Section 4
BUILDING INTERIOR

4.1 OVERVIEW OF BUILDING 14 INTERIOR REMEDIAL ACTION

The remedial action for the Building 14 interior was conducted almost exclusively by IDM, Inc. from January 1997 through August 1998 under subcontract to Bechtel National, Inc. A single area, Area 20A-East, was remediated by another contractor in 1996 and was inspected and released by the IVC. An initial characterization of portions of the building interior was conducted by TNU, Inc. during 1995 and 1996. This delineation work was done to evaluate the need for remedial work within the building, provide a basis for estimating the scope and cost of such work, and obtain sufficient data to perform supplemental limit calculations for use during the remedial action.

4.1.1 Data Sources

The data upon which this report are based were obtained almost exclusively through the IDM delineation and verification work. IDM also collected samples of subsurface soil during both the delineation and verification stages for radiological analysis. Samples of other solid materials, such as dust, grease, creteplank (a roofing material), and sludge were collected where appropriate and analyzed for radiological constituents to assist in the delineation. The results from the TNU delineation and verification surveys in Area 20A East provided the basis for the discussion of that area. Also included are the results of radon sampling conducted by the IVC.

The data collected by IDM and used in the preparation of this report include the following;

- Delineation Surveys (Appendix B)
- Verification Surveys (Appendix C)
- Verification Survey Results (Appendix D)
- Sample Radiological Analytical Results (Appendix E)
- Process Piping Report (Appendix F)

The delineation and verification surveys include continuous scan (delineation surveys only), direct α and β/γ activity measurements, and removable direct α and β/γ activity measurements. The soil and other samples collected were analyzed by gamma spectroscopy for various radionuclides and total uranium.

4.1.2 Structure of Section 4

This section describes the radiological condition of the building interior as delineated, summarizes the remedial actions taken, and documents the post-remedial radiological status of the building. Sections 4.2 through 4.16 each cover one area or set of areas that were handled as a single unit during the remedial action. Section 4.17 discusses the overhead process piping, which was investigated as single coherent feature of the building rather than as part of the individual areas in which the piping was present. Section 4.18 presents the results of the radon survey, and Section 4.19 discusses the in-bed drainlines.

The discussion of each area generally follows the same outline although it varies somewhat depending on the particular features of a given area. The main subsections in the discussion of each area generally follow the outline given below:

- Area Description and Usage
- Floors
- Subsurface Soil and Other Features
- Ceiling
- Walls
- IVC Inspections
- Application of Supplemental Limits

In some cases, there were additional features, such as the crane rails in Areas 14 North or 14 South, which would warrant a specific subsection within the area discussion. Throughout the course of the remedial action, it has been apparent that the actions taken by the remedial subcontractor and the focus of interested parties could readily be categorized by the different locations or surfaces within each area of the building. The above outline was therefore developed to help reviewers locate information on a given location within an area. The three general stages of the remedial action (delineation, remediation, and verification) were best described with respect to each building surface (e.g., floors, walls) or feature (e.g., subsurface soil, crane rails) in order to meet the stated objectives.

During the delineation stage, a combination of previous delineation data (by TNU), IDM delineation data, and professional judgment was used to determine the extent of contamination. Where it was evident that a surface was contaminated, less effort was expended in the delineation stage to allow resources to be shifted to the remedial work, expedite the work, and return the area to the property owner's use as soon as possible. If it was evident that minimal or no contamination was present, then the effort and focus were shifted from the delineation to the verification surveys. This approach is described in more detail in the sections for those areas where it was utilized.

Area Description and Usage: This section documents the past and present use of the area. Historical documents were reviewed, and knowledgeable personnel were interviewed during the remedial action to gain some insight into the operations that occurred within a given area, the construction of the area, and how it had changed since the start of MED operations. The extent and accuracy of such information was limited, and therefore it was difficult to describe the historical usage in detail in most instances.

Floors: The floors are included as a separate section in this report because they were delineated, remediated, and verified as a distinct surface. In each area or group of adjoining areas (e.g., Area 8A, 9A, 9B, 9C, 9D, and 9) a common grid on 1-meter by 1-meter centers was established with the origin at the southwest corner. Typically any tile present on the floor was removed to allow access to the original concrete slab. Where contamination was found, the floors were decontaminated using a Blastrac and, in some cases, a jackhammer where more extensive contamination occurred. In some instances the concrete floor slab was removed, regardless of whether it was contaminated or not, to allow access to the underlying contaminated soil. The verification surveys were performed, and the results are presented in a figure.

Subsurface Soil and Other Features: In most areas, subsurface soil samples were collected from soil borings and analyzed for radiological constituents to determine if the soil exceeded the site-specific criteria. In several areas, notably Areas 14 South, 14 North, 13, and 9, significant quantities of contaminated soil were removed. The open excavations were verified prior to backfilling by collection of composite samples on a systematic grid. The analytical results of the characterization, verification, and other samples are summarized in tables in Section 4, and the complete results are presented in Appendix E. The results presented in the summary tables are limited to the constituents for which generic or site-specific criteria are applicable to the Linde Site (total uranium, radium-226, and thorium-232). This section also addresses other subsurface features such as pipes, trenches, drains, and sumps. In some cases these features were significant enough to be addressed in a separate section.

Ceiling: The ceiling was generally treated as a distinct surface during the three stages of the investigation in the same manner as the floor. The same grid established for the floor was used for the ceiling surveys. The ceiling surveys and remedial work were somewhat more complex in that the work described in the ceiling sections generally included not only the ceiling of the area itself (usually the underside of the roof creteplank) but also the structural steel beams supporting the building. Surveys included both surfaces, but often the effort was focused on the structural steel components as it became evident that most of the contamination on the ceiling and overheads was present on the steel with the highest levels found on the upper horizontal surfaces of the beams. In several areas, mobile cranes and crane rails were present. These features were considered distinct enough from the walls, ceiling, and structural steel that they were surveyed and reported as distinct features. When the verification surveys were performed on the ceiling, an effort was made to include each type of surface present within a given grid cell to obtain a set of representative measurements and ensure that all features were included in the verification surveys. Therefore, the five-point measurements might include the creteplank ceiling, steel I-beams, and perhaps a pipe, conduit, or duct, where present. The results of the verification surveys for the ceilings are then presented in a figure.

Walls: The walls were addressed as separate surfaces for the same reasons as the floor and ceiling. The grid system used for the walls is based on that of the floor. The appropriate northing or easting floor grid cell coordinate is used along with a vertical coordinate to describe the wall cell location. Like the ceiling, structural steel beams were present along some of the upper walls and are therefore included in the surveys and discussions of those walls. The brick surfaces of the walls were generally among the least contaminated surfaces of the building. The walls were delineated, remediated, and verified in the same fashion as the floors and ceilings.

IVC Inspections: The role of the IVC in the remedial action in Building 14 was to provide an independent check of the post-remedial condition of the building. The IVC inspections and release letters pertaining to each area are summarized in this section. These letters are also included in Appendix G to demonstrate that each area has been fully inspected and determined to be below applicable radiological guidelines and criteria. The letters were issued to facilitate the release of each area to expedite the restoration and betterment activities performed following remediation in each area. A comprehensive report by the IVC will be issued at a later date.

Locations Exceeding Remedial Action Criteria: Provisions are made under DOE regulations for the application of supplemental limits in cases where remediation to existing generic guidelines or site-specific criteria would be considered cost prohibitive or for other reasons as discussed in Section 1. Those locations within each area where residual contamination exceeded the remedial action criteria are identified and discussed in the appropriate preceding subsection (floors, walls, etc.), and all locations, if there were any within the area, are summarized in this subsection.

4.1.3 Presentation of Results

Careful consideration was given in preparation of the PRAR as to the presentation of the results of the remedial action. An extensive body of data was collected during the delineation and verification stages, and considerable effort was expended during remediation of most surfaces throughout the building and much of the subsurface soil. Since the remedial action was a single-phase activity combining the delineation and remediation stages, it was decided not to present the results of the delineation stage in detail within the main text of the report. Such a presentation would be appropriate following the characterization of a structure for which the remedial action would be conducted in a separate and future action. However, given that the conditions represented by the delineation data no longer existed at the time this PRAR was prepared, the value of such a presentation would be limited. This information, nonetheless, has been retained and included in this report in the form of the set of delineation surveys in Appendix B.

A set of summary figures has been developed, one figure for each area in most cases, which captures the significant remedial activities occurring in each area and, in some instances, the extent of contamination. These are presented as the first figure in each of the subsections in Section 4 and usually illustrate such items as the extent of soil excavation; soil sample locations; areas of wall, floor, and overhead decontamination; and other significant features of the area. If an entire surface was decontaminated in an area with no unusual attributes noted, then that effort is not necessarily included in the figure but is clearly described within the text. The objective was to identify distinctive boundaries or locations of contamination or remedial activities on a given surface rather than to serve as an exhaustive summary of all remedial actions. Of particular importance in these figures are the locations of the areas at which supplemental limits will be applied. These locations, each assigned a location code such as LEC-14N-3, are shown in sufficient detail to aid in identifying and locating that feature in the future. The relevant surveys are cited in the text so that they may be reviewed if further information is desired.

One of the primary functions of the PRAR is to document the results of the remedial action. This remedial action resulted in the generation of large amounts of verification data in the form of the results of direct measurements and swipe samples. It was judged that a compilation of surveys or a tabular presentation of the data would not provide an adequate description or understanding of the post-remedial radiological status of the building. Therefore, the results of the verification surveys were compiled into an electronic database and presented in graphical form. Within each subsection are figures illustrating the results of the verification surveys. In most instances, one figure was prepared for the floor, one for the ceiling, and one or more for the walls. The purpose of the design of the figures was multifold: to present the results in a readily understandable manner, to illustrate the extent of coverage of each surface, and to demonstrate compliance with the generic surface guidelines. All four types of data are presented for each surface: direct-β/γ, direct-α, removable-

β/γ, and removable-α. Color was used to enhance legibility and illustrate the residual levels of surface activity. One color scale was used for direct measurements and a second color scale for removable measurements. In an evaluation of the extent of coverage, factors such as restricted access due to obstructions, sampling procedures (e.g., direct-α measurements taken at 10% of the direct-β/γ measurement locations), and the availability of previous survey results should be considered. These data, in conjunction with the data collected by the IVC, were used to release all surfaces and subsurfaces in all areas of the building as noted in the IVC letters.

4.2 AREAS 2 AND 3

This section describes the present and historical uses of Areas 2 and 3, presents the results of delineation surveys, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area.

4.2.1 Area Description and Usage

Areas 2 and 3 are located in the south-central portion of Building 14, adjacent to the large hallway. This area is beneath the first roof level and has a ceiling height of about 17.5 feet. The approximate floor dimensions are 46 feet long by 20 feet wide, covering an area of approximately 900 square feet.

During MED operations, the eastern portion of Areas 2 and 3 was used as a storage area (presumably in support of laboratory activities). Historical drawings suggest that the western portion was used as a bathroom/shower facility. A wall separating the storage area and the bathroom has since been removed, and the areas are currently used as one common storage area.

A 1-meter grid reference coordinate system was established for the floor, with the origin (A-0) located at the southwest corner. The grid system was established to facilitate selection of measurement and sampling locations and to provide a mechanism for relocating specific survey points for remediation and subsequent verification.

IDM, Inc., conducted the delineation survey, decontamination, and post-remedial action survey of these areas. The delineation surveys, the remediation work, and the post-verification surveys were conducted from April through July 1997. ORNL performed the IVC surveys during the week of September 15, 1997.

4.2.2 Floors

Delineation surveys were performed with particular emphasis placed on areas with a greater potential for contamination (e.g., drains, trenches, and corners/edges). The extent of floor contamination is shown in Figure 4.2-1. In general, contamination was limited to areas of the floor immediately adjacent to the walls. Larger areas of contamination were observed on the floor near the double door entrance next to the north wall and next to the opposite south wall. The depth of contamination varied from 0.25 to 1 inch, with the deeper contamination (0.5 to 1 inch) found along the north wall next to the northeast column (grid cells F-1 through F-4) and along the south wall, opposite the double doors (grid cells A-8 to C-10). These areas of deeper contamination also exhibited the highest readings for Areas 2 and 3 (approximately 80 to 100 times background).

Following removal of the tile and mastic, the concrete floor was decontaminated with several pieces of equipment, depending upon the nature and extent of contamination. For most of the floor surface area, a portable Blastrac shot-blasting unit was used to remove the upper 0.25 to 0.5 inch of floor material. Needle scaling guns were then used to remediate the edges of the floor and other areas where access was restricted. Light use of a jackhammer was employed to remove floor material where deeper contamination was found (0.5 to 1 inch). The concrete slab around the northwest column was removed to permit access to the contaminated subsurface portions of the column. Following the completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. Results of verification surveys for the remediated floor and subsurface sections are presented in Figure 4.2-2. All results are below the DOE generic guidelines for both average and removable surface activity.

4.2.3 Subsurface Soil and Other Features

Soil borings were advanced at eight locations within Areas 2 and 3 to evaluate the potential for subsurface contamination (Figure 4.2-1). Boring locations were based on the presence of elevated levels of floor contamination and proximity to floor drains. Discrete samples were collected at four depth intervals (0 to 1, 1 to 2, 2 to 3, and 3 to 4 feet) from each borehole. Each sample was analyzed for uranium-238, total uranium, radium-226, thorium-232, and potassium-40. The summary analytical results for total uranium, radium-226, thorium-232 are presented in Table 4.2-1. The complete analytical results are provided in Appendix E. Total uranium was detected at concentrations ranging from 0.3 to 10.7 pCi/g. Radium-226 was detected at concentrations ranging from 0.6 to 5.72 pCi/g, and thorium-232 was detected at concentrations ranging from 0.7 to 1.1 pCi/g.

All detected concentrations of total uranium from these ten borings were below the site-specific criterion of 60 pCi/g above background. All detected concentrations of radium-226 and thorium-232 were below the DOE generic guidelines for soil. Site-specific or generic guidelines have not been established for the other radionuclides that were included as analytes (uranium-238 and potassium-40).

Two floor drains are located within Areas 2 and 3 (shown in Figure 4.2-1). The drain in the western portion (B-3) is likely the remnant of the sewer line from the bathroom/shower facility. The eastern drain is believed to run southwest toward the drywall insert on the south wall. The function of this drain is not known. Both floor drains were surveyed and found to be within background levels.

After the surrounding concrete floor slab was removed, the subsurface footer/wall column on the north wall was decontaminated using jackhammers. Underlying soil was excavated to a depth of approximately 3 feet. Results from a soil sample obtained at the bottom of the excavation (grid F-5, Sample 724) indicated total uranium concentrations of 3.3 pCi/g. The results of all other soil samples collected from the soil borings were below generic and site-specific criteria.

4.2.4 Overheads and Ceilings

Delineation of the overheads included surveying the ceiling surface, suspended false ceiling tiles, heating ducts and exchangers, pipes, structural steel beams, and vent openings. The results of process piping surveys performed in Areas 2 and 3 are discussed in Section 4.17. Contamination was not detected in the false ceiling tiles and associated framing. As depicted in Figure 4.2-1, contamination was limited to certain pipes and valves: the 6-inch vertical pipe (280 cpm, grid A-4); 6-inch horizontal sewer pipe (270 cpm, grid A-0 to A-4); conduit tee in northwest section (250 cpm, grid F-0); asbestos steam piping insulation (320 cpm, grids A-13 to D-13); asbestos steam pipe insulation (250 cpm, grids A-5 to G-5); steam valve (600 cpm, grid A-13) (IDM Survey No. 277, background: 62 cpm). With the exception of small portions of the overheads and ceiling where access was restricted, all interior surfaces were thoroughly scanned.

Contaminated overhead structures were either removed (e.g., asbestos insulation on steam pipes) or decontaminated using needle scaling guns. Following completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. Results of the verification surveys for remediated overhead sections are presented in Figure 4.2-3. All results are below the DOE generic guidelines for both average and removable surface activity.

4.2.5 Walls

The interior walls were contaminated along the lower portions and base (less than 1 meter in height). More extensive contamination (up to 2 meters high and 1 inch deep) was observed on the north wall (western section) and south wall (central-eastern section). These contaminated wall surfaces generally correspond to the areas of deeper contamination found on the floor. At the western section of the north wall, contamination extended to a depth of 3 feet around the structural wall/footer column.

The lower portion of the walls (less than 1 meter) was decontaminated by needle scaling gun. Areas of more extensive contamination required removal of the brick sections of the wall using a jackhammer. Following completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. Results of verification surveys for the remediated wall sections are presented in Figure 4.2-4. All results are below the DOE generic guidelines for both average and removable surface activity.

4.2.6 IVC Inspections and Post-Remedial Action Status

During the week of September 15, 1997, ORNL representatives conducted an independent verification survey of Areas 2 and 3, following completion of remedial activities and verification surveys by IDM. The IVC results, summarized in correspondence from ORNL to DOE dated October 27, 1997, provide third-party verification that the area has been remediated to the appropriate cleanup criteria. The letter states: "*In Building 14, we have designated Areas 2, 3, 4, the hallway areas, all first floor offices (with the exception of 8A and 9A-D), and the Men's and Women's restrooms as being below Department of Energy Criterion*
releases Areas 2 and 3 in their entirety.

After clearance from the IVC, Areas 2 and 3 were restored to their original condition. Sections of the brick wall that were removed during decontamination were replaced with new bricks. The

cement floor was repaired, and new floor tile was installed. Equipment that was relocated during the remediation effort was moved back into place.

4.2.7 Locations Exceeding Remedial Action Criteria

All contaminated surfaces and subsurfaces within Areas 2 and 3 were remediated to below applicable criteria.

4.3 AREA 4

This section describes the present and historical uses of Area 4, presents the results of delineation surveys, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area.

4.3.1 Area Description and Usage

Area 4 is located in the southwestern portion of Building 14, adjacent to the large hallway and west of Areas 2 and 3. The approximate floor dimensions are 30 feet long by 20 feet wide. Area 4 is beneath the first roof level and has a ceiling height of about 17.5 feet. The area is divided into two general sub-areas by a permanent dividing wall. The western sub-area (referred to as "Area 4-Main") and the eastern sub-area ("Area 4A/4B") are connected by a doorway in the dividing wall. Two additional walls were erected within Area 4A/4B to enclose Area 4A. These walls are post-MED modifications.

During MED operations, Area 4-Main is believed to have been used as an ore preparation room ("grinder room"), presumably in support of laboratory activities. The grinder room is reported to have contained a gyratory sifter, centrifugal sifter, pot mill, disc mill, roll mill, gyratory mill, and calcium chloride solution tanks. The use of Area 4A/4B is less certain. It may have been used in support of grinder operations or as an office and/or changing room, judging by its proximity to the bathroom/shower facility in Areas 2 and 3. Currently, Area 4-Main houses miscellaneous laboratory equipment, and Area 4A/4B is used as an office. At the time of remediation, a fume hood was present next to the east wall of Area 4-Main. The hood was scanned and found to be free of contamination prior to its removal.

