1.0 INTRODUCTION

On behalf of Prometcor, Inc. (Prometcor), formerly Ronson Metals, McLaren/Hart, Inc. (McLaren/Hart) has prepared this Final Status Survey and Decommissioning Plan to outline final status survey activities and remediation of remaining concrete slabs, as necessary, in the areas formerly occupied by Buildings 1 through 5, removal of the asphalt cover of the parking lot, and radiological segregation of underlying surficial and subsurface soils in the building areas and in areas of interest within Area E located at the 55 Manufacturer's Place site located in Newark, New Jersey. As agreed, the cleanup of the thorium and uranium will be regulated by the U.S. Nuclear Regulatory Commission (US NRC) while the radium will be regulated by the New Jersey Department of Environmental Protection – Bureau of Environmental Radiation (NJDEP-BER).

This plan has been prepared in accordance with applicable requirements of the US NRC with information collected during site characterization investigations. The subject areas with impacts from radioactive materials have been characterized and further information will be generated as part of remedial and final survey activities.

This plan describes the remediation and survey activities of the second and final phase of remediation at the Prometcor site. The first phase of the final site remediation, status survey, and decommissioning is the completion of necessary decontamination of Buildings 1 through 6, demolition of Buildings 1 through 5, and final status survey (5849 Survey) of the building structures and building debris where applicable. The first phase of the final decommissioning of the site is described in the *Final Status Survey and Surficial Decontamination Plan for Buildings 1 through 6, Prometcor Site, Newark, New Jersey (June 1998)* submitted to and approved by the US NRC. It is understood that the US NRC will perform confirmatory surveys and upon approval release all above ground structures, excluding the slab. Note that final survey and removal, as necessary, of surficial contamination on concrete slabs will have been addressed to meet NRC requirements during the first phase of decommissioning of Buildings 1 through 6 and prior to the second and final phase of site decommissioning.

Upon completion of the Final Status Survey and Surficial Decontamination Plan, the second phase (Decommissioning Plan) described herein will be implemented. Survey and remediation activities described in this plan and presented as the final steps in the NRC decommissioning of the site, involve survey, decontamination, and removal of impacted concrete slabs as necessary, the asphalt cover of the parking lot, and underlying surficial and subsurface soils in the areas occupied by the Buildings 1 through 5 and Area E.

The final decontamination, final status survey, and decommissioning activities described in this plan will be performed in a manner consistent with the sampling and analytical guidelines contained in this plan, as well as applicable federal, state, and local requirements and regulations.

1.1 PURPOSE AND OBJECTIVE OF THE PLAN

The purpose of this plan is to specify the procedures and activities that will be employed to allow for the final survey activities and remediation of remaining concrete slabs in the areas that were formerly occupied by Buildings 1 through 5, the asphalt cover of the parking lot, and underlying surficial and subsurface soils within areas occupied by Buildings 1 through 5 and in Area E. The survey will be performed in accordance with the procedures and guidelines outlined in the NRC's *Manual for Conducting Radiological Surveys in Support of License Termination* (NUREG/CR-5849). This approach allows for an economic and safe approach to remediation of the concrete floor slabs and underlying soils and fill material in the areas of interest at the site.

The objective of the final site decommissioning will be remediate those soils and cover material that contain thorium concentrations in excess of 10 pCi/g, uranium concentrations in excess 10 pCi/g, and applicable surface contamination limits for both radionuclides. Radium-226 present at the site will also be addressed during the final site decommissioning, but will be completed under the review and approval of the NJDEP-BER. Confirmation radionuclide analyses will be performed to demonstrate that thorium, ^{228}Ra, and uranium concentrations are at or below NRC release criteria. Measurements of ^{238}U in samples will be used to determine if uranium concentrations are at or below the NRC citerion. Remediation of soils will ensure that external exposure rates meet the NRC criteria based on those gamma and x-ray fields that originate from the decay of thorium and uranium. Final remediation and final status survey results will be described in the Final Status Survey Report.

As previously discussed, it is Prometcor's desire to complete the remediation of the radiological constituents of concern and receive termination of the license from US NRC. In order to achieve this, it was discussed and agreed to that the US NRC would conduct confirmatory surveys (area by area) during both phases of work. This would in turn allow us to address any areas of concern the US NRC has while we are mobilized at the site, thereby reducing the duration of the project and excess time and cost on the part of both the Prometcor and the US NRC.

1.2 SITE DESCRIPTION

The following sections provide information concerning the nature and extent of radioactive material present at the Prometcor site. Descriptions of the radiological conditions at the site are based on radionuclide sample results for the 1997 Brown and Root Site Characterization (1997 Site Survey) and the 1998 McLaren/Hart Supplemental Source Area Characterization (1998 Site Survey) conducted by McLaren/Hart in March 1998 on behalf of Prometcor, Inc (Brown & Root 1997; McLaren/Hart 1998). Appendix A contains maps showing locations of samples collected during these site investigations.

1.2.1 Radionuclides in Soil

This summary describes the radiological conditions at the Prometcor site based on laboratory results of soil samples collected during the site investig ations. The discussion of sample results are presented by location and radionuclide (*i.e.*, Parking Lot: ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and total thorium; Building 1: ^{228}Th, etc). These and future sample results for thorium and uranium will be used as a guide for the selection of impacted soils above the NRC release criteria that warrant some level of remediation to obtain final unrestricted release status. Details regarding radionuclide concentrations measured at the site are also presented in Appendix A of the plan.

As previously stated, radium-226 present at the site will be addressed during final site remediation activities under the guidance and oversight of the NJDEP.

1.2.1.1 Parking Lot Area

During the 1997 Site Survey, twenty surface soil samples were collected and analyzed for gross alpha and beta, ^{226}Ra, ^{228}Th, ^{230}Th, ^{232}Th, and ^{238}U. Radium-226 levels range from 3 to 387 picocuries per gram (pCi/g). Th-228 levels range from 4 to 90 pCi/g. The total of the other isotopes for each of the samples was below 10 pCi/g.

During the 1998 Site Survey, fifty-four soil borings down to a depth of 4 feet were completed within the parking lot area. The investigation area of the parking lot extends east from Manufacturers Place to the railroad and north of Building 6 to the northern boundary of the parking lot. Based on gamma field screening, sixty-six out of a possible 216 discrete soil samples were submitted for radiochemical laboratory analyses samples (*i.e.*, 54 x 4 = 216, based on one foot intervals for each boring). Sample results received from the lab indicate that three areas in the parking lot contain elevated levels of both radium and thorium isotopes and include: (1) the area surrounding boring PK-BH-08 located toward the northern portion of the parking lot, (2) the area surrounding boring PK-BH-52 located along the eastern fenceline, at the midpoint of the parking lot, and (3) and the area surrounding PK-BH-02 located near the mid-western portion of the parking lot.

For 1998 survey, radium-226 levels range from 0.6 to 593 picocuries per gram (pCi/g), with an average concentration of 42 pCi/g. Elevated Ra-226 concentrations throughout the parking lot are only present in the top 1 to 2 feet of soil. The maximum concentrations (593 and 585 pCi/g) were detected at PK-BH-08 (northern portion of the parking lot) and PK-BH-52 located at the mid point of the parking lot along the fence that separate the parking lot and the adjacent railroad track, respectively.

Radium-228 levels range from 0.5 to 136 pCi/g, with an average concentration of 7.5 pCi/g. The maximum concentrations (128 and 136 pCi/g) were detected at PK-BH-08 and PK-BH-52,

respectively. The remaining elevated Ra-228 concentrations are found in the same locations and depths as the elevated Ra-226 and thorium concentrations.

Thorium-228 levels range from 0.4 to 188 pCi/g, with an average concentration of 8 pCi/g. The maximum concentration was detected in the first two feet of soil at boring PK-BH-08. Thorium-230 levels range from 0.3 to 2 pCi/g, with an average concentration of 0.8 pCi/g. The maximum Th-230 concentration was detected at boring PK-BH-36, located approximately five meters from Manufacturers Place toward the southern end of the parking lot. Thorium-232 levels range from 0.03 to 8.7 pCi/g, with an average concentration of 0.88 pCi/g. The maximum Th-232 concentration was detected at boring PK-BH-08, in the upper 2 feet of soil. As with radium, thorium contamination appears to be contained in the upper 2 feet of soil.

The NRC release criteria of 10 pCi/g is based on total thorium (*i.e.*, sum of Th-228, Th-230, and Th-232). The following locations have total thorium levels that exceed the NRC criteria: PK-BH-02, 06, 07, 08, 14, 18, and 52. The average total thorium level in the parking lot is 9.8 pCi/g, with a range of 1.2 to 198 pCi/g. The maximum concentration is at PK-BH-08.

Based on sample results, this area requires remediation of soils for thorium and uranium. Those soils that exceed the NRC release criteria will be segregated from clean soil and prepared for future disposal at a NRC-approved low-level radioactive waste disposal facility. Elevated radium-226 levels will be also be addressed during site remediation under the direction of the NJDEP.

1.2.1.2 Building 1

During the 1997 Site Survey, three soil samples were collected and analyzed for gross alpha and beta. All results were below the detection limits for gross alpha and beta.

During the 1998 Site Survey, fifteen subsurface borings were completed in Building 1. Fourteen were completed to a depth of 4 feet and one was completed to a depth of 8 feet. Based on field screening, 19 out of a possible 44 samples were sent to AEN for radiochemical laboratory analyses.

Radium-226 levels range from 1 to 718 pCi/g, with an average concentration of 59.2 pCi/g. Besides the maximum concentration in boring 04, Ra-226 concentrations of 103 and 98 pCi/g were measured at borings 10 and 12, respectively. The area extending along the southern wall from B1-BH-02 to B1-BH-12 (approximately 6-20 meters long and 4 meters wide) shows the presence of the highest radium concentrations. The highest concentration of radium-226 at B1-BH-04 is at a depth of 3 to 4 feet below the concrete floor. B1-BH-10 has the second highest Ra-226 level of 104 pCi/g at a depth of 2 to 3 feet. B1-BH-12 has the third highest Ra-226 level of 98 pCi/g at a depth of 3 to 4 feet. The remaining elevated radium levels in Building 1 are found in the upper 2 feet of soil.

Radium-228 levels range from 0.78 to 41 pCi/g, with an average concentration of 6.8 pCi/g. Borings 04, 10, and 12 have the highest concentrations of radium-228. These elevated areas are in the same locations as the elevated Ra-226 concentrations described above.

Thorium-228 levels range from 0.24 to 156 pCi/g, with an average concentration of 12.5 pCi/g. The highest Th-228 concentration measured is at B1-BH-04, found at a depth of 2 to 4 feet below the concrete flooring. Thorium-230 levels range from 0.25 to 1.5 pCi/g, with an average concentration of 0.7. The maximum Th-230 concentration was detected at boring 02. Thorium-232 levels range from 0.18 to 6.1 pCi/g, with an average concentration of 0.89 pCi/g. The maximum Th-232 concentration was also detected at boring 02. In summary, the highest thorium levels throughout the building were measured at borings 02, 04, 09, 10, and 12 at depths between 2 and 4 feet below the concrete floor. These are the same locations were the elevated radium was measured.

Locations where total thorium levels exceed NRC criteria include B1-BH-02, 04, 09, 10, and 12. The maximum total thorium level of 157 pCi/g is at B1-BH-04 at a depth of 3 to 4 feet below the concrete floor.

Based on sample results, this area requires remediation of soils for thorium and uranium. Those soils that exceed the NRC release criteria will be segregated from clean soil and prepared for future disposal at a NRC-approved low-level radioactive waste disposal facility. Elevated radium-226 levels will be also be addressed during site remediation under the direction of the NJDEP.

1.2.1.3 Building 2

During the 1997 Site Survey, one soil sample was collected and analyzed for gross alpha and beta, Ra-226, Th-228, Th-230, and Th-232. The radium-226 level 150 picocuries per gram (pCi/g). The Th-228, Th-230, and Th-232 levels were 60, 1.1, and 0.63 pCi/g, respectively.

During the 1998 Site Survey, six subsurface borings to a depth of 4 feet were completed in Building 2. Based on field screening, 8 out of a possible 24 samples were sent to AEN for radiochemical laboratory analyses. In addition, one dust sample and one smear sample were collected from the second floor in Building 2 and sent to the lab for radiochemical analyses.

The highest levels of radium isotopes in soil were detected at boring B2-BH-06 located toward the south wall of the building. Thorium levels were highest in boring 01 which is in the north east corner of the building. Maximum levels for all radionuclides are found in the upper 2 feet of soil below the concrete flooring. Down-hole gamma readings also indicate possible contamination between the two concrete floors. Additionally, three concrete floors were identified in an isolated area in the eastern end of the building. The extent of required decontamination of radioactive materials sealed between the concrete floors will be determine during survey remediation activities. Radium-226 levels in soil

range from 2 to 119 pCi/g, with an average concentration of 36 pCi/g. Radium-228 levels range from 1.1 to 14.3 pCi/g, with an average concentration of 6.2 pCi/g.

Thorium-228 levels range from 1.1 to 23 pCi/g, with an average concentration of 8 pCi/g. Thorium-230 levels range from 0.31 to 0.94 pCi/g, with an average concentration of 0.7 pCi/g, and thorium-232 levels range from 0.4 to 1.8 pCi/g, with an average concentration of 0.94 pCi/g.

Locations where total thorium levels exceed NRC criteria include B2-BH-01, 02, 04, and 05. The maximum total thorium level of 24.3 pCi/g is at B2-BH-04 at a depth of 1 to 2 feet below the concrete floor.

Results for the 2nd floor dust sample include: (Ra-226, 54 pCi/g); (Ra-228,15 pCi/g); (Th-228, 54 pCi/g); (Th-230, 2 pCi/g); (Th-232, 3.6 pCi/g). Results for the 2nd smear sample include: (Ra-226, 17 pCi/g); (Ra-228, 4.7 pCi/g); (Th-228, 0.45 pCi/g), (Th-230, 0.29 pCi/g); (Th-232, 0.35 pCi/g)

Based on sample results, this area requires remediation of soils for thorium and uranium. Those soils that exceed the NRC release criteria will be segregated and prepared for future disposal at a NRC-approved low-level radioactive waste disposal facility. Elevated radium-226 levels will be also be addressed during site remediation under the direction of the NJDEP.

1.2.1.4 Building 3

During the 1997 Site Survey, four soil samples were collected and analyzed for gross alpha and beta. Two of the samples were also analyzed for Ra-226 and Th-232. The radium-226 levels were 110 and 188 pCi/g. Th-228 levels were 34 and 154 pCi/g.

During the 1998 Site Survey, eight subsurface borings to a depth of 4 feet were completed in Building 3. Based on field screening, 10 out of a possible 32 samples were sent to AEN for radiochemical laboratory analyses. Radium-226 was detected at elevated levels in three of the eight boring locations (borings 01, 07, and 08). The highest level of Ra-226 at 63 pCi/g was detected at B3-BH-07 along the eastern wall bordering Manufacturer's Place. Radium-226 levels range from 0.92 to 63 pCi/g with an average concentration of 19 pCi/g. Elevated concentrations are generally in the upper 2 feet of soil below the concrete flooring. Based on observations in the field, there appears to be only one layer of concrete floor in Building 3.

Radium-228 levels range from 0.95 to 5 pCi/g with an average concentration of 2.3 pCi/g.

Thorium-228 levels range from 0.63 to 6.5 pCi/g with an average concentration of 2.2 pCi/g. The highest concentrations were measured at B3-BH-01, 07, and 08. Thorium-230 levels range from 0.44 to 0.89 pCi/g, with an average concentration of 0.6 pCi/g. Thorium-232 levels range from 0.5 to 0.8

pCi/g, with an average concentration of 0.7 pCi/g. Elevated thorium was found in the same locations were elevated radium was detected.

Based on sample results, this area requires remediation of soils for thorium and uranium. Those soils that exceed the NRC release criteria will be segregated and prepared for future disposal at a NRC-approved low-level radioactive waste disposal facility. Elevated radium-226 levels will be also be addressed during site remediation under the direction of the NJDEP.

1.2.1.5 Buildings 4 and 5

During the 1997 Site Survey, two surface soil samples were collected and analyzed for gross alpha and beta. All results were below the detection limits for gross alpha and beta.

During the 1998 Site Survey, six borings up to a depth of 4 feet were completed in Building 4. Based on field screening, 2 out of a possible 16 samples were sent to AEN for radiochemical laboratory analyses.

All radionuclide concentrations in Building 4 were less than 2 pCi/g. Radium levels were slightly higher than thorium levels, with a maximum radium-226 concentration of 1.69 pCi/g detected along the northern wall about 10 meters from the eastern wall.

Gamma and alpha surveys collected in Building 5 did not suggest the presence thorium or radium contamination in underling soil beneath the concrete floor. Surface contamination will be addressed during prior surficial decontamination activities.

1.2.1.6 Building 6

During the 1998 Site Survey, one boring to a depth of 4 feet was completed in Building 6 (B6-BH-01). This boring is located just east of the middle wall which separates the building into two areas. Based on field screening, 1 out of a possible 4 samples were sent to AEN for radiochemical laboratory analyses.

Radionuclide concentrations are as follows; (Ra-226, 6.3 pCi/g); (Ra-228, 2 pCi/g); (Th-228, 2.5 pCi/g); (Th-230, 1.1 pCi/g); and (Th-232, 0.15 pCi/g). This sample represents the upper 2.5 feet of soil below the concrete flooring.

However, due to elevated gamma readings obtained within Building 6, further samples will be collected during the final site remediation to determine if thorium or uranium are the source of the gamma readings. If thorium or uranium are the source, impacted media will be remediated so that Building 6 meets the applicable NRC release criteria.

1.2.1.7 Area E

During the 1997 Site Survey, 18 soil samples were collected and analyzed for gross alpha and beta. One of these samples were analyzed for Ra-226, Th-228, and Th-232. The radium-226 level 28 pCi/g. The Th-228 and Th-232 were 13 and 2 pCi/g, respectively.

During the 1998 Site Survey, four soil borings to a average depth of 1 foot were completed in Area E. 8 subsurface samples were sent to AEN for radiochemical laboratory analyses. Four surface soil samples and 5 subsurface soil samples from the soil pile were collected and sent to the AEN lab for radiochemical analyses.

Radium-226 levels range from 0.88 to 18.9 pCi/g with an average concentration of 4.3 pCi/g. The maximum Ra-226 level was measured at AE-BH-02. Radium-228 levels range from 0.85 to 4.9 pCi/g with an average concentration of 2 pCi/g.

Thorium-228 ranges from 0.6 to 3.4 pCi/g with an average of 1.4 pCi/g. Thorium-230 ranges from 0.45 to 1.2 pCi/g with an average of 0.83 pCi/g. Thorium-232 ranges from 0.44 to 1.6 pCi/g with an average of 1.58 pCi/g. All levels for total thorium are within the NRC criteria of 10 pCi/g.

All radium-226 levels are below 5 pCi/g for both the surface soil and soil pile samples. All radium-228 levels are below 2.2 pCi/g. In addition, all thorium results for surface soil and soil pile samples are below the 10 pCi/g NRC limit for total thorium.

Based on the extensive set of thorium and uranium sample results, Area E will not require remediation to meet the NRC release criteria. Radium levels within Area E will be addressed under the direction of the NJDEP.

1.3 WORK PLAN ORGANIZATION

The organization of this report is as follows:

- Section 2.0- Site Remediation: Provides descriptions and methodologies used to conduct remediation/decontamination activities for thorium and uranium contamination at the site in a manner which leads to unrestricted use status of the Prometcor site (i.e., floor slabs and soils). This section also includes training requirements

- Section 3.0- Radiation Protection: Provides a description of the radiological protection program that will be used during site remediation, including project organization and responsibilities, personnel training, personnel and equipment monitoring, decontamination methodologies, laboratory services, and administrative action levels.

- Section 4.0- Final Status Survey : Provides specific information concerning implementation and procedures for the final survey, including information concerning radiation detection and monitoring equipment, survey plan procedures, background determinations, sample analysis, quality assurance, comparison of sample results to release criteria, and final status survey report.

- Section 5.0- References: Identifies various rules and regulations that were used in the preparation of this plan.

In addition, Appendix A provides a summary of the radiological site characterization sample results generated during prior site investigations. Appendix B contains the Quality Assurance Plan. Appendix C contains the Site Health and Safety Plan which also includes the Radiological Control and Safety Requirements for Site Survey and Decontamination Activities.

2.0 SITE REMEDIATION

2.1 SITE DECOMMISSIONING PLAN OBJECTIVES, ACTIVITIES, AND TASKS

The overall objectives of this Site Decommissioning Plan are to:

- Conduct remediation/decontamination activities in a manner which leads to unrestricted use status of the Prometcor, Inc. (Prometcor) grounds (floor slabs and soils).

- Conduct remediation activities in a controlled manner consistent with applicable federal, state and local regulations for maintaining the health and safety of workers and the general public and protection of the environment.

Specific remediation program objectives for the Prometcor grounds are the cleanup criteria specified in USNRC Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-Product, Source or Special Nuclear Material *(USNRC, August 1987)* thorium soil contamination criteria specified in the USNRC Branch Technical Position for the Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations (SECY-81-576) *(USNRC, October 1981)*. The contamination guidelines based the NRC release criteria are:

Surfaces (e.g., concrete slab)

Natural Thorium	1,000 dpm/100 cm^2, average over 1 m^2 (670 dpm/100 cm^2 based on beta contamination only) 3,000 dpm/100 cm^2, maximum over 100 cm^2 (2,000 dpm/100 cm^2, based on beta contamination only) 200 dpm/100 cm^2, removable (130 dpm/100 cm^2, based on beta contamination only)

Soils

Thorium	10 pCi/g (Th-232 and Th-228) - Surface (Option 1 - NRC)
Uranium	10 pCi/g

Exposure Rates

5 μR/hr above background (average) at one meter above the floor and lower wall surfaces.

10 μR/hr above background (average) at one meter from soil surface.

20 μR/hr above background (maximum) at one meter from soil surfaces.

2.2 PLANNED REMEDIATION METHODOLOGY

Remediation activities and related health and safety monitoring support activities will be conducted in accordance with approved plans, procedures, instructions and drawings. A management control system described in Section 2.4 will be established to ensure that all work is conducted in accordance with the established and approved procedures and methods.

Remediation/decontamination of soils at the Prometcor grounds will be performed utilizing standard earthmoving equipment (i.e., backhoes, bulldozers, dump trucks) or hand-held equipment such as a standard garden shovel. Selection of removal equipment to be used will be based, in part, on the volume of soil that needs to be removed from the site. Jackhammers, vacuum blasters, needle guns, grinders, etc., will be used for scabbling pavement, concrete foundation, and structures. Segregation of impacted soils will be performed in order to minimize the volume of radioactive waste.

Contaminated soil exceeding the USNRC release criteria will be excavated using a backhoe and/or bulldozer or hand shovels depending upon the volume of contaminated soil. The material will be transported by dump truck, frontloader, or by hand to a stockpile(s) location(s) for off-site shipment to a licensed low-level radioactive waste disposal (LLRW) facility by truck or by rail using intermodals, B-25 boxes or similar containers. The contaminated material may also be loaded directly into the intermodals/containers.

Contaminated debris/dust from the decontamination of the pavement/structures will be placed in the trucks or intermodals/containers with the soil. Handling of contaminated materials will be performed and monitored in accordance with procedures outlined in the site Radiological Control Plan *(McLaren/Hart, June 1998)*, which includes ALARA and the project Health and Safety Plan *(McLaren/Hart, June 1998)*. At a minimum, these procedures will include:

- monitoring radioactivity in airborne particulates during remediation activities in the work areas and at the site perimeter;
- monitoring radiation/contamination levels in the work areas;
- dust suppression measures, such as wetting, tarps and the use of portable contamination control structures (i.e., tents) to reduce the potential for airborne contamination during handling of contaminated soil or debris and/or structures;
- decontamination procedures for cleaning equipment prior to removal from radiologically restricted (work) areas;
- storage requirements for temporary stockpiling of potentially contaminated materials such as soils, concrete, metal and containers (e.g., 55-gallon drums, B-25 boxes); and

- packaging, manifesting and transportation requirements for shipping the contaminated material to the LLRW disposal facility.

2.3 RADIOLOGICAL ASSESSMENT

As stated in the USNRC Draft Branch Technical Position on Site Characterization for Decommissioning *(USNRC, November 1994)*, dose assessments may not be necessary at sites that will be decommissioned in accordance with the interim cleanup criteria for release of the site for unrestricted use and license termination. The interim cleanup criteria are identified in USNRC's Site Decommissioning Management Plan Action Plan (1992). Relevant cleanup criteria established for the Prometcor grounds are presented in Section 2.1 of this SDP.

Since the preferred decommissioning/remediation alternative is to remediate the Prometcor grounds to the limits specified in the interim cleanup criteria for unrestricted use. Radium-226 release levels will be addressed with NJDEP and may include a future restricted use with a radon mitigation system required for any future structures built on the site.

2.4 MANAGEMENT CONTROLS AND PROCEDURES

Common earthmoving equipment such as excavators, bulldozers, and dump trucks will be used to perform remediation of the contaminated soil on the site. Common concrete removal equipment will be used for remediation of concrete or asphalt pavement or structures. Contaminated materials will be placed into shipping containers using dump trucks and excavators.

Remediation activities and related health and safety monitoring support activities will be conducted in accordance with Prometcor approved plans, procedures, instructions and/or drawings. Remediation activities affecting quality, including those of contractors, subcontractors and suppliers, will be performed in accordance with approved plans, procedures, instructions and/or drawings included in the appendices of this plan. Such documents include this Site Decommissioning Plan, the site Radiological Control Plan *(McLaren/Hart, June 1998)*, and related radiation monitoring and sampling procedures. These plans, procedures, instructions and/or drawings will be kept on file and readily available to remediation project personnel for their use at the Prometcor site.

Preparation, review, approval, distribution and revision of final QA and technical plans and/or procedures will be controlled. Controlled copies will be distributed to the Project Manager, the Health and Safety Manager, the Site Supervisor, the QA Coordinator and other project personnel performing or supervising work, as deemed appropriate by the Project Manager.

2.5.1 Remediation Organization and Responsibilities

McLaren/Hart will administer and coordinate all site remediation activities.

2.5.1.1 Project Manager

Overall project management will be the responsibility of Marc Cicalese of McLaren/Hart. Mr. Cicalese will lead the planning and implementation of all site decommissioning activities. The project manager will be the point of contact for all regulatory agencies and work closely with the Health and safety Manager/Radiation Safety Officer.

2.5.1.2 Quality Assurance Coordinator

Quality assurance coordination for field activities, data management, and project procedures and administration will be the responsibility of Mr. Jack Buddenbaum. The QA coordinator will work with the radiological safety and decontamination personnel to effectively implement all applicable QA procedures and standards. The objective of QA procedures will be to ensure that all data collection, operation and maintenance of field instrumentation, and remediation activities are performed in a safe manner and meet minimum quality standards specified in the procedures described in this plan.

2.5.1.3 Health and Safety Manager/Radiation Safety Officer (RSO

The Health and Safety Manager/RSO will be responsible for the development and implementation of field health and safety protocols and procedures and worker training for remediation and final status survey activities Mr. Jack Buddenbaum of McLaren/Hart will serve as The H&S Manager/RSO will coordinate or will assign a designee (e.g., radiological field supervisor; Darin McEleney of B. Koh & Associates) to perform daily health and safety activities at the site and be responsible for the administration and maintenance of all on-site health and safety records. Responsibilities include design, administration, and maintenance of all radiological control protocol and procedures.

2.5.1.4 Laboratory Manager

The Laboratory Manager (LM) is responsible for managing the activities for subcontractor laboratory services and ensuring that all sampling and analyses for the project are performed in accordance with approved procedures and QA programs. Tal Ijaz of McLaren/Hart will serve as Laboratory Manager. Additional responsibilities include ensuring that the laboratory data is properly compiled and validated, and that appropriate evaluations and comparisons to established limits are performed.

