alternative to using sample seals, evidence tape with collector's initials and the date may be used. Labels and seals or evidence tape will be completed with black indelible ink.

5.1.3 Documentation of Activities

Field documentation procedures will be in accordance with TP-ESP-401 and are described below. Copies of all documents will be kept on permanent record in Radian Central Records. Bound field logbooks and permanent, waterproof, black ink pens will be used to document the methodology, procedures, and events pertaining to sample and data acquisition. The logbooks will be considered formal documents representing a complete and organized record of all field activities. The entries will include, but are not limited to, pertinent items listed below:

- health and safety site-specific training;
- name of collector;
- sample media;
- sample description;
- volume of sample;
- date of sampling;
- sample location;
- sampling method applied;
- unusual environmental conditions;
- sampling conditions and problems;
- model and identification numbers of field instruments used;
- sample numbers;
- analytical parameters;
- field QA/quality control (QC) data;
- COC information; and
- other important notes on characterization activities, conditions, or problems.

Each sample team will maintain separate logbooks. Specific logbooks will be developed to record specific data. Each collected sample documented in the field logs is cross-referenced with the COC forms, the database management system, and the laboratory identification number.

5.1.4 Transportation of Samples

At the end of each sampling day, samples requiring shipment will be packaged in shipping containers as specified by the Radian laboratory and analytical protocols. Each shipping container will be sealed with a evidence tape and sent to the Radian laboratory by an overnight delivery service. LANL Health Physics will survey all samples prior to shipment to ensure radioactivity levels are below levels of concern for shipping. Radiological limits to meet DOT requirements include 2.0 nCi/g for total content ($\sim$0.6% U by weight) and 1000 dpm/100 cm^2 surface radiation. Samples will be surveyed prior to shipment to ensure these requirements are met. All applicable DOT requirements for shipping will be met.

5.2 DECONTAMINATION PROCEDURES

Decontamination procedures will be conducted in accordance with TP-ESP-900. Decontamination of all nondisposable equipment used during the building characterization will be mandatory.

The majority of waste generated from this sampling effort will be disposed of as sanitary waste. All sampling waste will be segregated according to potential contamination. Every effort will be made to dispose of sampling waste as sanitary waste.

All solid wastes generated from the decontamination activities and sampling activities will be collected in heavy duty garbage bags. Liquid waste generated from decontamination procedures, estimated to be 3-4 gal, will be contained and segregated by probable contaminants in a plastic 5-gal bucket and will be stored in a location designated by LANL personnel. All waste will be properly labeled.

A site in Building TA-3-141 will be designated as the decontamination area. All equipment will be decontaminated there. Another site in the immediate vicinity will be designated as the staging area for equipment used during the building characterization.

Following sample collection, sampling equipment such as scrapers, spatulas, screwdrivers, and other small hand tools will be subject to decontamination procedures to prevent cross-contamination. Sampling equipment used for the collection of organic parameter samples will be decontaminated by the following steps.

1. Use a brush to scrub excess sample from the equipment.
2. Wash with tap water and Liquinox in a 5-gal container.
3. Rinse with tap water in a separate container.
4. Rinse with deionized water with a hand sprayer.
5. Rinse with a 5% solution of HNO_3.
6. Rinse with deionized, organic-free water.
7. Rinse with isopropanol (optional to hasten drying).
8. Air dry.
9. Use immediately or wrap in aluminum foil (shiny side away from equipment).

Isopropanol and organic-free water will be supplied and decanted from glass or Teflon containers.

5.3 ANALYTICAL PROCEDURES

The analytical procedures to be used by the project laboratories are included in Table 5.1. This table also lists the required quantitation limits.

Table 5.1. Parameter, method number, holding times, and total number of samples

Parameter	Method	Holding time[a] (days)	Estimated total[b]
ICP metals - wipes	SW-846 6010	180	117 (77)
- bulk dust			6
- paint			11
- roof			6
thorium - wipes	Isotopic Analysis	180	2
- bulk	DOE HASL 1990 Manual		6
- roof	LANL Method 96		3
PCBs - wipes	Immunoassay	40	5
- wipes	SW-846 8080	7 + 40	1
- bulk oil		40	5
- roof		40	5

Note: The number in parenthesis is the additional number of samples needed to verify the absence of contamination.
[a]Listed by extraction then analysis.
[b]Includes QC samples.