A separate 1-meter grid reference coordinate system was established for the floor of each sub-area (Area 4-Main and Area 4A/4B). The origins (A-0) of both grids are located at the southwest corner. The grid system was established to facilitate selection of measurement and sampling locations and to provide a mechanism for relocating specific survey points for remediation and subsequent verification.

IDM conducted the delineation survey, decontamination, and post-remedial survey operations of these areas. The delineation surveys, the remediation work, and the post-verification surveys were conducted from May to August 1997. ORNL performed the IVC surveys during the week of September 15, 1997.

4.3.2 Floors

Delineation surveys were performed with particular emphasis on such areas as drains, trenches, and corners/edges, where the potential for contamination was greater. The extent of floor contamination is shown in Figure 4.3-1. In general, contamination was observed on the surface of the concrete floor (about 0.25 inch deep), beneath the floor tile and mastic layer. Based on similar findings in the large hallway and Areas 2 and 3, a limited delineation was performed to verify the presence of contamination. At various locations, contamination levels up to ten times background were observed following the removal of the tile and mastic layer. Consequently, the entire floor surface was conservatively assumed to be contaminated.

Following removal of the wall baseboard, floor tile, and mastic, the concrete floor was decontaminated with several pieces of equipment, depending upon the nature and extent of contamination. For most of the floor surface area, a portable Blastrac shot-blasting unit was used to remove the upper 0.25 to 0.5 inch of floor material. Needle scaling guns were used to remediate the edges of the floor and other areas where access was restricted. Following completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. Results of verification surveys for the remediated floor are presented in Figure 4.3-2. All results are below the DOE generic guidelines for both average and removable surface activity.

4.3.3 Subsurface Soil and Other Features

Soil borings were advanced at three locations within Area 4-Main and two locations within Area 4A/4B to evaluate the potential for subsurface contamination (Figure 4.3-1). Boring locations were based on the presence of elevated levels of floor contamination and proximity to floor drains. With the exception of the boring at grid F-0, discrete samples were collected at four depth intervals: 0 to 1, 1 to 2, 2 to 3, and 3 to 4 feet from each borehole. Boring F-0 was terminated 1 foot bgs when the drill struck the wall footer underneath the floor. Each sample was analyzed for uranium-238, total uranium, radium-226, thorium-232, and potassium-40. The summary analytical results for total uranium, radium-226, and thorium-232 are summarized in Table 4.3-1. The complete analytical results are provided in Appendix E. Total uranium was detected at concentrations ranging from 0.5 to 10.0 pCi/g. Radium-226 was detected at concentrations ranging from 0.39 to 5.29 pCi/g, and thorium-232 was detected at concentrations ranging from 0.25 to 1.10 pCi/g.

All concentrations of total uranium were below the site-specific criterion of 60 pCi/g above background. All concentrations of radium-226 and thorium-232 were below the DOE generic guidelines for soil. Site-specific or generic guidelines have not been established for the other radionuclides that were included as analytes (uranium-238 and potassium-40).

4.3.4 Overheads and Ceilings

Delineation of the overheads included surveying the ceiling surface, suspended false ceiling tiles (only in Area 4A/4B), heating ducts and exchangers, pipes, valves, and structural steel beams. With the exception of small portions of the overhead/ceiling where access was restricted, all interior surfaces were thoroughly scanned.

The only contamination observed in the overheads was in an approximately 1-foot-long remnant of steel piping that previously ran through the dividing wall between Area 4-Main and Area 4A/4B. The 4-inch-diameter pipe was previously cut flush with the wall surface on both sides, and only the length of pipe within the wall remains. Measurements taken within the pipe were about eight times background (IDM Survey 053). This section of overhead pipe was remediated by needle guns and/or die grinder.

Following completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. Results of verification surveys for the remediated overhead sections are presented in Figure 4.3-3. All results are below the DOE generic guidelines for both average and removable surface activity.

4.3.5 Walls

The original interior walls were contaminated along the lower portions and baseboards (less than 1 foot above the floor). Similar to the floors, a limited delineation effort was performed to confirm the presence of contamination. Based on the findings of contamination at various locations on the lower walls (up to ten times background), the entire lower portion of the original walls in Area 4 was conservatively assumed to be contaminated. With the exception of a small area behind the fume hood, wall surfaces above 1 foot were not contaminated. The contamination behind the fume hood was limited to a height of 1 meter on the brick wall surface. The walls enclosing Area 4A are post-MED modifications and were not contaminated.

The lower portion of the walls and the brick area behind the fume hood were decontaminated by needle scaling guns. Following completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. Results of verification surveys for the remediated wall sections are presented in Figures 4.3-4 and 4.3-5. All results are below the DOE generic guidelines for both average and removable surface activity.

4.3.6 IVC Inspections and Post-Remedial Action Status

Following completion of remedial activities and verification surveys by IDM, an independent verification survey of Area 4 was conducted by ORNL during the week of September 15, 1997. Their results, which are summarized in correspondence from ORNL to DOE dated October 27, 1997, provide third-party verification that the area was remediated to the appropriate cleanup criterion: "*In Building 14, we have designated Areas 2, 3, 4, the hallway areas, all first floor offices (with the exception of 8A and 9A-D), and the Men's and Women's restrooms as being below Department of Energy Criterion.*" This letter therefore releases Area 4 in its entirety.

After clearance from the IVC, Area 4 was restored to its original condition. The cement floor was repaired, and new floor tile was installed. Equipment that was relocated during the remediation effort was moved back into place.

4.3.7 Locations Exceeding Remedial Action Criteria

All contaminated surfaces and subsurfaces within Area 4 were remediated to below applicable criteria.

4.4 LARGE HALLWAY

This section describes the results of the delineation surveys and the remedial actions taken in the large hallway. The results of the verification surveys are presented, and the IVC release letter pertaining to this area is summarized.

4.4.1 Area Description and Usage

The large hallway is located south of Area 9 and runs from the loading dock on the west side of Building 14 to Area 14 South (Figure 4.4-1). The hallway is about 82 feet long and 9 to 11 feet wide with a total floor area of about 780 square feet (the loading dock is excluded). The ceiling height is 17.5 feet. A historical drawing (Linde Site drawing A63727, dated 1945) indicates that during MED operations no solid wall existed between Area 9 and the large hallway. An abandoned trench extended into the large hallway from Area 9 at the eastern end of the large hallway, and a pit known as the cylinder test pit was located toward the western end.

4.4.2 Floors

The floor was delineated by Surveys 57, 58, 60, 71, 77, and 375. The floor was covered with non-asbestos-containing tiles, which were removed to facilitate delineation of the concrete floor. Since no wall was present between the large hallway and Area 9 during MED operations, information from previous TNU surveys of the Area 9 laboratory floor suggested that the corridor floor would be contaminated at similar levels. Direct β/γ activity levels at the western end of the hallway were around 5,000 dpm/100 cm^2 or greater, increasing to around 15,000 dpm/100 cm^2 toward the eastern end. Direct β/γ activity measurements along the east wall/floor interface were up to 65,000 dpm/100 cm^2. Similar levels were found along the eastern section of the south wall. Various sections of the rubber expansion joints in the floor also had elevated contamination levels (11,000 to 24,000 dpm/100 cm^2). These measurements were generally regarded as conservative because the mastic remaining on the floor would tend to shield the contaminated surfaces.

The entire concrete floor surface was decontaminated by first removing the tile and then making several passes over the floor with a Blastrac unit and concrete scarifiers. Portable chipping hammers and needle guns were used to decontaminate areas along the walls that were inaccessible to the large equipment.

The results of the verification surveys for the large hallway floor are shown in Figure 4.4-2. The entire floor area was successfully decontaminated, and all results were below DOE generic surface guidelines.

4.4.3 Subsurface Soil and Other Features

Trench. A trench extending from Area 9 into the large hallway appears to have been constructed with the building. The trench was filled with sand and covered with concrete. Samples 593 and 594, collected from underneath the trench, contained total uranium at concentrations of 73.06 and 141.36 pCi/g, respectively. The soil surrounding the trench was subsequently excavated over a 2-meter width to a depth of 2 feet. Samples 725 and 730 were composite verification samples

collected on either side of the trench. The analytical results for both samples were below criteria for all analytes.

Cylinder Test Pit. The pit was 8 feet long by 5 feet wide by 4.5 feet deep and was lined with concrete on the sides and bottom. The bottom of the pit contained 2 to 3 feet of black grease or sludge, which was covered by 2 feet of soil. Several inches of concrete had been poured on top of the soil. A sludge sample collected from the pit (Sample 625) contained total uranium at a concentration of 4,029.77 pCi/g. A soil sample (Sample 626) from the pit contained total uranium at 471.92 pCi/g. A 4-inch-diameter pipe entered the pit at the western end of the base of the north wall. This drainpipe may originate from a trench in Area 9 or it may discharge to another drainpipe system. The pipe was plugged with sediment and clearly was not an active drainline. Sample 727, consisting of sludge collected from inside this drain, contained total uranium at a concentration of 1,468.32 pCi/g.

The cylinder test pit was remediated by removing 2 inches (or more in spots) of concrete from the walls. The concrete bottom was removed entirely along with a 6-inch layer of the underlying soil. The pipe was removed up to a junction next to the wall but could not be removed from underneath the wall because sand underlying a concrete slab in Area 9 caved in during the excavation. Verification soil sample 731 was taken at the base of the excavation and was below applicable criteria for all analytes.

Soil. In addition to the soil removed during the remediation of the trench and cylinder test pit, a section of soil was removed adjacent to the eastern end of the south wall to provide access to the footer. This section ran from grid cell A-17 to A-23 and was 1 meter wide. This soil was not contaminated except for a small area immediately adjacent to the footer.

Ten soil borings were drilled to a depth of 4 feet. The analytical results from these borings are summarized in Table 4.4-1. All of these results were below applicable criteria except for surface samples collected at SB-2 and SB-3, which had thorium-232 concentrations of 6.20 and 7.18 pCi/g, respectively. These concentrations were equal to or slightly above the generic soil guidelines of 5 pCi/g plus the background of 1.2 pCi/g for surface soil. The soil at SB-2 was left in place underneath the concrete slab, but the soil at SB-3 was removed to provide access to the south wall footer.

4.4.4 Ceiling

The overhead structures showed little evidence of contamination. Survey 340 documents a 1-inch-diameter electrical conduit and an insulated pipe that were contaminated above criteria. The electrical conduit was decontaminated, and the insulation on the pipe was removed and replaced. Survey 358 documents several locations on I-beams where paint samples were collected. The beam surfaces were below criteria at each location, and the analytical results of the paint samples were all below the site-specific criteria for total uranium. Additional survey efforts indicated that no further decontamination was needed. The absence of contamination in the overheads indicates that, despite the lack of a wall, there probably was a barrier of some type between Area 9 and the large hallway during MED operations.

The verification survey results for the large hallway ceiling are shown in Figure 4.4-3. All results were below criteria.

4.4.5 Walls

The north wall appears to have been constructed after the completion of MED operations. Survey 59 shows that all surveyed locations were below background. Remedial action on the north wall was limited to decontamination of the wall/floor interface in conjunction with the floor removal.

The south wall was delineated by Surveys 59 and 60. Direct β/γ measurements on the lower 2 meters of the wall ranged from 10,000 to 25,000 dpm/100 cm^2, with hotspots of up to 84,000 dpm/100 cm^2. This entire wall area was decontaminated using needle guns and chipping hammers. The brick at the base of the wall in the center was also contaminated, as was the expansion joint between the concrete floor slab and the south wall. Soil was excavated on the eastern end of the wall to allow decontamination of the footer to 3 feet below grade. One or two layers of brick were removed, and the top surface of the footer was decontaminated along this length of wall, as shown in Figure 4.4-1.

No contamination was noted on the west wall. A small washroom of post-MED construction is located next to the east wall. A stairwell leads to Area 14 South, and a doorway separates the two areas. The washroom was decontaminated as part of Area 9 because it shares the same ceiling. The stairwell was decontaminated as part of Area 14 South.

The results of the wall verification surveys are shown in Figure 4.4-4. All results were below DOE generic guidelines for surface contamination.

4.4.6 IVC Inspections

ORNL was the IVC for this remedial action. As part of the verification process, ORNL representatives periodically visited the site to review subcontractor data, take additional radiological measurements, and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area or portion of an area within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letter that pertains to the large hallway is discussed below.

ORNL representatives visited the site during the week of September 15, 1997. Following the visit, they issued a letter dated October 27, 1997, which states: *"In Building 14 we have designated Areas 2, 3, 4, the hallway areas, all first floor offices (with the exception of 8A and 9A-D), and the Men's and Women's rest rooms as being below Department of Energy criterion."* This letter therefore releases the large hallway in its entirety.

4.4.7 Locations Exceeding Remedial Action Criteria

All parts of the Large Hallway were successfully decontaminated below applicable criteria. Supplemental limits will therefore not be applied to any areas within the large hallway.

4.5 FIRST FLOOR OFFICES AND SMALL HALLWAY

This section describes the present and historical uses of the first floor offices and the small hallway, presents the results of delineation activities, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area. Figure 4.5-1 summarizes the extent of contamination in these areas and the remedial actions conducted.

4.5.1 Area Description and Usage

The first floor offices are located along the west wall of Building 14. The offices, mens and womens restrooms, mens showers, and small hallway were all included on a single grid and are all discussed in this section of the report. The office area is about 105 feet long and 30 to 34 feet wide and covers an area of about 3,200 square feet. The offices are located underneath the first roof level and the second floor offices and currently have a ceiling height of 8 to 10 feet. Site drawings show that these offices were present during MED operations. The second floor offices are believed to have been constructed sometime after the conclusion of MED operations. A relatively new drop ceiling has been installed in the first floor offices. The west and north walls of the area are the exterior building walls and are constructed of brick. The floors were covered with asbestos tile at the time the delineation was started, with the exception of the mens restroom and shower. Skylights are present in the mens locker room.

4.5.2 Floors

The floor tiles were removed to permit surveying of the concrete floor. Floor delineation data are included in Surveys 440, 454, 473, 495, 497, and 508. The floor area was marginally contaminated, as shown in Figure 4.5-1, with direct β/γ measurements typically in the range of 5,000 to 18,000 dpm/100 cm^2. The contamination on the floor of the offices was primarily near the office doorways. Higher levels of contamination were detected next to the eastern wall of the small hallway, where direct β/γ measurements were typically in the range of 15,000 to 65,000 dpm/100 cm^2. A maximum activity of 1,100,000 dpm/100 cm^2 was detected near the doorway into Area 9.

The entire floor area of the offices, with the exception of Areas 7D and 7G and the small hallway, were decontaminated. Because the mastic remaining on the floor after the tiles were removed could shield, to some extent, any activity present on the concrete, the decontamination was extended to most floor areas beyond those portions identified as exceeding criteria. The decontamination was accomplished primarily by Blastrac, with chipping hammers and needle guns used near the walls. The floor in the small hallway next to the southern end of the east wall required more aggressive decontamination that included the use of jackhammers to remove up to 2 inches of concrete in localized areas.

The results of the verification surveys for the floor are shown in Figure 4.5-2. All results were below DOE generic surface guidelines.

4.5.3 Soil

The first floor offices and small hallway are elevated 4 feet above the exterior ground surface and are at the same level as the adjacent Areas 8 and 9. The eastern two-thirds of the area is built

directly upon soil. The western 10 feet of the offices is over an empty space between the ground surface and the office floor. This space is enclosed by the north and west building exterior walls.

Twenty-seven soil borings were drilled to investigate the soil underlying this area. The soil boring locations are shown in Figure 4.5-1, and the analytical results are summarized in Table 4.5-1. Surveys 477, 496, and 499 include scan data from the concrete cores of several borings. Surveys 543, 544, and 548 contain scan data from some of the sample cores. The soil boring locations were selected based on a review of the historical use of the area and the presence of surface contamination. All borings except SB-7 were advanced in soil immediately underlying the floor slab. Boring SB-7 was drilled through the floor, and a single sample was collected in the 0- to 1-foot depth interval as measured from the exterior ground surface. All results from these samples were below applicable criteria.

4.5.4 Ceiling and Overheads

The ceiling consisted of a concrete slab, which was also the floor for the second floor offices. Gypsum tile covered the underside of the concrete, and a drop ceiling was suspended from the slab. The drop ceiling, which was believed to have been installed after conclusion of MED operations, was removed to permit access to the original ceiling surface. Survey 412 documents the delineation effort of the gypsum ceiling tile. All of the direct β/γ measurements were less than twice the background count.

No decontamination of the ceiling or overheads was required. Verification survey results are shown in Figure 4.5-3. All results were below the generic guidelines for surface contamination.

4.5.5 Walls

The walls were delineated by Survey 413, and minimal contamination was detected. One location on the north wall adjacent to an area of floor contamination required decontamination on the lower 6 inches of the wall. On the southern part of the east wall, the lower wall was similarly decontaminated next to an area of elevated floor contamination. The results of the verification surveys are shown in Figures 4.5-4 through 4.5-9. All results were below the generic guidelines for surface contamination.

4.5.6 IVC Inspections

ORNL was the IVC for this remedial action. As part of the verification process, ORNL representatives periodically visited the site to review subcontractor data, take additional radiological measurements, and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area or portion of an area within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letter that pertains to the first floor offices and small hallway is discussed below.

ORNL representatives visited the Linde Site the week of September 15, 1997. Following that visit they issued a letter dated October 27, 1997. The letter states: *"In Building 14 we have designated*

Areas 2, 3, 4, the hallway areas, all first floor offices (with the exception of 8A and 9A-D), and the Men's and Women's rest rooms as being below Department of Energy criterion." This letter therefore releases the area in its entirety.

4.5.7 Locations Exceeding Remedial Action Criteria

All locations within the first floor offices and small hallway were successfully decontaminated to below applicable criteria.

4.6 SECOND FLOOR

This section describes the present and historical uses of the second floor, presents the results of delineation activities, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area.

4.6.1 Area Description and Usage

The second floor in Building 14 is limited in size and is constructed over the first floor offices along the western wall north of the large hallway. The second floor consists of small offices similar to those on the first floor. Stairwells are located at the south and north ends of the office areas. North of the offices is a larger room called the HVAC room that previously housed the ventilation equipment for the entire building.

The second floor was constructed following the completion of MED operations. The west and north walls of the area are the original exterior walls and are composed of brick. The remainder of the area is composed of small offices with interior walls that are of post-MED construction. A tile floor was placed over a concrete slab, which is the structural floor for the second floor. This slab is believed to have been installed over creteplank that served as the original roof to the first floor offices.

In this section of the PRAR the summary figure, usually included as the first figure in each section, has been omitted. The minimal amount of contamination present and correspondingly low amount of remedial activity did not justify representation of the area in a summary figure.