2.5.1.5 Project Supervisor

The Project Supervisor (PS) will be Tom Grbic of McLaren/Hart or his designee and will be responsible for ensuring that remediation activities are being performed in accordance with plans, procedures, and design requirements established for the remediation project. The PS reports directly to the H&SM.

2.5.2 Minimum Qualifications for Key Positions

Minimum qualifications for the key project team positions are described below.

Project Manager
The Project Manager must possess a BS degree in engineering or science and have a minimum of 10 years experience in the nuclear field and five years broad management experience.

Quality Assurance Coordinator
The QAC must possess a BS degree in science or engineering and have a minimum of two years experience in QA- or QC-related activities.

Health and Safety Manager/Radiation Safety Officer
The H&SM/RSO must possess a BS degree in science or engineering and have two years experience in the nuclear field, or a high school diploma and eight years experience in the nuclear field.

Laboratory Manager
The LM must possess a BS degree in science or engineering and five years experience in nuclear-related operations or remediation activities, including three years experience in laboratory analysis.

Project Supervisor
The PS must possess a BS degree in science or engineering and have five years experience in supervision of field activities, such as decontamination and decommissioning, remediation, site characterization, or a high school diploma and ten years such experience.

2.6 TRAINING REQUIREMENTS

2.6.1 General

The purpose of training for the Prometcor Remediation Project is to provide personnel, qualified to work amid radiological and general hazards at the Prometcor site, the necessary knowledge to work safely. Training will be provided by radiological control personnel. The RSO will review the training program and will update it to reflect changes in the facility and procedures, as applicable.

Training will be requisite for workers involved in day-to-day operations of the remediation project, project and management personnel who will visit the site regularly and other personnel identified by the PM and the RSO.

2.6.2 Site Orientation and Training

Prior to entry into radiologically restricted areas, all personnel involved in remediation activities at the site, including contractor and subcontractor personnel, will be provided a site and radiological orientation. Objectives of this orientation are to assure that these personnel:

- Recognize labeled radioactive materials and understand the meaning of radiological warning signs;
- Understand that adherence to radiological control procedures and limits will minimize harmful effects to personnel and the environment from site radioactivity; and
- Recognize and understand the meaning of and proper response to emergency signals.

2.6.3 Radiation Safety Training

Persons who will require routine site access will receive basic Radiation Safety Training.

Radiation Safety Training will include the following topics:

- Radiation Fundamentals - basic characteristics of radiation and contamination.
- Radiation Exposure Limits and Controls - external radiation exposure control methods, procedures and equipment.
- Radiation Contamination Limits and Controls - contamination and internal radiation exposure control methods, procedures and equipment.
- Employee and Management Responsibilities for Radiation Safety.
- Emergency Procedures and Plans - an administrative system to report conditions potentially adverse to safety or quality.
- Biological Effects of Radiation - basic understanding of biological dose and methods of assessment.
- Contents of 10 CFR 19, Rights of Workers.
- Prenatal Exposure (Regulatory Guide 8.13).
- Airborne Radioactivity Program (Regulatory Guide 8.15).
- Dosimetry, Bioassay Requirements.

- Radiation Work Permits.
- ALARA.

Prior to being allowed unescorted worker access to the site and issuance of a TLD, if required, all personnel will be required to pass (with a score of 80% or better) a written exam that will demonstrate a basic knowledge of radiation worker training, and provide evidence of a recent medical examination.

2.7 TRAINING VERIFICATION AND DOCUMENTATION

All persons who work on-site must provide evidence of initial training and pertinent refresher training (e.g., training certificates, letters of certification, etc.) prior to being permitted to perform work potentially involving exposure to safety or health hazards. In addition, all site personnel will be required to sign a statement documenting that they have received site-specific training and that they understand the potential site hazards and necessary control measures to reduce and/or eliminate those hazards.

All training documentation, including the content of site specific training and any other subsequent training (e.g., periodic safety meetings, specific task safety training, etc.) will be maintained on site as part of the Prometcor files and will be available for inspection until the Final Radiological Release Survey is completed.

2.8 EMPLOYEE ACCESS TO INFORMATION

All pertinent information concerning the health and safety of onsite workers will be conveyed initially via site-specific training. Subsequently, documents used for training purposes will be provided to employees, or made available upon request. Any update information concerning safety or health conditions associated with this project will also be conveyed to project personnel.

2.9 CONTRACTOR ASSISTANCE

It is Prometcor's intention to perform the remediation of the grounds, primarily using contractor and subcontractor assistance. The responsibility for performance of remediation activities, however, will rest with Prometcor. Existing and additional Prometcor plans and procedures identified by Prometcor, which delineate relevant environmental and safety and health policies as well as administrative guidelines will be applied to the remediation project, as appropriate. Remediation work will be performed in accordance with these and other project-approved documents (this Site Decommissioning Plan, project work plans and work permits, the Radiological Control Plan [McLaren/Hart, June 1998] and radiological and safety procedures).

2.9.1 Contractors

McLaren/Hart will provide personnel to perform the duties of the site supervisor and Radiological Control (radcon) Technicians. McLaren/Hart will augment McLaren/Hart radcon staff with health physics technicians from their subcontractor B. Koh & Associates.

The overall role and responsibility of McLaren/Hart to provide the supervision and radiation control support necessary to ensure that:

- Prometcor remediation activities are planned and performed in accordance with the requirements established for this project.

- The grounds (soils, floor slabs, and asphalt covers) are remediated to acceptable levels and conditions which will allow for unrestricted use.

Subcontractors

Qualifications for the selected subcontractors for radiological control and laboratory services have been established and verified by McLaren/Hart. McLaren/Hart will establish and verify qualifications of any other subcontractors selected, for example, for excavation and demolition/decontamination work, as necessary.

2.10 SCHEDULE

As mentioned earlier during previous discussion between the NRC and Prometcor, it is imperative that Prometcor receive a NRC termination notice for their byproduct license by the end of 1998. Therefore, Prometcor requests that the NRC and Prometcor develop project milestones and completion dates that will allow for the timely termination of the said license by the end of 1998. Once a schedule has been agreed upon, Prometcor will submit a schedule to the NRC prior to the start of any site decommissioning activities.

3.0 DESCRIPTION OF METHODS USED FOR PROTECTION OF OCCUPATIONAL AND PUBLIC HEALTH AND SAFETY

3.1 FACILITY RADIOLOGICAL HISTORY

Section 1.0 of this Site Decommissioning Plan describes radiological survey results for the site. Based on current data and understanding, there are affected areas requiring remediation prior to the release of the site for unrestricted use. A summary of the previous assessments *(Brown & Root, February 1997)* and McLaren/Hart *(March 1998)* characterization data is provided in Section 1.0.

Using the methodology described in Draft NUREG/CR-5849, the Prometcor grounds were subdivided based on the potential for contamination of various types. These subdivisions were used as references for purposes of conducting additional site characterization activities and establishing sampling and measurement frequencies and patterns. Specifically, the site was segregated into affected and unaffected areas (see Table 3-1). These classifications are defined as follows:

- Affected Area. Area that has potential thorium and uranium contamination (based on plant operating history) or known contamination (based, in part, on preliminary radiological surveillance). This would normally include areas where thorium materials were used and stored, where records indicate spills or other unusual occurrences that could have resulted in the spread of thorium contamination. Areas immediately surrounding or adjacent to locations where thorium materials were used, stored or spilled are included in this classification because of the potential for inadvertent spread of thorium contamination.

- Unaffected Area. Any area not classified as affected is considered unaffected. Such areas are not expected to contain thorium residual radioactivity, based on the site history and previous survey information.

3.2 ALARA PROGRAM

Prometcor is committed to maintaining radiation exposure to workers and the general public As Low As Reasonably Achievable (ALARA). Prometcor management will demonstrate their commitment in this regard by assigning high priority to work plans and procedures that reasonably reduce personnel and environmental radiation exposures. The site utilizes the site Radiological Control Plan *(McLaren/Hart, June 1998)* and Project Radiation Protection Procedures to maintain individual and collective exposure ALARA and incorporates the ALARA philosophy into operating procedures. Furthermore, Prometcor places primary emphasis on design and engineering features to maintain exposures ALARA. When

practicable, design features are selected in lieu of administrative controls to maintain exposures ALARA. These practices and procedures will be applied consistently to the Prometcor remediation activities.

The ALARA philosophy is a fundamental objective of all effective radiation protection programs. Thus, maintaining individual and collective radiation exposures ALARA is a critical element of the site Radiological Control Program. Prometcor's commitment to the ALARA concept is emphasized in its policies, plans and procedures as evidenced by the implementation of:

- Radiation Protection and Contamination Control Program to control radioactive sources and minimize spreading of contamination.
- Work Activity Control Program utilizing Radiation Work Permits (RWPs) to control and track worker exposures.
- Safety Assessment and Review Program to evaluate potential exposure that may be received in performing the assigned task.
- Respiratory Protection Program to detect radiological hazards and provide appropriate respiratory protection equipment.
- Handling and Storage Program to ensure the proper handling, packaging and storage of radioactive material.
- Training Program which stresses the importance of continuous effective exposure control.

The remediation alternative selected by Prometcor also results in exposures to workers and the public that are ALARA. This is achieved by continuous monitoring of the radiological conditions at the site during remediation activities and by reducing to as little as possible the amount of material transported offsite. These measures minimize potential exposures to workers and the public during remediation activities and transportation to and handling at the selected low-level radioactive waste disposal facility.

3.3 HEALTH PHYSICS PROGRAM

The Prometcor Health Physics Program utilizes the Radiological Control Plan *(McLaren/Hart, June 1998)* and related procedures. Elements of this program include:

- Health and safety protection measures and policies as expressed in the appropriate Prometcor health and safety plans and procedures.

- ALARA.
- QA Program.
- Calibration and maintenance of survey equipment and instrumentation.
- Monitoring policy methods, frequencies and procedures.
- Radiological Control Program.
- Airborne Radioactivity Program.
- Respiratory Protection Program.
- Radiation Work Permit (RWP) and work controls.
- Emergency Action Procedure.
- Posting and labeling.
- Records and reports.
- Identification of potential sources of contamination exposure.
- Radioactive liquid handling procedure.
- Radiation Worker Handbook and Training Manual.
- Surface Contamination Program.
- Radioactive waste packaging procedure.
- Handling, storage and disposal of radioactive material procedures.
- Radioactive check source accountability procedure.
- Field sampling, tracking and analysis procedures.
- Bioassays.
- Dosimetry.

3.3.1 Quality Assurance Program

The Prometcor Health Physics Program is subject to management controls and QA requirements. In addition to general QA review and independent oversight, surveillances and audits may be performed.

Radiological surveys, including sampling and analysis, are performed in order to evaluate the effectiveness of remediation efforts in maintaining adequate radiological controls and to evaluate materials for removal and disposal.

Health physics instrumentation and equipment is inspected prior to use. Equipment failing the inspection due to malfunction, poor calibration, or inappropriateness because of use restrictions, is identified, marked and not used. Respiratory protection equipment is inspected according to the requirements and schedules specified in the site Airborne Radioactivity Procedure.

Periodic surveillances and audits of the Prometcor Health Physics Program may be conducted, depending on the length of remediation activities. The audits are performed by the QAC or his designee. Unusual events will be investigated as they occur.

3.3.2 Selection, Calibration and Maintenance of Equipment and Instrumentation

Radiological control personnel will determine the quantity, performance, necessary capabilities and proper use of radiation detection monitoring instrumentation and sampling equipment. They will be responsible for calibration, maintenance and proper storage of such equipment, and control of instrument check sources.

3.3.2.1 Selection Criteria

Selection criteria for portable and laboratory counting equipment are based upon the types of radiation to be detected, maintenance and calibration requirements, ruggedness, interchangeability, and upper and lower limits of detection capabilities.

3.3.2.2 Instrument Type, Purpose and Range

Table 3-2 lists the typical types of radiation detection instruments expected to be used during remediation of the Prometcor grounds. The data include manufacturer, model, probe, radiation type, efficiency and detector sensitivity.

3.3.2.3 Storage, Maintenance, Calibration and Testing

Radiation detection and monitoring instrumentation and sampling equipment will be stored and made available for routine use by radiological control personnel at locations such as the radiation protection field office and controlled contamination changeout areas. Maintenance of the radiation detection sampling equipment will be provided by radiological control personnel, instrument manufacturer's representatives or contracted service vendors.

Radiation detection and sampling instrumentation and laboratory counting instruments utilized for radiation safety purposes will be calibrated before initial use, after major maintenance and on a routine basis. Portable radiation detection and sampling equipment/instrumentation will be calibrated semi-annually by a qualified vendor in accordance with ANSI N42.17A-1989 guidance *(ANSI 1989)* for each type of radiation of concern at the site. Calibrations will consist of performance checks on each scale range of the instrument with a NIST-traceable radioactive source of known activity. Calibration and maintenance will be performed in accordance with the radiation control procedures. Portable instrumentation will be source-checked each day the instrument is in use.

3.3.3 Policies, Methods, Frequency and Procedures

Prometcor policies, methods, frequencies and procedures for effluent and environmental monitoring, radiation surveys and personnel monitoring (internal and external) are described in the Project Radiological Control Plan *(McLaren/Hart, June 1998)*.

3.3.3.1 Radiation and Contamination Surveys

Routine radiation and contamination surveys will be performed as necessary to ensure that personnel do not exceed established occupational exposure limits and controls and do not receive unnecessary exposure to radiation. The primary objective of the Prometcor Health Physics Program is to minimize personnel exposures ALARA by providing adequate and appropriate information to workers on radiation levels in the work area, enabling the work to be completed efficiently and with minimal exposure of workers.

Radiation and contamination surveys will also be used to determine the effectiveness of the overall radiological contamination and protection program. Information obtained from radiation and contamination surveys is used to re-evaluate operations, activities and methods to further reduce personnel exposures and maintain ALARA levels.

Radiation and contamination control surveys will be performed using approved procedures, qualified personnel and instruments appropriate to the type of radiation and/or contamination and type of survey required.

Types of routine radiation and contamination control surveys include:

Personnel Contamination Surveys (Self-Monitoring or Frisking)

Personnel contamination surveys (self-monitoring or frisking) are performed to detect and quantify the possible presence of radioactive material on the body. Self-monitoring frisking is a critical element of the Prometcor Project Contamination Control Program. Only individuals trained and qualified as radiation workers are permitted to perform self-monitoring. Visitors and non-radiation workers will be surveyed by a radiological control technician.

All personnel will be instructed in the proper method of removing outer clothing/tyveks and boot covers and monitoring for personal contamination as part of the formal Prometcor Radiation Safety Training Program. Friskers (personal contamination monitors) will be available at each exit from a radiologically restricted area and instructions will be provided at each personal frisking station. Instrumentation/specification of instruments used to monitor for personal contamination are presented in Table 3-2. In the event that personnel contamination is suspected or found, the radiological control

personnel will be notified and appropriate action taken as directed by the project Radiation Safety Officer (RSO).

Radiological control personnel will supervise any necessary personnel decontamination activities and evaluate the need for bioassay analysis. Bioassays will be initiated unless proper respiratory protection was used and nasal smears are negative. Whole body counts may be performed at the discretion of the RSO.

Area Contamination Surveys

Surveys for surface contamination will be conducted during remediation activities in all radiologically restricted and unrestricted areas established for the remediation project. These surveys will be performed in accordance with the Prometcor Surface Contamination Program and the General Radiological Survey Procedures. Surveys will include direct (fixed) and removable contamination measurements commensurate with the potential for contamination in the area. If levels of contamination exceed the Prometcor established limits, corrective actions will be taken, as directed by the RSO.

In general, area surface contamination surveys will be performed to provide:

Data for determining radiological conditions that will be used for the issuance of RWPs and for termination of RWPs.

Continuous monitoring of ongoing radiological work.

Data for the planning and implementation of sampling/remediation plans.

Characterization and Remediation Surveys

Radiation and surface contamination surveys are used to provide assessments of the radiological conditions in support of the design of characterization and/or remediation plans. Such surveys serve as the basis for determining the probability regarding the unrestricted release of a given material or property. Characterization and remediation surveys and related sampling may be conducted in a systematic or random manner, depending on the probability of contamination existing at that location. Characterization and/or remediation surveys will be performed in accordance with approved plans or procedures. Final radiological surveys in support of remediation will be performed consistent with Draft NUREG/CR-5849 *(USNRC, June 1992)*. Details of the final radiological surveys are discussed in Section 4.0. Characterization and Final Radiological Release Survey results are considered quality records and will be stored and maintained as part of the Prometcor files.

Materials and Equipment Surveys

Radiation and contamination surveys will be performed on material and equipment in restricted areas to be released for unrestricted use. The material or equipment surfaces are surveyed for direct (fixed) and removable contamination in accordance with approved procedures. Survey results are compared to established release criteria *(USNRC, August 1987)*. If a piece of equipment or material exceeds established limits, decontamination and resurveying of the equipment or material will be performed until the item meets release criteria. Material and equipment survey results are considered quality records and will be stored and maintained as part of the Prometcor files.

Shipping Surveys

Radiation and contamination surveys will be performed on radioactive material packaged to be shipped offsite in accordance with 49 CFR requirements. Shipping surveys are considered quality records and will be stored and maintained as part of the Prometcor files.

3.3.4 External Radiation Exposure Control

3.3.4.1 General.

It is the objective of the site Radiological Control Plan *(McLaren/Hart, June 1998)* not only to maintain exposures within the limits established by federal and state law, but also to minimize exposures to individuals, the total work force and the general population in accordance with the ALARA principle.

Remediation activities will be controlled such that no worker will exceed any 10 CFR 20 occupational limit and the total of all workers' exposures will be limited to ALARA. In addition, operations will be controlled to preclude releases to the environment of airborne radioactivity greater than the concentration limits of 10 CFR 20, Appendix B, Table 2, Column 1, or releases to surrounding water of radioactive liquids contaminated at levels greater than those listed in 10 CFR 20, Appendix B, Table 2, Column 2.

3.3.4.1.1 Personnel Monitoring for External Radiation

The purpose of the Prometcor personnel monitoring program for external radiation is to provide an indication of the level of external radiation exposure. Occupational exposure limits for licensed facilities and the Prometcor administrative exposure limits to external radiation are given in Table 3-3. Upon the initial site visit by any personnel requiring personnel monitoring, an USNRC Form 4 will be completed and signed.

3.3.4.1.1.1 Exposure to Minors

Individuals under the age of 18 will not be permitted to enter any radiologically restricted area at the Prometcor site.

3.3.4.1.1.2 Exposure to Unborn Child

As part of the radiation safety training (and reverification training) and prior to issuance of TLDs, all personnel authorized to receive radiation exposure will be given specific instruction regarding prenatal exposure risks to a developing embryo and fetus. This instruction will include both oral and written information contained in the Appendix to USNRC Guide 8.13, Instruction Concerning Prenatal Radiation Exposure.

3.3.4.1.1.3 Exposure to Visitors

Prometcor will control the exposure of visitors at the site to ALARA levels. For exposure control purposes, a visitor is defined as any person not qualified as a radiation worker who requires access to radiologically restricted areas.

Entry by a visitor to a radiologically restricted area will require the following:

- Assignment of a temporary TLD badge or self-reading dosimeter.
- Escort by a qualified radiation worker at all times while in the radiologically restricted area.
- Documentation of the following information:
  -Name
  -Social Security Number
  -Date of Visit

3.3.4.1.2 Personnel External Exposure Monitoring

3.3.4.1.2.1 Equipment

External radiation exposure monitoring will be accomplished with the use of primary dosimetry and radiation survey dose ratemeters. The primary dosimeter for this project will be the TLD badge, which measures whole body exposure.

Other devices that will be available for exposure control are self-reading dosimeters and dose rate survey meters. Self-reading dosimeters will be used by visitors to the site and as directed by the RSO.

The radiation survey dose ratemeter for this project will have a minimum detection rate of 2 μRem/hr, an accuracy of ±20% and a response time of 15 seconds. Radiation and/or contamination instrumentation and specifications are presented in Table 3-2.

3.3.4.1.2.2 Calibration

Portable dose rate survey instrumentation used to evaluate personnel exposure will be calibrated semi-annually by a qualified vendor in accordance with ANSI N42.17Z-1989 guidance *(ANSI 1989)* for each type of radiation of concern at the site. Portable instrumentation will be source-checked each day the instrument is in use. All calibrations will be NIST-traceable.

Self-reading dosimeters will be tested semi-annually by a qualified vendor in accordance with ANSI N13.5-1972 (R 1989) guidance *(ANSI 1989)*. TLD badges do not require field calibration, but must meet the performance criteria found in ANSI N13.15-1985 *(ANSI 1985)*.

3.3.4.1.2.3 Survey and Dosimetry Requirements

Surveys for radiation levels and/or contamination levels will be performed using appropriate portable radiation survey dose rate meters prior to working on materials known or suspected of being contaminated, to assess the level of hazards and aid in the establishment of appropriate radiological controls.

All personnel required to regularly enter and work in radiologically controlled areas will be provided with a primary dosimeter (TLD) following the requirements established in the site Radiological Control Plan *(McLaren/Hart, June 1998)*. This dosimeter will be worn daily, while at the worksite throughout the duration of the project. Dosimetry will be analyzed quarterly (or at the completion of the project, if sooner than three months) or at the time of employee termination (whichever is earlier) to determine radiation exposure of the individual. Visitors may be assigned a temporary TLD or a self-reading dosimeter.

3.3.4.1.2.4 Analysis

Dosimetry will be provided and processed by a National Voluntary Laboratory Accreditation Program (NAVLAP)-certified vendor. Dosimeters will be processed on a quarterly basis.

3.3.4.1.2.5 Recordkeeping

When self-reading dosimeters are used, the daily exposure will be recorded and tracked as a portion of the RWP. Exposure results will be monitored and evaluated by the RSO. Appropriate investigative action will be taken in the event that an individual's exposure exceeds the administrative limits shown in Table 3-3. Copies of TLD results for each employee will be maintained onsite and available for inspection. Personnel monitoring reports will be maintained in accordance with guidance from USNRC Regulatory Guide 8.7, Rev. 1, 1992. Records of all surveys and TLD results will be considered quality records and will be stored and maintained as part of the Prometcor files

3.3.5 Internal Radiation Exposure Control

3.3.5.1 General

It is Prometcor policy to maintain the internal exposures of radioactive materials to ALARA levels. The use of engineering controls will be employed to the maximum extent possible. If engineering controls are not adequate, as demonstrated by work area air sampling, then respiratory protection will be considered to control internal exposures. Internal exposure monitoring will consist of two major components: airborne exposure monitoring (air sampling) and internal monitoring (bioassays and in-vivo counting).

3.3.5.1.1 Engineering Controls

Engineering controls will be utilized to the maximum extent possible to control the production of dusts during the Prometcor remediation activities. Engineering controls may include, but are not limited to, water-misting or the use of dust control additives or tarps. Contamination control structures (i.e., tents) may also be used to minimize the spread of airborne contamination.

3.3.5.1.2 Monitoring of Airborne Radioactivity

Air sampling of the work areas will be performed daily during remediation/decontamination activities in accordance with the Prometcor Airborne Radioactivity Procedure. The frequency and location of sampling equipment will be dictated by the activities (i.e., vacuuming, scabbling, jackhammering, etc.) that occur each day. An adequate number of samples will be collected to be representative of the air in the work areas. Air sample volumes will be a minimum of 36 cubic feet and will be collected using high-volume or low-volume air samplers as directed by the RSO or designee.

If air sampling determines the possibility of an airborne release, the RSO will evaluate the possibility of an uptake. Evaluation will include, but not be limited to, collection and analysis of nasal smears and bioassays to determine exposures due to an uptake of thorium.

3.3.5.1.3 Equipment

Air sampling equipment will be calibrated in accordance with ANSI N13.1-1969 (R 1982) *(ANSI 1982)* within six months of the start of the project and every six months thereafter. Flow rates for the air samplers will be variable from 0.5 to 20 cfm. The analysis of air samples will be performed with equipment capable of a minimum detectable activity of 4.0 E-15 □Ci/ml for Th-232 (onsite analysis of the air samples results in gross alpha (□Ci/ml) concentrations). It is assumed that the gross alpha results are due entirely to Th-232. The analytical equipment will be calibrated in accordance with ANSI N42.17A-1989 guidance *(ANSI 1989)*.

When sampling for certain nuclides with very low Derived Air Concentration (DAC) values, such as Th-232, special considerations must be taken. During these times, the Minimum Detectable Concentration (MDC) desired for the field sampler/counting instrumentation may be almost impossible to obtain, due to the very large volumes of air and/or long counting times needed to obtain the desired MDC. One of the following steps will be taken to determine if long-lived isotopes with very low MDCs may be present on a given air sample filter.

Establish a graph of the time versus gross counts per minute for the decay of a typical air sample collected during normal, non-intrusive activities at the site of interest. This will result in a graph depicting the decay (slope) of naturally occurring, short-lived isotopes (i.e., Radon decay products) present on the air samples. Typically, two to three half-lives of short-lived nuclides will be observed and documented within 17-20 hours of the first counting.

Count each sample immediately after collecting air sample and again after approximately 17-20 hours. If decay of radioactive materials represented by 2 to 3 half-lives are observed after this time, it can be assumed that the filter contains naturally occurring, short-lived activity associated with radon, not long-lived activity from radionuclides such as Th-232.

As an added precaution, a predetermined number (approximately 5%
an offsite laboratory and analyzed for the nuclide of interest, th
demonstrate compliance to the specific DAC value, as listed in 10 C.

3.3.5.1.4 Analysis

Results of air samples will be compared with the limits from 10 CFR 20 for Th-232. If the air sample results are above 10% of the Th-232 limit, the RSO will be notified for appropriate action.

3.3.5.1.5 Respiratory Protective Equipment

In the event the engineering controls are not adequate to maintain airborne activity to established limits, respiratory protection will be issued to provide the necessary internal exposure control. Respiratory protective equipment will be issued and monitored in accordance with the existing Prometcor Radiological Control Program and Airborne Activity Procedure. Respiratory protective equipment will always be selected on the basis of hazard or presumed hazard. Whenever the degree of hazard cannot be determined prior to task initiation, a conservative approach for protecting personnel will be utilized. Respiratory protective equipment will be recommended by the RSO prior to the initiation of each new task or operation. The Respiratory Protection Program is described in further detail in Section 3.3.8.

3.3.5.1.6 Recordkeeping

Air sampling results will be monitored and evaluated by the RSO or designee. Appropriate investigation will be initiated in the event that any individual's personal air sample, or work area sample, or perimeter sample results exceed the administrative limits in Table 3-4. Records of all air sampling results and air sampling instrumentation calibrations will be considered quality records and will be stored and maintained as part of the project file.

3.3.5.1.7 Internal Monitoring

The primary means for monitoring for potential airborne-internal contamination is air sampling.

The bioassay program, as defined in the site Radiological Control Program, will be used as a supplement to airborne sampling during site remediation activities. This program will be used to aid in the determination of the extent of potential internal exposure to radioactive material to an individual. In-vitro (urinalysis) and in-vivo counting (lung counting, when deemed necessary) will be utilized to develop estimates of:

- The quantity of the radioactive material internally deposited in the critical organ;
- The rate of biological elimination; and
- The airborne radioactive concentrations to which the individual may have been exposed. Th bioassay sampling program is performed in accordance with the guidelines contained in Regulatory Guides 8.9, 8.11 and 8.26.

In the unlikely event of an internal contamination incident or an uncontrolled or suspected occurrence of airborne radioactivity, nasal smears of potentially exposed individuals will be collected and analyzed. Nasal smears may also be taken following use of personal respiratory protection, as specified by the RSO.

An evaluation of elevated bioassay results will be performed and documented. As part of this evaluation, the individual's dose commitment due to the potential uptake will be calculated. Based upon these calculations, the individual may be restricted from performing further work. Prometcor's administrative control levels are presented in Table 3-3.

Bioassay sampling may also be performed at any time (for example, as a result of non-routine work, airborne incidents, etc.) at the discretion of the RSO.