PCB = polychlorinated biphenyl

5.3.1 Laboratory Analyses

A hard copy of the data reports is required. All original COC forms must be returned with the laboratory results.

5.3.2 Field Screening

Maintenance responsibilities for field equipment are assigned to project team members with experience in handling this type of equipment. Maintenance procedures and schedules are determined by these members using experience and manufacturer's recommendations. All members for the project team that use the equipment are responsible for checking the equipment prior to and after use for problems. Each member using the equipment must be properly trained for usage and must respect and take care of the equipment. Field screening for PCBs with the immunoassay technique will be used on this project.

5.3.3 Sample Storage, Archiving, and Disposal

Once samples to be analyzed by field screening methods have been relinquished for analysis, they will not be accessible to anyone except authorized field screening personnel. If samples cannot be field screened the day they are collected and delivered, they will be stored in a locking storage cabinet located at the TA-3-141 facility. Only field screening personnel will have access to the storage area. Once the samples have been accepted by field screening personnel, they will remain in their custody until final field screening results are determined.

Samples submitted for laboratory analysis will become the responsibility of the laboratory regarding disposal.

5.3.4 Analytical Turnaround Time

The turnaround time requested for preliminary results from the project laboratories is no more than 5 working days from laboratory receipt of samples. Preliminary results will include the results determined immediately following analysis prior to any laboratory data validation and assemblage of the final data package.

5.4 SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Glass or plastic sample containers for standard laboratory analyses shall be received precleaned by an EPA-approved method. All containers will be capped and packed in a box during shipment to the field. Containers will be stored in a clean area. Procedure TP-ESP-701 will be followed where applicable. Table 5.2 lists the types of containers and preservatives required for each analysis.

5.5 CALIBRATION PROCEDURES AND FREQUENCY

Laboratory analytical instrumentation will be controlled through a calibration program that includes the following elements.

- Each instrument or analytical measurement system must be calibrated before use.
- Each instrument or analytical measurement system must follow the calibration procedures specified in the designated method.

In addition, the laboratory must have detailed calibration procedures in the form of a standard operating procedure (SOP), with a summary of the procedure provided in the laboratory QA plan. Standards used to calibrate an instrument or analytical measurement system must be National Institute of Standards and Testing or EPA-traceable, and the laboratory must maintain supporting documentation.

Table 5.2. Sample containers and preservation

Parameter	Container	Preservation	Holding time	Sample type	Minimum volume/sample
Rinsate blanks	plastic or glass	5% nitric acid	6 months	liquid	500 mL
ICP metals	plastic or glass	≤ 4°C	180	wipes stripped paint bulk[b] roof	N/A[a] 2 g 4 g + 20 mL 5 g
Thorium	plastic or glass	≤ 4°C	180	wipes bulk roof	N/A[a] 100 g 100 g
PCBs	glass	≤ 4°C	14	wipes bulk oil roof	N/A[a] 20 mL 30 g

[a]Wipes may be weighed before and after sample collection.
[b]Will be analyzed for total carbon, total organic carbon, and ignitability in addition to ICP metals.

PCB = polychlorinated biphenyl

5.6 INTERNAL QC CHECKS AND FREQUENCY

To check the quality of the field screening results, designated samples will be analyzed by the Radian. Field duplicates will be collected for field screening and laboratory analysis at a rate of 1 duplicate per 10 samples collected for a specific analysis. For example, if 10 samples are sent to a laboratory for PCB analysis, a field duplicate of 1 of the 10 samples will also be sent (for a total of 11 samples) for PCB analysis. It is estimated that one PCB wipe sample will be sent to the Radian laboratory for confirmatory analysis.

No trip blanks will be required for this project because no volatile analyses will be conducted. No field blanks will be collected for analysis because no water samples are required, except for decontamination wastes.

Two equipment rinsate blanks will be collected for laboratory analysis. Rinsate blanks will provide a measure of effectiveness of field decontamination procedures and alert project personnel to the possibility of cross-contamination.