4.6.2 Floors

Since the floor was of post-MED construction, it was generally expected to be free of contamination. Existing TNU surveys were reviewed, and the data confirmed that assumption. To investigate the slab itself, the floor tiles were removed over about 10 percent of the floor, and exposure measurements were made (Survey 3). Gross β activity measurements were also made using a floor monitor, and these were all within 1.5 times of background. No contamination was detected above criteria on the floors, and therefore no remedial work was performed.

A tank stand was present in the HVAC room and was delineated in Surveys 11 and 12. The tank had previously been removed. The stand was constructed of steel beams on the floor and stood about 1 foot above the floor surface. The surveys can be referenced for the location and construction details. The steel beams were found to be contaminated at 4 to 20 times background. The steel was fully decontaminated below criteria using needle guns and grinders.

The results of the verification surveys for the floor are shown in Figure 4.6-1. All results were below DOE generic surface guidelines.

4.6.3 Ceiling and Overheads

The ceiling and structural steel in the overheads were extensively delineated by Surveys 4, 13, 20, 22, 38, 132, 224, and 240. Samples of the creteplank and paint chips were also collected for isotopic analysis (Survey 129). The structural steel beams were found to be contaminated over much of the area. The highest levels were detected in the center half of the offices and on the eastern side of the offices and HVAC room. The contamination was primarily present on the horizontal surfaces of the beams and not the vertical surfaces. All beams exceeding criteria were decontaminated below generic surface guidelines using needle guns and small disk grinders.

The ceiling subsequently underwent a verification survey, and those results are shown in Figure 4.6-2. All results were below the generic guidelines for surface contamination.

4.6.4 Walls

The walls in this area were of post-MED construction except for the exterior north and west walls. The TNU surveys were reviewed and indicated minimal contamination. The only remedial actions performed on the walls occurred at the locations where overhead steel beams connected to the walls. At these locations, very localized contamination was present as a result of rust from the beams. These locations were decontaminated along with the steel beams.

The results of the verification surveys are shown in Figures 4.6-3 and 4.6-4. All results were below the generic guidelines for surface contamination.

4.6.5 IVC Inspections

ORNL was the IVC for this remedial action. As part of the verification process, ORNL representatives periodically visited the site to review subcontractor data, take additional radiological measurements and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area or portion of an area within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letter that pertains to the second floor is discussed below.

ORNL representatives visited the Linde site the week of April 14, 1997. Following that visit they issued a letter dated May 5, 1997. The letter states: *"We have declared the second floor as being below Department of Energy guidelines."* This letter therefore releases the second floor in its entirety.

4.6.6 Locations Exceeding Remedial Action Criteria

All locations on the second floor were successfully decontaminated to below applicable criteria.

4.7 AREAS 8, 10, AND 11

This section describes the results of the delineation surveys and the remedial actions taken in Areas 8, 10, and 11. The results of the verification surveys are presented, and the IVC release letters pertaining to these areas are summarized.

4.7.1 Area Description and Usage

Areas 8, 10, and 11 are located in the northwest portion of Building 14. These areas are located underneath the first roof level and have a ceiling height of about 17.5 feet. The combined floor area is about 2,000 square feet. A drainage trench system underlies the three areas.

During MED operations, Areas 8, 10, and 11 were used as a laboratory support area for production in the large bays. Following completion of remedial activities in Area 8, the area was converted to a laboratory. Area 10 is currently used for storage, and Area 11 is a machine shop.

IDM conducted the delineation survey, decontamination, and post-remedial survey operations of these areas. Some characterization work previously performed by TNU, Inc., in Areas 8, 10, 11, and the corridor was reported in a Technical Memorandum (BNI 1995).

4.7.2 Floors

The extent of floor contamination is shown in Figure 4.7-1. In general, Areas 8, 10, and 11 had only limited amounts of contamination, particularly when compared with that in the adjacent corridor area. The double doors between Area 11 and the corridor were likely responsible for minimizing the spread of airborne contamination into Areas 8, 10, and 11. The areas of floor contamination were for the most part immediately adjacent to the walls. Contamination was found along the entire east walls of Areas 10 and 11, along the eastern portion of the south and north walls of Area 11, along the wall dividing Areas 8 and 10, and along the west wall of Area 8. The most laterally extensive contamination was found in the southern part of Areas 8 and 10.

Point measurements were taken at several locations on the floor along the east wall of Areas 10 and 11 and along the north wall of Area 11, with levels ranging from 200 to 700 cpm (Survey 36) or 5,000 to 21,290 dpm/100 cm^2.

Following the Phase I characterization in 1995, an attempt was made to decontaminate the floors of Areas 8, 10, 11 and the corridor using a liquid-chelate technology. Due to restrictions imposed by the waste disposal facility, the composition of the reagent was altered and thus achieved only limited contaminant reduction.

Needle guns were used for aggressive decontamination of the concrete floor. More extensive contamination at the south end suggests that some process-related equipment may have been used there during MED operations. As indicated in Figure 4.7-1, these areas required removal of up to 2 inches of the concrete surface, whereas the other contaminated floor areas typically required the removal of 0.25 inch of concrete. Needle guns and wire brushes were used for decontamination of the overhead valve. Decontamination of the valve was somewhat difficult because the steam line on which it was located was in service.

Minor areas of contamination were identified in Area 11, as documented by Survey 173. The locations shown on this survey were decontaminated by chipping out very small sections of the concrete floor (typically 0.5 square foot). Because the contamination in this area was near the much more extensively contaminated corridor, the verification survey of Area 11 was postponed until the corridor was completed. Although the verification survey of Area 11 was never performed, these localized contaminated points are believed to be decontaminated below criteria based on the experience of the field personnel.

The results of the verification surveys for the floor are shown Figure 4.7-2. All measurements were below the surface criteria. A series of exposure measurements were also taken following decontamination and are reported in IDM Survey 264. Measurements ranged from 12 to 18 μR/hr with background at 11 μR/hr.

4.7.3 Subsurface Soil and Trenches

Soil borings were drilled at five locations within Areas 8, 10, and 11 and samples collected at four depth intervals: 0 to 1, 1 to 2, 2 to 3, and 3 to 4 feet. Soil boring samples were collected at the recommendation of the IVC following their inspection. These locations were selected based on the presence of previously identified floor contamination and survey readings by the IVC. Samples from four of the five borings were analyzed for uranium-238, total uranium, radium-226, thorium-232, and potassium-40. (SB-1 samples were not analyzed.) The analytical results are presented in Table 4.7-1. Uranium-238 ranged from 0.7 to 2.5 pCi/g, and concentrations above the MDA were detected in 9 of 20 samples. Total uranium was detected at concentrations ranging from 0.2 to 5.1 pCi/g. Radium-226 was detected in all 20 samples at concentrations ranging from 0.57 to 2.42 pCi/g. Thorium-232 was detected at concentrations ranging from 0.64 to 1.04 pCi/g and potassium-40 at concentrations ranging from 9.2 to 18.9 pCi/g.

All detected concentrations of total uranium were below the site-specific criterion of 60 pCi/g above background. All detected concentrations of radium-226 and thorium-232 were below the DOE generic guidelines for soil. Site-specific or generic guidelines have not been established for the other radionuclides that were included as analytes (uranium-238 and potassium-40).

The trenches were accessed through floor drains by removing the metal decking and scanning the accessible portions (typically a 1- to 4-foot length centered around each drain). Dust and sediment were removed from the drains during the survey to permit more accurate scanning. Two sediment samples were collected from the trenches. Sample TR-1 was a discrete sample collected from location C-6 in Area 8, and a second composite sample (TR-2) was collected from all the trenches in Areas 8, 10, and 11. These results are presented in Table 4.7-1. Sample TR-1 contained total uranium at a concentration of 131.9 pCi/g, exceeding the site-specific criterion of 60 pCi/g. Composite sample TR-2, collected from the locations shown in Figure 4.7-1, was below criteria for all constituents.

At location C-6 in Area 8, a direct reading was taken in the trench (IDM Survey 178). The in situ measurement showed elevated β readings of about 29,000 dpm/100 cm^2. A composite sediment sample also collected from the trenches had a total uranium content of 131.9 pCi/g. A swipe sample was taken from the container holding the sample, and the results were below background for both α and β measurements.

Sediment was removed from the portions of the trenches shown in Figure 4.7-1. An 8-foot section of the north-south trench in Area 10 (see Figure 4.7-1) was marginally contaminated and underwent surface decontamination.

4.7.4 Ceiling and Overheads

The ceiling and overhead structures, including I-beams, piping, valves, and installed equipment (heating and ventilation units), were scanned and reported in IDM Survey No. 45. All overhead surfaces, with the exception of the steam valve at cell J-1, were below 200 cpm, with background at 62 cpm. The valve had a gross reading of 3,150 cpm (about 100,000 dpm/100 cm^2), as documented by Survey 35. No other evidence of contamination was observed. The results of the verification surveys for the ceiling are shown in Figure 4.7-3.

4.7.5 Walls

IDM Survey 45 covers the walls, ceiling, and overheads. All wall surfaces were scanned and noted as being below 200 cpm, with background at 62 cpm.

Scan surveys performed for the walls higher than 2 meters above the floor and on the ceilings were more limited than the scans on the lower walls and floor. These modifications were made to accommodate time constraints and were justified based on the distribution of contamination found during the delineation surveys. The walls were routinely decontaminated up to 1 foot above the floor wherever floor contamination was found adjacent to the wall.

The results of the verification surveys for the walls are shown in Figures 4.7-4 and 4.7-5. All wall surfaces were successfully decontaminated below criteria.

4.7.6 IVC Inspections

ORNL visited the Linde Site during the week of April 14, 1997, and issued a letter dated May 5, 1997. Item No. 2 of that letter states: *"All above ground surfaces in areas 8, 10, and 11, are also released. No subsurface investigations have been conducted."* This letter therefore releases the floor, walls, and overheads.

The only post-remedial action activity was the collection of subsurface soil samples, which was done at the request of the IVC following the site visit during the week of April 14.

During the week of September, 15, 1997, ORNL visited the Linde Site and inspected several areas. Following that visit they issued a letter dated October 27, 1997. The fourth bullet of that letter states: *"We have reviewed the core sample results taken from Areas 8, 10, and 11, and conclude that the subsurface of these areas are below Department of Energy guidelines."* This letter releases the underlying soil and thereby completes the release of Areas 8, 10, and 11.

4.7.7 Locations Exceeding Remedial Action Criteria

All parts of Areas 8, 10, and 11 were successfully decontaminated below criteria.

4.8 CORRIDOR

This section describes the results of the delineation surveys and the remedial actions taken in the corridor outside of Areas 8, 10, and 11. The results of the verification surveys are presented, and the IVC release letter pertaining to this area is summarized.

4.8.1 Area Description and Usage

The corridor is located in the northwest portion of Building 14. This area is located underneath the first roof level and has a ceiling height of about 17.5 feet. The floor of the corridor is raised 4 feet above the floor in Area 12 and has an area of about 900 square feet. During MED operations, the corridor provided access for large quantities of uranium ore brought into Building 14 for processing via a railroad spur. The corridor is now used as a storage area.

IDM conducted the delineation survey, decontamination, and post-remedial survey of these areas. The remedial activities are documented in Figure 4.7-1, which includes Areas 8, 10, and 11, as well as the corridor, on the same grid. Characterization work previously performed in the corridor by TNU, Inc., is reported in a Technical Memorandum (BNI 1995).

4.8.2 Floors

Data from the previous TNU investigation indicated that the entire floor was contaminated, with direct activity levels ranging from 5,000 to 25,000 dpm/100 cm^2. Survey 139 provides partial coverage of the floor, with direct β/γ activity levels of 3 to 16 times background. A concrete overpour, 1 to 2 inches thick, was detected over the northern 12 feet of the corridor. This overpour is suspected to be the result of a previous decontamination effort. Because the overpour is located over the roof of the utility access tunnel, no corebores could be taken at this location, as they were at other locations in the corridor. However, investigation of cracks in the overpour indicated direct β/γ activity levels of 5,000 to 24,000 dpm/100 cm^2 in the concrete beneath the overpour.

A number of cracks in the floor were investigated during Surveys 360 and 362. The locations of these cracks are shown in Figure 4.7-1. Surface scans of these cracks revealed that contamination was 2 to 27 times background, as shown in Survey 362 in which the background was 37 cpm. Nine cores were drilled to a depth of 4 inches in the cracks at locations documented by Survey 360 to investigate the migration of contamination through the cracks. Contamination was 3 to 19 times background in the cracks. The highest levels of activity occurred in the first 2 inches, with significant attenuation below 2 inches in most cases. A 480-volt electrical transformer located near the northeast corner of the corridor serves the entire building. The transformer was surveyed, and no contamination was found, as shown by Survey 817.

The entire floor of the corridor required remediation. All of the overpour was removed using jackhammers, and small needle guns or chipping hammers were used to remove the remaining contamination from the original concrete. The remainder of the floor was decontaminated using a Blastrac in three passes, which removed about 1/8 inch of concrete in each pass. The cracks were remediated using a jackhammer to create a V-shaped cut along the cracks to depths of 2 to 3 inches.

The results of the verification surveys for the corridor floor are shown in Figure 4.8-1. All results were below criteria.

4.8.3 Subsurface Soil and Other Features

Soil. Seven borings were drilled to depths of up to 4 feet to investigate the soil beneath the corridor. The locations of the borings are shown in Figure 4.7-1. The results of the sample analyses are given in Table 4.8-1. The maximum total uranium activity was 10.74 pCi/g detected in surface soil sample SB-11. This value is well below the site-specific criterion of 60 pCi/g. Radium-226 was detected in this same sample at 5.28 pCi/g. The generic criterion for surface soil is 5 pCi/g plus background, which is 1.1 pCi/g (DOE 1992). All other samples were less than criterion for radium-226 and thorium-232. Based on these sample results, no soil was excavated; however, about 150 cubic feet of soil was removed on the south side of the steam return pit to trace the routing of the drainline, as discussed below.

Steam Return Pit. The steam return pit, as it is called on blueprints for Building 14, received condensate from several steam lines or traps. The condensate was subsequently discharged to the drain system through a drainline on the south wall of the pit. The pit was delineated by Survey 217. The concrete sides and bottom of the pit were contaminated at levels ranging from 16,000 to 81,000 dpm/100 cm^2. Initial attempts to remediate the sides and bottom of the pit were not entirely successful; therefore, at least 2 inches of concrete was removed from each surface, and the pit was then reconstructed.

Steam Return Pit Drainline. The drainline runs horizontally due south out of the pit at a depth of about 4 feet below the floor surface. A 45-degree elbow approximately 4 feet from the pit directs the drainline downward about 8 feet below the floor surface, after which it passes through two 45-degree elbows and joins an east-west drainline. Survey 217 includes data on the horizontal run of the drainline in which direct β/γ activity was detected up to about 150,000 dpm/100 cm^2 at a point 3 feet beyond the pit. During Survey 373, measurements were taken at different locations on the pipe cross-section and length. The highest levels of contamination were detected on the bottom of the pipe and 6 inches into the pipe, with direct β/γ results up to 65,000 dpm/100 cm^2. An obstruction was encountered 3 feet into the pipe, which prevented further measurements. Survey 403 includes several additional measurements on the horizontal section of pipe and documents a large area swipe sample collected from the pipe interior. The swipe sample showed no detectable activity, indicating there was no removable contamination in the pipe. Survey 687 documents the diagonal run of the drainline after the first 45-degree elbow. Measurements were taken on the top and bottom centerlines at 1-foot intervals. Contamination levels on the bottom of the pipe ranged from 48,387 to 64,516 dpm/100 cm^2; levels on the top of the pipe were one-third to one-half the bottom measurements. An obstruction was encountered 5 feet into the diagonal section of the drainline, preventing further measurements. One sample was collected from the drainline for isotopic analysis. Total uranium detected in this sample was 9.52 pCi/g.

The drainline was remediated by excavating and removing the horizontal run (about 4 feet) and plugging the first foot of the diagonal section with concrete.

4.8.4 Ceiling

The creteplank ceiling and overhead structural steel were delineated by Surveys 116, 289a, 289b, and 309. The steel was highly contaminated, with direct β/γ results commonly in the range of 50,000 to 200,000 dpm/100 cm^2. Several test decontamination efforts (documented by Surveys 322, 323, 328, and 329) were conducted on sections of steel beams on which direct β/γ contamination of up to 1,200,000 dpm/100 cm^2 was detected. The levels of contamination on the creteplank were considerably lower than those encountered on the steel, with direct β/γ results in the range of 1,000 to 12,000 dpm/100 cm^2.

Decontamination of the creteplank by sponge blasting required removal of up to 0.5 inch of the creteplank in some areas. The steel was decontaminated initially by sponge blasting, usually requiring several passes followed by grinding to attain levels below criteria.

Asbestos piping insulation in the overhead was contaminated and was removed and replaced. Several valves and pipes were contaminated, one of which required removal of about ten concrete blocks out of the west wall to provide access for decontamination with needle guns. The blocks were then replaced. Steam supply lines that supplied the entire site were in this area and could not be shut off, making the decontamination of the overheads a difficult process.

The results of the verification surveys for the ceiling and overheads are shown in Figure 4.8-1. All areas were successfully decontaminated to below criteria.

4.8.5 Walls

The north wall was delineated by Survey 304. The structural steel, piping, and metal associated with the sliding door were the most highly contaminated portions of the north wall area. Direct β/γ measurements of the structural steel ranged from 30,000 to 130,000 dpm/100 cm^2 and from 5,000 to 20,000 dpm/100 cm^2 for the sliding door and piping. Measurements of sheet metal installed in former windows were at background levels. Direct β/γ measurements of the lower brick and purlins ranged from 4,000 to 44,000 dpm/100 cm^2. The north wall was remediated by sponge blasting the structural steel and metal piping and doorframe. The lower 1 meter of the brick wall was decontaminated, as were localized areas of brick where steel beams joined the wall.

The south wall extends only from the floor up to about 2.5 meters, above which pipe and HVAC ducts are routed. This wall appeared to be of post-MED construction. The south wall was delineated by Survey 305, and all measurements were within background levels; therefore, no remediation was performed on the south wall.

The east wall, delineated by Survey 306, appears to be of post-MED construction because measurements of the concrete block were at background levels. It is thought that during MED operations the ore was brought into Building 14 through the door in the north wall of the corridor and deposited in wooden bins on the floor of Area 12, which was 4 feet below the floor of the corridor and Area 9. The steel columns showed direct β/γ measurements of 10,000 to 322,000 dpm/100 cm^2. The structural steel was decontaminated by sponge blasting, and contaminated electrical conduit and boxes were either removed or decontaminated. A steam-operated heater located 10 feet above the floor had high levels of external contamination (15,000 to

329,000 dpm/100 cm^2) and was removed for disposal. A valve located along the wall/ceiling interface in grid cell K-17 was decontaminated with needle guns after about ten concrete blocks were removed to provide access.