3.3.5.1.7.1 Contamination Control Limits

The main goal of the Prometcor Contamination Control Program is to maintain all radioactive contamination and radiation at ALARA levels. To achieve this goal, action limits for the Remediation Project have been established for surface, equipment, liquid and airborne contamination. These action limits are summarized in Table 3-4.

3.3.5.1.7.2 Airborne Contamination Control

Contamination at the Prometcor site exists as dry, non-volatile thorium and radium-226 compounds. This contamination may exist in soils, structures and concrete. Remediation activities may generate contaminated airborne dust.

Personnel and public exposure to airborne radioactivity is controlled using engineered controls, contamination containment structures (tents), high-efficiency particulate air (HEPA) ventilation systems and respiratory protection equipment. Contamination containment structures include temporary herculite tents or enclosures to maintain airborne contamination within a confined area. Contamination containment structures are normally used in conjunction with HEPA-filtered ventilation systems and equipment.

3.3.6 Radiological Contamination Control Program

Radiological contamination control is an essential part of the Prometcor Health Physics Program. Radiological contamination control during remediation of the Prometcor grounds will be based on the requirements specified in the existing Prometcor Radiological Contamination Control Program, Surface Contamination Program and Airborne Radioactivity Program.

The critical elements of the Prometcor Radiological Contamination Control Program, as defined in the referenced documents, consists of:

- Establishment of contamination control limits.
- Implementation of airborne contamination control measures.
- Identification and monitoring of radiologically restricted areas.
- Implementation of work controls (i.e., radiation work permits).
- Implementation of contamination control surveys.
- Utilization of personal protective clothing and equipment.
- Implementation of controlled containment and storage of radioactive materials.

3.3.6.1 Identification and Monitoring of Access to Restricted Areas

To aid in control of radiation exposure and limit the spread of radioactive material, a system of identifying radiologically restricted/controlled areas will be implemented for the Prometcor site as specified in the site

Radiological Control Plan *(McLaren/Hart, June 1998)*. Prometcor grounds will be divided into two distinct areas for radiation exposure control. These areas are restricted and unrestricted areas.

Restricted area means any area to which access is controlled by Prometcor for purposes of protection of individuals from exposure to radiation and radioactive materials. Within the restricted areas, various radiological control zones (RCZs) will be designated to aid in radiation exposure control and control of the radioactive materials that may be present. Types of RCZs include, but are not limited to: *RADIOACTIVE MATERIALS AREA, RADIATION AREA, SURFACE CONTAMINATION AREA and CONTAMINATED AIRBORNE ACTIVITY AREA.*

In all cases, the radiologically restricted/controlled area will be delineated with distinctive barrier tape or rope and signs. The signs will feature the radiation symbol and appropriate wording to warn workers of the potential hazards. A description of the radiation symbol and appropriate signs can be found in USNRC Regulatory Guide 8.1 and ANSI Standard N2.1-1969 *(ANSI 1969)*.

Entry points to restricted/controlled contamination areas will be posted in accordance with 10 CFR 20.1902. Instructions will be posted describing proper techniques of personnel frisking, donning and doffing of protective clothing and other special entry requirements.

Each restricted/controlled area will consist of a controlled side and uncontrolled side. A step-off area will separate the two sides. A personnel survey meter (frisker) will be available to be used by individuals for the required personnel survey.
Unrestricted area means any area to which access is not controlled by Prometcor for purposes of protection of individuals from exposure to radiation and radioactive materials.

3.3.6.2 Work Controls and Work Permits

A Radiation Work Permit (RWP) is an administrative tool used to control work performed inside the radiologically restricted area and to inform all personnel involved in a particular work activity of specific hazards involved and precautions to be taken in the work area.

Additionally, the RWP will serve to instruct the workers as to what protective equipment may be needed and what monitoring will be required. All work performed on the Prometcor site will be performed under the authority of an RWP, as specified in the site Radiological Control Plan *(McLaren/Hart, June 1998)*.

All work will be administratively controlled via RWPs. RWPs will be issued weekly and reviewed daily by the RSO or his designee. The RWP will include the following information:

- Task(s) to be performed.

- Location(s) of task(s).
- Radiological hazards involved with task(s).
- Most recent relevant radiation survey results.
- Required personnel protective equipment.
- Applicable special uses or restraints.
- Names and signatures of individuals performing task(s).

A daily safety meeting will be conducted, to include all workers, to review safety and radiological conditions and/or changes to the RWP.

An RWP will be issued at the start of remediation operations and weekly or monthly thereafter for routine activities. The RWP will be terminated at the end of seven days (or 30 days for routine activities) or when conditions change.

3.3.6.3 Contamination Control Surveys

Contamination surveys will be performed, as necessary, to ensure that personnel do not spread surface contamination beyond controlled surface contamination area (CSCA) boundaries. Surface contamination will be controlled to minimize unnecessary external and internal exposure resulting from the intake of loose radioactive material by inhalation, ingestion, or skin absorption. Surveys are taken to determine whether contamination levels exist and to determine the extent and magnitude of contamination levels.

Areas and/or equipment where surface contamination exceeds the limits specified in Section 2.0 will be designated CSCAs until they are decontaminated or covered. Loose contamination above limits found in non-radiologically controlled areas require implementation of established emergency actions, including immediate decontamination. Routine surveys of surface contamination will be performed with frequencies indicated per RSO instructions. As a general practice, surface contamination surveys will be performed daily in controlled areas and at least weekly in uncontrolled areas.

Surveying for personnel contamination is the responsibility of and will be performed by individuals who are trained and qualified as radiation workers. Radiological Control Technicians (RCTs) will survey all other persons. Instructions will be posted at each survey station on using the equipment, on acceptable limits of contamination and on actions to be taken if an individual exceeds limits. Individuals exceeding the established limits will be decontaminated in accordance with methods specified in the Prometcor Surface Contamination Procedure.

3.3.6.4 Personal Protective Clothing

Protective clothing is provided to all individuals who are required to enter controlled contamination areas. Anti-contamination (anti-C) clothing is worn by personnel to break the chain of contamination transfer and keep the body free from contamination. Anti-C clothing, as specified by the RCT, will be worn when either surface contamination or airborne radioactive contamination might exceed allowable limits.

Anti-C clothing is designed to protect the worker's head, neck and ears, trunk and extremities from radioactive contamination. Anti-C clothing includes, but is not limited to: coveralls, hoods, caps, overshoes, anti-contamination gloves, safety shoes and respiratory protection equipment. Protective clothing requirements, including donning and doffing, are specified in the Prometcor Surface Contamination Procedure. For specific tasks, protective clothing requirements will be stated on the RWP. Proper donning and doffing of protective clothing and whole body frisking techniques will be covered during site-specific training.

3.3.6.5 Controlled Containment and Storage

All work activities conducted at the Prometcor site involving removable (smearable) radioactivity above the Prometcor limits for unrestricted areas and unrestricted release for equipment will be performed in contamination control containments or with equipment equipped with HEPA filtration. Temporary containments will be used when a potential exists for airborne contamination to approach 25% of 10 CFR 20, Appendix B, Table 1, Column 3 limits, and will be operated under negative pressure with respect to the outside air to prevent release of contamination to the outside area.

Equipment, tools and materials contaminated above unrestricted release limits will be controlled in accordance with the Prometcor Surface Contamination Program. Such material will be stored in identified storage areas. Contaminated metallic equipment and material may be stored in containers outside the main controlled area. The storage areas will be conspicuously posted with appropriate postings. Such material may also be stored in isolated identified storage areas inside buildings with the appropriate postings. Contaminated soil and rubble as a result of remediation activities may be stored inside or outside the main control area, but inside a fenced area. Such areas will be conspicuously posted and the material will be covered to minimize the potential for airborne dispersion of radioactive materials.

3.3.7 Airborne Radioactivity Monitoring Program

Airborne radioactivity monitoring will be conducted to confirm the effectiveness of the Prometcor Radiological Protection and Contamination Control Program. Airborne radioactive monitoring will include local work area sampling, or personnel sampling.

Routine air samples will be collected with Radeco H-809V portable air samplers, variable-flow-rate samplers, low-volume air samplers, or equivalents, with appropriate media filters. Personnel (lapel) air samplers will be used, as required, when deemed necessary by the RSO.

The sampler head will be placed as close to the work area as possible and within the breathing zone of the workers in order to collect a representative breathing air sample. The samplers will be operated to collect a minimum volume of 36 cubic feet.

At a minimum, air samples will be collected at least every eight hours in areas where radiological work is being performed. For the most part, continuous air monitoring will be performed to support remediation activities conducted at the project site.

Routine air samples will be counted in the field using a gas proportional counter or equivalent for gross alpha/beta activity. Air samples may also be sent to a qualified outside laboratory for specific nuclide (isotope) analyses or cross checks.

Analysis of air samples will be performed by qualified personnel using calibrated equipment and existing procedures. Air sampling equipment will be calibrated every six months, in accordance with ANSI N13.1-1969 (R 1982) *(ANSI 1982)*. Analysis equipment will be calibrated in accordance with ANSI N42.17A-1989 guidance *(ANSI 1989)*.

3.3.8 Respiratory Protection Program

When establishing radiological controls for work involving potential airborne radioactivity, primary consideration is given to utilizing techniques that will prevent airborne radioactivity to maintain loose surface contamination in controlled areas to ALARA levels. Airborne radioactivity generated during remediation of Prometcor grounds will be minimized to the extent practical by the use of engineered controls (e.g., water-misting or tarpaulins).

If such engineered controls are not feasible or cannot be adequately applied, respiratory protection will be used. Thus, when it becomes necessary for individuals to work in areas where airborne radioactive contamination could potentially exceed the levels specified in 10 CFR 20, Appendix B, Table 1, Column 3, respiratory protection equipment will be issued and used in accordance with 10 CFR 20.1703. Respirators may be worn by workers to minimize inhalation of dust, even though not required by the Prometcor Airborne Radioactivity Program.

3.3.8.1 Wearing Respiratory Protective Equipment

When airborne radioactivity concentrations exceed limits of Table 3-5, respiratory equipment must be used to protect personnel. The protection factor for a full-face filtered air respirator is 50. As shown in Table 3-5, full-face filtered air respirators will not be worn in airborne concentrations greater than 50 times the limit.

In situations where airborne concentrations of radioactive material exceed the stated concentration guides for filtered air respirators in Table 3-5, a supplied air respirator may be used. A Delmonex air supply system or equivalent will be used to provide breathing air. As shown in Table 3-5, supplied air respirators will not be worn in airborne concentrations greater than 2,000 times the limit. The protection factor for particulates, gases and vapors afforded by a continuous-flow, full-face supplied air respirator is 2,000. No other respiratory equipment will be used at airborne concentrations 2,000 times the limit. All respirators will meet NIOSH/MSA approval.

3.3.8.2 Respiratory Protection Maintenance Program

Respirators will be maintained in accordance with the manufacturer's recommendations for repairs, cleaning and disinfection. All respirators and auxiliary equipment will be surveyed after cleaning by a Radiological Control Technician (RCT) prior to packaging for re-issue. All respirators will be decontaminated by an RCT prior to packaging. The RCT will ensure that Prometcor established surface contamination limits are not exceeded. The RCT will issue respirators only to respirator-qualified personnel who have passed a physical exam, a fitness-for-work evaluation and a respirator fit test. Prior to issuing a respirator, the RCT will inspect the respirator for damage and will seal it in a plastic bag for personnel issue.

3.3.8.3 Respiratory Protection Training Program

Training, including fit tests, is provided to all respirator users and individuals who direct the work of users of respirators. The training is conducted by the RSO or designee. Potential respirator users must have a medical exam and a fitness for work approval prior to issuance of a respirator. Training, medical exam for fitness and work, and fit test records will be maintained by radiological controls personnel.

3.3.9 Emergency Procedures

The project related Health and Safety procedures identify various types of general and radiological emergencies and their required response actions. Such emergencies include, but are not limited to: radioactive spills, high airborne radioactivity, loss of radioactive material, medical emergencies (both non-life-threatening and life threatening) and fire. Additional response actions will be supplied by the local fire and emergency medical departments.

3.3.10 Posting and Labeling

All areas on the Prometcor site where radioactive materials are present will be posted in accordance with the requirements of 10 CFR 20.1902. Containers of radioactive materials and sealed source materials will be marked with the standard radiation symbol and the words *CAUTION RADIOACTIVE MATERIAL*. Areas will be classified and posted as *RADIATION AREAS* or *RADIOACTIVE MATERIAL AREAS*, per 10 CFR 20.1902. In addition, areas where radioactive material is handled in dispersible forms, such that the potential for inhalation of airborne radioactivity exists, are designated as controlled contamination areas and will be posted as *CONTAMINATION AREAS OR AIRBORNE RADIOACTIVITY AREAS*.

Determination of the area postings is made by the RSO or designee. Radiological control personnel will routinely inspect the site for proper postings, including damaged or missing postings, and will evaluate the need for additional postings.

3.3.11 Records and Reports

Records of individual exposures to radiation, radiation surveys and monitoring results and the disposal of material will be maintained in accordance with 10 CFR 20 Subpart L (Records). Records related to the radiation safety program will be maintained as part of the Prometcor files. Records which will be maintained in this fashion include, but are not limited to: personnel training and indoctrination, personnel exposure, respiratory protection, fit tests, medical examination and fitness for work results, radiation surveys and monitoring results, calibration and maintenance results, accident investigations, bioassays, liquid releases, TLD badge reports and waste disposal.

3.3.12 Potential Sources of Contamination Exposure

Internal exposures of thorium or radium-226 are a potential source of exposure to occupational workers, visitors, or the general public relative to the Prometcor site. The major remediation and decontamination activities that have the highest potential of causing internal exposure at the Prometcor site are presented below.

3.3.12.1 Grounds

The potential sources of contaminant exposure from remediation of the Prometcor grounds include:

- Excavation of Soil
- Jackhammering, Scabbling, Scarifying of Concrete or Asphalt Pavement

3.4 CONTRACTOR PERSONNEL

3.4.1 Radiation Protection and Contamination Control Program and Related Procedures

Prometcor radiation protection policies and procedures will be followed during performance of the remediation activities to ensure that contractor and subcontractor occupational exposure is controlled in accordance with the site Radiological Control Plan *(McLaren/Hart, June 1998)* and ALARA. Contractors and subcontractors performing work at the Prometcor site will be required to complete all radiation and industrial safety training, successfully pass the examination, participate in the bioassay program, and complete a physical and fitness for work exam, and will be issued a TLD, if necessary, before starting work.

3.4.2 Prometcor Contractor and Subcontractor Responsibilities

3,4,2,1 Prometcor

Prometcor has contracted with McLaren/Hart to provide radiological safety support during remediation activities. In this regard, Prometcor is responsible to:

- Ensure that contractor performs radiation and contamination surveys prior to performing remediation work in both the restricted and unrestricted areas of the site.
- Review and approve work authorizations through the issuing of purchase orders.
- Support contractors in job planning to implement ALARA.
- Monitor contractor personnel for external exposure and contamination in both the restricted and unrestricted areas of the site.
- Ensure proper posting and labeling of radiation and contamination area boundaries.
- Ensure that all surveys and approvals for release for unrestricted use all materials and equipment are performed before leaving the site.
- Ensure that all contractor support functions (surveys, reports, reviews, etc.) are properly documented, maintained and available for review.
- Ensure workers have been fully informed of and possess a thorough understanding of the health and safety requirements that apply to their job assignments.

- Ensure that all training is scheduled and completed prior to job startup and maintain auditable training records, which will include any follow-up training and all annual refresher training.

3.4.2.2 Contractors and Subcontractor

All project Environmental Safety and Health Plans, including Radiological Protection and Contamination Control programs, procedures and instructions will be available to personnel working at the Prometcor site. All individuals working in or frequenting the radiologically restricted areas of the site will be responsible for complying with the requirements established by these documents in support of the Prometcor project. All contractor/subcontractor personnel who could potentially come in contact with radioactive materials should understand that a knowledge of standard radiation protection rules and practices is an integral part of their job duties and responsibilities. Each person should be aware that it is their responsibility to minimize their own exposure to radiation and be cognizant of their obligations to Prometcor and co-workers for the safe handling of radioactive materials. Each individual working at the Prometcor site is responsible to perform their job in accordance with Prometcor plans and procedures and job training, and in accordance with the principle of maintaining his or her exposures ALARA. Each person who could reasonably be expected to handle radioactive materials will receive periodic instruction in the general and specific radiological aspects which they may encounter.

3.5 RADIOACTIVE WASTE MANAGEMENT

Radioactive waste generated as a result of remediation activities at the Prometcor site will be managed in accordance with the Prometcor Waste Management Program. This program, as presented below, ensures that waste generated from remediation activities are controlled, handled, transferred, stored, transported and disposed of in accordance with applicable USNRC, DOT and state regulatory requirements.

3.5.1 Waste Type

The following types of contaminated material are expected to be generated as a result of remediation activities at the Prometcor site.

3.5.1.1 Grounds

Radiological surveys and sampling of Prometcor grounds indicate elevated levels of contamination of soils. Areas that exceed the NRC limit for thorium will be remediated

3.5.1.1.1 Pavement (Asphalt and Concrete)

Asphalt covering and concrete slabs will be removed and surveyed for thorium contamination based on comparison to surface contamination limits.

3.5.1.1.2 Liquids

Although no liquids are anticipated to be generated during remediation activities, if generated, liquids will be collected and analyzed to confirm that they meet the USNRC 10 CFR 20, Appendix B, Table 2, Column 2 release limits for unrestricted use. The liquids will be released for unrestricted use if by analysis they are verified to meet the USNRC 10 CFR 20, Appendix B, Table 2, Column 2 release limits. Liquids that exceed the USNRC release limits will be solidified or evaporated, reduced to a residue and disposed of in an approved licensed low-level radioactive waste disposal facility.

3.5.1.1.3 Dry Active Waste

Dry Active Waste (DAW) will be produced as a result of Prometcor site remediation activities. The DAW will consist mainly of papers and plastic (gloves, anti-C clothing, tissues, wipes, etc.). The DAW material will be collected in metal containers, analyzed for radioactivity and shipped to a licensed low-level radioactive waste disposal facility if contaminated above the USNRC release limits for unrestricted release. DAW that meets the USNRC limits for unrestricted use will be placed in a staged refuse container and disposed of as normal waste.

3.5.2 Regulatory Requirements

The remediation activities conducted on the Prometcor site will be performed in accordance with the applicable requirements of 49 CFR, 10 CFR 71, 10 CFR 30, 10 CFR 20 and applicable low-level radioactive waste disposal facility license conditions for the processing and disposal of radioactive waste. Radioanalysis will be performed by qualified USNRC-licensed contractor radiological laboratories. Sampling and analysis of contaminated soil, water and other material will be conducted in accordance with approved sampling survey plans or procedures and related QA plans. The primary analytical protocol for the analysis of contaminated material will be gamma spectroscopy. Gross alpha and gross beta analysis will also be performed to a lesser extent. Laboratory analysis will be performed by qualified personnel using calibrated and maintained equipment and approved laboratory procedures. The analysis will be performed in accordance with the laboratory's approved QA Program. Cross checks will be performed with USNRC/Oak Ridge Institute for Science and Education (ORISE) as required. All analytical instrumentation and equipment will be calibrated using NIST-traceable standards.

3.5.3 Projected Quantities of Contaminated and Non-Contaminated Material to be Transported Offsite

Small volumes of contaminated and potentially contaminated material include concrete, asphalt and DAW. No significant quantities of special wastes, such as chelates, chemicals, or mixed waste, are expected to be generated as a result of remediation activities. Material that can be easily and economically decontaminated will be disposed of at the discretion of Prometcor.

Volumes of contaminated soil will require remediation and disposal at an USNRC-approved disposal facility.

3.5.4 Temporary Onsite Storage

Temporary storage of contaminated material, such as soil, concrete and DAW may be necessary during remediation of the Prometcor site. Stored contaminated material will comply with exposure rate and surface contamination limits established by the Prometcor Radiation Protection and Contamination Control programs. Contaminated soil may require stockpiling prior to shipment. Stockpiled soil (if required) will be covered with tarps.

If suspected mixed waste is encountered, it will be sampled, analyzed, and if determined to be mixed waste, the USNRC will be notified. Prometcor will dispose of mixed waste, as approved by cognizant regulatory authorities.

TABLE 3-1

AREA CLASSIFICATIONS
PROMETCOR SITE
NEWARK, NEW JERSEY

Structure or Area	Classification
Parking Lot Asphalt Parking Lot Subsurface Soil	Affected Affected
Building 1 Floor Building 1 Subsurface Soil	Affected Affected
Building 2 Floor Building 2 Second Floor Building 2 Subsurface Soil	Affected Affected Affected
Building 3 Floor Building 3 Subsurface Soil	Affected Affected
Building 4 Floor Building 4 Subsurface Soil	Unaffected Unaffected
Building 5 Floor Building 5 Subsurface Soil	Unaffected Unaffected
Building 6 Floor Building 6 Subsurface Soil	Unaffected Unaffected
Sidewalk	Affected
Area E Surface Soil Area E Subsurface Soil	Affected Affected

TABLE 3-2
INSTRUMENTATION SPECIFICATIONS AND REQUIREMENTS FOR RADIOLOGICAL SURVEYS AND MONITORING

Type of Measurement	Meter		Description	Detector		Description	BKG	EFF	Detector Sensitivity	Mode of Operation
	Make	Model		Make	Model					
Dose rate measurements	Bicron	Micro Rem	Exposure rate analog display in units of □Rem/hr	Bicron	N/A	Internally mounted tissue equivalent scintillator	7 μRem	N/A	2 μRem/hr	Analog display of dose rate
Exposure rate measurements	Ludlum	19	Exposure rate analog display in units of □R/hr	Ludlum	N/A	Internal 1" x 1" NaI scintillation	7 μR	N/A	2 μR/hr	Analog display of exposure rate
Low level gamma scans, correlation with exposure rates or activity concentration	Ludlum	2221	LCD digital scaler/rateneter with analog scaler	Ludlum	44-10	2" x 2" NaI scintillation	4500 cpm	Approx 900 cpm per μR/hr	2 μR/hr	Digital and analog display of count rate
Low level gamma scans, correlation with exposure rates or activity concentration	Ludlum	2241	LCD digital scaler/rateneter	Ludlum	44-10	2" x 2" NaI scintillation	4500 cpm	Approx 900 cpm per μR/hr	2 μR/hr	Digital display of count rate
Direct measurements for beta/gamma emitters	Ludlum	2221	LCD digital scaler/rateneter with analog scaler	Ludlum	44-9	15 cm² GM tube	50 cpm	23%	86 cpm	Digital and analog display of count rate
Direct measurements for alpha/beta/gamma emitters and surface scanning	Ludlum	2241	LCD digital scaler/rateneter with analog scaler	Ludlum	43-68	Gas flow proportional detector (100 cm² active area with thin aluminized mylar window 0.8 mg/cm²)	300 cpm	37%	383 cpm	Digital display of count rate
Direct measurements for alpha emitters	Ludlum	2221	LCD digital scaler/ratemeter with analog scaler	Ludlum	43-5	Zinc sulfide probe, 50 cm² active area with .8 mg/cm² aluminized mylar	.5 cpm	11%	5 6 cpm	Digital and analog display of count rate
Portable contamination monitor	Ludlum	3	Count rate analog display	Ludlum	44-9	15 cm² GM tube	50 cpm	approx 23%	N/A	Analog display of count rate
Portable floor contamination monitor	Eberline	ESP-1	LCD digital scaler/ratemeter	Ludlum	43-37	Gas flow proportional detector (425 cm² active area with thin aluminized mylar window 0 8 mg/cm²)	1,500 cpm	50% β	1680 cpm	Digital display of count rate
Air samplers	Radeco	H-809V1	Variable flow rate sampler	N/A	N/A	N/A	N/A	N/A	N/A	Timed sample of no more than 15 min
Air samplers	Eberline	RAS-1	Flow rate sampler	N/A	N/A	N/A	N/A	N/A	N/A	Continuous
Air samplers	SKC	PCXR3	Variable flow rate sampler	N/A	N/A	N/A	N/A	N/A	N/A	Continuous
Air sample and smear counter scaler	Ludlum	2929	LCD digital alpha/beta scaler	Ludlum	43-10-1	Phoswich-type scintillation photomultiplier.	60 cpm beta 0.07 cpm alpha	27% 30%	89 cpm 3 7 cpm	Digital display of count rate

TABLE 3-3

RADIATION EXPOSURE LIMITS

Whole Body	Occupational Exposure Limit	Prometcor Administrative Limits
Total Effective Dose Equivalent	5 rem/yr	1 rem/yr
Sum of deep dose equivalent plus committed dose equivalent to any individual organ or tissue	50 mrem/yr	5 rem/yr
Lens of eye, skin and extremities	15 rem/yr	1.5 rem/yr
Shallow dose	50 mrem/yr	5 rem/yr
Minor	10% of occupational dose limits	10% of Administrative Dose Limits. However, no minors are permitted to enter a restricted area.
Embryo/Fetus	0.5 rem/gestation period	0.5 rem/gestation period
General public	0.1 rem/yr	0.1 rem/yr

TABLE 3-4

SAMPLING ACTION LEVELS

Type of Measurement	Reading	Action
TLD - Personnel	>50 mrem/qtr	☐ Investigate exposure source(s), evaluate tasks/operations involving potential for exposure, establish ALARA controls to reduce exposures as appropriate. ☐ Notify PM and RSO.
TLD - Project Site Perimeter	20 mrem/qtr	☐ Determine source and evaluate impact on public. ☐ Notify PM/RSO.
Work Area Air Samples for Particulate Radioactivity	Administrative Limit (50% of 10 CFR 20 limit)	☐ Investigate additional engineering methods to reduce exposure to airborne materials. ☐ Notify PM and RSO. ☐ Increase frequency of work site air sampling.
Work Area Air Samples for Particulate Radioactivity	0.10 to 0.50 of 10 CFR 20 Limit	☐ Investigate the need for respiratory protection. ☐ Notify PM and RSO.
Perimeter sampling for Particulate Radioactivity	>0.5 of 10 CFR 20 Limit	☐ Notify PM and RSO. ☐ Evaluate controls of offsite emissions and modify as appropriate.

TABLE 3-5

REQUIRED RESPIRATORY PROTECTIVE DEVICES

Type of Radioactivity	**Concentration Guide Limit* in □Ci/ml**	**Type of Device**
Alpha and Beta Gamma Emitters	a) BKD to 5×10^{-13}	a) None required.
	b) 5×10^{-13} to $<2.5 \times 10^{-11}$	b) Full-face filtered air purifying respirator.
	c) 2.5×10^{-11} to $<1 \times 10^{-9}$	c) Continuous flow full-face supplied air respirator.
	d) 1×10^{-9}	d) Non allowed - no entry.

* *Based on 10 CFR 20, Appendix B limits for Th-232 and the protection factors of 10 CFR 20.*

4.0 FINAL RADIOLOGICAL STATUS SURVEY PLAN

The Final Radiological Survey Plan presented in this section has been designed and survey activities will be performed in accordance with the applicable guidance provided in Draft NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination *(USNRC, June 1992)*.

4.1 BACKGROUND INFORMATION

General background information on the Prometcor site is presented in Section 1 of this plan and in the June 1998 *Final Status Survey and Surficial Decontamination Plan for Buildings 1 through 6 for the Prometcor Site* submitted to the NRC.

4.2 FINAL STATUS SURVEY OVERVIEW

4.2.1 Survey Objectives

Based on site characterization results, the principal contaminants at the Prometcor site is processed natural thorium and radium-226 (Ra-226).

Prometcor will demonstrate compliance with thorium and Ra-226 limits (Section 4.2.3) through performance of a Final Radiological Release Survey of the Prometcor grounds. This final survey plan has been designed and subsequent survey activities will be performed in accordance with the guidance provided in Draft NUREG/CR-5849, Manual for Conducting Radiological Surveys in Support of License Termination *(USNRC, June 1992)*.