5.7 DATA REDUCTION, VALIDATION, AND REPORTING

To ensure data usability, this plan has been written to enhance precision, accuracy, representativeness, completeness, and comparability of the resultant analytical data. Precision is a measure or estimate of the reproducibility of measurements under a given set of conditions. Accuracy is the ability to obtain a true value. Representativeness refers to data that realistically reflect site characteristics. Completeness is determined by comparing the number of theoretically obtainable results/samples under ideal conditions to the actual number of valid results obtained. Comparability expresses the confidence with which the data are considered to be equivalent with regard to analytical methodologies, detection limits, units of measurement, and sample preparation.

The overall precision of sampling during this field effort will be assessed by reviewing the results of field QC duplicate samples. Sampling precision for samples submitted to the laboratory will be expressed as the relative percent difference (RPD) in the analytical results of field QC duplicate samples. The calculation for RPD is:

$$RPD = \frac{V1-V2}{(V1+V2) \div 2} \times 100$$

where V1 and V2 are reported concentrations for each duplicate sample.

One duplicate sample for every 10 will be collected and submitted under blind conditions to the laboratory. There are no specific control limits for field precision because natural heterogeneity of the environmental media usually controls the precision level. Heterogeneity may further compromise the ability to obtain a true duplicate of some samples. Wipe samples may be collected side-by-side but cannot be homogenized by ordinary means. However, the precision goal for sampling during this effort is 25% relative difference. All the field duplicate analytical results may be reviewed as a group to make a general conclusion about field sampling precision.

Sampling accuracy will be assessed by evaluating the results of rinsate blanks, percent recovery from spiked samples, and adequacy of detection limits. Rinsate blank results are evaluated to determine whether field cross-contamination, preservation, and handling have contributed sources of error to the sampling process. Comparability will be accomplished by consistently using approved sampling techniques, analytical methods, detection limits, and units of measurement for each analyte.

Field data and field log notes will be reviewed by the team leaders on a daily basis. Prior to submission of samples to the laboratory, the team leader will review sample COC forms with the submitted samples.

The project QA Specialist will review the field logbooks and field data at the end of the sampling period, and more frequently as needed. The project QA Specialist will sign off on each page of the logbooks and the field survey forms to indicate review.

The laboratory data sets will be verified against the laboratory statement of work to determine that the proper analysis was conducted on the samples and to verify that reported results are accurately transcribed and complete.

Ten percent of the laboratory data will be validated to determine whether the control samples are within acceptable limits. Ten percent validation should be sufficient to satisfy data quality needs for the project. Data validation is the review of field measurements and analytical results against a defined set of QC criteria. This validation includes verifying that samples were analyzed within the proper holding times and checking that the accuracy and precision for the analytical and field results are within specified limits. The EPA validation criteria will be used as a guidance for the process. The validated laboratory data packages are signed by the reviewer with a description of the procedure used with any qualifiers pertaining to that data set.

Assurance of quality data will be documented by the following steps:

- appropriate training of field teams to demonstrate proficiency in approved sampling procedures;
- documentation and review of field records and logbooks for sample collection;
- review of laboratory analysis for appropriate methods, analytes, and required deliverables for each data set;
- validation of laboratory data packages at a frequency of 10% using EPA validation guidance; and

- QC samples (duplicate or side by side) at a rate of 10% of samples submitted to the laboratory.

5.8 FIELD CHANGES

When an event occurs that delays sample processing, affects holding times, delays work, or negatively impacts data, it will be documented and corrective actions will be taken immediately to ensure project data quality. A report detailing the event will be completed with actions to be taken to correct the situation. The procedure for reporting will be guided by Radian procedure Quality Assurance Administrative Procedure (QAAP) 16.2 as deemed appropriate by the project manager. A corrective action report will be completed for each event with the guidance of Radian procedure QAAP 16.1.

Any deviation from the sample and testing plan or change in procedure must be reported and recorded when it occurs and noted in the field logbook as a field change or variance. All personnel involved in the work process will be informed of the changes. A variance is a departure from a requirement that does not have a significant negative impact on project quality.

5.9 PERSONNEL TRAINING

All personnel will be site-specific trained for access to LANL. This will include General Employee Awareness Training, Radiation Worker II, and any building-specific training that will be required.

All field personnel will receive training in the use of field-level procedures defined in this plan at the beginning of the project to ensure consistency of sampling. The PCB immunoassay field screening will be conducted by personnel trained in its use and analysis.