The west wall, which was present during MED operations, limited the spread of contamination into Areas 8, 10, and 11. The west wall was delineated by Survey 307, and test decontamination data for one location are reported in Survey 330. All of the structural steel on the west wall was contaminated, with direct β/γ measurements of 10,000 to 65,000 dpm/100 cm^2 on the steel columns and 5,000 to 15,000 dpm/100 cm^2 on the door and window frames and electrical conduits and boxes. Direct β/γ measurements on the floor at the clay tile wall ranged from 1,000 to 75,000 dpm/100 cm^2. All of the structural steel on the west wall was decontaminated. The brick was decontaminated around the areas identified as exceeding criteria, and additional decontamination was performed around the steel. A total of about 40 to 50 percent of the brick surface was decontaminated.

The results of the verification surveys for the west and north walls are shown in Figure 4.8-2 and in Figure 4.8-3 for the east and south walls. All results were below criteria.

4.8.6 IVC Inspections

ORNL was the IVC for this remedial action. As part of the verification process, ORNL representatives periodically visited the site to review subcontractor data, take additional radiological measurements, and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area or portion of an area within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letter pertaining to the corridor is discussed below.

ORNL representatives visited the Linde Site during the week of September 15, 1997. Following that visit, they issued a letter dated October 27, 1997. The letter states: *"The corridor that separates Areas 10 and 11 from Area 12 was surveyed on a previous date, and is below Department of Energy cleanup criterion."* This letter therefore releases the corridor in its entirety.

4.8.7 Locations Exceeding Remedial Action Criteria

All parts of Areas 8, 10, and 11 were successfully decontaminated to below the remedial action criteria.

4.9 AREA 9

This section describes the present and historical uses of Area 9, presents the results of delineation activities, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area.

4.9.1 Area Description and Usage

Area 9 is located in the central portion of Building 14. This area is located underneath the first roof level and has a ceiling height of about 17.5 feet. The floor area is about 3,500 square feet.

An abandoned and filled-in drainage trench system underlies the area. During MED operations, this area, along with the large bays (Areas 12, 13, 14 North, and 14 South), were used for large production processes. Prior to and following remedial activities, the area served as a research and development laboratory.

4.9.2 Floors

Area 9 was included in the Phase I characterization effort conducted in 1995 by TNU. The data from this characterization were used to guide the decontamination of the floor rather than performing additional delineation efforts. Survey results for direct β/γ measurements ranged up to 44,650 dpm/100 cm^2.

The entire floor area was decontaminated with a Blastrac, which was used in several passes to cover most of the floor. Parts of the floor in the western and southern portions of Area 9 were removed by jackhammer to a depth of 2 inches. A 1-inch-thick concrete overpour was detected in the southern part of Area 9. Survey 818 shows elevated activity levels between the overpour and the original concrete slab where yellow cake residue was observed. The overpour was not detected in the northern part of Area 9.

Two laboratory fume hoods located near the east wall were left in place because of the difficulty and expense of relocating the hoods. The fume hoods are mounted on a channel steel form that is bolted to the floor. A steel plate is riveted to the base of each hood, which prevents access to the floor. Areas of the concrete floor beneath the fume hoods are designated as supplemental limit locations LEC-9-1 and LEC-9-2. These locations are shown in Figure 4.9-1. The areas of LEC-9-1 and LEC-9-2 are approximately 107 square feet each. The area under the northeast corner of the north fume hood (LEC-9-1) was accessible to a limited degree. An active drainline running east to west under the fume hood was found at this location, and there was a drain in the floor under the fume hood. The drain was removed and replaced with concrete to a depth of 6 inches below the floor. The accessible surrounding concrete floor underneath the fume hood was decontaminated. In order to estimate the activity present under the fume hoods, three sections of tile were removed from the floor immediately adjacent to the fume hoods in grid locations P-16, I-15, and M-13. The results for direct β/γ measurements, reported in Surveys 1032 and 1033, ranged from 15,620 to 19,015 dpm/100 cm^2 immediately underneath the tile. The readings were reduced to 1,358 to 2,037 dpm/100 cm^2 after 3 inches of concrete was removed. Results of floor measurements previously made by TNU were also reviewed to determine the potential for contamination underneath the fume hoods.

A floor drain found within the accessible area beneath the fume hood was removed and plugged. This drain is further described in Section 4.9.4.

The results of the verification surveys for the floor are shown in Figure 4.9-2. All results were below criteria.

4.9.3 Soil

Soil borings were drilled at 16 locations, as shown in Figure 4.9-1. Samples were collected at the 0-1, 1-2, 2-3, and 3-4 foot intervals in each boring. The analytical results of these samples are

shown in Table 4.9-1. The core samples were scanned, and direct β/γ measurements were 34 to 100 cpm, with background at 75 cpm. The maximum concentration of total uranium was 25.5 pCi/g, which is well below the site-specific criterion of 60 pCi/g. All concentrations of radium-226 and thorium-232 were below the DOE generic guidelines for soil. No soil was excavated based on the results of samples collected from these borings, but soil was excavated in conjunction with the trench removal, as discussed in the following section.

4.9.4 Trenches and Drainpipes

A network of abandoned drainage trenches, shown in Figure 4.9-1, was discovered during the investigation of Area 9. The trenches had been previously filled in with sand, and a 4-inch-diameter cast iron pipe down the center of the trench had been abandoned in place. These trenches were approximately 1 foot wide and 2 feet deep except along the west wall where the depth gradually increased to 4 feet as the trench approached the south wall.

Delineation data from the trenches are included in IDM Surveys 818, 1291, 1292, 1458, 1500, 1544, and 1580. Three square holes centered over different sections of the trenches were excavated to a depth of 1 foot at the locations shown in Survey 1291. Direct point measurements (Surveys 1291 and 1292) were taken on the bottom and sides of the excavations. Direct β/γ measurements ranged from 12,403 to 34,730 dpm/100 cm^2. The trench was also excavated within Room 9C (Survey 1458). Direct β/γ measurements at this location ranged from 1,300 to 149,000 dpm/100 cm^2. A single measurement taken at a fifth location in the trench (Survey 818) showed a direct β/γ count of 128,000 dpm/100 cm^2. Although not specified on the survey, this measurement is believed to be from the top of the trench after the overlying concrete floor was removed but before any soil was excavated.

The entire trench network, as shown in Figure 4.9-1, was removed. The excavation was 3 to 4 feet wide centered about the trench and 2 feet deep except along the west wall, where the excavation depth gradually increased to 4 feet as the trench approached the south wall. A 5-foot section of trench in Room 9D that was removed contained mercury-contaminated soil. A mercury-sensitive powder was used to delineate the soil contamination, and no mercury contamination was detected in the soil left in place.

A drainpipe was detected in the southern end of Area 9, beginning in grid cell A-0 and extending to the east wall. The pipe was 2 feet below grade at the western end and 4 feet below grade at the east wall. Measurements were made on the interior and exterior of the buried pipe at A-0. Direct β/γ measurements were 21,000 and 73,000 dpm/100 cm^2 on the interior and exterior, respectively, as determined by Survey 1500. The pipe and surrounding soil were removed to a depth of 2 feet at the western end and 4 feet at the east wall. A 10-foot section of the pipe at the western end was filled with cement and left in place because it was encased in concrete that supported the south wall. This section is shown in Figure 4.9-1 and is designated as location LEC-9-3.

As mentioned in Section 4.9.2, a floor drain was located in the floor underneath the accessible portion of the fume hood. A direct β/γ measurement taken within this drain showed 21,000 dpm/100 cm^2. The drain was removed and replaced with concrete to a depth of 6 inches without impacting the receiving drainpipe.

The drainpipes previously known to be in Area 9 are attributed to two phases of construction. Pipes in the first set appear to be associated with the construction of Building 14, or were present during MED operations, and include the drainline network and floor trenches shown in Linde Drawing A63726 dated January 15, 1937. The second set is a network of 3-inch-diameter cast iron pipes shown in Union Carbide drawing 2742 dated May 9, 1978; these pipes were presumably installed shortly thereafter. The latter drawing also shows the precise locations of the fume hoods in relation to the new drainpipes and floor drains. The contaminated floor drain in question clearly is not part of this new installation. A nearby drain was identified during delineation and was investigated as Drain No. 1 during Survey 1670.

This floor drain and associated drainpipe or pipes, therefore, appear to be part of a third drainpipe system which, based on the elevated readings found in the floor drain, is potentially contaminated. The associated drainpipe network is likely small and is suspected to lead from the floor drain underneath the north fume hoods at LEC-9-1 to a pipe discharging into the end of the former trench at grid cell M-9. A pipe was discovered at this location during remediation of the trench, but no indication of contamination was evident. The pipe end was plugged before the trench was backfilled.

The drainpipe that received flow from the removed floor drain is designated as LEC-9-4 based on the contamination discovered in the floor drain. The presence of contamination in the drainpipe is likely, but its extent is unknown. The routing of the drainpipe is speculative (i.e., whether it connects to the trench) but is also unknown.

4.9.5 Ceiling and Overheads

The ceilings and overheads in Area 9 were extensively delineated, with complete coverage of the ceiling and approximately 95 percent of the overheads. Results from the measurements of the overhead beam are documented by Surveys 847, 849, 872, 873, 903-906, and 934-938. Results for the creteplank ceiling are documented in Surveys 848, 850, 868-871, and 927-931. Surveys 851 and 874 document delineation of the overhead HVAC system. Direct β/γ measurements of the creteplank ceiling were rather uniform, with readings ranging from a low of 75 to 100 cpm up to 250 cpm. Background readings were 75 cpm for all surveys except No. 931, for which background was 50 cpm. The survey results of the overhead I-beams show elevated direct β/γ contamination over much of the area. Measurements ranged from 200 to 1,600 cpm, with background at 75 cpm.

To gain access to the ceiling, the drop ceiling (a post-MED ceiling installed about 10 feet above the floor) was removed. All of the structural steel in the overheads was decontaminated by sponge blasting, and the vertical beams were decontaminated over their full length. The creteplank ceiling required no decontamination.

The results of the ceiling/overhead verification surveys are shown in Figure 4.9-3. All results were below criteria.

4.9.6 Walls

The delineation survey results of the south, west, east, and north walls of Area 9 are reported in IDM Surveys 821, 822, 823, and 827, respectively. The delineation survey results for Rooms 8A, 9A, 9B, 9C, and 9D, which are used for offices, are reported in IDM Surveys 829, 828, 826, 832, and 831, respectively. These latter four surveys include results of measurements on all four walls, up to 3 meters above the floor, within the respective rooms. These surveys provided complete coverage of all wall surfaces within Area 9, including the five offices. These surveys were used in conjunction with survey data collected previously by TNU, which indicated that there was no contamination on the upper wall surfaces.

The south wall was delineated by a scanning survey (No. 821) and covered the lower 3 meters of the wall from cell A-3 to A-18 (the wall from cell A-0 to A-2.5 is within Room 9D). Direct β/γ measurements were generally uniform over the entire wall and were only slightly elevated. Gross counts ranged from a low of 60-100 cpm up to 75-150 cpm. The background count was 71 cpm.

The west wall was similarly delineated by a scanning survey (No. 822) that covered the lower 3 meters of the wall from cell A-2 to Q-2. The β/γ readings were generally uniform over the entire wall and were between one and three times the background count. Counts were measured at levels from 75-100 cpm to 75-200 cpm. The background count was 71 cpm.

The east wall was similarly delineated by a scanning survey (No. 823) that covered the lower 3 meters of the wall from cell A-18 to F-18. The remainder of the wall was not scanned. Beta/gamma counts were generally low (one to two times background), with the exception of an I-beam at cell F-18, where measurements ranged from 75 to 75-130 cpm. The background count was 71 cpm. A count of 75-700 cpm was measured on the first meter of the I-beam above the floor, but the count decreased to 75 cpm in the second and third meters.

The north wall was delineated by a scanning survey (No. 827) that covered the wall on the second and third meters above the floor from cell R-3 to R-18. The first meter above the floor was not scanned except on the doors. Beta/gamma levels were generally low at one to four times background. With the exception of the I-beam at cell F-18, counts were measured at levels from 75-125 to 75-250 cpm. The 75-250 cpm measurement occurred in only a single location, on a door. The background count was 75 cpm.

The walls in Room 8A were delineated by a scanning survey (No. 829) that covered all four walls up to 3 meters above the floor. Beta/gamma counts were generally uniform at one to three times background. Counts ranged from 100-125 cpm to 100-200 cpm. The background count was 75 cpm.

The walls in Room 9A were delineated by a scanning survey (No. 828) that covered all four walls up to 3 meters above the floor. Beta/gamma counts were generally uniform at one to three times background. Counts ranged from 75-100 cpm to 150-200 cpm. The background count was 75 cpm. The highest levels were found on the west wall.

The walls in Room 9B were delineated by a scanning survey (No. 826) that covered all four walls up to 3 meters above the floor. Beta/gamma counts were generally uniform at one to three times

background. Counts ranged from 75-100 cpm to 150-200 cpm. The background count was 75 cpm. The highest levels were found on the west wall.

The walls in Room 9C were delineated by a scanning survey (No. 832) that covered all four walls up to 3 meters above the floor. Beta/gamma counts were generally uniform at one to two times background. Counts ranged from 75-100 cpm to 75-175 cpm. The background count was 75-100 cpm.

The walls in Room 9D were delineated by a scanning survey (No. 831) that covered all four walls up to 3 meters above the floor. Beta/gamma counts were generally uniform at one to two times background. Counts ranged from 75-100 cpm to 100-175 cpm. The background count was 75-100 cpm.
Only two sections of wall required remediation. In Room 9B, a 5-foot-long section of the north clay tile wall was removed from the ground surface up to 4 feet. A small area on the south wall in Cell A-8 was decontaminated.

The results of the verification surveys in the main room of Area 9 are shown in Figure 4.9-4 for the east and south walls and in Figure 4.9-5 for the west and north walls. The results of the verification surveys for the walls in the offices (Areas 8A, 9A, 9B, 9C, and 9D) are shown in Figure 4.9-6 for the direct measurements and Figure 4.9-7 for the removable measurements. All results were below criteria.

4.9.7 IVC Inspections

ORNL was the IVC for this remedial action. As part of the verification process, ORNL representatives periodically visited the site to review subcontractor data, take additional radiological measurements, and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area, or portion of an area, within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letters that pertain to Area 9 are discussed below.

ORNL representatives visited the Linde Site the week of June 1, 1998. Following that visit they issued a letter dated June 10, 1998. The letter states: *"The ceiling in area 14SW and the overheads and ceilings in area 9 were surveyed and both areas were verified to be below DOE guidelines."* This letter therefore releases the overheads and ceilings.

During the visit, the IVC identified several areas that required additional decontamination. The decontamination was performed, and additional verification surveys, labeled as post-IVC surveys, were performed.

ORNL representatives visited the Linde Site the week of July 6 to 13, 1998. Following that visit they issued a letter dated September 16, 1998. That letter states: *"The exposed soils in areas 9 Lab and 14SE were scanned and soil samples were collected. The remaining concrete floor surfaces were also surveyed. After further decontamination efforts, review of the post-remedial action radiological data supplied by the subcontractor, and additional data collected from the remediated areas collected by the independent verification contractor, these areas are verified*

not to have residual contamination above the guidelines as defined in Department of Energy (DOE) Order 5400.5. Walls in area 9 Lab were also scanned and after removal of additional contaminated material this area has also been verified not to have contamination above DOE guidelines. There is a portion of the subsurface in area 9 Lab containing a pipe that will be included in the request for supplemental standards, as it is above clean-up criterion." This letter therefore releases the walls and floors of Area 9 but not the soil.

An IVC letter dated October 23, 1998, states: *"All soil samples have now been analyzed and the outstanding subsurface soils in Areas 9 and 14 fall below the site specific soil criterion of 60 pCi/g total uranium."* This letter therefore releases the subsurface soil in Area 9.

4.9.8 Locations Exceeding Remedial Action Criteria

Residual contamination remaining in several locations within Area 9 exceeds the remedial action criteria. These areas have been discussed above and are summarized below:

1. Floor Underneath Fume Hoods (LEC-9-1, LEC-9-2). Two fume hoods located in the northeast section of Area 9 were left in place during remediation. The floor area under each fume hood is approximately 107 square feet.

2. Drainpipe (LEC-9-3). A 10-foot-long section of drainpipe next to the south wall, in cells A-1 to A-3, was left in place. The 4-inch-diameter pipe is about 2 feet below the floor. The soil immediately surrounding the pipe may be considered potentially contaminated.

3. Drainpipe (LEC-9-4). The drainpipe receiving runoff from the contaminated floor drain that was removed from beneath the fume hood designated as LEC-9-3 is likely contaminated. The extent of contamination within the drainpipe is unknown, as is the drainpipe routing, but it is suspected that it connects to a pipe that terminated at the end of the former trench at grid cell M-9.

4.10 AREAS 12 AND 13

This section describes the present and historical uses of Areas 12 and 13, presents the results of delineation activities, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area.

4.10.1 Area Description and Usage

During MED operations, Areas 12 and 13 were part of a common area that included Areas 12, 13, and 14 (North and South). The exact use of these areas is not known, but it is likely that process vessels were in this location. Currently the areas are used as a research laboratory. During the remedial action, Areas 12 and 13 were treated as a contiguous unit, and a single grid was established for use in both areas during delineation and verification surveys. The origin of the grid was in the southwest corner of Area 14A, which, at the time the work was performed, opened into Area 12. Area 14A was a small room built within Area 14 North with its own 10-foot-high ceiling. The walls, floor, and ceiling in Area 14A were removed during the remedial activities

conducted in Area 14 North. The activity in Area 14A is therefore not discussed further, and data for this small area are not presented in the figures.

The south and west walls in Areas 12 and 13 are constructed of 1-foot by 1-foot by 8-inch-wide tile blocks on top of the concrete floor slabs. The floor of the corridor and Area 9 to the west is 4 feet above the floor in Areas 12 and 13. A stairwell in the northwest corner of Area 12 leads down to a utility tunnel that runs under the north end of the areas.

4.10.2 Floor

Previous delineation surveys by TNU indicated that much of the floor surface and the subsurface soil were contaminated. The entire concrete slab floor was cut out and removed for disposal. About a 1-foot-wide strip of the concrete slab was left in place along the east and south walls and around the center wall sections to provide adequate structural support for the wall. A concrete overpour, approximately 2 inches thick, had been placed over the concrete roof of the utility tunnel along the north wall of the area. This roof was approximately 8 inches thick and heavily reinforced with rebar. The overpour was removed entirely, and yellow cake was observed on the roof. Delineation of the roof (Surveys 294 and 296) revealed activity at 3 to 10 times background. The contamination was removed by chiseling away 2 to 3 inches of the concrete roof. The details of these remedial activities are shown in Figure 4.10-1.