4.2.1.1 Soil Contamination

The specific objective of the Final Radiological Release Survey of the Prometcor grounds is to demonstrate that average soil contamination levels are within the acceptable release limits specified in the USNRC Branch Technical Position for the Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations, October 1981 (SECY-81-576) (USNRC, October 1981).

The specific objectives of the Final Radiological Release Survey of the Prometcor grounds is to demonstrate that:

- Average processed thorium concentrations are within the acceptable release limit of 10 pCi/g. Averaging will be based on a 100 m^2 grid area. Final release levels for Ra-226 will be addressed with the NJDEP. With respect to the Prometcor site, four surface samples will be collected from each affected 10 m x 10 m (100 m^2) grid area and analyzed for Ac-228 and Ra-226 via gamma spectroscopy. Actinium-228 is assumed to be in equilibrium with Th-228 and will be used to measured

the level of Th-228 in a sample. At least 30 soil samples will be collected from unaffected areas. See section 4.3.3 for details on sampling approach.

- The limit for processed thorium activity at any location within an affected area is within three times the average guideline value.

- Reasonable efforts will be made to identify and remove hot spots within affected areas that may exceed the average guideline by greater than a factor of $(100/A)^{\square}$, where A is the area (in m^2) of the hot spot.

- Exposure rates do not exceed 10 μR/hr above background at 1 m above the surface. Exposure rates may be averaged over a 100 m^2 grid area. Maximum exposure rates over any discrete area <100 m^2 may not exceed 20 μR/hr above background.

The above conditions will be demonstrated at the 95% confidence level for each survey unit as a whole.

4.2.1.2 Surface Activity on Structures

The specific objectives of the Final Radiological Release Survey of paved (concrete or asphalt) areas are to demonstrate that:

- Average surface contamination levels for each survey unit are within the acceptable release limits *(USNRC, August 1987)*. Averaging will be based on 1 m^2 area direct measurements and indirect measurements (swipes) obtained at each 1 m x 1 m grid intersection.

- Small areas of residual activity known as "hot spots" in an affected area do not exceed three times the average value. Draft NUREG/CR-5849 *(USNRC, June 1992)* allows averaging elevated areas if the contamination levels are between one and three times the average limit, and the weighted average over any contiguous 1 m^2 area is less than the average limit.

- Reasonable efforts have been made to clean up removable activity and removable activity does not exceed 20% of the average surface activity guidelines.

- Exposure rates in locations that may be occupied are less than 5 μR/hr above background. Exposure levels are measured at 1 m from floor/lower wall surfaces and are averaged over floor areas, not to exceed the size of a small office, i.e., about 10 m^2.

4.2.2 Identity of Contaminants and Compliance with Established Release Limits

Based on the knowledge of site operations and the results of site characterization efforts, the significant radiological contaminants has been determined to be thorium and radium-226.

The surface/soil contamination guidelines are:

Surfaces/Structures

Ra-226	100 dpm/100 cm^2, average over 1 m^2
	300 dpm/100 cm^2, maximum over 100 cm^2
	20 dpm/100 cm^2, removable
Natural Thorium	1,000 dpm/100 cm^2, average over 1 m^2 (670 dpm/100 cm^2 based on beta contamination only)
	3,000 dpm/100 cm^2, maximum over 100 cm^2 (2,000 dpm/100 cm^2, based on beta contamination only)
	200 dpm/100 cm^2, removable (130 dpm/100 cm^2, based on beta contamination only)

Soils

Thorium	10 pCi/g (Th-232 and Th-228) - Surface (Option 1 - NRC)

Exposure Rates

5 μR/hr above background (average) at one meter above the floor and lower wall surfaces.

10 μR/hr above background (average) at one meter from soil surface.

20 μR/hr above background (maximum) at one meter from soil surfaces.

4.2.3 Organization and Responsibilities

The Final Radiological Release Survey will be performed by a team composed of qualified personnel currently employed by Prometcor's contractor, McLaren/Hart and personnel from McLaren/Hart's subcontractor, B. Koh & Associates, Inc. For the most part, this is the same organizational structure that was used by McLaren/Hart to complete the Supplemental Source Area Characterization of the Prometcor site in March 1998.

4.2.4 Training

All members of the Final Radiological Release Survey Team will be qualified and trained commensurate with their assigned tasks. Training will vary according to potential exposure and the nature of the individual's job duties. In addition to the regular radiation worker training, special training will be provided on equipment, special techniques and practices relative to the survey activities for those individuals who will be involved in taking radiological measurements and samples. Documentation of training participation and results of testing to demonstrate knowledge and skills will be retained in the Prometcor files.

4.2.5 Laboratory Services

Analytical services for measuring gross alpha/beta activities in air and water samples (if required) and for gamma spectrometry analysis for soils and debris will be performed by AEN in accordance with documented and approved procedures and the laboratories' approved QA plans. Field and laboratory chain-of-custody procedures will be observed for all samples. Contractor laboratory activities will be monitored by the QA Coordinator.

4.2.6 General Survey Plan

The radiological survey plan for the Prometcor grounds consists of systematic processes and procedures that have been deemed acceptable by industry standards and the USNRC and are consistent with the guidelines provided in Draft NUREG/CR-5849 *(USNRC, June 1992)*. Specific activities have been defined and detailed tasks have been delegated to the appropriate team members to ensure that a timely and thorough survey is conducted. Table 4-1 provides a breakdown of activities and tasks that are currently a part of the Prometcor Final Radiological Survey Plan. Tasks will be performed in accordance with guidelines stated in Draft NUREG/CR-5849.

4.3 SURVEY PLAN AND PROCEDURES

4.3.1 General

The contamination potential of the Prometcor grounds and adjacent areas has been based on a review of site history, review of records, interviews with employees and the results of the characterization surveys. To the extent that locations of measurements or sampling in support of characterization, remediation control surveys, or other previous surveys have not been disturbed since such earlier surveys and the radiological status should therefore be unchanged, the previous data will be utilized in support of the termination survey. The survey protocol for the Prometcor grounds is based on the potential for elevated residual thorium.

4.3.2 Instrumentation

Two categories of instrumentation will be utilized in conducting the final radiological release surveys of the Prometcor grounds. The categories are direct reading/measuring field instruments and laboratory instruments. All instruments used for the final radiological survey will be appropriate for the measurements being made.

The field and laboratory instrumentation to be used for the survey activities, along with typical parameters and detection sensitivities for the instrumentation and survey technique, is listed in Table 4-2.

For instruments used for integrated measurements, the sensitivity (minimum detectable activity) is approximated by:

$$M = \frac{2.71 + 4.65\sqrt{B_R \bullet t}}{t \bullet E \bullet \frac{A}{100}}$$

where

MDA	=	activity level in disintegrations/minute/100 cm^2
B_R	=	background rate in counts/minute
t	=	counting time in minutes
E	=	detector efficiency in counts/disintegration
A	=	active probe area in cm^2

For ratemeter instruments utilized for surface activity measurements, the sensitivity is approximated by:

$$MDA = 4.65 \frac{\sqrt{B_R / 2t_c}}{E \bullet \frac{A}{100}}$$

where

MDA =		activity level in disintegrations/minute/100 cm^2
B_R	=	background rate in counts/minute
t_c	=	meter time constant in minutes
E	=	detector efficiency in counts/disintegration
A	=	active probe area in cm^2

Measurements of the gamma dose rate will be made with a sodium iodide (NaI) scintillator, μR-meters, μRem-meters, or other equivalent scintillation instruments.

Field instruments will be calibrated a minimum of once every six months, using NIST-traceable standards. Calibration will be for the alpha and beta-gamma energies present at the site.

An appropriate check source (i.e., Th-230 for alpha instruments, Tc-99 for beta instruments, and Cs-137 for gamma detector instruments) will be available for each field instrument at the time of the instrument response check. Daily checks will be logged for each instrument. If a response is not duplicated to within three standard deviations of the measurement, the instrument will be tagged and taken out of service pending recalibration.

4.3.3 Survey Plan

4.3.3.1 Area Classification and Gridding

To assure sufficient survey data to allow 95% confidence level statistical evaluation for every portion of the Prometcor site, the number and location of survey points in any portion is keyed to the level of contamination as revealed in the site characterization. Based on results of the site characterization, various areas were classified as either affected or unaffected by historical radiological materials production and consequent contamination. Sampling results presented in Appendix A show areas that are impacted from historical operations.

To facilitate location and referencing of sample points, affected areas will be gridded using 10 m x 10 m for affected areas. A 10 m x 10 m grid system may or may not be established for the unaffected areas.

4.3.3.2 Surface Scans

Surface scans will be conducted for alpha and beta radiations. Instrumentation to be used for surface scanning is listed in Table 4-2. The instruments having the lowest detection sensitivity will be used, based on physical surface conditions and measurement locations.

Scanning speeds will be no greater than 1 detector width per second for alpha and beta detection instruments and 0.5 m per second for gamma instruments. Audible indicators (headphones) will be used to identify locations, having elevated (1.5 to 3 times ambient) levels of direct radiation. All scanning results will be noted on standard field record forms.

Areas of elevated direct radiation (above the guideline limit) identified during scan surveys will be identified, documented, remediated and the identified area re-scanned. Readings before and after remediation of the identified area will be documented.

4.3.3.3 Direct Measurements

Direct measurements of alpha surface activity will be performed at selected locations using instrumentation described in Table 4-1. Unless precluded by surface conditions or physical parameters, the most sensitive of the instruments listed for surface measurements will be used. Measurements will be conducted by integrating counts over a one-minute period.

Because the scanning techniques are not capable of detecting and thorium activity at <25% of the guideline level, direct surface activity measurements will be systematically performed at 1 m intervals on affected area structures.

For unaffected areas, a minimum of 30 random measurements, or one measurement per 50 m^2 of paved/concrete area, will be performed.

4.3.3.4 Removable Contamination Measurements

A smear sample of removable contamination will be collected at each measurement location on both affected and unaffected area structures. Beta-gamma and alpha activity will be determined.

4.3.3.5 Exposure Rate Measurements

Gamma exposure rates will be measured at 1 m above ground/floor surfaces, using an NaI (Tl), μRem-meter, or a μR-meter or equivalent gamma scintillation instrument. Measurements will be uniformly spaced as described in the subsequent sections.

4 3.3.6 Soil Sampling

Four surface (0 to 15 cm) soil samples (approximately 500 grams each) will be systematically collected from each affected area grid section (10 m x 10 m, or 100 m^2) at locations equidistant from the center and each of the four corners. These samples will be analyzed for Actinium-228 (Ac-228) and Ra-226 via gamma spectroscopy. Actinium-228 is the gamma emitting radionuclide associated with Th-232 that will be used to determine the thorium-228 (Th-228) concentrations (pCi/g) A review of the characterization data *(Brown & Root, February 1997; McLaren/Hart, March 1998 in Appendix A)* has shown that the Th-232 and Th-228 are not in equilibrium. However, the Th-228 is in equilibrium with Ra-228, which is the first daughter product of Th-232. At each surface sampling location contact beta-gamma levels will be measured prior to sampling to determine whether surface contamination is present.

For unaffected areas, at least 30 samples will be obtained from random locations. In addition, at each surface sampling location, contact beta-gamma levels will be measured prior to sampling to determine whether surface contamination is present.

4.3.3.7 Water Sampling

If required, water samples will be analyzed for gross alpha and gross beta content utilizing EPA Method 900 0, and via gamma spectrometry utilizing EPA method 900.1.

4.3.3.8 Background Level Determinations

Site specific background level readings for the various instrumentation will be obtained by measuring the activity level for an area similar to the final survey locations, but removed from the site in question. Background thorium and Ra-226 data for soil was obtained during the McLaren/Hart site characterization activities (March 1998).

4.4 QUALITY ASSURANCE

4.4.1 Quality Assurance Program

Final radiological survey activities which are deemed quality affected will be performed in accordance with technical plans/procedures established for the project.

4.4.2 Definition of Responsibilities

The QA coordinator and other individuals responsible for assuring that an appropriate QA program has been established and verifying that activities affecting quality have been correctly performed, have sufficient authority, access to work areas, and organizational freedom to:

- identify quality problems;
- initiate, recommend, or provide solutions to quality problems through designated channels;
- verify implementation of solutions, and
- assure that further processing, delivery, installation, or use is controlled until proper disposition of a nonconformance, deficiency, or unsatisfactory condition has occurred.

Surveys will be performed by trained individuals following written field procedures and using properly calibrated instruments sensitive to alpha, beta or gamma radiation associated with thorium and radium-226. Samples will be tracked from collection to analysis. Data will be recorded on prepared data sheets or in logbooks and reviewed for accuracy and consistency. This data will be considered as part of the project quality records and will be stored and maintained by Prometcor.

4.4.3 Quality Assurance Coordination

QA coordination is performed by the QA Coordinator, who will be responsible for ensuring all QA objectives of the survey are met, reviewing selected field and analytical data to ensure adherence to procedures, and approving the quality of data before it is used to test hypotheses regarding attainment of cleanup standards. The QA Coordinator will not be involved in survey activities that generate data and will report directly to the Project Manager

4.4.4 Plans and Procedures

The Final Radiological Release Survey, including project sampling plans, direct measurements, sample analyses, instrument calibration, daily functional checks of instruments and sampling methods will be performed according to written and approved procedures and/or plans Field and technical plans will be reviewed by the QA Coordinator and reviewed and approved by the Project Manager and Project Radiation Safety Officer prior to issuance. The project Document Control Administrator will control these documents.

4.4.5 Documentation Requirements

All data obtained in support of final radiological survey and remediation are considered quality records and will be recorded and maintained in the Prometcor files. The QA Coordinator will ensure that chain-of-custody and data management protocols are followed for remediation-related samples. In addition, field procedures for the proper handling, shipping and storage of samples will be complied with.

All samples collected as part of the Final Radiological Release Survey and which contribute data demonstrating attainment of release criteria will be retained by Prometcor

4.4.6 Training and Qualification of Survey Staff

In addition to basic radiation worker training, all personnel conducting the surveys will receive training in the procedures to be performed. The extent of training and qualifications will be commensurate with the scope, complexity and nature of the activity to be performed. Training will be designed to achieve initial proficiency and to maintain that proficiency at least over the course of the decommissioning process. Records of training to demonstrate qualification will be maintained.

4.4.7 Equipment Maintenance and Calibration

Measuring equipment will be maintained, calibrated and tested to assure the validity of the survey data. Instrument calibration and maintenance will be documented.

Proper maintenance of equipment varies, but maintenance information and use limitations are provided in the vendor documentation. All measuring and analyzing equipment will be tested and calibrated before initial use and will be recalibrated if maintenance or modifications could invalidate earlier calibrations. Field and laboratory equipment specifically used for obtaining final radiological survey data will be calibrated based on NIST-traceable standards. In those cases where NIST-traceable standards are not available, standards of an industry-recognized organization will be used. Minimum frequencies for calibrating equipment will be established and documented.

Measuring equipment will be tested at least once on each day the equipment is used. Test results will be recorded in tabular or graphic form and compared to predetermined acceptable performance ranges. Equipment that does not conform to the performance criteria will be immediately removed from service and will remain out of service until the deficiencies are resolved.

4.4.8 Data Management

The generation, handling, computation, evaluation and reporting of final radiological survey data will be performed in accordance with Draft NUREG/CR-5849 *(USNRC, June 1992)* and standard Prometcor review and approval protocol. This protocol includes a system of data review and validation to ensure consistency, thoroughness and acceptability.

4.4.9 Sample Chain-of-Custody

Chain-of-custody procedures delineate records of sample collection, identification, transport and disposal that will be maintained to ensure that samples are neither lost nor tampered with and that a sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field.

4.4.10 Data Presentation

Measurement data will be converted to units of □R/hr (exposure rates) and dpm/100 cm^2 (surface activity) for comparison with guidelines. Values will be adjusted for contributions from natural background. Average values for survey units will be determined and compared with guideline levels. Data for each survey unit will be tested against the 95% confidence level objective, using guidance and procedures described in Draft NUREG/CR-5849 *(USNRC, June 1992)*.

4.4.11 Audits/Surveillance

Comprehensive internal audits and field surveillance/inspections will be performed as required to assure that the remediation activities are performed in accordance with specified technical and QA requirements.

All findings and observations will be resolved. All surveillance documentation will be retained as Prometcor QA records.

4.4.12 Health and Safety

Consistent with the approach for any operation, remediation activities have been planned and will be monitored to assure the health and safety of the worker and the public are adequately protected. All remediation activities will be conducted in accordance with the site Radiological Control Plan *(McLaren/Hart, June 1998)* and site-specific health and safety guidelines.

4.5 RESULTS COMPARED TO THE RELEASE CRITERIA

This section describes how McLaren/Hart will collect samples for purposes of segregating impacted soils that are found to be above the NRC release criteria and those that are below the regulatory values. It also describes the comparisons that will be made between surface sample results and the NRC surface contamination limits.

4.5.1 Soil

Release criteria will be considered to have been met for each 10 m x 10 m grid section if average concentrations of thorium in four samples collected at locations equidistant from the center and each corner of the grid are less than 10 pCi/g and 5-10 pCi/g, respectively. The limit for thorium soil activity at any location is three times the average guideline value, or 30 pCi/g. If the residual activity exceeds this level, this area will be remediated and resurveyed. Release levels for Ra-226 will be addressed with the NJDEP.

Identified areas of elevated thorium activity between one and three times the guideline value will be tested to ensure that the average concentration is less than $(100/A)^{\square}$ times the guideline value, where A is the area of the elevated activity. If this condition is satisfied, the average activity within the 10 m x 10 m (100 m^2) contiguous area containing the region of elevated activity will be determined to assure that it is within the guideline value. The same approach will be used for Ra-226.

Thus, the survey must demonstrate that the mean concentration of processed thorium on the site is less than the release criterion of 10 pCi/g, and that there is sufficient data to establish this fact with 95% confidence that the "true mean concentration" of processed thorium on the site is less than the release criterion.

As part of site final radiological surveys, Prometcor proposes to compare 6-inch surface samples with the USNRC limit. The sample results will be used to determine compliance at the 95% confidence level. Methods used to determine compliance with the limit at the 95% confidence level will be consistent with Draft NUREG/CR-5849 *(USNRC, June 1992)*.

Exposure rate measurements will be made and an average calculated for each 10 m x 10 m grid (100 m^2). The exposure rate measurements will be evaluated according to the 95% confidence criterion. Methods used to determine compliance with the 95% confidence level will be consistent with Draft NUREG/CR-5849 *(USNRC, June 1992)*. The maximum exposure rate may not exceed twice the guideline value above background. If the exposure rate is above this value, the area will be remediated and resurveyed.

4.5.2 Paved Areas/Structures

For paved areas, release criteria will be considered to have been met if for each 1 m x 1 m grid section if average contamination levels of the samples obtained from the 1 m x 1 m grid are within the limits established in Section 4.2.2.

If contamination levels exceed the specified limits, the area will be remediated and resurveyed.

Small areas of residual activity known as "hot spots" may not exceed three times the average value. The hot spot limit will be applied to areas of up to 100 cm^2. The average activity level in the 1 m^2 area containing a hot spot must be within the guideline

4.5.3 Water

Water generated or collected during remediation activities will be stored in 55 gallon drums. Three samples will be collected per drum, composited, and sent to an outside lab for radium and thorium analyses. If results are less than or equal to the 10 CFR 20 limits, then the water will be disposed of via

the local sanitary sewer. If concentrations exceed the federal criteria, then McLaren/Hart will use a drum evaporator to reduce volume and combine any residues with contaminated soils. The residues and soils will be properly packaged for low-level radioactive waste disposal.

4.5.4 Calculating Means

Mean net concentrations must be calculated for grid blocks and for the site as a whole. The mean is defined as:

$$\bar{x} = \frac{1}{n} \sum_{x=1}^{n} X_i \qquad (1)$$

Here n is the number of samples used in computing the mean and x_i is the concentration in the i_{th} sample. This mean of the concentrations of the samples taken from a particular survey unit is an approximation of the true mean concentration of the contaminant within that unit.

The variation of the concentrations in samples taken from a survey unit is an indication of the reliability of the sample mean as an estimate of the true mean. This is usually determined as the standard error of the mean

$$s = \sqrt{\frac{\sum_{i=1}^{n} x_i^2 = \frac{\left(\sum_{i=1}^{n} x_i\right)^2}{n}}{n::1}} \qquad (2)$$

The variables have the same meaning here as in equation (1)

4.5.5 Comparing Means with the Release Criteria

Levels of residual activity (i.e., elevated areas) that exceed the guideline values initially will be compared directly with the guideline. Areas of elevated activity between one and three times the guideline value will be tested to assure that the average surface activity level within a contiguous 1 m^2 area (for structures) or 100 m^2 (for soil) containing the elevated area is less than the guideline value. To evaluate whether this averaging condition is satisfied, additional measurements will be performed and the extent of the elevated area determined. The average (i.e., weighted average) for the 1 m^2 or 100 m^2 area will then be calculated, taking into consideration the relative fraction of the 1 m^2 or 100 m^2 area occupied by the elevated area(s), using the relationship

$$\bar{x}_w = \frac{1}{n_s}\sum_{i=1}^{n_s} x_i \left[1 - \sum_{k=1}^{n_k} A_k\right] + \sum_{k=1}^{n_k} Y_k A_k$$

where

$_w$	=	weighted mean including elevated area(s)
x_i	=	systematic and random measurements at point i
n_s	=	number of systematic and random measurements
y_k	=	elevated area activity in area k
A_k	=	fraction of 1 m^2 occupied by elevated area k
n_k	=	number of elevated areas.

The calculated average levels will be tested against the guideline limit at the 95% confidence level using the following equation:

$$\mu_\alpha = \bar{x} + t_{1-\alpha,df}\frac{S_x}{\sqrt{n}}$$

where

$t_{1-\alpha, df}$	=	the 95% confidence level obtained from Draft NUREG/CR 5849, Appendix C, Table C-1: df (degrees of freedom) is n-1; α is the false positive probability, i.e., the probability that μ_α is less than the guideline value if the true mean activity level is equal to the guideline value.
	=	is the calculated mean
s_x	=	is the standard deviation
n	=	is the number of individual data points used to determine x and s_x.

This will ensure that each survey unit provides a 95% confidence level that the true mean activity level meets the guideline.

4.6 DOCUMENTATION

The Prometcor grounds will be accurately mapped in relation to the surrounding areas. Direct measurements and analytical results will be documented in the following manner:

- Location of the measurement or sample.
- Date of measurement or sample collection.

- If required, the measured concentration of the specific nuclide (Th-232, Th-228 and Ra-226) will be in pCi/l or pCi/g.
- Measurements of radiation will be reported in the following units: alpha, beta, or gamma-emitting contamination in dpm/100 cm^2, gamma ray exposure or dose rate in μR/hr or mRem/hr.
- The analytical error at (2σ) confidence level.
- Name of surveyor, sampler and analyst
- Analysis date
- Confidence level, standard error, etc., of analytical results.
- Name of person verifying results

In addition, the following information may be provided:

- Description of survey and/or sampling equipment.
- Survey and sampling procedures, including sampling times, rates and volumes.
- Analytical procedures.
- Calculational methods.
- Calculation of the lower limit of detection.
- Calibration procedures and data.

The results for each survey and/or sample analysis will be listed in tabular form with the respective survey/sampling location, as identified on the survey/sampling map. The results of the survey will be documented in a Final Radiological Status Report. This report and related documents and other information will be considered quality records and will be stored and maintained by Prometcor.

4.7 FINAL STATUS REPORT

The results of the Final Radiological Survey will be submitted to the USNRC in a Final Radiological Status Report. The report will summarize the survey results and will demonstrate that the Prometcor grounds meet unrestricted release criteria with the requisite level of certainty. Reference to procedures used, supporting calculations, figures identifying sample locations and tables showing the average and maximum exposure rates, as well as the related confidence levels for each grid or survey unit, will be contained in the report. The report format and content will follow the recommendations contained in Draft NUREG/CR-5849 *(USNRC, June 1992)* Raw field and laboratory data will not be provided in the report. However, this data will be available for USNRC review. All field and analytical data will be stored and maintained by Prometcor as quality records

Once the final survey is complete, a comprehensive project documentation report will be prepared. This report will contain a summary of all work performed, and will be structured to facilitate review by the NRC. This report will provide the data necessary to support the position for release of the

buildings for unrestricted use with regard to NRC and guidelines on the presence of radioactive materials. As such, the final report will include all final survey data. The primary information provided within the report will include the following:

- Background of the facility including reason for decommissioning and management approach;
- Site description including type and location of facility, ownership, and facility description;
- Operating history including licensing, processes performed, and waste disposal practices;
- Decommissioning activities including results of previous surveys and decontamination/removal procedures;
- Final survey procedures including sampling parameters, background levels, major contaminants identified, guidelines established, equipment and procedures selected and surveying procedures;
- Survey findings including techniques for reducing/evaluating data and comparison of findings with guideline values and conditions; and
- A summary and conclusion of final site status.

TABLE 4-1
OVERVIEW OF MAJOR ACTIVITIES AND TASKS

ACTIVITIES	TASKS
Evaluate contamination potential	1. Review operating history with respect to the Prometcor Remediation Project site (completed). 2. Review radiological data from Site Characterization Report *(Brown & Root, February 1997)* and McLaren/Hart Site Characterization *(March 1998)* (completed). 3. Identify radionuclides of concern and determine guidelines (completed). 4. Classify "affected" and "unaffected" areas (completed).
Establish grid reference system	1. Install grids. 2. Prepare survey maps.
Determine background levels	1. Measure outdoor exposure rates (completed). 2. Collect and analyze background soil samples (completed).
Perform direct measurements	1. Conduct surface scans on site grounds. 2. Determine frequency and locations of measurements to meet Prometcor Remediation Project criteria. 3. Measure exposure rates on site grounds.
Collect samples	1. Determine frequency and locations of sampling to meet criteria. 2. Collect systematic and special samples.
Analyze samples	1. Count air sample filters. 2. Analyze water, soil and other solid samples for thorium and Ra-226, as required. 3. Collect TLD data on a quarterly basis.
Interpret data	1. Convert data to standard units. 2. Calculate average levels. 3. Compare data with criteria.
Prepare and submit report	1. Construct data tables. 2. Develop figures/graphics. 3. Prepare text. 4. Submit report to NRC.
Confirmation survey	1. NRC reviews report. 2. NRC conducts confirmation survey.

TABLE 4-2
INSTRUMENTATION SPECIFICATIONS AND REQUIREMENTS FOR RADIOLOGICAL SURVEYS AND MONITORING

Type of Measurement	Meter		Description	Detector		Description	BKG	EFF	Detector Sensitivity	Mode of Operation
	Make	Model		Make	Model					
Dose rate measurements	Bicron	Micro Rem	Exposure rate analog display in units of μRem/hr	Bicron	N/A	Internally mounted tissue equivalent scintillator	7 μRem	N/A	2 μRem/hr	Analog display of dose rate
Exposure rate measurements	Ludlum	19	Exposure rate analog display in units of μR/hr	Ludlum	N/A	Internal 1" x 1" NaI scintillation	7 μR	N/A	2 μR/hr	Analog display of exposure rate
Low level gamma scans, correlation with exposure rates or activity concentration	Ludlum	2221	LCD digital scaler/ratemeter with analog scaler	Ludlum	44-10	2" x 2" NaI scintillation	4500 cpm	Approx 900 cpm per μR/hr	2 μR/hr	Digital and analog display of count rate
Low level gamma scans, correlation with exposure rates or activity concentration	Ludlum	2241	LCD digital scaler/ratemeter	Ludlum	44-10	2" x 2" NaI scintillation	4500 cpm	Approx 900 cpm per μR/hr	2 μR/hr	Digital display of count rate
Direct measurements for beta/gamma emitters	Ludlum	2221	LCD digital scaler/ratemeter with analog scaler	Ludlum	44-9	15 cm^2 GM tube	50 cpm	23%	86 cpm	Digital and analog display of count rate
Direct measurements for alpha/beta/gamma emitters and surface scanning	Ludlum	2241	LCD digital scaler/ratemeter with analog scaler	Ludlum	43-68	Gas flow proportional detector (100 cm^2 active area with thin aluminized mylar window 0.8 mg/cm^2)	300 cpm	37%	383 cpm	Digital display of count rate
Direct measurements for alpha emitters	Ludlum	2221	LCD digital scaler/ratemeter with analog scaler	Ludlum	43-5	Zinc sulfide probe, 50 cm^2 active area with .8 mg/cm^2 aluminized mylar	.5 cpm	11%	5.6 cpm	Digital and analog display of count rate
Portable contamination monitor	Ludlum	3	Count rate analog display	Ludlum	44-9	15 cm^2 GM tube	50 cpm	approx 23%	N/A	Analog display of count rate
Portable floor contamination monitor	Eberline	ESP-1	LCD digital scaler/ratemeter	Ludlum	43-37	Gas flow proportional detector (425 cm^2 active area with thin aluminized mylar window 0.8 mg/cm^2)	1,500 cpm	50% β	1680 cpm	Digital display of count rate
Air samplers	Radeco	H-809V1	Variable flow rate sampler	N/A	N/A	N/A	N/A	N/A	N/A	Timed sample of no more than 15 min
Air samplers	Eberline	RAS-1	Flow rate sampler	N/A	N/A	N/A	N/A	N/A	N/A	Continuous
Air samplers	SKC	PCXR3	Variable flow rate sampler	N/A	N/A	N/A	N/A	N/A	N/A	Continuous
Air sample and smear counter scaler	Ludlum	2929	LCD digital alpha/beta scaler	Ludlum	43-10-1	Phoswich-type scintillation photomultiplier.	60 cpm beta 0.07 cpm alpha	27% 30%	89 cpm 3.7 cpm	Digital display of count rate

5.0 REFERENCES

NRC 1974 Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, U.S. Nuclear Regulatory Commission, 1974.

NRC 1981 USNRC Branch Technical Position for the Disposal or Onsite Storage of Thorium or Uranium Wastes From Past Operations (SECY-81-576), USNRC, October 1981.

NRC 1987 Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for By-Product, Source or Special Nuclear Material.

NRC 1991 Air Sampling in the Workplace, NUREG-1400, U.S. Nuclear Regulatory Commission, 1991.

NRC 1992 Manual for Conducting Radiological Surveys in Support of License Termination, NUREG/CR-5849, U.S. Nuclear Regulatory Commission, 1992.

NRC 1993 Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material, U.S. Nuclear Regulatory Commission, 1993.

NRC 1995 Standards for Protection Against Radiation, 10 CFR 20, U.S. Nuclear Regulatory Commission, 1995.

Villforth 1970 Radiological Health Handbook, U.S. Department of Health, Education, and Welfare, 1970.

APPENDIX A

RADIOLOGICAL SAMPLING RESULTS FROM THE SUPPLEMENTAL SOURCE AREA CHARACTERIZATION

SAMPLING LOCATIONS FOR THE PROMETCOR FACILITY

This Appendix presents the results of the radiological soil sampling for the source area characterization performed by McLaren/Hart in March 1998 and the concentrations reported by Brown and Root (Site Characterization Report, February, 1997). A summary of the radiological results from the McLaren/Hart soil characterization survey, for each area of the facility, are provided in Tables A-1 through A-6. The summary results present the range of concentrations in soils for all radionuclides measured, as well as the average of these concentrations.

A complete listing of all results, for all samples, is presented in Tables A-9 through A-18. These Tables list all soil concentrations reported by both McLaren/Hart and Brown & Root. Figures A-1 through A-8 present the locations of these samples for both sets of analyses.

Table A-1
Range of Radionuclide Concentrations in Soils for the Parking Lot (pCi/g)

Radionuclide	Minimum	Maximum	Average
Radium-226	0.6	593	42
Radium-228	0.5	136	7.5
Thorium-228	0.4	188	8
Thorium-230	0.3	2	0.8
Thorium-232	0.03	8.7	0.88
Total Thorium	1.2	198	9.8

Table A-2
Range of Radionuclide Concentrations in Soils for Building 1 (pCi/g)

Radionuclide	Minimum	Maximum	Average
Radium-226	1	718	59.2
Radium-228	0.78	41	6.8
Thorium-228	0.24	156	12.5
Thorium-230	0.25	1.5	0.7
Thorium-232	0.18	6.1	0.89
Total Thorium		157	

Table A-3
Range of Radionuclide Concentrations in Soils for Building 2 (pCi/g)

Radionuclide	Minimum	Maximum	Average
Radium-226	2	119	36
Radium-228	1.1	14.3	6.2
Thorium-228	1.1	23	8
Thorium-230	0.31	0.94	0.7
Thorium-232	0.4	1.8	0.94
Total Thorium		24.3	

Table A-4
Range of Radionuclide Concentrations in Soils for Building 3 (pCi/g)

Radionuclide	Minimum	Maximum	Average
Radium-226	0.92	63	19
Radium-228	0.95	5	2.3
Thorium-228	0.63	6.5	2.2
Thorium-230	0.44	0.89	0.6
Thorium-232	0.5	0.8	0.7

Building 4
Two soil samples were sent to the laboratory for radiological analysis; all radionuclide concentrations were below 2 pCi/g.

Building 5
Gamma and alpha surveys of Building 5 did not suggest the presence of radium or thorium in soil underlying the concrete floor, hence no soil samples were collected for radiological analyses.

Table A-5
Radionuclide Concentration in Soils for Building 6 (pCi/g)
Only one sample was sent for radiological analysis

Radionuclide	Concentration
Radium-226	6.3
Radium-228	2
Thorium-228	2.5
Thorium-230	1.1
Thorium-232	0.15

Table A-6
Range of Radionuclide Concentrations in Soils for Area E (pCi/g)

Radionuclide	Minimum	Maximum	Average
Radium-226	0.88	18.9	4.3
Radium-228	0.85	4.9	2
Thorium-228	0.6	3.4	1.4
Thorium-230	0.45	1.2	0.83
Thorium-232	0.44	1.6	1.58

TABLE A-7
McLAREN/HART SOIL SAMPLING RESULTS FOR THE PARKING LOT AREA

MH-Borehole Location*	Soil Concentration (pCi/g)				
	Ra-226	Ra-228	Th-228	Th-230	Th-232
PK-BH-01-1	5.35	2.2	1.56	0.76	0.86
PK-BH-02-1	291.9	28.2	56.17	1.05	1.14
PK-BH-02-2	3.24	1.7	1.98	0.42	0.46
PK-BH-03-1	5.43	2.11	1.12	0.53	0.99
PK-BH-04-1	15.29	3.91	6.85	0.57	0.68
PK-BH-05-1	65.71	16.56	8.61	0.56	0.53
PK-BH-05-2		1.16	0.9	0.51	0.57
PK-BH-06-1	219	28.81	24.95	0.8	1.31
PK-BH-06-2		1.01	0.84	0.5	0.6
PK-BH-07-1	11.29	4.16	9.43	0.87	1.24
PK-BH-08-1	593.5	127.8	187.8	1.54	8.73
PK-BH-08-2	2.48	1.09	0.71	0.58	0.57
PK-BH-09-1	1.91	3.01	2.71	1.12	1.22
PK-BH-11-1	16.28	6.37	5.33	0.66	0.7
PK-BH-11-2	7.58	3.3	1.06	0.65	0.82
PK-BH-14-1	10.16	2.33	7.72	1.91	1.3
PK-BH-16-1	12.53	3.48	0.83	0.52	0.61
PK-BH-16-2		0.73	0.56	0.59	0.45
PK-BH-17-1		0.49	0.49	0.44	0.58
PK-BH-18-1	73.74	10.01	30.07	0.45	0.57
PK-BH-18-2	0.7	1.14	0.83	0.29	0.63
PK-BH-19-1	2.41	0.97	1.44	1.79	0.42
PK-BH-20-1			0.97	0.3	0.03
PK-BH-23-1		0.68	0.64	0.47	0.81
PK-BH-23-2	1.74	2.21	0.69	0.85	0.69
PK-BH-25-1	3.92	1.52	0.67	1.13	0.68
PK-BH-26-1	0.77	1.17	0.7	0.37	0.71
PK-BH-26-2		0.79	0.95	0.29	0.68
PK-BH-27-1	1.31	1.85	1.21	1.18	1.1
PK-BH-28-1	1	1.29	0.9	0.78	0.61
PK-BH-28-2	0.6	0.8	0.72	0.39	0.61
PK-BH-29-1		1.32	1.36	1.33	1.33
PK-BH-30-1	8.55	2.93	4.73	0.77	1.61
PK-BH-30-2	2.32	1.76	1.25	0.45	0.73
PK-BH-31-1	9.4	2.5	1.53	0.94	1.04
PK-BH-31-2		0.57	0.69	0.38	0.38
PK-BH-32-1	3.03	1.94	0.73	0.6	0.57
PK-BH-33-1	1.01	1.2	0.69	0.62	0.72
PK-BH-35-1	1.67	2.06	1.5	1.49	1.49
PK-BH-35-2		0.88	0.41	0.7	1.02
PK-BH-36-1	1.13	1.27	1.04	2.01	1.07
PK-BH-38-1	3.34	0.73	1.1	0.45	0.41
PK-BH-38-2		2.2	1.1	1.07	1.12
PK-BH-39-1	4.04	2.52	1.74	0.93	0.81
PK-BH-39-2		0.95	0.64	0.68	0.64
PK-BH-40-1	40.98	9.04	3.69	1.12	0.54

TABLE A-7 (Continued)
McLAREN/HART SOIL SAMPLING RESULTS FOR THE PARKING LOT AREA

1H-Borehole Location*	Soil Concentration (pCi/g)				
	Ra-226	Ra-228	Th-228	Th-230	Th-232
PK-BH-40-2	3.34	1.19	0.85	0.56	0.31
PK-BH-41-1	11.76	4.58	7.48	1.03	1.38
PK-BH-41-2	0.96	1.1	0.79	0.94	0.68
PK-BH-42-1	31.68	8.13	2.7	0.98	0.21
PK-BH-42-2	1.33	2.49	0.42	1.26	0.73
PK-BH-42-3	0.85	1.4	0.79	0.37	0.63
PK-BH-43-1	3.19	1.28	0.68	0.58	0.64
PK-BH-43-2		1.06	0.6	0.57	0.67
PK-BH-44-1	1.72	1.76	2.03	1.27	0.77
PK-BH-45-1	17.04	6.38	2.46	0.49	0.58
PK-BH-45-2	1.16	1.45	1.13	0.59	0.73
PK-BH-46-1	2.76	1.75	2.32	1.6	0.52
PK-BH-46-2	0.79	0.98	0.53	0.34	0.31
PK-BH-47-1	3.68	2.86	5.4	0.54	0.98
PK-BH-47-2	0.9	1.26	1.16	0.48	0.73
PK-BH-52-1	585.3	135.9	102.8	1.43	1.06
PK-BH-52-2		0.99	0.65	0.64	0.63
PK-BH-54-1	8.01	3.01	1.46	1.21	0.52

e Figure A-1 for Locations of McLaren/Hart Boreholes

TABLE A-8
BROWN & ROOT SOIL SAMPLING RESULTS FOR THE PARKING LOT AREA

B&R-Borehole ID	Borehole Location*	Soil Concentration (pCi/g)				
		Ra-226	Th-228	Th-230	Th-232	U-238
PB-SS-001	49D	387.84	57.25	0.94	1.00	6.93
PB-SS-002	49D	73.19	15.52	0.37	0.41	2.45
PB-SS-004	50C	61.34	14.74	0.34	0.54	4.03
PC-SS-001	48E	118.20	31.79	1 72	1.06	5.38
PC-SS-002	48F	125.14	39.87	1.16	1.22	4.03
PC-SS-003	49F	100.21	28.28	1.02	1.09	4.16
PC-SS-004	49F	47.86	20.86	0.81	1.69	2.53
PD-SS-001	52D	2.92	9.98	0.80	3.19	0.62
PD-SS-002	53E	4.03	11.97	0.71	2.19	0.32
PD-SS-004	54F	4.78	17.30	0.85	1.88	0.42
PE-SS-001	46D	131.63	27.37	0.59	0.69	3.15
PE-SS-002	45D	47.55	11.63	0.44	0.51	1.36
PF-SS-001	38I	14.35	9.33	0.88	1.12	0.38
PF-SS-002	37H	16.34	9.34	0.73	0.89	0.45
PG-SS-003	34I	57.62	13.11	0.51	0.49	
PI-SS-002	24H	8.06	3.92	0.48	0.54	1.40
PI-SS-003	25I	22.85	10.40	1.40	4.69	38.94
PJ-SS-001	23G	34.69	16.17	1.01	1.09	2.35
PJ-SS-002	20D	301.58	90.55	0.35	1.45	0.44
PJ-SS-003	23D	28.22	14.81	1.10	1.34	0.59
PK-SS-005	17C	85.38	22.19	0.59	1.24	0.71
PL-SS-002	11D	3.30	14.94	1.27	4.84	0.90

* See Figure A-2 for Locations of Brown & Root Boreholes

TABLE A-9
McLAREN/HART SOIL SAMPLING RESULTS FOR BUILDING 1

MH-Borehole Location*	Soil Concentration (pCi/g)				
	Ra-226	Ra-228	Th-228	Th-230	Th-232
B1-BH-01-1	9.44	2.20	3.95	0.63	0.78
B1-BH-01-2	1.51	1.12	0.74	0.60	0.73
B1-BH-02-1	13.04	4.63	5.91	1.56	6.13
B1-BH-02-2	1.60	1.28	0.87	1.49	0.46
B1-BH-03-1	8.64	1.58	2.61	0.41	0.60
B1-BH-03-2	1.40	0.95	0.84	0.82	0.66
B1-BH-04-1	4.27	1.56	1.63	0.92	0.43
B1-BH-04-2			0.24	0.55	0.18
B1-BH-04-3	717.80	41.07	156.90	0.35	0.32
B1-BH-04-4	16.87	1.54	1.85	0.48	0.25
B1-BH-06-1	1.48	1.75	0.55	0.32	0.37
B1-BH-08-1	1.34	1.11	0.71	0.53	0.77
B1-BH-09-1	37.13	8.37	8.98	0.85	1.23
B1-BH-10-1	103.80	10.26	12.33	0.39	0.63
B1-BH-11-1	5.00	2.11	1.43	0.62	0.72
B1-BH-12-1	35.90	9.09	0.66	0.25	0.24
B1-BH-12-2	98.79	29.86	32.01	1.42	0.96
B1-BH-13-1	1.05	0.78	0.59	0.56	0.74
B1-BH-14-1	6.61	3.26	4.02	0.60	0.77

* See Figure A-3 for Locations of McLaren/Hart Boreholes

No soil samples were measured by Brown & Root for Building 1

TABLE A-10
McLAREN/HART SOIL SAMPLING RESULTS FOR BUILDING 2

MH-Borehole Location*	Soil Concentration (pCi/g)				
	Ra-226	Ra-228	Th-228	Th-230	Th-232
B2-BH-01-1	47.19	10.25	8.47	0.94	1.81
B2-BH-01-2	2.00	1.46	1.13	0.57	0.84
B2-BH-02-1	20.32	5.25	9.81	0.79	1.09
B2-BH-03-1	7.12	2.46	2.81	0.68	0.79
B2-BH-04-1	74.47	9.59	23.08	0.62	0.62
B2-BH-05-1	21.59	5.27	8.63	0.31	0.40
B2-BH-06-1	119.30	14.26	8.97	0.81	1.07
B2-BH-06-2	3.56	1.12	1.09	0.71	0.90
B2-DS-01-1	54.60	15.40	53.81	2.02	3.67
B2-SM-01-1	17.07	4.69	0.45	0.29	0.35

* See Figure A-5 for Locations of McLaren/Hart Boreholes

TABLE A-11
BROWN & ROOT SOIL SAMPLING RESULTS FOR BUILDING 2

B&R-Borehole ID	Borehole Location*	Soil Concentration (pCi/g)				
		Ra-226	Th-228	Th-230	Th-232	U-238
B2-CD-001	4E	149.22	59.97	1.10	0.63	0.45

* See Figure A-6 for Locations of Brown & Root Boreholes

TABLE A-12
McLAREN/HART SOIL SAMPLING RESULTS FOR BUILDING 3

MH-Borehole Location	Soil Concentration (pCi/g)				
	Ra-226	Ra-228	Th-228	Th-230	Th-232
B3-BH-01-1	42.68	5.02	5.83	0.55	0.77
B3-BH-01-2	2.21	0.95	0.74	0.44	0.55
B3-BH-02-1	0.92	1.08	0.80	0.63	0.87
B3-BH-03-1	1.00	1.20	0.96	0.89	0.83
B3-BH-05-1	1.42	1.11	0.80	0.57	0.81
B3-BH-06-1	0.97	1.15	0.63	0.61	0.59
B3-BH-07-1	63.09	4.84	4.03	0.89	0.85
B3-BH-07-2	17.18	1.92	1.96	0.60	0.69
B3-BH-08-1	58.25	4.74	6.46	0.78	0.87
B3-BH-08-2	1.76	1.13	0.68	0.47	0.52

* See Figure A-7 for Locations of McLaren/Hart Boreholes

TABLE A-13
BROWN & ROOT SOIL SAMPLING RESULTS FOR BUILDING 3

B&R-Borehole ID	Borehole Location	Soil Concentration (pCi/g)				
		Ra-226	Th-228	Th-230	Th-232	U-238
B3-CD-003	5E	109.05	34.23	0.57	0.68	0.68
B3-CD-004	4E	188.4	153.6	0.81	2.28	53.13

* See Figure A-8 for Locations of Brown & Root Boreholes

TABLE A-14
McLAREN/HART SOIL SAMPLING RESULTS FOR BUILDING 4

	Soil Concentration (pCi/g)				
MH-Borehole Location	Ra-226	Ra-228	Th-228	Th-230	Th-232
B4-BH-04-1	1.69	1.21	1.09	0.59	0.90
B4-BH-06-1		1.14	0.94	0.61	0.74

No soil samples were measured by Brown & Root for Building 4

TABLE A-15
McLAREN/HART SOIL SAMPLING RESULTS FOR BUILDING 6

	Soil Concentration (pCi/g)				
MH-Borehole Location	Ra-226	Ra-228	Th-228	Th-230	Th-232
B6-BH-01-1	6.26	2.00	2.55	1.12	0.15

TABLE A-16
BROWN & ROOT SOIL SAMPLING RESULTS FOR BUILDING 6

	Borehole	Soil Concentration (pCi/g)				
B&R-Borehole ID	Location	Ra-226	Th-228	Th-230	Th-232	U-238
B6NE-SS-001	12CC	4.67	8.95	0/96	0.89	0.70

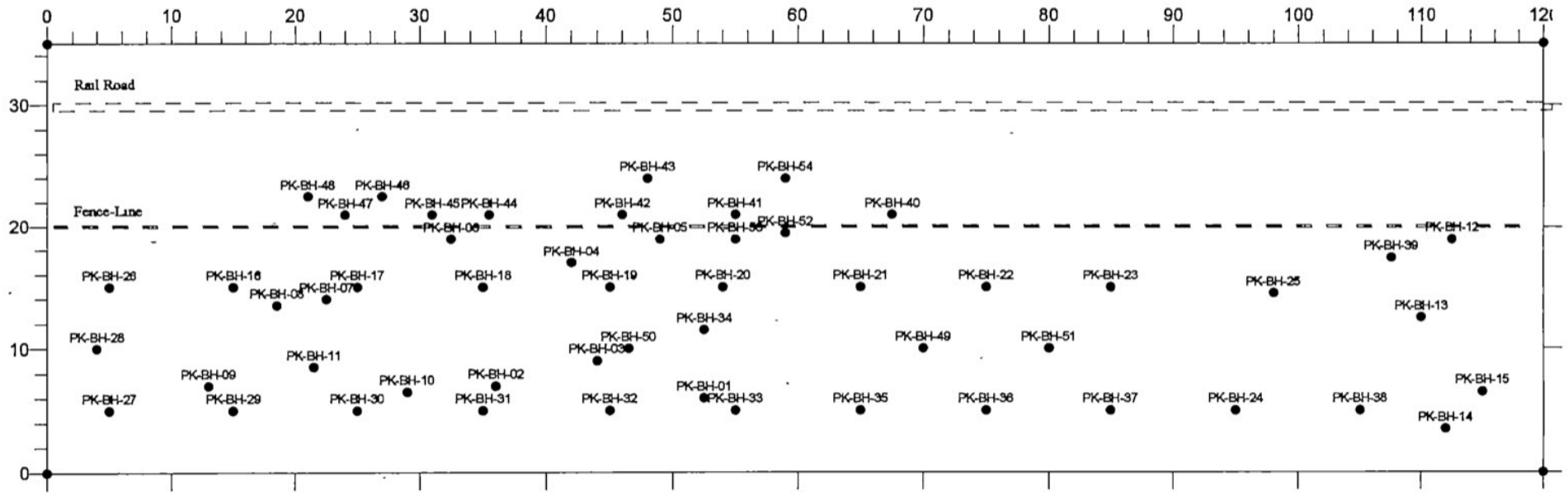
TABLE A-17
McLAREN/HART SOIL SAMPLING RESULTS FOR AREA E

MH-Borehole Location*	Soil Concentration (pCi/g)				
	Ra-226	Ra-228	Th-228	Th-230	Th-232
AE-BH-01-1	1.55	1.88	1.27	1.05	1.12
AE-BH-01-2	2.17	1.41	1.29	0.86	0.94
AE-BH-02-1	18.89	4.90	3.47	0.88	1.58
AE-BH-02-2	1.71	2.16	1.56	1.26	1.44
AE-BH-03-1	8.27	2.72	1.87	0.45	0.45
AE-BH-03-2	1.15	0.85	0.60	0.71	0.56
AE-BH-04-1		1.55	1.27	0.67	0.92
AE-BH-04-2	0.88	1.57	1.02	1.01	0.82

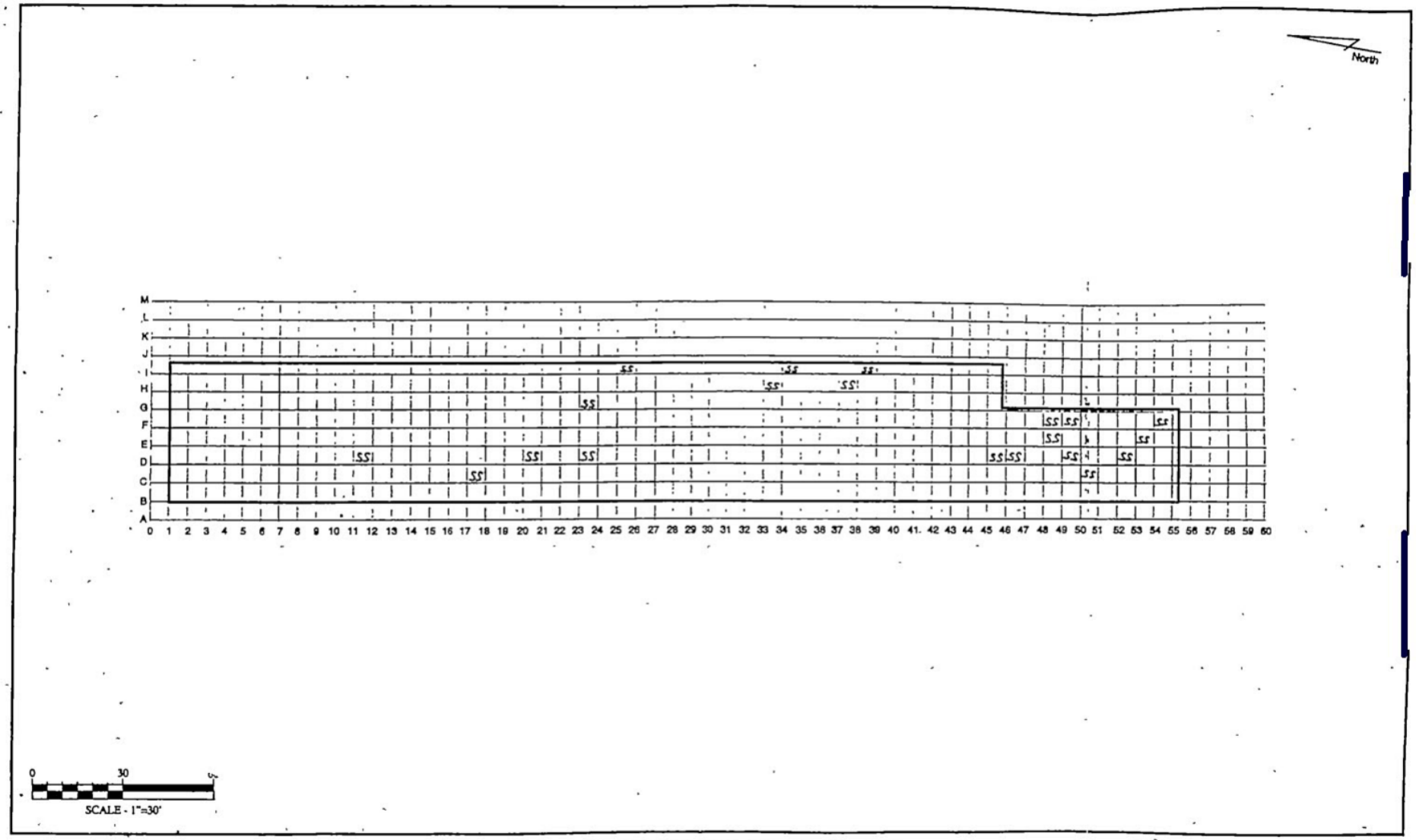
TABLE A-18
BROWN & ROOT SOIL SAMPLING RESULTS FOR AREA E

B&R-Borehole ID	Borehole Location*	Soil Concentration (pCi/g)				
		Ra-226	Th-228	Th-230	Th-232	U-238
E3-SS-005	1D	28.28	12.98	1.47	2.05	0.36

Figure A-1
Boring Locations for the Parking Lot (McLaren/Hart)