An elevated concrete platform of post-MED construction is located in the southeast corner of Area 12. This platform is 2 feet above the floor level and houses laboratory apparatus. During the removal activities, it was observed that the original concrete floor did not extend underneath this platform, suggesting that the concrete floor had been removed when the platform was installed. The platform also contains several trenches used to channel process piping. The platform was surveyed (Survey 295) and was found to be one to three times background. Decontamination of the platform surfaces was not required.

The verification surveys of the floor are shown in Figure 4.10-2. The areas surveyed were limited to those areas where the slab was left in place adjacent to the walls, the restored ceiling of the concrete tunnel, and the platform. All results were below the DOE generic surface guidelines.

4.10.3 Subsurface Soil

This section discusses the remedial action conducted on the soil beneath the floor surface of Areas 12 and 13, including the soil left in place underneath the west, east, center, and south walls. Discussion of the investigation, remedial activities, verification activities, and post-remedial status of the soil is divided into five subsections based on location under the floor slab or one of the four walls. The utility tunnel wall bounds the soil on the north and, because it extends well below grade, the soil was excavated up to the concrete, with the base of the excavation well above the base of the tunnel wall. Therefore, no contamination was left in place adjacent to or underneath the north wall of either area.

4.10.3.1 Soil Remaining Beneath the Floor

The soil near the east wall in Area 13 was excavated to a depth of 1 to 2 feet beneath the concrete floor slab. The vertical extent was bounded initially by several pre-verification composite samples (339, 340, 341) to demonstrate that the contamination had been fully removed.

A review of existing TNU soil sample analytical data indicated the presence of soil contamination underneath the areas. A number of soil borings were drilled at the locations shown in Figure 4.10-1 at depths of up to 4 feet to further characterize and delineate the extent of contamination. Total uranium up to 666 pCi/g was detected in these soil borings. Two soil borings were drilled through the post-MED platform in the southeast corner of Area 13. The maximum concentration of total uranium detected in these borings was 7.58 pCi/g, confirming that no soil exceeding site-specific criteria is located beneath the platform.

The soil was excavated over the entire footprint of Areas 12 and 13 to within about 1 foot of the east, south, and center walls. Soil was removed directly up to the footer or knee wall under the west wall and the utility tunnel wall on the north end of the areas. The soil was excavated to a depth of 4 feet throughout Area 12 and on the west side of Area 13. A center band of soil in Area 13 was removed to a depth of 3 feet, and the soil on the east side of Area 13, north of the platform, was excavated to a depth of 1 to 2 feet. Several pre-verification composite samples (included in Table 4.10-1 under Miscellaneous Soil Samples) were taken near the east wall to assist in bounding the vertical extent of contamination.

A layer of black ash was found underneath most of the slab. The ash was typically 10 to 12 inches thick but was up to 20 inches thick in places. Yellow cake residue from the uranium refining process was found primarily underneath the west knee wall but was not observed under the center wall.

Following completion of the soil excavation, composite soil samples were collected from the base of the excavation and analyzed for radiological constituents. All sample results were below the site-specific criterion for total uranium and the generic guidelines for radium-226 and thorium-232 except for Sample 428 collected at location N3/E3, which contained 70.39 pCi/g of total uranium. The soil was excavated an additional 1 foot from grid cells K-10 and K-12 to S-10 and S-12. Additional verification samples were collected from this additional excavation, and total uranium detected was 18.12 to 38.07 pCi/g.

A temporary gravel ramp had been installed at the north end of Area 12 to permit access to the excavated soil by the construction equipment. Following completion of the soil excavation, composite verification soil samples from underneath the former ramp were collected. The total uranium concentration in these samples (413 through 416) ranged from 15.52 to 39.06 pCi/g.

Following completion of the excavation and verification sampling activities, the IVC collected soil samples for analysis.

4.10.3.2 Soil Remaining Beneath the West Wall in Area 12 (Knee Wall)

The west wall in Area 12 is supported by a concrete footer, also called a knee wall. About 18 inches beneath the surface of the concrete floor, an 8-inch-thick concrete slab extends outward about 12 inches from the footer. An electrical conduit runs the length of the building along this wall footer. The soil in Area 12 was excavated to the surface of the footer and horizontal slab. The soil was left in place beneath the horizontal slab. The side of the excavation extended down to 4 feet below grade and was typically flush with the vertical edge of the horizontal slab, although the excavation continued underneath the slab toward the wall in certain locations. Six soil samples collected from soil beneath the slab contained total uranium ranging from 35.83 to 17,910 pCi/g. Sample 352 contained material clearly identified as yellow cake. Survey 3001 documents areas of elevated contamination on the side of the excavation. Most of the soil underlying the slab exceeding site-specific criteria is in two sections, which are designated as locations LEC-12/13-1 and LEC-12/13-2 (Figure 4.10-3). For purposes of estimating size, LEC-12/13-1 is assumed to be 18 feet long by 1 foot wide by 1.5 feet deep for a total volume of 27 cubic feet. LEC-12/13-2 is assumed to be 24.5 feet long by 1 foot wide by 1.5 feet deep for a total volume of 37 cubic feet. The width and depth of these two areas match the width of the horizontal slab and the depth of the excavation beneath the slab.

4.10.3.3 Soil Remaining Beneath East Wall in Area 13

Contamination in the soil near the east wall was generally less extensive than elsewhere in the area and required excavation to a depth of only 1 to 2 feet. The soil was excavated only to within about 1 foot of the wall to maintain sufficient structural support for the wall. Four samples were collected from the exposed soil on the eastern side of the excavation. Samples 335, 336, 358, and 361 were composite samples collected at the locations shown in Figure 4.10-3. The results for total uranium from these samples ranged from less than background to 21.78 pCi/g. These samples were taken from a layer of black ash-like material similar to a layer of black ash present throughout the area immediately underneath the slab. Although the same material contained elevated activity levels at other locations in the area, the soil underneath the entire east wall was below the site-specific criterion.

4.10.3.4 Soil Remaining Beneath Center Wall

The soil was excavated to within about 1 foot of the wall that divides Areas 12 and 13. Eight composite or grab samples were collected from soil on the side of the excavation. Total uranium concentrations in these samples ranged from 8.03 to 1,013.54 pCi/g. The results for each sample are shown in Table 4.10-1 and in Figure 4.10-3. Samples were collected primarily from the black ash, and contamination exceeded the site-specific criterion in five of them. Surveys of the excavation walls were performed before the excavation was backfilled. Surveys 3002 and 3003 show areas of elevated contamination exceeding the remedial action criteria on each side of the center wall. This contamination occurs next to both the north and south sections of the center wall, and the locations are designated as LEC-12/13-3 and LEC-12/13-4. For the purpose of estimating volume, both locations are assumed to be 16 feet long by 2.5 feet wide by 1 foot deep for a total volume of 41 cubic feet. A short 0.5-meter section connected to the south wall was evaluated as part of the south wall.

4.10.3.5 Soil Remaining Beneath South Wall

The soil in Areas 12 and 13 was excavated to within about 1 foot of the wall and to a depth of 3 to 4 feet beneath the floor slab. Seven composite or grab samples from the soil on the side of the excavation were analyzed by gamma spectroscopy. Total uranium concentrations in these samples ranged from 37.92 to 3,613.91 pCi/g. Surveys 3004 and 3005 detail areas of elevated activity on the side of the excavation adjacent to the south wall. Two soil samples collected near the western end of the wall contained elevated levels of total uranium. Sample 353, which was collected from beneath floor slab about 0.5 meter from the west wall, had a total uranium concentration of 3,613.91 pCi/g. Sample 352, collected about 1.5 meters from the west wall, had a total uranium concentration of 218.01 pCi/g. Survey 3004 shows a thin layer of black ash underneath the slab extending from the west wall outward about 2.5 meters with localized contamination. Clay soil was beneath the black ash. Composite samples 367 (Area 12) and 368 (Area 13), which were collected 6 to 12 inches beneath the base of the wall, contained total uranium at concentrations of 37.9 and 52.6 pCi/g, respectively. Based on these results, the soil next to and underneath the knee wall is designated as LEC-12/13-5. For the purpose of estimating volume, this location is conservatively estimated to have dimensions of 41 feet long, 2 feet wide, and 1 foot deep for a total of 82 cubic feet.

Most of the remainder of the soil along the west wall appears to be contaminated above the site-specific criterion. Samples 363, 337, and 360 (collected at the locations shown in Figure 4.10-3) had total uranium concentrations of 815.05, 177.65, and 205.70 pCi/g, respectively. Surveys 3003 and 3005 detected elevated levels of activity in soil between 4 and 11 meters from the west wall. This contamination is about 6 to 20 inches beneath the slab, decreasing to a depth of 2 inches between 9 and 11 meters from the west wall, where only a thin lens of black ash appears to be present. The ash layer ends short of the elevated platform and ramp. This section of soil is designated as location LEC-12/13-6. For the purpose of estimating volume, this location is conservatively estimated to have dimensions of 6.5 feet long, 2 feet wide, and 1 foot deep for a total of 13 cubic feet.

4.10.4 Trenches and Pedestal

Two drainage trenches, one in the center of Areas 12 and one in Area 13, are shown in Figure 4.10-1. The trenches were removed and replaced during restoration of the area.

The remnant of a large concrete pedestal was encountered beneath the floor slab in the southern part of Area 12. The pedestal is believed to have at one time supported a large industrial air compressor. The concrete surface of the pedestal was contaminated and was broken up and removed for disposal. Six to 12 inches of soil underneath the slab was then excavated.

4.10.5 Ceiling

The overhead structural steel had been previously surveyed by Bechtel National, Inc. and TNU, and limited decontamination was performed at that time. Since the delineation markings were still present, it was unnecessary to perform further surveys to identify the contaminated portions of the steel. IDM decontaminated the contaminated areas (indicated by red paint) and surveyed adjacent areas to ensure that all contamination was detected and removed. The creteplank was not contaminated.

Following decontamination, extensive scan surveys were performed on all of the contaminated areas. The results of these verification scans (presented in Appendix C) demonstrate that the steel was successfully decontaminated to below guidelines. The results of the verification surveys are shown in Figure 4.10-4. Because of time constraints, only a fraction of the decontaminated ceiling areas were verified by standard 5-point surveys. Only the 5-point direct measurement verification data are reflected in Figure 4.10-4; however, the surveys in Appendix C demonstrate complete decontamination to below guidelines.

4.10.6 Walls

As with the ceiling, the walls had been extensively delineated during past efforts by Bechtel National, Inc. and TNU. Markings identifying the location and extent of contamination were clearly visible and were used to guide the decontamination. The extent of contamination and the remedial activities are discussed in the following paragraphs.

The north wall, an exterior brick wall, was contaminated only on the lower 2 to 3 feet. More of the contamination was present on the Area 13 side. The brick was decontaminated by using needle guns to remove 1 to 2 inches of brick.

The east wall was glazed tile and required minimal decontamination except for the lower 1 foot of the wall.

The south wall of both areas is composed of 1-foot by 1-foot by 8-inch drain tile and is of post-MED construction. The wall was supported directly by the concrete floor slab with no underlying footer. Minimal contamination was detected on the south wall. Contaminated parts of a large double steel door and doorframe in Area 13 were replaced.

The west wall is a post-MED wall composed of 8-inch concrete block resting on a concrete footer or knee wall that extended 4 feet above grade to the floor of the adjoining corridor and Area 9. The wall was extensively delineated by Surveys 16, 17, 156, and 303. Contamination was found along most of the lower portion of the wall, requiring the removal of 2 inches of concrete on the south end of the wall and up to 6 to 12 inches in the north end. Yellow cake was found on a below-grade horizontal slab encasing an electrical conduit. A sample taken from this material contained total uranium at nearly 18,000 pCi/g. The below-grade concrete surface of the footer and slab were decontaminated to the extent possible without risking the structural integrity of the wall.

When decontamination was complete, scan surveys were performed to ensure successful remediation of the areas. As with the ceiling surveys described above, only a limited portion of the decontaminated areas underwent the 5-point verification survey process for which the results are shown in Figures 4.10-5 through Figures 4.10-7. The scan surveys, included in Appendix C, can be used in combination with the figures to provide a complete representation of the post-remedial radiological condition of the walls.

4.10.7 Crane and Crane Rails

As in other areas of the building, an overhead crane and crane rail system is in place for use in relocating heavy pieces of equipment. The crane rails along the west wall of Area 12 and east wall

of Area 13 were successfully decontaminated to below generic guidelines. The center crane rails (those along the east wall of Area 12 and the west wall of Area 13) remained above guidelines despite extensive decontamination efforts. The results of the post-decontamination survey are shown in Survey 404. The average residual direct β/γ activity was 8,300 to 19,000 dpm/100 cm^2, which corresponds to the "General Area" measurements on Survey 404. As with the crane rails in Area 14 North, the extent of steel remaining above criteria is limited to localized areas around the bolts connecting the cross members to the crane rail. Restricted access prevented full decontamination by conventional decontamination equipment. These locations are designated as LEC-12/13-8 and LEC-12/13-9 and are illustrated in Figure 4.10-3. The actual areas of contamination exceeding DOE generic surface guidelines are limited to 6-inch by 12-inch areas around each group of bolts. A total of 34 sections of bolts are affected, a total area of 17 square feet.

4.10.8 Stairwell, Sump, and Sump Drainlines

A stairwell in the northwest corner of Area 12 provides access to the utility tunnel that runs underneath the north wall of the building. A sump at the base of the stairwell received drainage from two clay tile drainlines on the east and west sides and from a drainpipe discharging from the north. The utility tunnel was delineated by Surveys 376 and 1222. Contamination exceeding guidelines was found on the floor, sides of the stairs, parts of the walls, and some of the overhead electrical conduits. A 4-inch-diameter drainpipe on the north face of the wall, about 4 to 6 feet above the bottom of the sump, was found to be contaminated (Survey 376) and plugged with sand. The sand was removed, and the first foot of the pipe was surveyed; surface measurements ranged from 10,000 to 140,000 dpm/100 cm^2. The latter measurement was likely biased high because of residual contaminated sand within the pipe, which formed a solid plug about 1 foot into the pipe. A concrete plug was then placed in the pipe. The floor, stairs, and wall surfaces were all successfully decontaminated to below criteria using needle guns and chipping hammers. Two 6-inch overhead electrical conduits were also decontaminated. A soil boring was drilled in the base of the sump, and samples were collected to a depth of 4 feet. Total uranium in these samples was within background levels.

The sump at the base of the stairwell was delineated by Survey 810, which also included the three drainlines that discharged into the sump. The bottom and sides of the sump were contaminated as was the sediment in the sump, as indicated by Sample 751. The total uranium concentration was 99.14 pCi/g. The sides and bottom of the sump were decontaminated by removing 1 to 2 inches of concrete.

Sample 790 was scale material from the north pipe and contained 6,573 pCi/g of total uranium, as shown by Survey 1260. The scan results indicated that the east and west drainlines were below criteria, and the generic guidelines (300 cpm or 9,000 dpm/100 cm^2) occurred only at the end of the east drainline that was removed during the decontamination of the sump. The surfaces of the accessible portions of the remainder of the east pipe and all of the west pipe were below guidelines. The north pipe is about 10 feet long and leads to a trench in the utility tunnel. This pipe was found to exceed the generic guidelines in Survey 810 (16,000 dpm/100 cm^2 between 1 and 2 feet into the pipe) and in Survey 1260 (54,000 dpm/100 cm^2). This pipe is believed to be in use, receiving flow from the trench in the utility tunnel. Because contamination within the tunnel has previously been

reported (i.e., releases from MED-era injection wells flowing into the utility tunnel), the potential exists for re-contamination of the drainpipe if remediation is pursued before potential contamination within the tunnel is addressed. Limited surveys of the tunnel near the access door at this point, taken as part of a previous radiological safety and support program, have also shown some contamination on the floor. This pipe is designated as supplemental limit location LEC-12/13-7 (see Figure 4.10-3).

4.10.9 IVC Inspections

The ORNL team serving as the IVC for this remedial action periodically visited the site to review subcontractor data, take additional radiological measurements, and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area, or portion of an area, within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letters that pertain to Areas 12 and 13 are discussed below.

ORNL representatives visited the Linde Site during the week of April 14, 1997. Following that visit, they issued a letter dated May 5, 1997. Concerning Area 12, that letter states: *"All surfaces above ~1 foot of the wall/floor interface in area 12 were also released as below guidelines, with the exception of one "hot spot" on the lower horizontal surface, on the uppermost horizontal I-*

Concerning Area 13, the letter states: *"Finally, in area 13, all surfaces above ~l foot of the floor/wall interface were declared below guidelines with the exception of an I-beam that runs along the west wall. Hot spots were found along the beam on the lower horizontal surface closest to the wall. This area will need further decontamination."*

ORNL representatives visited the site during the week of July 14, 1997. Following that visit, they issued a letter dated July 30, 1997. That letter states: *"The subsurface and remaining floor areas 12 and 13, of building 14, were thoroughly investigated and our results align fairly well with those from the turnkey subcontractor. A tentative hazard assessment on the soil underneath both the walls and remaining floor areas is being prepared. This assessment also includes the footer surfaces that were in the process of being remediated until the structural integrity came into question. Our verification survey was therefore limited to the areas not covered in the scope of the hazard assessment (i.e., the open excavated areas and the remaining floor surfaces). With the exception of a strip of soil in area 13 (which was subsequently remediated), all excavated areas are below Department of Energy soil guidelines for the state of New York."*

ORNL representatives visited the site during the week of May 4, 1998. Following that visit, they issued a letter dated May 20, 1998. That letter states: *"The entrance stairway leading down to the utility tunnel, adjacent to area 12 was also surveyed and contamination above guidelines was detected. This elevated area was reported and additional decontamination was conducted. After additional decontamination the area was verified to be below the DOE order."*

On September 21, 1998, ORNL issued a letter clarifying the status of the independent verification of Building 14. Concerning Area 12, the letter states: *"The walls, steps, ceiling, and pipes associated with the stairwell in area 12, that leads to the utility tunnel, was also surveyed and is below DOE guidelines for surface contamination. The internal piping was cleared during the*

process piping investigations." Another letter dated October 23, 1998, confirmed this information; therefore, all surfaces in the stairwell leading to the tunnel in Area 12 have been released.

On November 10, 1998, ORNL issued a letter to provide the results of their evaluation of radiological data taken by the subcontractor for Building 14. That letter states: *"We agree with their* (the subcontractor's) *findings that the surfaces of the sump located in the utility tunnel section of area 12, as well as the east and west drain lines leading into the sump, fall below the Department of Energy (DOE) criterion for radiological surface cleanup."*

4.10.10 Locations Exceeding Remedial Action Criteria

Several areas have been identified within Areas 12 and 13 where contamination exceeds the remedial action criteria. These areas are summarized below:

1. Soil Remaining Underneath West Wall (LEC-12/13-1 and LEC-12/13-2). This location consists of two sections of soil beneath the center wall. Estimated volumes of impacted soil are 27 and 37 cubic feet, respectively.

2. Soil Remaining Underneath Center Wall (LEC-12/13-3 and LEC-12/13-4). This location consists of two sections of soil beneath the center wall. Estimated volumes of impacted soil are 41 cubic feet for each location.

3. Soil Remaining Underneath South Wall (LEC-12/13-5 and LEC-12/13-6). This location consists of two sections of soil beneath the south wall. Estimated volumes of impacted soil are 13 and 82 cubic feet, respectively.

4. Stairwell Sump North Drainline (LEC-12/13-7). This 10-foot drainline connects a trench in the utility tunnel on the north side of the building to a sump at the bottom of a stairwell in the northwest corner of Area 9.

5. Center Crane Rails (LEC-12/13-8 and LEC-12/13-9). These locations include the 6-inch by 12-inch areas around the bolts connecting the crane rails to the cross members. The total affected area is 17 square feet.

The soil contamination along the south wall of Areas 12 and 13 is common to that of the north wall of Area 14 North. These sections have been evaluated independently based on the results obtained from each area. A careful evaluation of all data suggests that all the locations along the common wall should be combined where appropriate.

4.11 AREA 14 NORTH

This section describes the present and historical uses of Area 14 North, presents the results of delineation activities, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area.

4.11.1 Area Description and Usage

During MED operations, Area 14 North was part of a common area that included Areas 12, 13, 14 South, and 15. The exact use of these areas is not known. Currently, Area 14 North is used as a research laboratory. A small room in the northwest corner of Area 14 North, known as Area 14A, was constructed after the conclusion of MED operations. This room was initially surveyed as part of the work performed in Areas 12 and 13, and a modest amount of decontamination was performed on the west wall. Later, during the investigation and remediation of Area 14 North, it was determined that the soil underlying Area 14A was contaminated. The east and south walls and the roof over Area 14A were subsequently demolished to facilitate the remedial activities.

4.11.2 Floors

Delineation showed contamination over most of the floor (Survey 855). Concentrations on the western portion of the floor, located south of Area 14A, were less than twice the background activity of 906 cpm. Most of the remainder of the floor showed elevated β/γ readings that were two to five times background or greater. Survey 785, performed on the floor/wall joints, floor cracks, trench walls, and drains, detected elevated contaminant levels at most of these locations, with direct β/γ measurements ranging from 8,000 to 483,000 dpm/100 cm^2. The highest levels were detected in the trenches, floor cracks, and drains. The floor/wall joint at the west wall showed β/γ measurements of 63,000 dpm/100 cm^2.

Portions of the floor were initially decontaminated, but because further investigation showed underlying soil contamination, the floor over nearly all of the area was removed and replaced. A narrow strip of the concrete slab (1 to 2 feet wide) was decontaminated and left in place adjacent to the east and north walls, as shown in Figure 4.11-1. It was necessary to leave a section of the slab and underlying soil in place because the north wall rests on the slab and is not supported by a foundation.

The results of the verification surveys for the floor are shown in Figure 4.11-2. The available data are limited to areas adjacent to the walls because most of the floor was removed and replaced.

4.11.3 Soil and Other Subsurface Features

Ten soil borings were drilled within Area 14 North, and samples were collected at 1-foot intervals to a depth of 4 feet (Survey 672). In addition, one soil boring was drilled in Area 14A during the investigation of Areas 12 and 13. Scans of the samples as they were removed showed β/γ levels of approximately 1 to 15 times background. The results of the isotopic analyses of the samples are summarized in Table 4.11-1, and complete results are provided in Appendix E. Total uranium was detected in the soil borings prior to remediation at levels up to 684.32 pCi/g. After the initial excavation, three composite soil samples (844, 876, 877) were collected from the north and south sides of the excavation. Subsequent to the sampling, additional soil between the initial excavation boundary and the walls was removed where necessary and practical. Sample 844 was a composite soil sample from beneath the knee wall along the west wall, and the total uranium measured in this sample was 1,287.40 pCi/g. Samples 876 and 877 were composite samples of material underlying the north wall prior to removal of the material. A layer of black ash was present immediately beneath the slab with a typical depth of 6 inches, increasing to 2 feet near the center of the wall. The thickness of the ash layer decreased closer to the west wall, to the point where it disappeared

completely, and then reappeared near the corner formed by the north and west walls. Sample 877 was a composite sample collected from the ash layer; sample 876 was a composite sample from the soil underlying the ash layer. Total uranium was present in the ash sample (877) at a specific activity of 247.29 pCi/g and in the soil sample (876) at 14.93 pCi/g.

The drainage trenches and sumps shown in Figure 4.11-1 were surveyed during Survey 785. Direct β/γ readings up to 483,000 dpm/100 cm^2 were taken in the west trench and up to 95,000 dpm/100 cm^2 in the east trench. The drainlines discharging into the sumps were also surveyed, and β/γ readings up to 102,000 dpm/100 cm^2 were measured.

The soil throughout Area 14 North was excavated to various depths as shown in Figure 4.11-1. The soil on the western half of the area was removed to a depth of 4 feet, the eastern half to a depth of 2 feet, and the southern portion to a depth of 3 feet. All of the trenches, sumps, and drainlines underlying the floor were removed and replaced.

Several concrete equipment pedestals, as shown in Figure 4.11-1, were uncovered during soil excavation and removed or decontaminated. The surfaces of concrete around column footers located below the slab were also decontaminated. Delineation data on two columns located in grid cells G-8 and A-8 are documented in Surveys 891 and 894, respectively.

Some areas of soil exceeding the site-specific criterion of 60 pCi/g for total uranium were left in place underneath the north wall at locations LEC-14N-4, LEC-14N-5, and LEC-14N-6, as shown in Figure 4.11-1. The residual soil underneath the north wall begins immediately below the slab and extends downward 2.5 feet beneath the slab surface. This soil was left in place because its removal would have jeopardized the structural integrity of the building. Composite soil samples were collected from these areas and analyzed for total uranium and other isotopes. Sample 876 was collected from soil underneath the northwest corner of the north wall at location LEC-14N-4. Although the total uranium concentration of 14.93 pCi/g in this sample was well below the site-specific standard, this location has been designated as exceeding the remedial action criteria based on the results of a sample collected on the other side of the wall in Area 12. IDM Sample 877 is a composite sample collected from the two remaining locations underneath the north wall between grid cells M-3 and M-8 (locations LEC-14N-5 and LEC-14N-6). This sample was collected from an ash layer at 0.5 to 2 feet below the slab surface and had a total uranium concentration of 247.29 pCi/g. Location LEC-14N-4 is estimated to contain 12 cubic feet of ash at a depth of 4 to 8 inches from the floor surface. Location LEC-14N-5 is estimated to contain 12 cubic feet of ash and 12 cubic feet of clay soil at a depth of 4 to 20 inches from the floor surface. Location LEC-14N-6 is estimated to contain 9 cubic feet of ash at a depth of 4 to 8 inches from the floor surface.

IDM Samples 878 and 879 are composite samples collected from the three sections of soil in Area 14 North, designated as LEC-14N-1, LEC-14N-2, and LEC-14N-3, left in place underneath the west knee wall. These samples also included soil from two locations in Area 14 South: LEC-14S-1 and LEC-14S-2. Sample 878 was a biased composite sample selected from areas of elevated activity identified by scanning. Sample 879 was an unbiased composite sample. The concentrations of total uranium in Samples 878 and 879 were 78.91 and 87.85 pCi/g, respectively, which indicate relatively low and uniform levels of residual activity. Very little residual soil (less

than 1 cubic foot) remains underneath each of these three areas. This assertion is based on the conceptual model for contamination (i.e., acid draining down the footer and over the horizontal concrete extension housing the electrical conduit) and the experience gained during the remedial action in which virtually all of the soil exceeding criteria was removed. These three locations are designated because of residual contamination on the concrete surface. The estimated areas exceeding criteria at these three locations are 5.5 square feet, 1.3 square feet, and 0.5 square feet at LEC-14N-1, LEC-14N-2, and LEC-14N-3, respectively.

Verification soil samples were collected from a grid established as shown in Figure 4.11-1. The area was divided into 3-meter by 3-meter blocks or 3-meter by 4-meter blocks at the western and northern boundaries. Samples were collected from each 1-square-meter cell within a block and composited into a single sample. These samples are identified by their block number (e.g., N2/E1) and are IDM Samples 849 to 875. The analytical results for these samples are provided in Appendix E. The maximum activities detected in the post-verification soil samples were 17.61 pCi/g for total uranium and 0.91 pCi/g for radium-226; these values were well below their respective guidelines.

4.11.4 Ceiling

The structural steel members adjoining the ceiling were delineated by Survey 895. The results indicated elevated activity levels over all of the steel. All of the structural steel was decontaminated below criteria, primarily by sponge blasting with limited use of grinders and needle guns.

The creteplank ceiling was scanned at the same time as the steel, and although the delineation results were not documented, the creteplank was found to be below criteria. Four ventilators located in the roof were also scanned and found to be below criteria. The interiors of the ventilators were scanned by extending probes through the louvers to the extent possible (6 to 12 inches). The results of the ceiling verification surveys are shown in Figure 4.11-3.

4.11.5 Crane Rails

Crane rails are located on the east and west walls, and two crane rails are located in the center of Area 14 paralleling the east/west rails. These rails are I-beams that support a small manually operated crane.

The western crane rail was delineated and documented along with the western wall by Surveys 900 and 915. This rail was decontaminated and fully meets surface release criteria.

The center crane rails consist of two parallel rails joined by channel steel cross members. The delineation of the center crane rails is documented by Surveys 892 and 893. The crane rails and supporting cross members were fully decontaminated by sponge blasting with the exception of the underside of the top flange of each crane rail, on the interior side only, where areas above criteria remained following repeated decontamination efforts. These areas are around the bolts that connect the cross members to the I-beams at evenly spaced intervals. The residual contamination over the bolts ranged from 4,500 to 16,100 dpm/100 cm^2 as shown by Survey 1139.

Delineation of the eastern crane rail is documented by Survey 898 as part of the eastern wall delineation. The crane rails were decontaminated by sponge blasting and, similar to the center crane rails, had residual contamination exceeding criteria. These areas were on the upper surface of the I-beam around the bolts connecting the cross members to the I-beam. The residual activity levels are documented by Surveys 1131 and 1139. These areas are designated as LEC-14N-7 and LEC-14N-8 (see Figure 4.10-1).

4.11.6 Walls

Contamination on the walls in Area 14 North was generally marginal and spotty. The east wall survey results are documented by Surveys 898 and 899. Contamination was found on the structural steel on the upper portion of the wall and on conduits and other fixtures on the wall. The brickwork generally had low levels of β/γ contamination. Concentrations on the wall below the structural steel were typically two to three times background levels. Concentrations on the structural steel were up to eight times background. Initial direct measurements were taken on the north wall and documented by Surveys 886 and 913. The north wall was constructed after the conclusion of MED operations; therefore, the direct probe measurements were discontinued and surface scans were performed on the remainder of the wall. These scans showed that β/γ levels were not significantly elevated. Results for the west wall are documented by Surveys 887, 900, 914, 915, and 1220.

The verification surveys focused on the areas that required remediation. Due to obstructions caused by equipment or other access restrictions, some survey locations were clustered together rather than distributed evenly in a grid pattern. The results of the verification surveys are shown in Figure 4.11-4.

4.11.7 IVC Inspections

ORNL was the IVC for this remedial action. As part of the verification process, ORNL personnel periodically visited the site to review subcontractor data, take additional radiological measurements, and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area or portion of an area within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letters that pertain to Area 14 North are discussed below.

ORNL representatives visited the site during the week of January 12, 1998. Following that visit they issued a letter dated January 30, 1998, which states: *"Area 14 North, with the exception of the cross members associated with the crane rail, all surfaces above six inches from floor/wall interface have been determined to be below the clean-up guidelines as defined in the Department of Energy Order 5400 (wall surfaces to six inches from the floor will be remediated as part of the floor)."* Therefore, this letter releases the walls, ceiling, and overheads with the exception of the crane rail cross members described in Section 4.11.5.

ORNL representatives visited the site during the week of March 2, 1998. Following that visit they issued a letter dated March 16, 1998, which states: *"The subsurface and remaining floor areas in 14N and 14SW were thoroughly investigated and our results align well with those of the*

subcontractor. Tentative supplemental standards for portions of the soil underneath both the walls and knee wall areas are being developed. With the exception of the locations to be covered by supplemental standards, Areas 14N and 14SW are verified not to have residual contamination above the guidelines, as defined in the Department of Energy (DOE) Order 5400.5. This closes out Area 14N as the other portions were covered in a previous letter." This letter, therefore, releases the floor and subsurface of Area 14 North with the exception of the areas underneath the walls that are candidates for supplement limits.

An IVC letter dated October 23, 1998, states: *"All soil samples have now been analyzed and the outstanding subsurface soils in Areas 9 and 14 fall below the site specific soil criterion of 60 pCi/g total uranium."* This letter therefore releases the subsurface soil in Area 14 North.

4.11.8 Locations Exceeding Remedial Action Criteria

Several locations that exceed the remedial action criteria have been identified within Area 14 North. These locations were discussed above and are summarized in this section. Each location has been assigned a reference number (e.g., LEC-14N-1) for use in the text and in Figure 4.11-1 where each location is shown. These areas are:

1. Concrete surface of west knee wall (LEC-14N-1, LEC-14N-2, LEC-14N-3). Three sections of the knee wall supporting the west wall exceed the generic surface guidelines.

2. Soil under north wall (LEC-14N-4, LEC-14N-5, LEC-14N-6). Three sections of soil underlying the north wall between Area 14N and Areas 12 and 13 exceed the site-specific criteria.

3. Center crane rails (LEC-14N-7). The area on the upper surface of the cross member surrounding the bolts connecting it to the I-beam (crane rail) exceeds surface criteria. Total area is 10 square feet. Contamination occurs on both the west-center and east-center crane rails.

4. East crane rail (LEC-14N-8). The area on the upper surface of the cross member surrounding the bolts connecting it to the I-beam (crane rail) exceeds surface criteria. Total area is 5 square feet.

4.12 AREA 14 SOUTH

This section describes the present and historical uses of Area 14 South, presents the results of delineation activities, discusses the remediation activities conducted in the area, and presents the post-remedial action status of the area.

4.12.1 Area Description and Usage

During MED operations, Area 14 South was part of a common area that included Areas 12, 13, and 14 (North and South). The exact uses of these areas are not known. Currently, Area 14 South is used as a research laboratory. For the purpose of the remedial action, the area was divided into two different sections, designated as Area 14 Southwest and Area 14 Southeast, because a

containment structure was located between the two areas. The boundary between the two areas was about 7.5 meters east of the grid origin and ran north to south within Area 14 South.

4.12.2 Floors

The floor in Area 14 South was delineated by Survey 901; the cracks, joints, and trench were delineated by Survey 819. In the latter survey, the highest activity levels were detected in or around the sump located in grid cell 7-D. Relatively low levels of activity were found on the floor except for areas around the sump, along the south wall between grid cells A-10 and A-12, and around grid cells H-8 to H-10.

The entire floor from the west wall to approximately the center of Area 14 South was removed and replaced following excavation of underlying soil (Figure 4.12-1). Other areas around the column, the sump in the southeast corner, and elsewhere (as shown in Figure 4.12-1) were decontaminated using needle guns or sponge blasting. In some cases, decontamination in the smaller areas consisted only of removing anchor bolts embedded in the floor.

The floor surfaces underneath the process columns were inaccessible for remediation. An area average calculation was made using existing data obtained from around the columns (Bechtel 1997). Based on the results of this calculation, the floor surface underneath the column centered at grid cell E-13 (designated as Column 1 in the calculation) was estimated to have fixed activity of 5,245 dpm/100 cm^2 based on direct β/γ measurements. This slightly exceeds the DOE generic guidelines for average total activity. The floor area underneath the concrete pad is therefore designated as location LEC-14S-11 (shown in Figure 4.12-1). The pad is approximately 5 feet by 8 feet, or a total area of 40 square feet.

The verification surveys of the floor are shown in Figure 4.12-2. Verification surveys were not performed over the western and north-central part of the area where the floor was removed.

4.12.3 Subsurface Soil and Other Features

Thirteen soil borings were drilled to investigate the subsurface soil. These locations are shown in Figure 4.12-1 and are documented in Survey 673. The borehole numbers, corresponding sample numbers, and selected analytical results are presented in Table 4.12-1. Concentrations for total uranium ranged up to 147.61 pCi/g in these soil boring samples. Additional samples were collected at other locations. Sample 905, in grid cell D-14, contained total uranium at a concentration of 118.75 pCi/g and was representative of the soil just east of a concrete pad supporting a large process column. Sample 906 was a horizontal corebore composite sample collected from grid cell D-14 under the same concrete pad. Total uranium was detected in this sample at 77.7 pCi/g. These samples are described in Survey No. 1694. Lightweight oil was detected at a depth of 3 feet in the bottom of soil boring 14, which was located on the south side of a large process column; however, the oil was not detected during hand excavation of the soil, indicating that its presence was limited. Direct measurements in the south-central portion of the area (Surveys 1694 and 1753) showed elevated soil activity levels ranging from 150 to 3,200 cpm.

The soil was excavated to a depth of 2 to 4 feet over the western half of the area, as shown in Figure 4.12-1. Verification samples were taken at the locations shown in Figure 4.12-1, and the results are presented in Table 4.12-1. Most of these verification samples were composite samples

collected over nine grid cells (per standard procedure), but six additional composite or discrete samples were collected by different techniques due to space restrictions or other limitations. Sample 907 was a horizontal corebore sample collected at grid cell D-13 underneath the south section of the concrete pad supporting the large process column. Total uranium in this sample was 24.1 pCi/g. Sample 908 was a horizontal corebore sample collected at grid cell F-11 underneath the northwest section of the same concrete pad. Total uranium in this sample was 5.3 pCi/g. Sample 908, also a horizontal core sample, was collected at grid cell D-11 underneath the west section of the same concrete pad supporting the circulation pump and column. Total uranium in this sample was 3.1 pCi/g.

IDM Samples 910, 911, and 912 were grab samples collected from areas with restricted access. Sample 910 was collected in grid cell D-14 underneath the southeastern section of the concrete pad supporting the large process column, and Sample 911 was collected in grid cell C-15 under the eastern side of the same pad. Sample 912 was collected in grid cell A-18 from clay at a location east of the contamination noted to have begun decreasing from west to east. Total uranium detected in Samples 910, 911, and 912 was 20.2, 9.6, and 12.3 pCi/g, respectively.