MANUFACTURERS PLACE

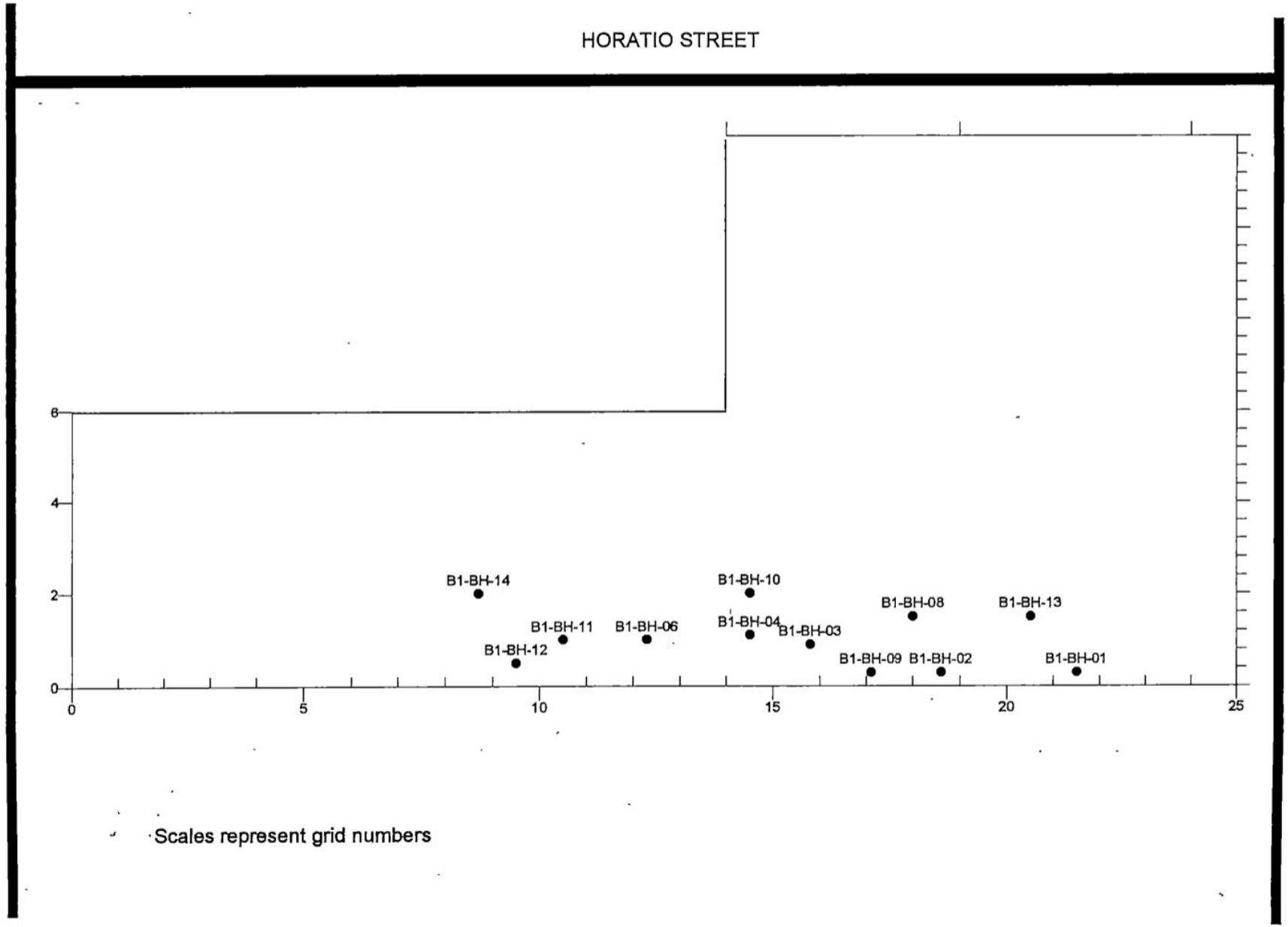


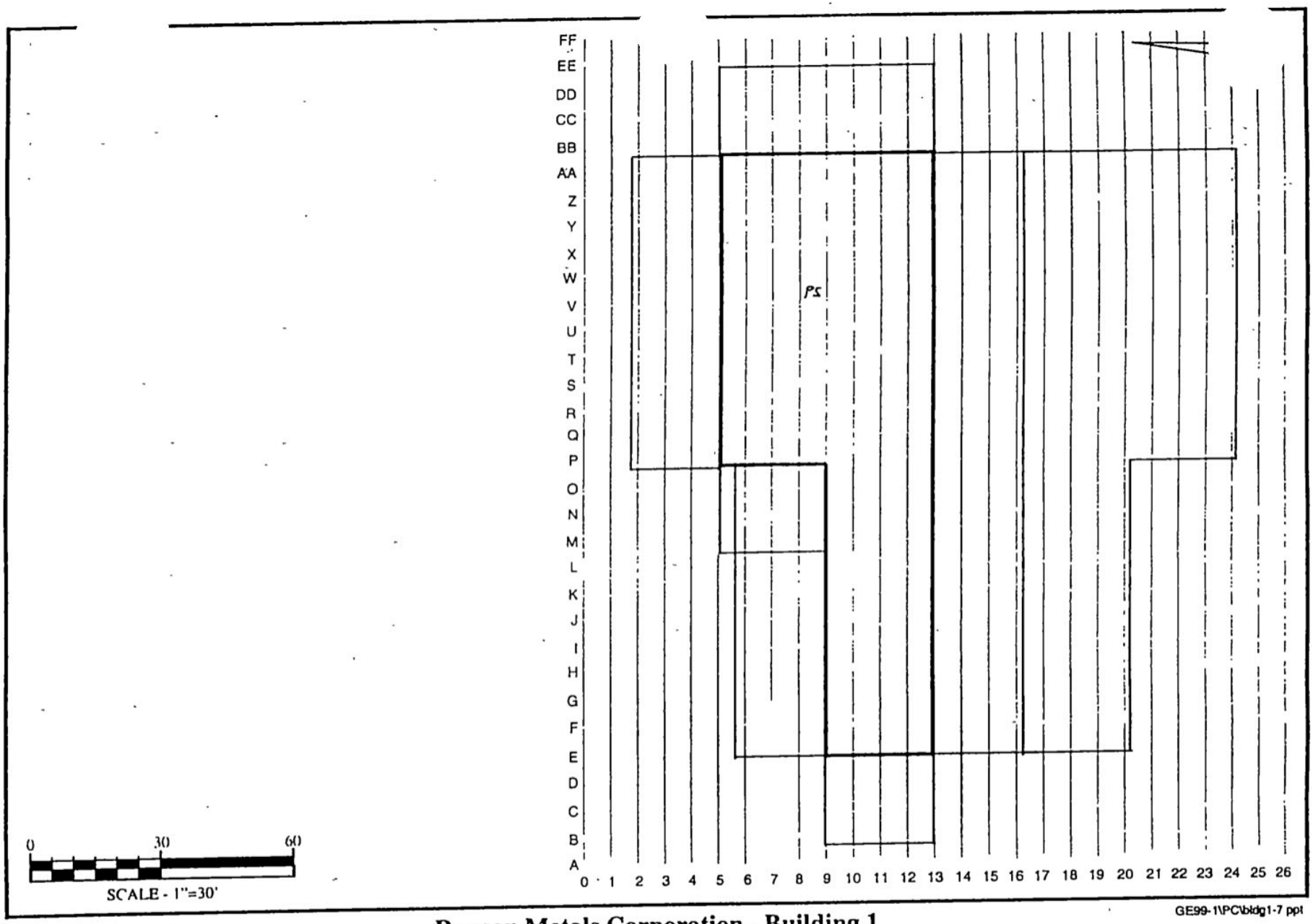
Bronson Metals Corporation - Paved Parking Area

GE99-11/PC/paved_a/ ppt

Figure A-2

Figure A-3
Boring Locations for Building 1 (McLaren/Hart)

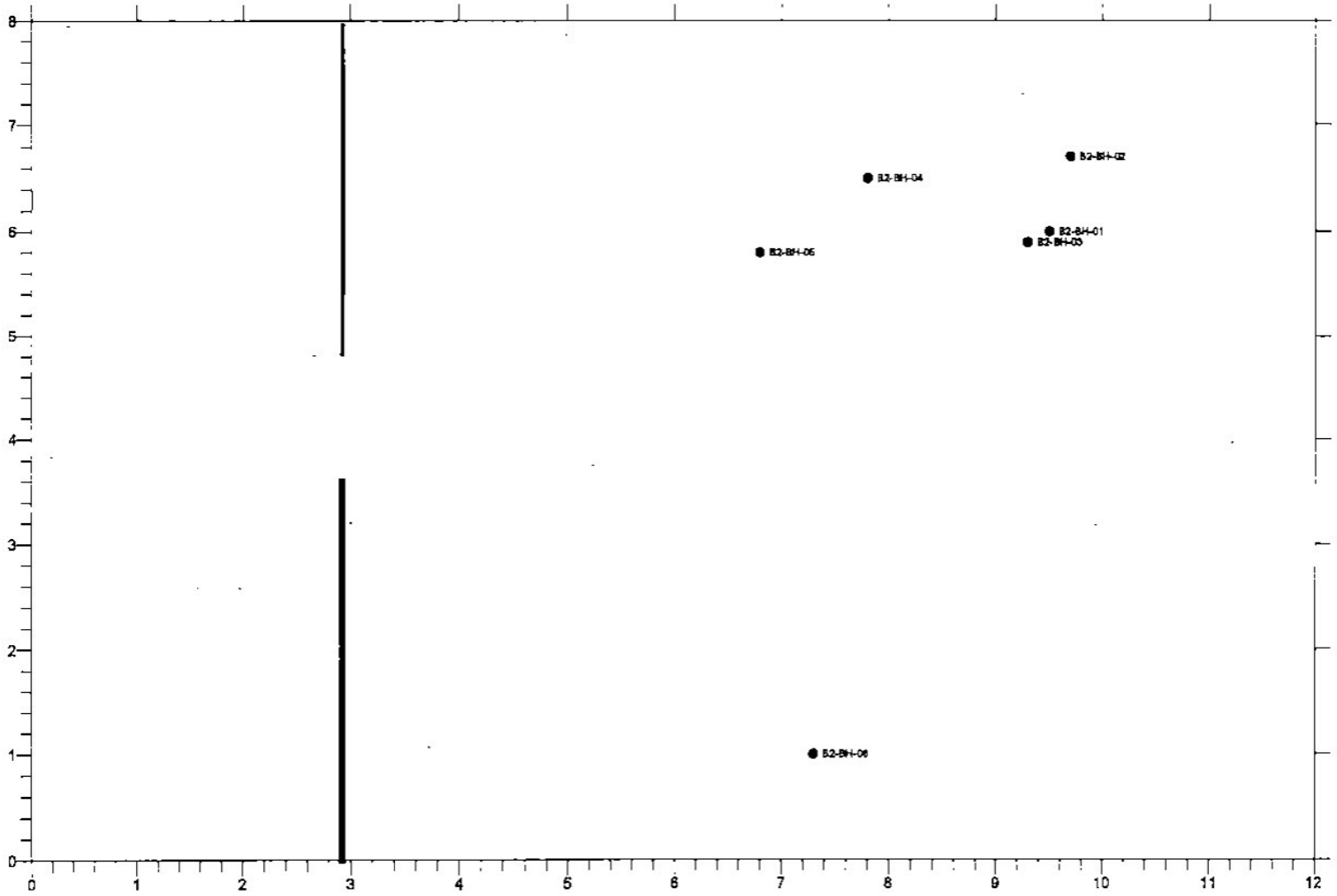




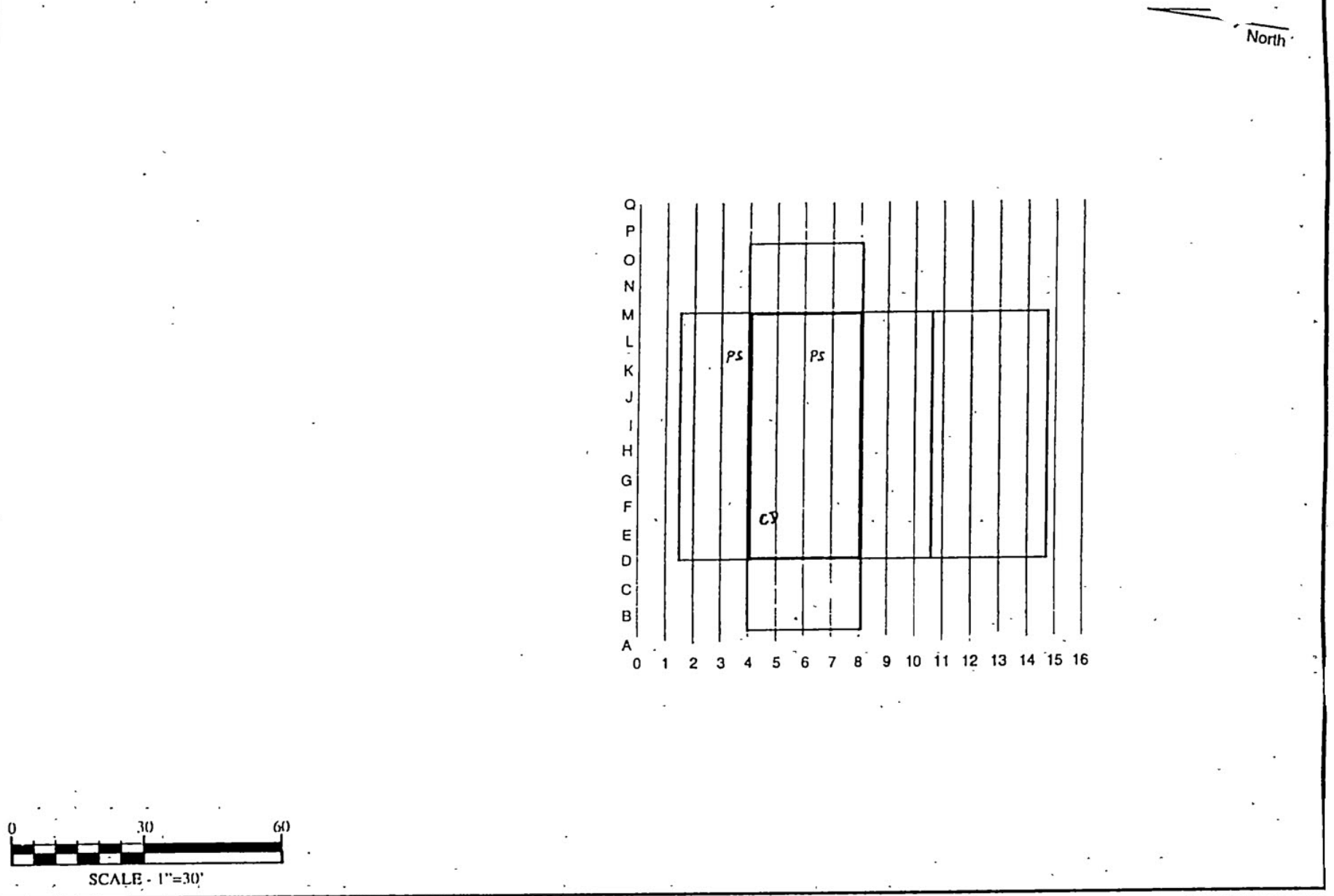
Ronson Metals Corporation - Building 1

Figure A-4

Figure A-5
Boring Locations for Building 2 (McLaren/Hart)



Scales represent grid numbers

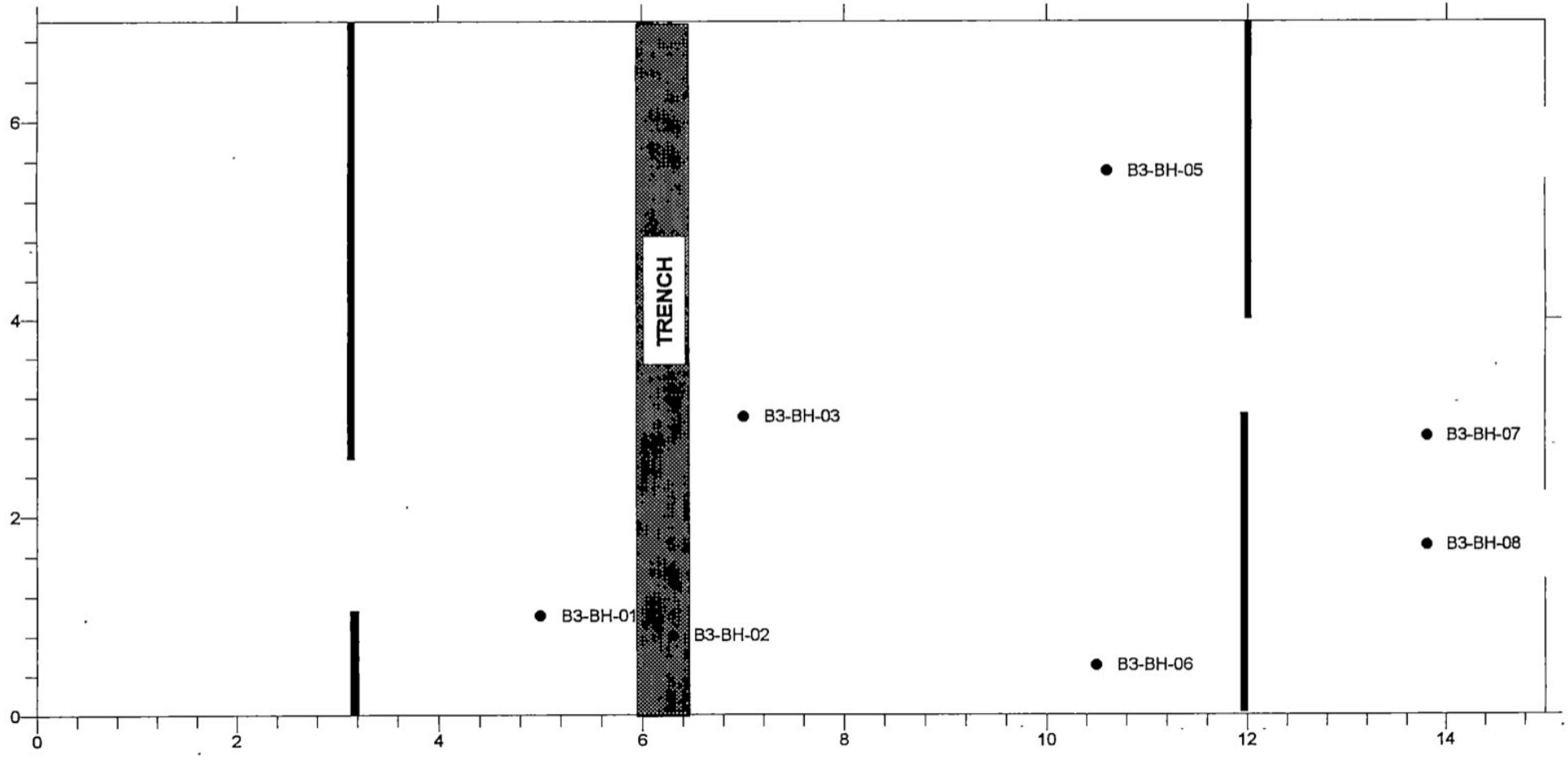


Ronson Metals Corporation - Building 2

GE99-1\PC\bldg1-7 ppt

Figure A-6

Figure A-7
Boring Locations for Building 3 (McLaren/Hart)



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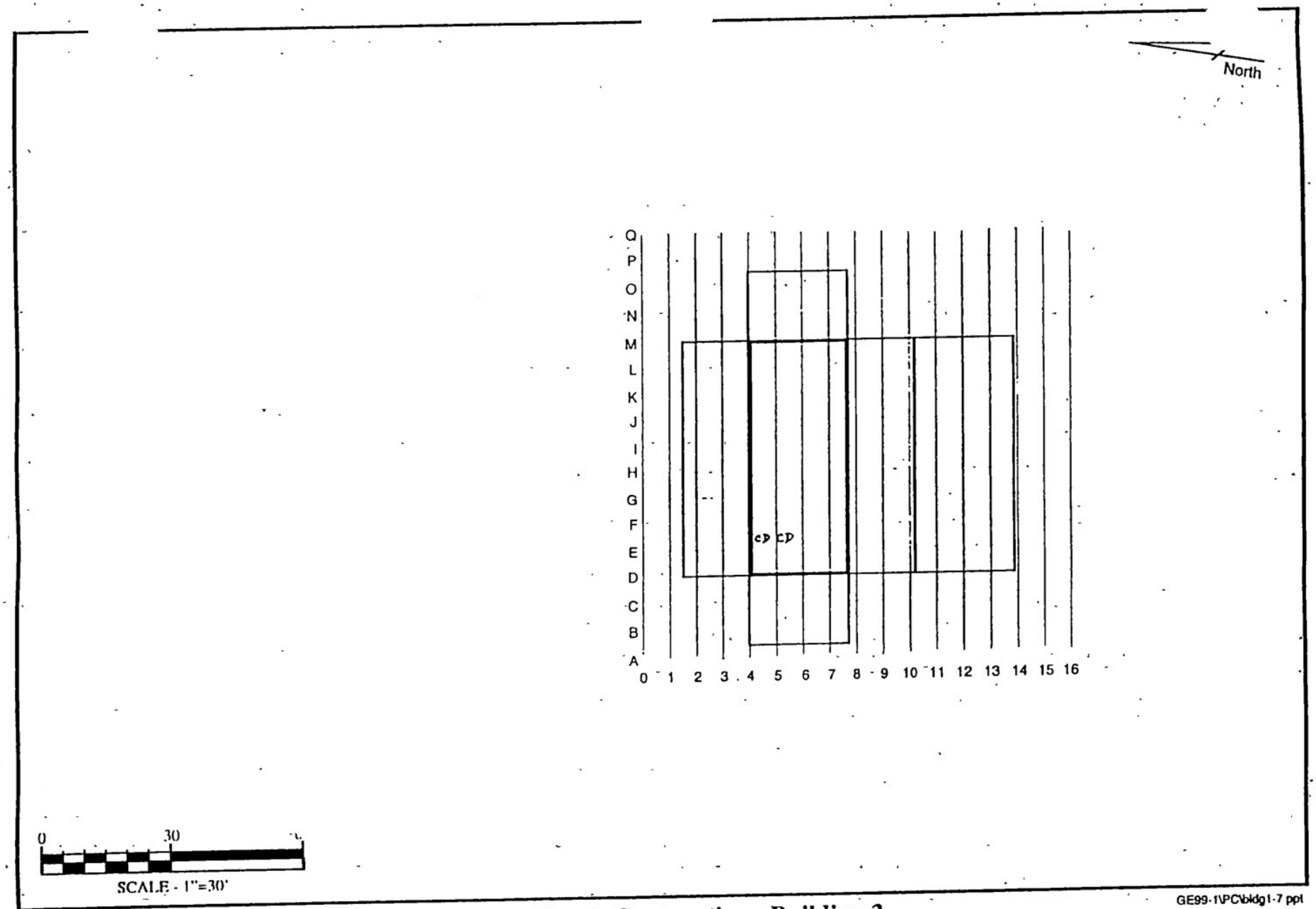


Ronson Metals Corporation - Building 3

Figure A-8

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN RADIOACTIVE MATERIALS DECOMMISSIONING AND FINAL STATUS SURVEY

Prometcor's Radiological QAPP

Quality assurance (QA) will be a key component of the proposed decommissioning program. QA ensures that all activities performed are protective of human health and the environment; and, confirms that the data generated is of a sufficient frequency and quality. To meet these needs, Prometcor has prepared this Quality Assurance Project Plan (QAPP) for final status survey work. This plan outlines the data quality objectives, the basis for survey design, and the methods to be used for analytical evaluations and documentation. The procedures defined by the QAPP will provide for consistent and uniform implementation of fieldwork throughout each phase of the fieldwork. The following sections summarize the various portions of the QAPP requiring consideration.

QAPP.1 APPLICABLE STANDARDS

The QAPP process outlined is consistent with ANSI/ASME NQA-1, Quality Assurance Program Requirements for Nuclear Facilities (ANSI 1989). As such, the procedures outlined within this QAPP provide details with respect to the program employed for quality assurance specific to McLaren/Hart's operations.

QAPP.2 ORGANIZATIONAL STRUCTURE

The organization structure for the proposed decommissioning work will provide personnel with direct experience in radiological screening, decontamination, and final survey actions consistent with decommissioning criteria. The project organization for the proposed work is as follows:

QAPP.3 DOCUMENTATION REQUIREMENTS

All aspects of the project will be documented in detail to ensure adequate representation of the work performed and the ability to duplicate confirmatory measurements. Documentation of the work process will be in accordance with accepted industry standards and will provide a summary of all procedures and activities performed during the project. The following activities will each be subject to documentation, among others:

- Site Set-Up - The methods used for site set-up will be identified, such as the location of key support functions, clearing of areas, and the screening performed to identify work zones.
- Analytical Capabilities - The use of the on-site gamma spec laboratory may be appropriate to support the work performed. The use of the laboratory, calibration data, and other operating parameters will be identified.
- Site Screening Instruments - The instruments used for site screening will be adequate to provide the detection limits required to ensure all work meets with applicable cleanup criteria. The instruments used, their detection limits, and their calibration information will each be identified.
- Site Screening - All data obtained from the screening activities will be recorded using a defined grid coordinate system capable of providing reproducible data as part of the final confirmatory survey. All data will be recorded in a hard copy written form.

QAPP.4 TRAINING OF STAFF

All staff assigned to work potentially involving exposure to radioactive materials will be subject to training with respect to radioactive principles, site-specific hazards, screening procedures, documentation requirements, and decommissioning procedures. This training will be provided as part of a site-specific training the results of which will be summarized and recorded.

QAPP.5 EQUIPMENT MAINTENANCE AND CALIBRATION

Equipment used to evaluate radioactivity will be maintained, calibrated, and tested prior to commencing work to ensure the validity of the data developed. The operation of this equipment and the recordation of data developed will be performed by only those personnel that have been trained and can demonstrate proficiency with such activities.

All equipment calibration will be performed based on the use of accepted standards such as those traceable to the National Institute of Standards (NIST). If necessary, the instruments used will be calibrated at various times during the work to ensure the validity of the data developed.

QAPP.6 DATA MANAGEMENT

Data management will be performed to ensure the consistency, accuracy, and detail necessary for decommissioning activities. All data developed will be recorded in logbooks with support, as appropriate, using electronic media. All recorded information will be placed in the logbook so that a clearly defined reference can be made to the location from which the data was obtained. Further, all calculations pertinent to the data will also be retained to support data review and interpretation.

The data developed will be reviewed on a weekly basis by the QA Officer to ensure adequate representations of the screening activities are made on a consistent basis. All review work will be signed and dated. The data reviewed will be subject to filing to provide for permanent data retrieval.

APPENDIX C

HEALTH AND SAFETY PLAN

McLaren Hart®
ENVIRONMENTAL ENGINEERING CORPORATION

HEALTH AND SAFETY PLAN

CLIENT:	RONSON CORPORATION
SITE NAME:	Prometcor Site (Formerly Ronson Metals)
SITE ADDRESS:	45-65 MANUFACTURER'S PLACE, NEWARK NEW JERSEY
PROJECT NUMBER:	
DATE PREPARED:	August 1998
DATE(S) REVISED:	
DATE EXPIRES:	April 1999

HEALTH AND SAFETY PLAN APPROVALS

	Name	Signature	Date
PROJECT MANAGER	Marc Cicalese		
FIELD SUPERVISOR/ SITE/RADIATION SAFETY OFFICER	Jack Buddenbaum	Jack B Buddenbaum	8/19/98
HEALTH & SAFETY MANAGER	Jack Buddenbaum	Jack B Buddenbaum	8/19/98
Acknowledgments:			
CONTRACTOR:	B. Koh & Associates	Jack B Buddenbaum for	8/19/98
CONTRACTOR:			

TABLE OF CONTENTS

ATTACHMENTS

1.0 GENERAL INFORMATION

1.1 Introduction

This Health & Safety Plan (HASP) addresses those activities associated with the scope of work stated in the HASP and will be implemented by the Site Safety Officer (SSO) and the Radiation Safety Officer (RSO) during site work. Compliance with this HASP is required of all persons and third parties who enter this site. Assistance in implementing this plan can be obtained from the Site Safety Officer and Project Manager, and/or the Health and Safety Manager (HSM). The content of this HASP may change or undergo revision based upon additional information made available to health and safety (H&S) personnel, monitoring results or changes in the scope of work. Any changes proposed must be reviewed by H&S staff and are subject to approval by the HSM and Project Manager.

This site specific Health & Safety Plan has been prepared for the use of McLaren/Hart and its employees and supplements the Health and Safety training that each McLaren/Hart employee receives. The health and safety guidelines in this Plan were prepared specifically for this site. Due to the potentially hazardous nature of the site covered by this Plan and the activity occurring on the site, it is not possible to discover, evaluate, and provide protection for all possible hazards which may be encountered. This plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if these conditions change.

This Plan is not intended to be used by any other contractor or personnel of any such contractor. This Plan may not address the specific health and safety needs or requirements of any other such contractor and its employees. Neither this Plan nor any part of it should be used on any other site.

McLaren/Hart expressly disclaims any and all guarantees or warranties, express or implied, that the Plan will meet the needs or requirements of any such contractor or its employees. McLaren/Hart, therefore, cannot and does not assume any liability by the use or reuse of the Plan by any client, contractor or their employees or agents. Any reliance on the Plan will be at the sole risk and liability of such party.

1.2 Executive Summary

The facility is located at 65 Manufacturer's Place, Newark, NJ. The facility was used to refine rare metals; Cerium refining, cerium alloy manufacturing, scrap metal processing and the use of thorium for the production of vacuum tube ion scavengers. Soil sampling will be conducted for the analysis of radioactive isotopes (thorium, radium, and uranium).