One section of soil remaining underneath the west knee wall (designated as location LEC-14S-1) exceeds the remedial action criteria. This section is in grid cells B-0 and C-0, identified in Survey 1267. IDM soil samples 878 and 879 were composited from this location and location LEC-14S-2 and from the Area 14 North west wall footer at LEC-14N-1, LEC-14N-2, and LEC-14N-3. These samples show total uranium at 78.91 and 87.85 pCi/g, slightly above the site-specific criterion of 60 pCi/g. Location LEC-14S-1 is a 4-inch-thick lens of soil located immediately underneath a horizontal concrete slab containing an electrical conduit. This area is about 3 to 4 feet long, with an estimated volume of 1 cubic foot. The volume estimate is considered conservative because it is not likely that the contamination extends back to the wall footer. This location also contains an estimated 2 square feet of concrete exceeding surface criteria. Location LEC-14S-2 has an estimated 1 square foot of concrete that exceeds surface criteria, but the soil was remediated to below criteria at this location.

As in Area 14 North, several concrete pads were found beneath the floor slab during the excavation. The slabs likely served as support for former process equipment, perhaps during MED operations. These slabs, shown in Figure 4.12-1, were either decontaminated or removed.

A sump located at grid cell D-7 was delineated by Survey 1040. Surface contamination levels ranged up to 60,000 dpm/100 cm^2. The sump and associated drainlines were removed and replaced.

Another sump located in the southeast corner of the area was delineated in Surveys 445 and 824. Surface contamination ranged from 4,800 to 17,000 dpm/100 cm^2. The sump was removed and replaced.

4.12.4 Walls

Area 14 South, also known as the high bay, is the tallest area in Building 14, with a ceiling height of approximately 55 feet. Each wall is similar in construction, with brickwork extending the full height of the walls. Structural steel beams begin approximately 20 feet above the floor near the

wall surfaces. Delineation of the walls focused more on the contaminated structural steel and less on the brick, which proved to be below criteria over most of the wall surfaces. Continuous scans were performed on the brickwork from the scaffolding assembled to access the structural steel. The results of these delineation scans were not documented in all cases due to the uniformly low levels of activity detected on the brick. The individual walls are described in the following sections.

4.12.4.1 North Wall

The north wall was delineated by Surveys 854 (steel), 864 (steel), 888 (brick), 889 (steel), 919 (brick/beam), and 1374 (beam-supplemental limits). The brickwork was found to have only slightly elevated activity levels except in areas immediately adjacent to the steel beams. The structural steel, as on the other walls in the area, was generally contaminated at levels exceeding surface criteria. Survey 889 documents direct measurements on the steel, with activities ranging from 16,000 to 68,000 dpm/100 cm^2. All of the structural steel was decontaminated. The brick was decontaminated only on the lowest half meter in grid cells H-18 to H-20 and in other locations immediately adjacent to the steel. One surface of one I-beam on the north wall could not be decontaminated to below surface criteria. This was on the horizontal beam at elevation LL on the lower surface of the I-beam lip facing the wall, as shown by Survey 1374. The residual activity on this horizontal surface ranged from 6,000 to 9,000 dpm/100 cm^2. This beam is designated as location SSL-14S-7, as shown in Figure 4.12-3.

A 6-inch-wide ledge midway up the eastern part of the north wall (the portion between Area 14 South and Area 15) underwent an additional decontamination effort following initial inspection by the IVC. The verification survey results for this ledge are included in Survey 1540.

The verification survey results for the north wall are shown in Figure 4.12-4.

4.12.4.2 South Wall

Several delineation surveys were performed on the brick and structural steel on the south wall. Some of the surveys focused on the wall where a roll-up door was installed, on a mandoor, or on areas where supplemental limits will be applied to the I-beams or footer. Each area is discussed below.

Structural Steel. The structural steel was fully delineated by Surveys 853, 865, and 890. Scanning results from the eastern third of the wall ranged from three to six times background. Results of direct measurements taken on the center and western walls (Survey 890) ranged from 5,000 to 44,000 dpm/100 cm^2. All of the steel beams were decontaminated to below criteria by sponge blasting except for three horizontal beams on the western end of the south wall. These exceptions, as documented in Surveys 1347, 1351, and 1354, occur on each beam on the top side of the lower sill between the beam and the wall. It was possible to gain access to these surfaces with a probe, but they could not adequately be decontaminated with the sponge blast equipment or other tools because of space restrictions. The vertical and upper surfaces on the same side of these I-beams were successfully decontaminated, as demonstrated by the surveys. Residual activity levels ranged from 3,000 to 36,000 dpm/100 cm^2. In contrast, the vertical surfaces did not exceed

1,400 dpm/100 cm^2. These locations are designated as LEC-14S-4, LEC-14S-5, and LEC-14S-6 and are shown in Figure 4.12-3.

Brick Wall. As previously noted, the brick wall was scanned during the remediation phase while the scaffolding was in place rather than during separate delineation surveys. The low levels of activity observed in Survey 917, where levels were three to four times background, support the assessment that the wall was largely uncontaminated. Survey 1288 documents elevated activity levels between grid cells A-14 and A-18. Decontamination was performed on the lower first meter of the wall between grid cells A-2 and A-18 and on the footer wall beneath the floor.

Several surveys were performed in support of the removal of brick and installation of a roll-up door in the western end of the south wall during the remedial action. This portion of the wall was originally a window that was filled in with bricks, perhaps during the 1940s. Survey 812 documents conditions on the exterior wall. Surveys 825 and 883 document the interior surface of the wall in the area where the door was installed. Activity levels on the interior wall surface were up to 45 times background. Surveys 1031 and 1041 document conditions of the interior of the wall during removal of the brick. Elevated β/γ measurements ranged up to 805,000 dpm/ 100 cm^2. Three samples of the brick and mortar (802, 803, and 804) were taken for isotopic analysis. Total uranium in these samples ranged up to 27,566 pCi/g. The brick was removed westward from the western side of the roll-up door to the nearby mandoor and included the first four rows of bricks above the floor**.** Because the bricked-over window extends several feet eastward beyond the eastern side of the roll-up door, there is potential for contamination to exist within the wall on and below the former window ledge and within the brick, as it did in the portion of the wall that was removed. This area is therefore designated as LEC-14S-9. The size of this location is conservatively estimated to be 10 feet long by 10 feet high or 100 square feet. The actual former window area is expected to be somewhat less. The ledge and adjacent brick and mortar are expected to be contaminated within this area, and the mortar within the brick above the ledge may also be contaminated in isolated locations. The mechanism of contamination around the ledge can likely be attributed to the collection of dust on the ledge and tar paper and within air pockets in the mortar, but the origin of contamination found within the brick or mortar elsewhere is less certain. One possible explanation is that during MED operations the sand and cement used to mix the mortar were placed on the floor, where they became mixed with loose yellow cake residue.

A similar bricked-over window exists in the central part of the south wall. Although no intrusive investigations have been performed at this location, the same potential for internal contamination within the wall exists on and adjacent to the former window sill ledge and throughout the brick mortar. This location is therefore designated as location LEC-14S-10, although the area is below criteria on the interior wall surface. The size of the area is conservatively estimated to be 10 feet high by 25 feet long, or 250 square feet. The actual former window area is expected to be somewhat less.

A section of natural gas piping along the south wall about 3.5 meters above the floor was removed and replaced because of external contamination. A 5-meter length of the pipe was removed, beginning in the southwest corner.

Footer. Elevated levels of activity were detected in the concrete footer wall and the first several courses of bricks resting on the footer. Bricks were removed from the wall between grid cells A-7 and A-19. As documented in Survey No. 1752, the contamination on top of the footer wall was higher toward the western end, decreasing toward the eastern end. As shown in Survey 1737, the inner two courses of bricks in the first two layers were removed between grid cells A-7 and A-16. As the level of contamination decreased closer to the eastern wall, fewer bricks or only portions of bricks were removed between grid cells A-18 and A-19. Following decontamination, all surfaces of the brick and concrete wall footer were below surface criteria except in grid cells A-13 through A-17, where residual activity levels ranged from 5,271 to 13,278 dpm/100 cm^2. These measurements were taken at the intersection of the perpendicular brick surface and the horizontal footer surface, and the outer course of bricks could not be removed because of risk to the structural integrity of the wall. As a conservative estimate, it is assumed that the same levels of activity detected on the footing prior to decontamination remain between the horizontal brick surface and the footer surface in grid cells A-7 through A-19. The pre-decontamination levels were 8,897 to 132,432 dpm/100 cm^2, as measured by Survey 1752. This remaining outer brick/footer interface area, shown in Figure 4.12-1 is designated as location LEC-14S-3. The estimated activity remaining under the first layer of the outermost course of bricks is 30,769 dpm/100 cm^2 based on the arithmetic average of the data from Survey 1752. The data in grid cells A-11 through A-14 are excluded from this average because they were taken on a subgrade equipment pedestal. The affected area is estimated to be 13 square feet (4 inches wide by 39.3 feet long).

Mandoor. Routine maintenance was performed on the mandoor located just west of the roll-up door in the south wall. When the door frame was removed, elevated levels of contamination were found on the surface of the newly exposed brick and on the mortar filling the gap between the brick and the steel door frame. The contamination level was generally higher within the mortar due to high porosity and cavities within the mortar. Surveys 1514 and 1516 show the condition of the door frame as it was found. More precisely, Survey 1516 was made shortly after midnight on the morning of June 8, 1998, to document the radiological condition of the doorway and debris prior to its removal. The time recorded on the survey, 2200 hours, was intended to reflect the condition of the door at the time it was first discovered on the evening of June 7. Survey 1514 is a subsequent survey made during the afternoon or evening of June 8. No further work on the door frame was done between the two surveys other than to remove the debris. The doorway was subsequently remediated, and verification results were documented in Surveys 1578 and 1579.

The results of the verification surveys for the south wall are shown in Figure 4.12-5. Areas that are candidates for supplemental limits include the three horizontal beams, the footer, and the remaining bricked-over windows. The locations of these areas are shown in Figure 4.12-3.

4.12.4.3 West Wall

The west wall could not be delineated and documented by usual methods because of a large HVAC unit located in the center of the upper half of the wall. The unit extends about 10 feet out from the wall and prevented the use of the mobile lift that was used during all other delineation work on the walls and ceilings. Instead, scaffolding was built, and the brick wall and structural steel were decontaminated as required. It was not the practice to document radiological conditions during the remedial phase; therefore, no delineation surveys are available for the west wall. As was standard

throughout the area, activity on the brick wall was found to be generally below surface criteria, and the structural steel members were uniformly contaminated. Delineation Survey 881 includes measurements made on steps leading to the large hallway and the adjacent knee wall.

The structural steel, consisting of horizontal I-beams and vertical columns, was entirely decontaminated using needle guns and sponge blasting. The lower 6 feet of the wall was also decontaminated, but otherwise only spots of contamination were detected and decontaminated on the brick, typically where steel beams joined the brick.

The results of the verification surveys for the west wall are shown in Figure 4.12-6. All surfaces were decontaminated below criteria, and no areas for supplemental limits remain on the west wall.

4.12.4.4 East Wall

The east wall was delineated by Surveys 918, 1347, and 1374. As documented in Survey 918, point measurements were taken over the entire lower 4 meters of the wall. As was typical of the brick walls, results were two to four times background. The remainder of the wall was scanned after scaffolding was assembled for the decontamination of the structural steel. Three of the steel beams were delineated during Surveys 1347 and 1374, with surface activities ranging from 3 to 12 times background. The structural steel was completely decontaminated. Minor decontamination was performed on the brick, primarily where the steel joined the wall. An area of one of the horizontal beams (designated as location LEC-14S-8 between elevations KK and LL) exceeded generic guidelines following decontamination efforts, with residual direct β/γ activity levels of 5,000 to 10,000 dpm/100 cm^2. The post-remedial condition of the beam is indicated in Survey 1498. On this beam, as on the other beams for which supplemental limits will be applied, the residual fixed contamination is located on the upper horizontal surface of the lower sill of the I-beam facing the wall. A roll-up door in this wall was removed and replaced after the decontamination of the area was complete. A small horizontal strip of contaminated brick just above the door, previously inaccessible because it was blocked by the door roll, was detected and decontaminated. Surveys 1787 and 1788 document the verification of the roll-up door.

The results of the verification surveys for the east wall are shown in Figure 4.12-6. Only one location, LEC-14S-8, remained above criteria following decontamination.

4.12.5 Ceiling

The structural steel on the ceiling of Area 14 South was delineated by Survey 867. Point measurements were taken primarily on the structural steel, with surface activities measured up to 134,000 dpm/100 cm^2. As shown in Figure 4.12-7, no measurements were taken at the western end of the area because the HVAC units obstructed access, and none were taken at the eastern end because of additional HVAC units that hang approximately 15 to 20 feet below the ceiling. Contamination was expected to be uniform in the overheads, however, because it resulted from deposition of acid mist. The decontamination and verification surveys were performed by constructing a contained platform on top of the lower crane assembly and moving it in approximately 12-foot intervals. Because of the alignment of the platform, verification data could not be collected along several narrow north-south bands. All of the structural steel was decontaminated to below surface criteria. No decontamination of the creteplank was required.

The results of the verification surveys are shown in Figure 4.12-7.

4.12.6 Crane and Crane Rails

A crane suspended from the ceiling in Area 14 South is used to move large equipment within the area. For the purpose of documenting the surveys and decontamination, the crane was surveyed as three components. The first component was the lower crane assembly, which is oriented north to south. A small maintenance platform is suspended from the assembly. The second component was the crane winch assembly, or trolley, which sits on top of the lower crane assembly and houses the winch motor. The crane winch assembly rides on rails fixed to the lower crane assembly, allowing the winch to move north-to-south. The third component was the crane rails, which run east to west, on which the lower crane assembly rides.

Survey 1034 is a delineation survey of the lower crane assembly. The direct measurements ranged from 19,000 to 139,000 dpm/100 cm^2. The highest levels of activity were associated with the grease and the gear wheels that were in contact with the grease. The higher levels are probably due to dust accumulating in the grease. Access restrictions prevented a delineation survey of the winch assembly.

The crane rails, lower crane assembly, and winch were decontaminated by sponge blasting after loose or caked grease was removed with rags or scrapers. The verification surveys for these three components are Surveys 1306, 1307, 1338, 1339, 1368 to 1373, 1411, 1426, and 1467. The results of these surveys are not illustrated in a figure, but all of the 273 direct measurements and all of the 66 removable measurements were below their respective MDAs, which in turn were well below the applicable surface criteria. As with most of the structural steel in the building, the crane had several layers of paint over the steel, and in most instances all of the contamination could be removed simply by removing the paint.

4.12.7 IVC Inspections

ORNL was the IVC for this remedial action. As part of the verification process, ORNL representatives periodically visited the site to review subcontractor data, take additional radiological measurements, and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area or portion of an area within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letters that pertain to Area 14 South are discussed below.

Area 14 South was divided into two areas, Area 14SW and Area 14SE, for the purpose of delineation, remediation, and verification activities. The IVC inspections and subsequently issued letters therefore maintain the same naming convention in the letters referenced below.

ORNL representatives visited the site during the week of January 12, 1998. Following that visit they issued a letter dated January 30, 1998, which states: *"Area 14 Southwest, accessible areas six inches from floor/wall interface up to approximately twelve feet along the south and west*

walls have also been determined to be below Department of Energy guidelines." This letter therefore releases the south and west walls in Area 14SW up to a height of 12 feet.

ORNL representatives visited the site during the week of March 2, 1998. Following that visit they issued a letter dated March 16, 1998, which states: *"The subsurface and remaining floor areas in 14N and 14SW were thoroughly investigated and our results align well with those of the subcontractor. Tentative supplemental standards for portions of the soil underneath both the walls and knee wall areas are being developed. With the exception of the locations to be covered by supplemental standards, areas 14N and 14SW are verified not to have residual contamination above the guideline as defined in the Department of Energy (DOE) Order 5400.5. Area 14SW has been verified to be below DOE guidelines with the exception of the overheads and walls above twelve feet."* This letter therefore releases the floor, walls, and subsurface of Area 14SW.

ORNL representatives visited the site during the week of May 4, 1998. Following that visit they issued a letter dated May 20, 1998, which states: *"With the exception of the ceiling and locations to be covered by supplemental standards, area 14SW is verified not to have residual contamination above the guidelines as defined in Department of Energy (DOE) Order 5400.5."* This letter therefore releases all of Area 14SW, with the exception of the ceiling.

ORNL representatives visited the site during the week of June 1, 1998. Following that visit they issued a letter dated June 10, 1998, which states: *"The walls, piping, and part of the overhead structures in Area 14SE were surveyed. This area is verified not to have residual contamination above guidelines defined in the Department of Energy (DOE) Order 5400.5. The exception is an area along the wall that leads to Area 15. This area will be renovated and post-remedial surveys will be conducted."* The letter also addresses Area 14SW with the following statement: *"The ceiling in area 14SW and the overheads and ceilings in area 9 were surveyed, and both areas were verified to be below DOE guidelines."* This letter therefore releases the walls, with the exception of the north wall in common with Area 15, part of the ceiling, and the piping in Area 14SE. It also releases the ceiling and overheads in Area 14SW.

ORNL representatives visited the site during the week of July 6-13, 1998. Following that visit they issued a letter dated September 16, 1998, which states: *"The ceiling, exposed subsurface soils, and remaining floor areas of Area 14SE were investigated. This area of investigation includes approximately one foot of the bottom of the wall…. The exposed soils in Areas 9 Lab and 14SE were scanned and soil samples were collected. The remaining concrete floor surfaces were also surveyed. After further decontamination efforts, review of the post-remedial action radiological data supplied by the subcontractor, and additional data collected from the remediated areas collected by the independent verification contractor, these areas are verified not to have residual contamination above the guidelines as defined in Department of Energy (DOE) Order 5400.5."* This letter therefore releases the floor and lower 1 foot of the walls of Area 14SE. The ceiling is also released.

A letter dated September 21, 1998, was issued by ORNL to clarify ORNL's standing on several issues. In the letter it states: *"Survey data collected by the subcontractor at an area along the wall between Area 14SE and Area 15, have been released as falling below the DOE surface guidelines."* This letter therefore releases the north wall of Area 14SE where it adjoins Area 15.

An IVC letter dated October 23, 1998, states: *"The ceiling in Area 14SE has been determined to fall below the surface guidelines as defined in Department of Energy (DOE) Order 5400.0... All soil samples have now been analyzed and the outstanding subsurface soils in Areas 9 and 14 fall below the site-specific soil criterion of 60 pCi/g total uranium."* This letter therefore releases the subsurface soil in Area 14 North and the ceiling in Area 14 Southeast (eastern part of Area 14 South). This statement is intended to specifically release the remaining portion of the Area 14SE ceiling which was excepted in the June 10, 1998, IVC letter.

With the exception of those areas denoted for application of supplemental limits, all parts of Area 14SE have been released by the IVC.

4.12.8 Locations Exceeding Remedial Action Criteria

Several locations that exceed the remedial action criteria have been identified within Area 14 South. These areas were discussed above and are summarized in this section. These areas are:

1. Soil and West Wall Footer and Soil (LEC-14S-1 and LEC-14S-2). One section of soil in which total uranium exceeds the site-specific criteria remains underneath the knee wall. Location SLL-14S-1 is in grids B-0 and C-0 and is about 5 feet long. The contaminated soil is located underneath the concrete slab in which the electrical conduit is embedded. About 2 square feet of the slab remains contaminated above criteria. Location SLL-14S-2 is centered on grid cell C-0 and is about 4 feet long. Approximately 1 square foot of the concrete slab remains contaminated above criteria.