1.3 Acknowledgment

I acknowledge having reviewed this Health & Safety Plan, understand its contents and agree to abide by it. Additionally, I am current in the training and medical surveillance requirements specified in 29 CFR 1910.120, 'Hazardous Waste Operations and Emergency Response.

NAME *(Please Print)*	SIGNATURE	COMPANY AFFILIATION	DATE
Jack Buddenbaum		McLaren/Hart	
Marc Cicalese		McLaren/Hart	
Tom Grbic		McLaren/Hart	
Talaat Ijaz		McLaren/Hart	
Darin McEleney		B. Koh & Associates	
Duane Raffel		B. Koh & Associates	

2.0 PROJECT INFORMATION

2.1 Site Description and Background Information

The facility is located at 65 Manufacturer's Place, Newark, NJ. The facility was used to refine rare metals; Cerium refining, cerium alloy manufacturing, scrap metal processing and the use of thorium for the production of vacuum tube ion scavengers.

2.2 Purpose of Site Work

To perform necessary decontamination of concrete flooring/slabs in the areas formerly occupied by Buildings 1 through 6, asphalt cover of the parking lot, and surficial/underlying soils within the areas occupied by Buildings 1 through 5, parking lot, and Area E.

2.3 Scope of Work

Using direct surface and wipe sample readings, a 5849 survey for radioactive surface contamination will be completed on the site. Decontamination of surfaces will be performed to meet NRC release criteria.

2.4 Utility Clearance

1. To be performed by: McLaren/Hart
2. Date to be performed: TBA
3. Methods Utilized: TBA

3.0 HEALTH AND SAFETY RISK ANALYSIS

3.1 Non-chemical/Non-radiological Hazards

Non-chemical hazards are associated with:

1. Slip, trip fall
2. Heat stress
3. Biological Hazardous (rodents, spiders, insects...)
4. Cold stress
5. Confined spaces

3.2 Chemical Hazards

TABLE 3-1
KNOWN AND/OR PROBABLE CONTAMINANTS*

CONTAMINANT	SOURCE OF CONTAMINATION	MEDIA (soil/water/air)	RANGE OF CONCENTRATION
radium	unknown	surfaces/soils	15 - >4000 dpm/100 cm^2 <1 - >700 pCi/g
thorium	site operations	surfaces/soils	15 - >4000 dpm/100 cm^2 <1 - >700 pCi/g

TABLE 3-2
ASSESSMENT OF CHEMICAL/RADIOLOGICAL HAZARDS

Chemical Name[a] (or class)	PEL/TLV[a]	Other Pertinent Limits[a] (Specify)	Warning Properties - Odor Threshold[a]	Potential Exposure Pathways	Acute Health Effects	Chronic Health Effects
Low Level Radioactive Materials	See attachment 4	See attachment 4	See attachment 4	See attachment 4	See attachment 4	See attachment 4
Low Level Radioactive Materials: Alpha, Beta & Gamma Radiation,	Total effective dose equivalent (radiation workers): 5 rem/year 100 mrem/7 days 2 mrem/hr	embryo: 0.5 rem; minors: 500 mrem/year Skin: 50 rem/year Lens: 15 rem/year	NONE Detection only through radiological monitoring	Inhalation, skin absorption, ingestion, skin and eye contact, direct exposure	beta emitter: Cataracts, nausea, loss of appetite, internal organ damage. Beta/gamma: Erythema, ulceration, hair loss, blood change	Delayed cancer (may occur), genetic effects, reduced life expectancy.

[a]PEL = OSHA Permissible Exposure Limit; represents the maximum allowable 8-hr. time weighted average (TWA) exposure concentration.
TLV = ACGIH Threshold Limit Value; represents the maximum recommended 8-hr. TWA exposure concentration.
STEL = OSHA Short-term Exposure Limit, represents the maximum allowable 15 minute TWA exposure concentration.
TLV-STEL = ACGIH Short-term Exposure Limit; represents the maximum recommended 15 minute TWA exposure concentration
C = OSHA Ceiling Limit, represents the maximum exposure concentration above which an employee shall not be exposed during any period without respiratory protection.
IDLH = Immediately Dangerous to Life and Health; represents the concentration at which one could be exposed for 30 minutes without experiencing escape-impairing or irreversible health effects
( ) = ACGIH TLV Intended Change
[SKIN] = Indicates a significant contribution of the total exposure by the cutaneous route
Warning = Represents the lowest concentration detectable in a given population. However, detection varies greatly with the individual.
REL = NIOSH Recommended Exposure Limit, based on a 10-hour TWA exposure

4.0 HEALTH AND SAFETY FIELD IMPLEMENTATION

4.1 Personal Protective Equipment (PPE) Requirements

PPE may be upgraded or downgraded by the site health physicist, industrial hygienist, HSM, or qualified site safety officer based upon site conditions and air monitoring results.

TABLE 4-1
PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIREMENTS

TASK No.	LEVEL OF PPE	PPE: SUIT	GLOVES	FEET	HEAD	EYE	EAR	RESPIRATOR
1	C	Std.	N	Steel	–	Glass	–	NA

[a] Personal Protective Equipment (PPE):

SUIT:
- Std = Standard work clothes
- Tyvek = Uncoated Tyvek disposable coverall
- PE Tyvek = Polyethylene-coated Tyvek
- Chemrel = Chemrel coverall with hood
- Saranex = Saranex-laminated Tyvek
- Lt PVC = Light wt. PVC rain gear
- Med PVC = Medium wt. PVC suit
- Hvy PVC = Heavy wt. PVC coverall with hood
- Road = Roadwork vest
- Nomex = Nomex coveralls

GLOVES:
- Work = Work gloves (canvas, leather)
- Neo = Neoprene gloves
- PVC = PVC gloves
- N = Nitrile gloves
- V = Vinyl gloves
- L = Latex gloves

[a] Personal Protective Equipment (PPE):

FEET:
- Steel = Steel-toe boots
- Steel+ = Steel-toe Neoprene or PVC boots
- Booties = PVC or Latex booties

HEAD:
- HH = Hard hat

EYE:
- Glass = Safety glasses
- Goggle = Goggles
- Shield = Face shield

EAR:
- Plugs = Earplugs
- Muff = Ear muffs

[a] Personal Protective Equipment (PPE):

RESPIRATOR:
- APR = Air-purifying respirator
- Full APR = Full face APR
- Half APR = Half face APR
- PAPR = Powered Air-purifying Respirator
- SAR = Airline supplied air respirator
- SCBA = Self contained breathing apparatus
- Escape = Escape SCBA
- OV = Organic Vapor cartridge
- AG = Acid gas cartridge
- OV/AG = Organic vapor/Acid gas cartridge
- AM = Ammonia cartridge
- D/M = Dust/mist pre-filter and cover for cartridge
- HEPA = High efficiency particulate air filter cartridge

OTHER:
- * = Use if contact with wet soil or water
- ** = Optional use except if specific hazard present

4.2 Monitoring Equipment Requirements

Monitoring is conducted by the Radiation Safety Officer, Site Safety Officer or designee. Conduct contaminant source monitoring initially. Complete breathing zone monitoring during remediation activities. Log direct reading monitoring as specified in the Table 4-2 Monitoring Protocol and record results on Direct Reading Report form. Direct reading instrumentation shall be calibrated in accordance with manufacturing requirements and performance checked daily with check sources. Calibration records will be kept on file at the site. Daily instrument checks will be documented on the Instrument Calibration Log; refer to Attachment 2.

TABLE 4-2
MONITORING PROTOCOLS AND CONTAMINANT ACTION LEVELS

Contaminant	Monitoring Equipment	Monitoring Frequency	Use	Action Level	Protective Measures
Radioactive Material (radium, thorium, uranium which emit alpha, beta, and gamma radiation) present on surfaces and in subsurfaces.	Gas proportional, G-M, and alpha survey meters and smear samples (e.g., Whatman 41)	Initial and Periodic thereafter	Frisk all tools, equipment, personnel (whole body) [egress of Exclusion area]	> 100 cpm above background > 33 dpm/100 cm^2 (alpha) > 220 dpm/100 cm^2 (beta/gamma)	Locate source of contamination and remove or decontaminate
External Radiation (Gamma/X-ray, thorium, radium, uranium)	μR survey meter TLDs and/or Visual pocket dosimeter	Initial and throughout site activities	μR survey meter should be used for initial survey of external radiation. TLDs and/or Pocket dosimeters should be used by all personnel involved with site survey and decontamination activities.	2.0 mrem/hr	Temporarily halt work and consult with health physicist and/or radiation safety officer

Annual radiation occupational exposure limits
Whole body. 500 mrem/year or 100 mrem/week
Skin 50,000 mrem/year or 12,500 mrem/quarter
Lens: 1,500 mrem/year or 3,750 mrem/quarter

4.3 Decontamination Procedures

Depending on the specific job task, decontamination may include personnel themselves, sampling and decontamination equipment, and/or heavy equipment. The specified level of protection for a task (A, B, C, or D) does not in itself define the extent of personal protection or equipment decontamination. For instance, Level C without dermal hazards will require less decontamination than Level C with dermal hazards. Decontaminated heavy equipment will always require decontamination to prevent cross-contamination of samples and/or facilities. The following sections summarize general decontamination protocols.

4.3.1 Decontamination and Heavy Equipment

Heavy equipment will be decontaminated prior to personnel decontamination. Contaminant systems will be set-up for collection of decon fluids and materials.

Vehicles that become contaminated with suspect debris will be cleaned prior to leaving the site. The wheel wells, tires, sides of vehicles, etc. will be high-pressure washed at a location specified by the RSO or designee and surveyed for residual radioactive contamination by the RSO or designee prior to release.

4.3.2 Personnel

Use steps and procedures outlined below as guidelines for personnel decontamination:

- Brush loose soil debris from body,
- Screen boot, suit and gloves with survey meters;
- Wash and remove boots (where appropriate);
- Wash and remove suit (where appropriate);
- Wash and remove respirator (where appropriate);
- Wash and remove gloves;
- Field wash hands;
- Contain all PPE;
- Place all decon waters in on-site containers and secure for future disposal.

4.3.3 Samples and Sampling Equipment

The same decontamination line used for personnel decon will be used for surveying and decontamination of sampling equipment. At a minimum the following is performed:

- Refer to work plan for specific equipment decontaminator policies and procedures;
- Decon equipment will be washed in TSP solution or equivalent and rinsed in distilled water;
- Sampling equipment will be brushed clean and rinsed with distilled water or other appropriate cleaning materials;
- Samples will be dry-wiped and scanned with the gas proportional, alpha, GM survey meters prior to packaging.

4.3.4 Decon Wastes

- Spent decon solutions will be drummed, composite sampled for thorium, radium, and uranium and disposed of vis sanitary sewers if levels are at or below 10 CFR 20 limits. Sampling and analysis of waste water will be performed to minimize the volume of liquid waste specified as radioactive.

- Decontamination shall be performed in a manner that minimizes the amount of waste generated.

5.0 SITE OPERATING PROCEDURES

5.1 Initial Site Entry Procedures

- Locate nearest available telephone.
- Prior to working on-site, conduct an inspection for physical and chemical hazards.
- Conduct or review utility clearance prior to start of work, if appropriate.
- Note any specialized protocols particular to work tasks associated with the project.

5.2 Daily Operating Procedures

- Hold Tailgate Safety Meetings prior to work start and as needed there after (suggest daily, however minimum of weekly).

  (See Attachment 2 for Tailgate Safety Meeting Form.)

- Use monitoring instruments and follow designated protocol and contaminant action levels.
- Use personal protective equipment (PPE) as specified.
- Use hearing protection if noise levels exceed 85 dbA.
- Remain upwind of operations and airborne contaminants, if possible.
- Establish a work/rest regime when ambient temperatures and protective clothing create a potential heat stress hazard.
- Do not carry cigarettes, gum, etc. into contaminated areas.
- Refer to Radiation Safety Officer (RSO), Site Safety Officer (SSO) for specific safety concerns for each individual site task.
- Be alert to your own physical condition.
- <u>All accidents, no matter how minor</u>, must be reported immediately to the RSO/SSO.

6.0 EMERGENCY RESPONSE PROCEDURES

6.1 Emergency Incident Procedures

The nature of work at contaminated or potentially contaminated work sites makes emergencies a continual possibility. Although emergencies are unlikely and occur infrequently, a contingency plan is required to assure timely and appropriate response actions. The contingency plan is reviewed at tailgate safety meetings.

6.1.1 Emergency Incident Procedures

If an emergency incident occurs, take the following action:

Step 1: Size-up the situation based on the available information.

Step 2: Notify the, Radiation Safety Officer, Site Safety Officer, and/or Field Supervisor.

Step 3: Only respond to an emergency if personnel are sufficiently trained and properly equipped.

Step 4: As appropriate, evacuate site personnel and notify emergency response agencies, e.g., police, fire, etc.

Step 5: As necessary, request assistance from outside sources and/or allocate personnel and equipment resources for response.

Step 6: Consult the posted emergency phone list and contact key project personnel.

Step 7: Prepare an incident report. Forward incident report to Project Manager/Health and Safety Manager within 24 hours.

6.1.2 Medical Emergencies

If a medical emergency occurs, take the following action:

Step 1: Assess the severity of the injury and perform life-saving first aid/CPR as necessary to stabilize the injured person. Follow universal precautions to protect against exposure to blood borne pathogens.

Step 2: Get medical attention for the injured person immediately. (Call 911 or consult the Emergency Contacts list which must be posted at the site).

Step 3: Notify the Site Safety Officer and Field Supervisor immediately. The Site Safety Officer will assume charge during a medical emergency.

Step 4: Depending on the type and severity of the injury, transport the injured employee to the nearest hospital emergency room. If the injury is not serious, then transport the injured employee to a nearby medical clinic. Consult your Health & Safety Manager for guidance, if necessary.

Step 5: Notify the injured person's personnel office, including the Regional Manager, Project Manager, and Health and Safety Manager.

Step 6: Prepare an accident report. The Radiation Safety Officer, and/or Site Safety Officer is responsible for its preparation and submittal to the Health and Safety Manager (HSM) and Corporate Health and Safety Director within 24 hours. CHSD fax number is (916) 638-7622.

6.1.3 Site-Specific Procedure

Information regarding radiation safety is provided in McLaren/Hart's Health & Safety Policy: HS-21 (See Attachment 4).

6.2 Emergency Routes

From Site - East on East Ferry Street
Turn right on Wilson Avenue
Hospital is on left between Jefferson St. and Madison St.

See Hospital Route Map - Attachment 3

6.3 Site Specific Requirements in Event of an Emergency:

6.3.1 Facility Notifications

Environmental:	589-1380 (Security)
Safety:	589-1380 (Security)
Security:	589-1380 (Security)
Facilities:	589-1380 (Security)

6.3.2 Locate Shut-Offs

Gas:	Located and secured prior to start of site activities
Power:	Located and secured prior to start of site activities
Fuel:	Located and secured prior to start of site activities

6.3.3 Evacuation Route

If evacuation is required, the Field Supervisor shall:

Step 1: Activate the communication system to alert site workers of evacuation. Personnel shall be advised to remain upwind of contaminants, if possible, and proceed to the designated assembly area.

Step 2: Account for all personnel at the assembly area.

Step 3: Notify the client of the need to initiate evacuation procedures for other site personnel.

Step 4: Notify the Fire and Police Departments and request their assistance for evacuating the surrounding area and residences.

6.3.4 Spill Containment Plan

If a spill of hazardous material occurs, the following steps shall be taken to mitigate the incident:

Step 1: Notify the Field Supervisor, and he/she shall assess the extent of the spill to determine if it can be safel mitigated with the personnel and protective equipment available at the site.

Step 2: If the release is beyond the field team's capabilities, the Field Supervisor shall evacuate the site personnel to a safe location upwind of the release, and notify the Project Manager and Fire Department.

Step 3: The Project Manager shall notify the client, Health and Safety Manager, Corporate Health and Safety Director, and regulatory agencies, if necessary.

Step 4: If the spill can be safely mitigated using defensive actions, first don the appropriate PPE. Initially, Level C PPE should be worn until air monitoring indicates a downgrade in PPE is appropriate.

Step 5: Takes steps to secure the area and to prevent unauthorized persons from entering the area.

Step 6: Takes steps to contain the spill and to prevent it from reaching sewers, storm ditches, etc.

Step 7: Clean up the spill with absorbent, neutralizers, soil removal as appropriate. Place waste in sealed, labeled containers for proper disposal.

EMERGENCY CONTACTS
(To be Posted)

TITLE	NAME	PHONE NUMBER
EMERGENCY		
Police	Emergency Service	911 or (201) 481-2900
Fire	Emergency Service	911 or (201) 481-2900
Local Hospital	St. James Hospital	(201) 465-2772
Local Ambulance/Rescue	Iron Bound Ambulance Service	(201) 589-3795
Poison Control Center	Statewide Center	(800) 962-1253
Haz. Waste Natl. Response Center	HAZMAT	(800) 424-8802
PROJECT/BUSINESS		
Project Manager	Marc Cicalese	Office: (908) 647-8111
Practice Area Leader	Marc Cicalese	Office: (908) 647-8111
Health & Safety Manager/RSO	Jack Buddenbaum	Office: (908) 647-8111
Corporate Health & Safety Director	David Durst	(916) 638-3696
Field Supervisor	Tom Grbic	Office: (908) 647-8111
Site Safety Officer/RSO designee	Darin McEleney	Office: (716) 592-3431 Pager:
Alternate Site Safety Officer/RSo designee	Duane Raffel	Office: (716) 592-3431
Client Contact	Daryl K. Holcomb	(908) 469-8300
Site Contact	Security	(b)(6)
Subcontractor	B. Koh & Associates	(716) 593-3431
Subcontractor		

Site Location: Waydell Street

ATTACHMENT 1

SITE MAPS

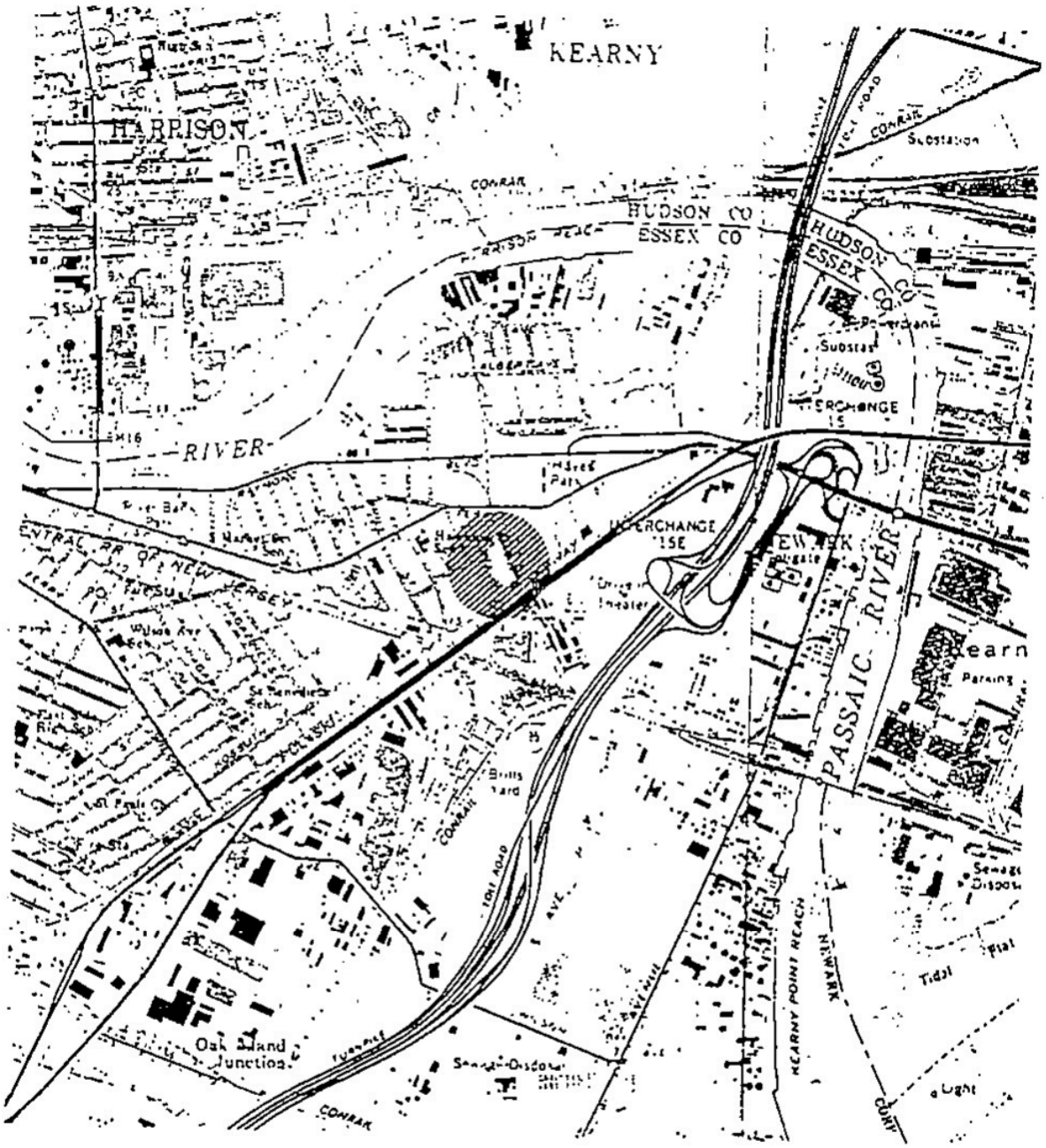


Figure 1. Elizabeth and Jersey City quadrangles, USGS 7½' topographic series, 1981 photo revision

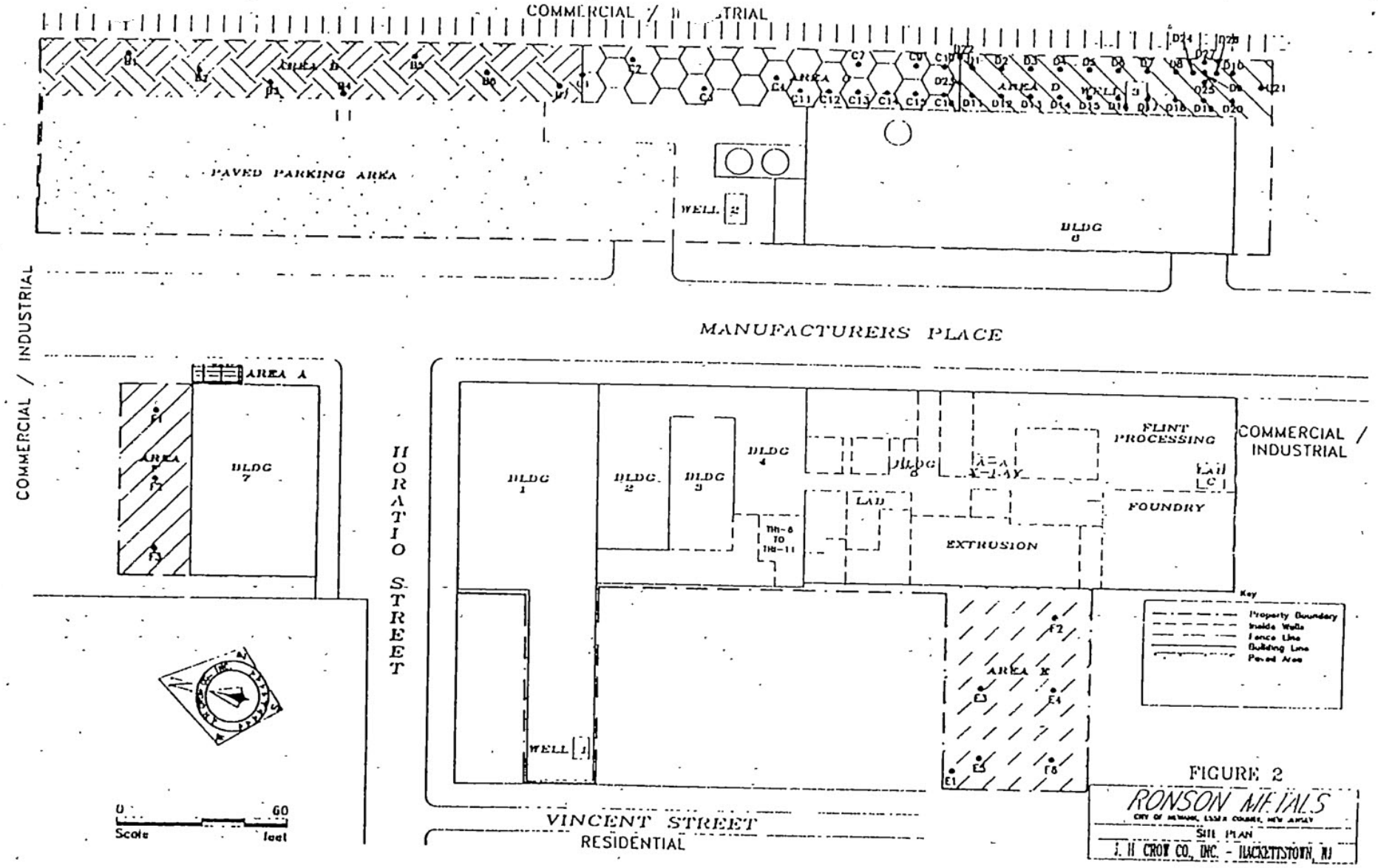


FIGURE 2

RONSON METALS

SITE PLAN

J. H CROW CO., INC. - HACKETTSTOWN, NJ

ATTACHMENT 2

HEALTH AND SAFETY FORMS

Add forms as appropriate for the task(s) performed.

- ☐ Utility Clearance, Underground Service Alert
- ☐ Utility Clearance, McLaren/Hart Utility Clearance Checklists
- ☐ Direct Reading Report Form
- ☐ Instrument Calibration Log
- ☐ Tailgate Safety Meeting Form
- ☐ PM/Field Supervisor Audit Form
- ☐ Other: _____

McLaren Hart

Date:_____ Ticket No._____
Dig Alert Expiration Date:_____
(List Utilities Present on Back of Sheet)

NTACT UNDERGROUND SERVICE ALERT (USA) BEFORE YOU DIG

UTILITY CLEARANCE REQUEST

(Completed by Project Manager)

Work/Clearance Previously at this location? Y ☐ N ☐

Today's Date:_____ Dig-In Start Date:_____

Project Name:_____ Task No.:_____

Exact Location of Utility Clearance (address, etc.):_____

Facility Contact Name:_____ Telephone No.: ( )_____

Facility Engineer Name:_____ Telephone No.: ( )_____

Site Description (Include Operational Constraints/Hazards):_____

What Facility Utility Drawings are Available?_____ If available, please provide.

Project Manager Signature _____ Assigned Field Supervisor Signature _____

(Completed by Project Manager) **CHECKLIST** (Completed by Clearance Engineer)

1. Site/Facility Drawings Available? Y ☐ N ☐
   Checked with (Fac. Engr., Facility Contract, Other)? Y ☐ N ☐
   Emergency/Safety Shut-Off Switches Located on Utility Plan? Y ☐ N ☐

Identify Known Utility

		Field Verification (Completed by Clearance Engineer)	
		INITIAL/DATE	NOTES
A.	Water Lines		
B.	Sanitary/Industrial Sewer		
C.	Storm Drains		
D.	Electrical Lines or Vaults		
E.	Natural Gas		
F.	Liquid Fuel		
G.	Steam		
H.	Compressor Air		
I.	Telephone/Cable		
J.	Overhead Lines or Pipes		
K.	Others (List)		

Clearance Engineer:_____
(Name - Print) (Initial) (Date)

Clearance Review:_____
(Name - Print) (Initial) (Date)

ments: Must be included!
fety Plan (By P.M.)
etch (By Clearance Engineer).
Others (List):_____

Distribution:
Project Manager_____
Field Supervisor_____
Project File_____
Health and Safety Manager_____

(J:FORMS\HS15-L4/93)

McLaren Hart
ENVIRONMENTAL ENGINEERING CORPORATION

RADIATION MONITORING

CLIENT/SITE:_____ DATE/TIME:_____

INSTRUMENT/DATE CALIBRATED:_____ BACKGROUND READING/LOCATION:_____

MONITORING SITE	MONITORING LOCATION	DATE DRUM INSTALLED/REMOVED	mR/MIN	mR/HOUR

Copy to Health and Safety Manager and Project File.
H&S Manager Review:_____ Date:_____

McLaren Hart
ENVIRONMENTAL ENGINEERING CORPORATION

INSTRUMENT CALIBRATION LOG

Page ___ of ___

Client Name and Site:	Project Manager:	Task Number:

Calibration Event:

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Person Calibrating:	Date:
Instrument Type:	Calibration Gas:
Model:	Calibration Gas Concentration (ppm):
Serial #:	Reading (ppm):
Calibrator Model:	Adjusted Reading (If Necessary):
Comments:	

Comments:

NOTE: Return to HSM Upon Completion of Site Work.

McLaren Hart
ENVIRONMENTAL ENGINEERING CORPORATION

TAILGATE SAFETY MEETING

DATE_____ TIME_____ PROJECT NO._____

SITE LOCATION_____

_____

TYPE OF TRAINING

_____ Technical Transfer/H&S Meeting _____ Tailgate Safety Meeting

_____ HASP Reading/Review _____ Other:_____

_____

TRAINING PRESENTED BY:_____

TOPICS COVERED:_____

_____

_____

ATTENDEES

NAME PRINT	SIGNATURE

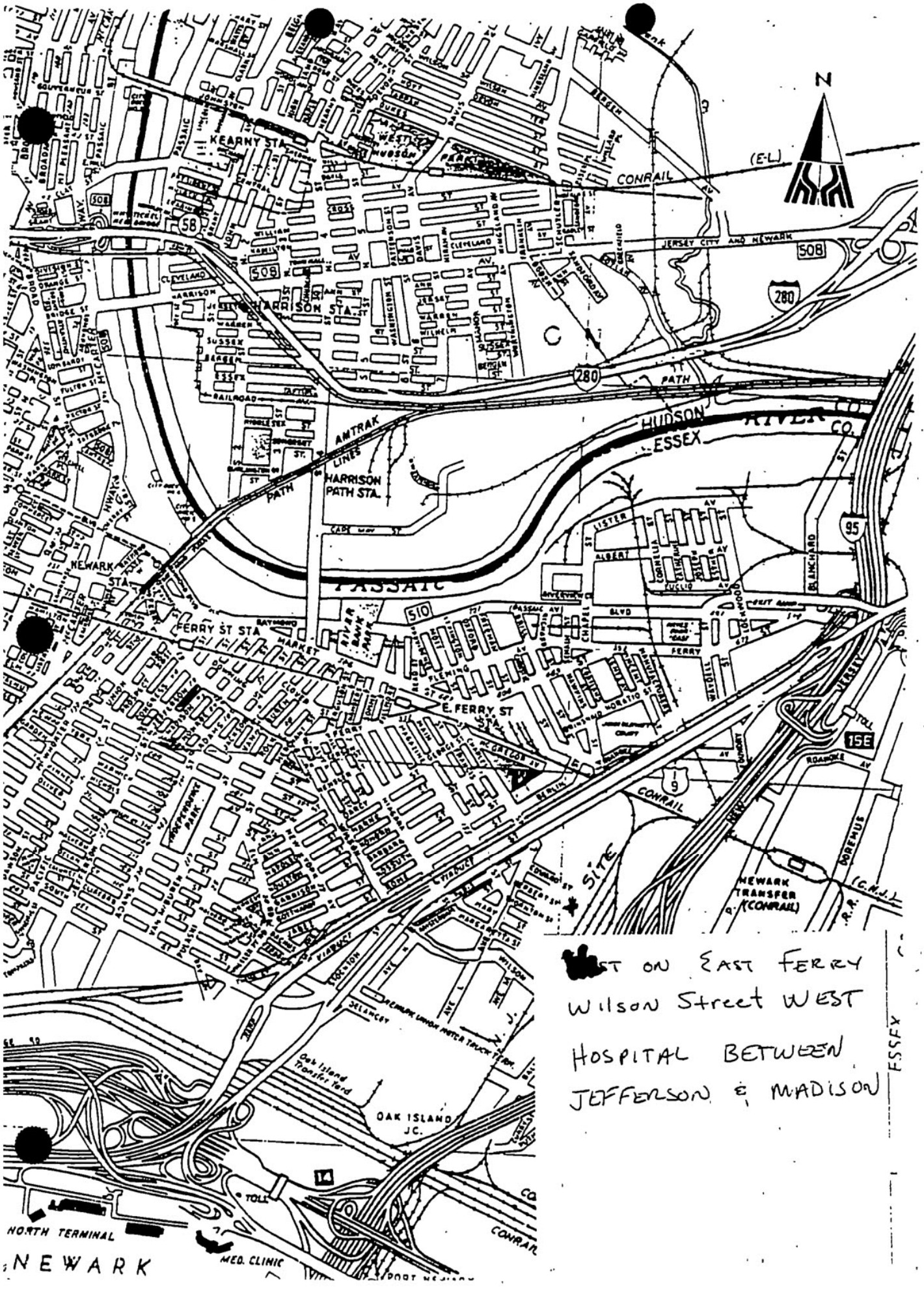
SUPERVISOR:_____ DATE:_____

(Copy to Health and Safety Manager and project file.)

H&S Manager Review_____ Date_____

ATTACHMENT 3

HOSPITAL ROUTE MAP



ST ON EAST FERRY
WILSON STREET WEST
HOSPITAL BETWEEN
JEFFERSON & MADISON

ATTACHMENT 4

RADIOLOGICAL CONTROL AND SAFETY REQUIREMENTS FOR SITE SURVEY & DECONTAMINATION ACTIVITIES

ATTACHMENT 4

RADIOLOGICAL CONTROL AND SAFETY REQUIREMENTS FOR SITE SURVEY & DECONTAMINATION ACTIVITIES

PROMETCOR, INC.
NEWARK, NEW JERSEY

1.0 DISCLAIMER NOTICE

The radiological control and safety requirements/guidelines contained within this appendix were developed for the Prometcor, Inc. site specifically for characterization activities and should not be used on any project or site without prior approval of the site Radiation Safety Officer.

The Prometcor radiological control and safety requirements and guidelines are effective only if each worker follows the requirements and guidelines. Intentional disregard by characterization personnel of the established requirements/guidelines may result in unnecessary exposure or release of radiation or radioactive materials.

2.0 IDENTIFICATION AND MONITORING OF RADIOLOGICALLY RESTRICTED (CONTROL ZONES) AREAS

To aid in the control of radiation exposure and limit the spread of radioactive material, a system of identifying radiologically restricted areas will be implemented by McLaren/Hart, Inc. (McLaren/Hart).

The Prometcor site will be divided into three distinct areas for radiation exposure control. These areas are unrestricted, controlled and restricted areas.

Restricted Area means any area access to which is controlled by McLaren/Hart for purposes of protection of individuals against undue risks from exposure to radiation and radioactive materials. Within the restricted areas, different zones may be designated to aid in radiation exposure control and control of the radioactive materials present.

Unrestricted Area means any area access to which is neither limited nor controlled by McLaren/Hart for purposes of protection of individuals from exposure to radiation and radioactive materials.

Controlled Area means an area, outside a restricted area, but inside the site boundary, access to which can be limited by McLaren/Hart for any reason.

The radiologically restricted areas may be delineated with distinctive barrier tape/rope or signs. If utilized, the signs will have the radiation symbol, standard colors, and appropriate wording to warn workers of the potential hazard. A description of the radiation symbol and sign can be found in USNRC Regulatory Guide 8.1 and ANSI Standard N2.1-1969. The radiation symbol will not be used for any purpose other than radiological control.

All radiological posting will be done by or at the direction of radiological control personnel. Movement or removal of posted radiation warning signs, tags, or boundary markers by personnel other than radiological personnel or without their approval may be cause for disciplinary action.

2.1 Radioactive Materials Area

A *Radioactive Materials Area* is an area that contains radioactive materials in amounts exceeding 10 times the 10 CFR 20, Appendix C. Each Radioactive Materials Area (RMA) must be posted with signs meeting applicable standards, including the radiation symbol, and the words "CAUTION - RADIOACTIVE MATERIALS AREA" or "DANGER - RADIOACTIVE MATERIALS."

2.2 Radiation Area

Radiation Area means any area, accessible to personnel, in which radiation levels could result in an individual receiving a dose equivalent in excess of 5 mRem in 1 hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates.

Entrance to Radiation Areas will be conspicuously posted with "CAUTION - RADIATION AREA" signs.

2.3 Contaminated Area

A contamination area is an area which contains radioactive material which can spread. The amount of contamination is measured in disintegrations per minute per 100 cm^2. Contamination above the lowest limits in Table 2-1 will constitute a contamination area. The area will be isolated and posted. The posting will read "CAUTION - CONTAMINATED AREA".

2.4 Airborne Radioactivity

Areas accessible to personnel, such as a room, enclosure, or area will be posted as *Airborne Radioactivity Areas* if airborne radioactivity composed wholly or partly of licensed material exists in concentrations:

(1) In excess of the derived air concentrations (DACs) specified in Appendix B of 10 CFR 20.

(2) To such a degree that an individual present in an area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 DAC hours.

Each Airborne Radioactivity Area must be posted with signs meeting applicable standards,including the radiation symbol, and the words "CAUTION - AIRBORNE RADIOACTIVITY AREA".

Additional instructions or requirements such as "RWP required"," TLD required," "Contact Health Physics Prior to Entry," as appropriate, may be attached as inserts to each of the above specified postings.

2.5 Radiation Work Permits

The Radiation Work Permit (RWP) is a administrative tool used to control work occurring inside the radiologically restricted area(s) and to make all of the personnel involved with the work aware of specific hazards and precautions in the specific work area. Additionally, the RWP will instruct the workers as to what protective equipment may be needed and what monitoring will be required.

An RWP will be required for any of the following conditions:

- Entering a radiation area.
- Entering a contaminated area.
- Entering an airborne radioactivity area.
- Unknown radiological conditions in an area to be entered or equipment to be opened.

2.5.1 Work Control

All work will be administratively controlled via RWPs. RWPs will be issued daily or weekly, depending on the length of the work task, and reviewed daily by the PRSO or his designee. The RWP will list the following information:

(1) Task(s) to be performed.
(2) Location of Task(s).
(3) Radiological Hazards Involved with Task(s).
(4) Most Recent Radiation Survey Results.
(5) Required Personnel Protective Equipment.
(6) Special Units or Restraints.
(7) Signature of the RSO or his designee.
(8) Signature(s) of the individual(s) performing the required work

A daily safety meeting will be conducted with all workers to review safety and radiological conditions and/or changes to the RWP as appropriate.

An RWP will be issued at the start of characterization operations and daily or weekly thereafter. The RWP will be terminated at the end of 24-hours or 7 days or when conditions change.

3.0 PERSONNEL PROTECTIVE EQUIPMENT

3.1 Selection

To maintain the internal exposure of radioactive materials to ALARA, engineering controls will be used to the maximum extent possible. If engineering controls are not adequate, as demonstrated by work area air sampling, then respiratory protection will be considered to control internal exposures to radioactive materials.

All respiratory protective equipment (RPE) will be recommended by the Project Radiation Safety Officer (PRSO) or his designee prior to the initiation of each new task or operation.

RPE will always be selected on the basis of hazard or presumed hazard. Whenever the degree of hazard can not be determined prior to task initiation, a conservative approach for protecting personnel will be assumed.

Respiratory equipment may be used to limit the potential for intake of radioactive materials. Protection factors as specified in 10 CFR 20, Appendix A will not be applied and potential exposures will be based upon measured volumes of contamination in the air.

3.1.1 RPE Use

Consistent with the applicable portion of 10 CFR 20.1703, the following requirements will apply to the use of RPE at this project:

(1) RPE will only be used by those persons who have been examined by a licensed physician and found medically qualified to wear the prescribed equipment.

(2) Project personnel will use the prescribed RPE in accordance with their training and the requirements of the work permit.

(3) Only equipment recommended by the PRSO will be permitted.

(4) Only equipment that has been selected, maintained, and inspected prior to commencement of work will be permitted.

(5) Personnel will only be permitted to use equipment for which they have been adequately trained and fitted.

(6) Only equipment that has been properly fitted in accordance with the acceptable methods contained in NUREG-0041 will be permitted for use.

(7) Only equipment that has been adequately decontaminated will be permitted to be reused.

(8) Only approved RPE will be allowed for use during the remediation project.

(9) Only NIOSH and MSHA-approved respiratory equipment will be used.

(10) Communications (voice, visual, or signal line) will be maintained between all individuals present. Planning will be such that one individual, unaffected by any likely incident, will have the necessary resources to assist the others in case of any emergency.

(11) Respiratory protective equipment will not be worn when conditions exist that prevent a good face-to-facepiece seal.

(12) Cartridges and filters used in conjunction with air-purifying respirators will be changed daily, or upon increased breathing resistance; whichever comes first.

(13) No contact lenses will be permitted when wearing respiratory protection.

Additional requirements may be identified as work progresses.

3.1.2 Training and Instructions

As part of the radiation worker orientation training, individuals will be instructed in the proper donning and doffing of respirators. They will also be fit tested (if required) and instructed on the proper field test to be used to insure an adequate fit.

In addition, individuals will be instructed on the proper maintenance and cleaning of respirator.
The worker will also be advised that the worker may leave the work area any time for relief from respirator use in the event of respirator failure, physical/psychological distress or other emergency situations.

4.0 MONITORING REQUIREMENTS AND ACTION LEVELS

4.1 Radiation Monitoring

4.1.1 Environmental Monitoring

Characterization activities will be controlled such that no member of the general public will exceed the USNRC 10 CFR 20 nonoccupational limit of 100 mRem/year. Operations will be conducted such that minimal releases to the environment of airborne and liquid radioactivity will occur. The most restrictive concentration limits for the radionuclides of concern (Ra-226, Th-232 and Th-228) will be applied to the characterization activities and are taken from 10 CFR 20, Appendix B, Table 2, Columns 1 and 2 and are presented here.

	10 CFR 20	
Radionuclide	Air (μCi/ml)	Water (μCi/ml)
Th-232	4.0 E-15	3.0 E-8

In any event, exposure to the public, due to external or internal (inhalation and ingestion) exposures of radioactive materials from the Prometcor site will be limited to 100 mRem. Sampling for airborne and liquid radioactive materials will be performed in accordance with Sections 4.1.1.2 and 4.1.1.3 or at the direction of the Project Radiation Safety Officer (PRSO) or designee.

To ensure that the nonoccupational dose to the public is met, monitoring of the environment near intrusive subsurface soil sampling activities will be performed. Monitoring will consist of the three potential pathways of exposure to the public. The pathways consist of direct (external) exposure to radiation, internal (inhalation and ingestion) of radioactive material from the site.

4.1.1.1 Direct Exposure

Direct exposures will be monitored with exposure rate instruments (i.e., Bicron FRem or equivalent).

Exposure rate measurements will be taken periodically as part of the general site radiation survey program. These measurements will be performed with calibrated instruments, qualified personnel and in accordance with approved procedures.

4.1.1.2 Airborne Radioactive Materials

Airborne materials are included in the environmental monitoring program to determine possible inhalation exposures to radioactive materials by the public. During remediation operations involving potentially or known radioactive materials, air samples will be collected near intrusive soil sampling activities at the site using low volume or variable rate air samplers. The collection and analysis of the air samplers will be performed with qualified personnel, in accordance with approved procedures and with calibrated equipment. The minimum detectable activity of the air sample and counter combination must be able to detect is <4.0 E-15 μCi/ml (Th-232).

When sampling for certain nuclides with very low Derived Air Concentration (DAC) values, such as Th-232, special considerations must be taken. During these times, the Minimum Detectable Concentration (MDC) desired for the sampler/counting instrumentation may be almost impossible to obtain, due to the very large volumes of air and/or long counting times needed to obtain the desired MDC. The following steps, which are described in Field Procedure FP-15, "Air Sampling," can be taken to determine if long-lived isotopes with very low MDCs may be present on a given air sample filter:

- Establish a graph of the time versus gross counts per minute for the decay of a typical air sample collected during normal, non-intrusive activities at the site. This will result in a graph depicting the decay (slope) of naturally occurring, short-lived isotopes (i.e., Radon decay products) present on the air samples. Typically, two to three half-lives of short-lived nuclides will be observed and documented within 17-20 hours of the first counting.

- Count each sample immediately after collecting air sample and again after approximately 17-20 hours. If decay of radioactive materials represented by 2 to 3 half-lives are observed after this time, it can be assumed that the filter contains naturally occurring, short-lived activity associated with radon, not long-lived activity from radionuclides such as Ra-226 or Th-232.

- As an added precaution, a predetermined number of samples can be sent to an offsite laboratory and analyzed for the nuclide of interest, thus providing additional data to demonstrate compliance to the specific DAC value, as listed in 10 CFR 20, Appendix B, Table 1.

4.1.1.3 Liquid Radioactive Materials

Liquid radioactive materials that may be generated as a result of characterization activities will be sampled and analyzed to determine that the material is within the limits established in 10 CFR 20, Appendix B, Table 2 for Ra-226, Th-232 and Th-228. The sample collection and analysis will be performed with qualified personnel.

If sample results are greater than the NRC 10 CFR 20, Appendix B, Table 2 limits, an evaluation will be performed to determine proper corrective action and disposition of the liquid.

4.1.2 Actions

If any environmental pathway exposure exceeds the limits, then characterization operations will be reviewed by the PM and PRSO to determine the cause of increased pathway exposure and the effect of the exposure on the public and the environment.

Additional measures (i.e., watermisting, tarping, restricting access) will be initiated to reduce the exposure pathway.

4.2 Occupational Radiation Monitoring and Exposure Limits

4.2.1 Radiation Exposure Limits

Radiation exposure limits are used for controlling personnel exposure to radiation (excluding medical and dental exposures) to levels which are believed to cause no ill effects even if the employee was exposed to these levels throughout his/her working life. These limits are based on those promulgated by Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation." Personnel should endeavor to maintain their own exposures as low as reasonably achievable and below these limits.

The occupational exposure limits (10 CFR 20.1201(a)) and the Prometcor administrative exposure limits for radiation workers are given in Table 4-1. It will be the goal of McLaren/Hart to maintain individual radiation exposure to less than 1 Rem.

4.2.2 Exposure to Minors

The occupational dose limits for minors specified in 10 CFR 20.1207 is 10 percent of the annual dose limits specified for adult workers.

However, to minimize exposures to minors, individuals under the age of 18 are not permitted to enter any radiologically restricted area at the site.

4.2.3 Exposure to Unborn Child

Because of the high radiosensitivity of newly formed and fast growing cells, female employees who work in radiologically restricted areas and their supervisors will be advised of the National Council on Radiation Protection and Measurement recommendations to keep radiation exposure to an embryo or fetus to the very lowest practical level during the entire gestation period and to limit the dose to the unborn child to a maximum 500 mrem or less during the entire period of pregnancy as specified in 10 CFR 20.1208 (a).

The dose to an embryo will be taken as the sum of the deep dose equivalent to the declared pregnant woman and the dose to the embryo/fetus from radionuclides in the declared pregnant woman.

The McLaren/Hart policies regarding exposure to an embryo or fetus are derived from those of Regulatory Guide 8.13 and 8.36 and are very strict in limiting the exposure of fertile females.

These policies are in place to protect the unborn child.

- It is the responsibility of all fertile females on site whose job involves work with radioactive material to declare their pregnancy to their supervisor/manager as soon as it is confirmed.

- Upon declaration of pregnancy, it is the responsibility of McLaren/Hart management to ensure that all proper precautions are taken to minimize exposure to the unborn child of the female employee.

As part of the radiation safety orientation training and prior to issuance of TLDs (if required), all

personnel authorized to receive radiation exposure will be given specific instruction about prenatal exposure risks to a developing embryo and fetus. This instruction will include both orally and in writing, the applicable information contained in the Appendix to U.S. Nuclear Commission Guide 8.13 (see Figure 4-1).

The signed statements will be kept with the training records and will be retained by McLaren/Hart as part of the project files.

4.2.4 Exposure to Visitors

McLaren/Hart will control the exposure of visitors to its worksite to levels as low as reasonably achievable (ALARA). For exposure control purposes a "visitor" is defined as any person not qualified as a "radiation worker" and who requires access to radiologically restricted areas.

Entry by a visitor to a radiologically restricted area will require the following:

(1) Assignment of a temporary TLD badge or self-reading dosimeter;

(2) Escort by a qualified radiation worker at all times while in the radiologically restricted area

(3) Documentation of the following information:
   (a) Name
   (b) Social Security Number
   (c) Date of Visit

Visitors are not allowed access to any area where there is a significant risk of internal deposition of radioactive material.

4.3 Personnel External Exposure Monitoring

4.3.1 Equipment

As stated previously, the purpose of personnel monitoring for external radiation is to provide an indication of the level of external radiation to which an individual has been exposed. Monitoring for external radiation exposure will be accomplished with the use of primary dosimetry and radiation survey dose rate meters. The primary dosimeter for this project will be the thermoluminescent dosimetry badge (TLD) capable of measuring the worker's whole-body (deep and shallow dose equivalent) exposure.

Other devices that will be available for exposure control are self reading dosimeters and dose rate survey meters. The self reading dosimeters will be used by visitors to the site and as directed by the PRSO or designee.

The radiation survey dose rate meter for this project will have a minimum detection rate of 2 μR/hr, an accuracy of " 10%, and a response time of 15 seconds. Radiation and/or contamination instrumentation and specifications are presented in Table 4-2.

4.3.2 Calibration

Portable dose rate survey instrumentation used to evaluate personnel exposure will be calibrated semi-annually by a qualified vendor in accordance with ANSI N42.17A-1989 guidance for each type of radiation of concern at the site. Portable instrumentation will be source checked each day the instrument is in use. All calibrations will be performed using standards traceable to the National Institute of Standards and Technology (NIST).

Self reading dosimeters will be tested semi-annually by a qualified vendor in accordance with ANSI N13.5-1972 (R 1989) guidance. TLD badges do not require field calibration, but must meet the performance criteria found in ANSI N13.15-1985.

4.4 Survey and Dosimetry Requirements

4.4.1 Surveys

Surveys for radiation levels and/or contamination levels will be performed using appropriate portable radiation survey dose rate meters prior to working on known or materials suspected of being contaminated to assess the level of hazards and aid in the establishment of appropriate radiological controls.

These surveys will be performed by qualified individuals using calibrated instruments and in accordance with approved procedures.

4.4.2 Dosimetry

Consistent with 10 CFR 20.1502, all personnel who are likely to receive, in one year from sources external to the body, a dose in excess of 10 percent of the limits specified in 10 CFR 20.1201(a) will be monitored by dosimeters. While it is unlikely that any worker will receive a dose in excess of 10 percent of the specified limits, a voluntary dosimetry program will be established for the following:

(1) Personnel entering an area posted as a radiation area.

(2) Personnel who routinely remain in spaces immediately adjacent to radiation areas. Even though the general area radiation levels in the space are less than one mRem per hour, personnel may be monitored.

(3) Personnel who directly handle or touch radioactive material, or personnel in a controlled surface contamination area, even though they do not enter a radiation area. However, it is permissible for personnel to handle radiation survey instruments containing check sources without being monitored with dosimeters.

4.4.2.1 Thermoluminescent Device (TLD)

If utilized, McLaren/Hart will use TLD badges to measure personnel radiation exposure for permanent record purposes. The TLD measures ionizing radiation by emitting a measurable amount of visible light which is directly proportional to the amount of incident radiation. The TLD measures both beta and gamma exposure.

The results of the TLD badge measurements are the basis of the legal record of an employee's exposure. Therefore, any deliberate action by an employee which invalidates the TLD measurements is cause for disciplinary action.

An individual's permanent TLD badge will be worn on the front of the body between the waist and neck, facing away from the body. TLD badges are to be placed in the special onsite storage location when not being used. TLD badges are not to be taken offsite (i.e., home, car).

All personnel required to regularly enter and work in the radiologically restricted area will be provided with a primary dosimeter (TLD). This dosimeter will be worn daily throughout the duration of the project. Dosimetry will be analyzed at the completion of the project to determine radiation exposure of the individual. Visitors will be assigned a temporary dosimeter (TLD) or a self-reading dosimeter (SRD).

4.4.2.2 Issuance

Workers will not be issued a TLD until the worker has:

- Provide evidence of the physical fit for duty and fit for respirator use (when required).
- Completed NRC Form 4.
- Provide a urine sample for baseline bioassay (when required).

All employees upon permanent departure from the project will turn in dosimetry and provide a urine sample (if required) for closeout bioassay.

4.4.2.3 Loss or Damage of TLDs

Each instance of a lost or damaged personnel TLD will be reported promptly to radiological control personnel.

Individuals who lose or damage their TLD while in a radiologically restricted area will immediately exit the area and report the condition to the RCT. The individual will be restricted from entering restricted areas until an exposure estimate has been completed and a new TLD issued.

4.5 Analysis

Dosimetry will be provided, processed and evaluated by an offsite dosimetry processor that:

(1) Holds current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NAVLAP) of the National Institute of Standards and Technology (NIST); and

(2) Approved for the type of radiation (gamma and high energy beta from Ra-226, Th-232 and Th-228 decay products) that most closely approximates the type of radiation for which the individual wearing the dosimeter is monitored.

Dosimeters will be processed at the completion of the project.

4.6 Recordkeeping

4.6.1 Dosimetry

When self reading dosimeters are used, the daily exposure will be recorded and tracked on a separate form for visitors and as a portion of the Radiation Work Permit (RWP) for radiation workers. Copies of TLD results (NRC Form 5) as they relate to a named employee will be maintained by McLaren/Hart and available for inspection. Personnel monitoring reports will be maintained with guidance from NRC Regulatory Guide 8.7, Rev. 1, 1992.

Copies of NRC Form 4 and Form 5 for individual workers will be maintained as part of the project file for the duration of the project.

4.7 Radiation and Contamination Surveys

Records of radiation and contamination surveys will include:

(1) Date and time of survey.
(2) Type(s) of instrument(s) used, including the model numbers and calibration information.
(3) Sketch and description of survey area.
(4) Contact and general exposure rates and/or contamination levels.
(5) Location of any boundaries and step-off pads.
(6) Name of individual performing survey and reviewing supervision.

A form that includes the information presented above will be developed for this project.

Records of all surveys will be maintained by McLaren/Hart for the duration of the project.

4.8 Personnel Internal Radiation Limits and Exposure Control

It is the policy of McLaren/Hart to maintain the internal exposure of radioactive materials to ALARA. The use of engineering controls to the maximum extent possible will be employed. If engineering controls are not adequate, as demonstrated by work area air sampling, then respiratory protection will be considered to control internal exposures to radioactive materials. The effectiveness of the internal exposure control program will be confirmed through the use of air sampling surveys and bioassay.

Characterization operations will be controlled such that no member of the public and no worker will exceed any 10 CFR 20 nonoccupational or occupational limit, respectively, and the total of all workers' internal exposures will be limited to the lowest reasonably achievable.

4.8.1 Engineering Controls

Engineering controls will be utilized to the maximum extent possible to control the production of dusts during the characterization activities. Engineering controls may be, but are not limited to using tarps or coverings, water misting or dust control additives.

5.0 ACTION LEVELS

5.3.1 Action Levels for Radiation

The main goal of the McLaren/Hart radiological control activities is to maintain all radiation levels ALARA. To achieve this goal, action levels for the McLaren/Hart Remediation Project have been established for potential external and internal radiation exposure and will be 10% of annual dose limits as determined by direct reading instruments or air sample results.