2. Concrete Footer/Brick Wall Interface on the South Wall (LEC-14S-3). Contaminated brick was removed from the bottom four rows of brick in the south wall to the extent possible. The outer layer of brick left in place is suspected to have elevated activity levels at the interface of the brick and the underlying concrete footer between grid locations A-7 and A-16.

3. Horizontal I-Beams on the South Wall (LEC-14S-4, LEC-14S-5, LEC-14S-6). Three horizontal I-beams on the south wall, at the western end, have elevated levels remaining following decontamination. This contamination is limited to the full length of the upper surface of the lower lip of the I-beam on the side facing the wall. Restricted access prevented full decontamination of this surface.

4. Horizontal I-Beam on the North Wall (LEC-14S-7). One horizontal I-beam on the north wall at elevation LL, at the western end, has elevated levels remaining following decontamination. As with the I-beams on the south wall, this contamination is limited to the full length of the upper surface of the lower lip of the I-beam on the side facing the wall.

5. Horizontal I-Beam on the East Wall (LEC-14S-8). One horizontal I-beam on the east wall has elevated levels remaining following decontamination. As with the I-beams on the south

wall, this contamination is limited to the full length of the upper surface of the lower lip of the I-beam on the side facing the wall.

6. Former Window Concrete Ledge and Brick on the South Wall (LEC-14S-9, LEC-14S-10). Two former windows located in the south wall were filled in with brick. Two areas, one on the western section of the wall and one on the central section, are potentially elevated within the surface of the wall.

7. Floor Underneath Column 1 (LEC-14S-11). The floor underneath Column 1, centered at grid cell E-13, is part of the original floor and was inaccessible for remediation. Based on an average of data from the adjacent floor surfaces, this floor area is estimated to have a fixed activity of 4,245 dpm/100 cm^2 based on direct β/γ measurements. The size of the affected floor area is approximately 5 feet by 8 feet, a total area of 40 square feet.

4.13 AREA 15

This section describes the present and historical uses of Area 15, presents the results of delineation activities, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area.

4.13.1 Area Description and Usage

During MED operations, Area 15 appears to have been used as a preparatory area for uranium ore. A floor plan of Building 14 (#A63727 dated 1945) indicates that a wall separated Area 15 from Areas 12 and 13, where the main processing is believed to have taken place based on elevated contamination levels. Area 15 also appears to have been used as a proving laboratory maintenance room with tool-crib storage. Currently the area is used as a research facility with equipment, control panels, and tanks covering large portions of the floor. A large 4-foot-deep pit in the southern end of the room houses a blower, pumps, and other auxiliary process equipment associated with the operation of a large tank located to the north.

4.13.2 Floors

The floor in Area 15 shows evidence of having been replaced or patched in a number of sections over the years, and portions are of post-MED construction. The floor was delineated by Survey 355, and areas of higher activity were further delineated by Survey 418. Two data sets were recorded during Survey 355. The first was taken using a floor monitor and provided the most extensive coverage of the floor. These data are split into ranges, which are color-coded as shown in Survey 355 (Appendix B) and the measurement range values written with the figure. The second data set includes 4-point measurements of locations such as cracks and bolts suspected of having elevated levels of activity. The floor was moderately contaminated, with levels typically ranging from 2,000 to 30,000 dpm/100 cm^2 when surveyed with a large-area surface scan using the floor monitor set in high-sensitivity mode. The floor scan results showed that most of the concrete slab surface was two to three times background, indicating the need for further investigation. Investigation with hand-held Geiger-Mueller pancake detectors indicated that many areas of the floor, especially those with cracks and equipment hold-down anchor bolts in the concrete, exceeded surface release criteria. The data indicate that the highest levels of contamination were near the

southern end of Area 15; several elevated areas were found near the northern end. The large pit at the southern end of the area is of post-MED construction. Previous surveys showed low levels of activity in the pit.

The cracks in the floor were delineated by Surveys 356 and 457. The core surveys (370, 397, 399, 406, 408, 414, 423, 425, and 427) also contain information about the concrete portion of the cores as well as the underlying soil. Surface scans of the concrete cores revealed highly elevated activity levels at two locations west of the tank. Survey 399, a survey of a concrete core from SB-3, had a direct β/γ measurement of 86,000 dpm/100 cm^2 on the side of an expansion joint. The concrete core sample at CC-1 (Survey 370) had the same level of activity on the top of the core. However, these measurements were the exception. The floor cracks and joints generally showed contamination of 2 to 20 times background with significant attenuation 2 to 4 inches beneath the floor surface.

The offices (Areas 15A, 15B, and 15B-1) were of post-MED construction. Floor tiles were removed in the offices to provide access to the concrete surfaces, and surveys showed no activity above criteria.

As shown in Figure 4.13-1, large open areas of the floor were decontaminated with floor scabblers and scarifiers. Areas where large equipment could not be moved were decontaminated with the equipment in place, mostly with small needle guns and chipping hammers. More extensive contamination, breaks in the concrete, or old equipment hold-down anchor bolts typically required the use of jackhammers to remove up to 2 inches of concrete. A heater, which was believed to have been moved from another location and installed in Area 15B-1, was found to be contaminated at levels ranging from 5,000 to 10,000 dpm/100 cm^2. Some minute contamination was detected on the floor under the heater. The heater and floor were decontaminated, and the heater was removed.

A large 20-foot-diameter tank near the southern end of the area sits on what is believed to be the original concrete floor. Direct β/γ measurement results from floor survey 335 indicate that contamination on the west side ranged from background to 27,000 dpm/100 cm^2 and on the east side from background to 2,500 dpm/100 cm^2. Based on these activity levels surrounding the tank, at least part of the floor underneath the tank is expected to exceed the DOE generic surface criteria. The floor area underneath the tank is designated as LEC-15-1.

The verification surveys of the floor are shown in Figure 4.13-2. All floor surfaces surveyed were below criteria except for the area beneath the tank.

4.13.3 Subsurface Soil and Trenches

A trench, believed to have been constructed concurrently with the building, was discovered during the course of the investigation. The trench was located near the middle of the area, extending from the west wall at grid cell T-0 eastward to cell T-6. The trench was filled with sand, and a concrete slab was placed on top flush with the floor. The debris in the trench was removed, and the trench bottom and sides were scanned. No activity above criteria was detected. Two samples of sediment in the trench were analyzed (Report 7, Nos. 1 and 2), with total uranium results of 1.72 and 1.1.5 pCi/g, respectively.

A second trench, only 6 inches deep, running north to south along the eastern side of the large tank and equipment pit, appeared to be of post-MED construction. Surface scans and analysis of a sediment sample from the trench (Report 8, No. 35) detected total uranium at 0.84 pCi/g.

Based on the survey and sample analytical results, no remedial action was necessary for either trench.

A cable pit along the east wall at grid cell Z-8 was delineated by Survey 429. The bottom and sides of the pit were below criteria. A metal cover plate and metal lip on which the lid rests were heavily rusted. Three samples of the rust (Samples 297-1, 297-2, and 297-3) were analyzed, with total uranium present at 56.36, 61.46, and 61.09 pCi/g, respectively. The lid was below criteria, but the rust on the metal lip exceeded criteria and was removed using a wire wheel and needle gun.

The subsurface soil was investigated in conjunction with the cores of the concrete slab. Soil borings were drilled at 12 locations (SB-1 through SB-12) to depths of up to 4 feet beneath the base of the slab. Scan data from the concrete cores and soil are included in Surveys 370, 397, 399, 408, 414, 423, 425, and 427. Two of the soil borings, SB-6 and SB-11, are not documented on the survey forms. Cores of only the concrete slab were collected at three additional locations (CC-1, CC-2, and CC-3); the scan data from these cores are included in Surveys 399, 406, and 414. The soil boring and concrete core locations are shown in Figure 4.13-1. All analytical results for the soil samples were below criteria, with maximum detected activities of 4.29, 1.09, and 1.93 pCi/g for total uranium, radium-226, and thorium-232, respectively.

4.13.4 Ceiling and Overheads

The ceilings and overhead structural steel beams were delineated by Surveys 417, 422, 430, 439, and 446. Samples of paint chips collected from the overhead beams are documented in Survey 448. The contamination on the beams was more extensive, and levels were generally higher toward the southern end of the beams, declining toward the north. Direct β/γ measurements were typically in the 5,000 to 15,000 dpm/100 cm^2 range. The creteplank ceiling was scanned during the delineation surveys of the overheads and found to be well below criteria. Analysis of paint samples from the I-beams (Samples 314 through 319) demonstrated that contamination on the beams was higher on the horizontal surfaces than on the vertical beam surfaces. These results are included in Table 4.13-1.

In order to decontaminate the overhead beams, a containment structure was constructed on the mobile overhead crane to serve as a platform for the remedial work. All of the steel surfaces at the southern end of Area 15 required decontamination. The extent of steel requiring decontamination decreased toward the northern end of the area, where contamination was less uniform and limited to the horizontal steel surfaces and lower parts of the vertical beam surfaces. Sponge blasting was the primary decontamination technique used, supplemented by the use of needle guns or chipping hammers for the more difficult areas. No decontamination of the creteplank was necessary.

The results of the verification surveys for the ceiling and overheads are shown in Figure 4.13-3. All survey results were below criteria.

4.13.5 Walls

The walls were fully delineated during the course of the investigation in Area 15, but due to time and logistics constraints, the results of those surveys were not documented. Generally, only the vertical steel I-beams that support the building were found to be contaminated. The only other contaminated wall locations were a hidden horizontal I-beam in the east wall (Survey 449) and a 6-inch-wide horizontal ledge on the south wall.

A hidden I-beam on the east wall of Area 15 runs the length of Areas 15B and 15B-1. The beam, which is about 20 feet long and about 12 to 15 feet above the floor, supports the metal panels or curtain wall placed in a former window above the beam. A solid concrete block wall is underneath the beam next to Area 15B-1. The area underneath the beam next to Area 15B consists of an 8-foot-high doorway with a concrete block wall supported by a steel beam between 8 feet and the I-beam. Sheet metal covering the I-beam was removed, revealing contamination up to 200,000 dpm/100 cm^2 (direct β/γ activity). Sample 312 indicated that paint on the beam contained 1,657.9 pCi/g of total uranium. The beam was successfully decontaminated to levels below criteria.

The south wall was constructed such that two walls, about 6 inches apart, were joined about 30 feet above the floor. A horizontal plaster ledge was constructed to connect the two wall sections, with the upper horizontal surface of the ledge within Area 14 South and the lower horizontal surface within Area 15. Contamination was detected in the plaster, and the remediation of this ledge was performed during the remedial activities in Area 14 South.

A few bricks on the southern end of the east wall were decontaminated by removing 1 to 2 inches of the brick surface. Direct β/γ activity, typically in the range of 5,000 to 15,000 dpm/ 100 cm^2 but up to 29,000 dpm/100 cm^2 in some locations, was detected on about 35 square feet of brick. This area of contamination was remediated.

The results of the verification surveys are shown in Figures 4.13-4 through 4.13-7. All verification survey results were below DOE generic surface guidelines.

4.13.6 Crane and Crane Rails

The crane and crane rails were delineated and decontaminated and were documented as part of the overhead structural steel or ceiling remediation activities. The results of the ceiling verification surveys are shown in Figure 4.13-3. All verification survey results were below DOE generic surface guidelines.

4.13.7 IVC Inspections

ORNL was the IVC for this remedial action. As part of the verification process, ORNL representatives periodically visited the site to review subcontractor data, take additional radiological measurements, and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area or portion of an area within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letter that pertains to Area 15 is discussed below.

ORNL representatives visited the site during the week of November 10, 1997. Following that visit they issued a letter dated December 22, 1997, which states*: "Area 15 (all interior surfaces and the subsurface), with the exception of the surface beneath the large experimental tank, adjacent to the pit on the south side of the area, has been determined to be below remedial action guidelines. Areas 15A, 15B, and 15B-1 (all interior surfaces and subsurfaces), have been determined to be below remedial action guidelines."* This letter therefore releases all of Areas 15, 15A, 15B, and 15B-1 except for the surface beneath the large tank.

4.13.8 Locations Exceeding Remedial Action Criteria

One location that exceeds the remedial action criteria has been identified within Area 15. This location was assigned a reference number (LEC-15-1) for use within the text and in Figure 4.13-1, and is described below:

1. Floor under tank (LEC-15-1). The concrete floor underneath the tank is believed to be the original floor and therefore is likely to exceed the generic DOE surface guidelines, based on delineation data of the surrounding floor. The floor area is estimated to be 250 square feet.

4.14 AREA 20A-WEST

This section describes the present and historical uses of Area 20A-West, presents the results of delineation surveys, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area.

4.14.1 Area Description and Usage

Area 20A-West is located in the southwestern corner of Building 14, adjacent to Area 4 and Area 20A-East and 20B. The approximate floor dimensions are 26 feet long by 26 feet wide with an area of about 700 square feet. Area 20A-West is on the ground level, approximately 4 feet lower than the adjacent western first floor section.

Area 20A-West was part of the MED pilot plant operations facility in the early 1940s. Since then, the pilot plant area has been subdivided into different rooms. All walls in Area 20A-West are original except for the east wall. Area 20A-West is currently used as a turbine research and development department. Heavy steel turbine equipment and associated piping are present in the area. Historical drawings indicate that a pinch roll press was housed in this part of the pilot operations area. A trench system running east-west and a sump pit were also in place during MED operations. The sump was not found during the remediation efforts and is suspected to have been previously removed. A second trench running north-south has been installed (Figure 4.14-1).

A 1-meter grid reference coordinate system was established for the floor with the origin (A-0) located at the southeast corner. The grid system was established to facilitate selection of measurement and sampling locations and to provide a mechanism for relocating specific survey points for remediation and subsequent verification.

IDM conducted the delineation survey, decontamination, and post-remedial action survey operations in this area. The delineation surveys were conducted in September 1997 and the remediation work and the post-verification surveys in November 1997. ORNL reviewed post-remedial action data during the week of January 12, 1998, and conducted confirmatory surveys on a subsequent site visit.

4.14.2 Floors

Delineation surveys were performed with particular emphasis placed on such areas as drains, trenches, and corners/edges where there was a greater potential for contamination. Surveys of the floor surfaces did not indicate the presence of contamination. The results of the verification surveys are shown in Figure 4.14-2. All results were below DOE generic guidelines for fixed and removable surface contamination.

4.14.3 Subsurface Soil and Other Features

Soil borings were advanced at five locations within Area 20A-West to evaluate the potential for subsurface contamination (Figure 4.14-1). Contamination was not found on the floor surfaces. Boring locations were evenly spaced throughout Area 20A-West, and discrete samples were generally collected at four depth intervals: 0 to 1, 1 to 2, 2 to 3, and 3 to 4 feet in each borehole except for Boring 3, in which three intervals were sampled down to 3 feet. Each sample was analyzed for uranium-238, total uranium, radium-226, thorium-232, and potassium-40. The summary analytical results for total uranium, radium-226, and thorium-232 are presented in Table 4.14-1. The complete analytical results are provided in Appendix E. Total uranium was detected at concentrations ranging from nondetect (-1.19) to 3.77 pCi/g. Radium-226 was detected at concentrations ranging from 0.45 to 2.82 pCi/g, and thorium-232 was detected at concentrations ranging from 0.65 to 1.11 pCi/g.

All detected concentrations of total uranium were below the site-specific criterion of 60 pCi/g above background. All detected concentrations of radium-226 and thorium-232 were below the DOE generic guidelines for soil. Site-specific or generic guidelines have not been established for the other radionuclides that were included as analytes (uranium-238 and potassium-40).

Delineation surveys of the east-west trench indicated contamination of the bottom and sides of the entire trench. Levels were found to range from 220 to 410 cpm (IDM Survey 784, background: 43 cpm). Due to restricted access to the contaminated areas, needle scaling guns were used exclusively to remediate the trench. Following completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. Results of verification surveys for the remediated trench sections are presented in Figure 4.14-2. All results are below the DOE generic guidelines for both average and removable surface activity.

Surveys of the north-south trench did not indicate the presence of contamination. The sump pit shown on the historical drawing was not found and may have been removed previously.

4.14.4 Ceilings and Overheads

Delineation of the overhead surfaces included surveying the ceiling surface, heating ducts and exchangers, pipes, structural steel beams, and vent openings. Contamination was limited to portions of the overhead structural steel beam/brick wall interface along the northwest and southwest overheads. Levels were observed in the range of 258 cpm on the southeastern section (IDM Survey 1067, background: 51 cpm) to 370 cpm on the northeast section (IDM Survey 784, background: 43 cpm).

Due to restricted access to the contaminated areas, needle scaling guns were used exclusively to remediate the overhead structural steel/top of wall interface. Scaffolding was erected to provide access to the overhead contamination. Following completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. Results of verification surveys for the remediated overhead sections are presented in Figure 4.14-3. All results are below the DOE generic guidelines for both average and removable surface activity.

4.14.5 Walls

Limited contamination was found on the sections of the wall surface (about 10 linear feet) adjacent to the overhead contamination discussed in the previous section. No other areas of wall contamination were identified. The upper walls (higher than 2 meters) received slightly less extensive survey coverage based on the absence of notable contamination on the floors or lower walls.

Needle scaling guns were used to remediate the contaminated vertical section of wall. Scaffolding was erected to provide access to the contaminated area. Following completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. Results of verification surveys for the remediated wall sections are presented in Figure 4.14-4. All results are below the DOE generic guidelines for both average and removable surface activity.

4.14.6 IVC Inspections and Post-Remedial Action Status

Following completion of remedial activities and verification surveys by IDM, ORNL representatives reviewed post-remedial action data during the week of January 12, 1998. Their results, summarized in correspondence from ORNL to USACE dated January 30, 1998, provide third-party verification that the area was remediated to the appropriate cleanup criteria. The letter states: "*Area 20A West was determined to be below Department of Energy Order 5400.5 guidelines via a review of data collected by the turnkey subcontractor.*" On a subsequent site visit, the IVC conducted confirmatory surveys of Area 20A-West. The results were consistent with IDM's verification data.

After clearance from the IVC, Area 20A-West was restored to its original condition. Equipment that was relocated during the remediation effort was moved back into place.

4.14.7 Locations Exceeding Remedial Action Criteria

All parts of Area 20A-West were successfully decontaminated below the remedial action criteria.

4.15 AREAS 20A-EAST, 20B, 20B-1, AND 20C

This section describes the present and historical uses of Area 20A-East, 20B, 20B-1, and 20C; presents the results of delineation activities; discusses remediation activities conducted in the area; and presents the post-remedial status of the area.

4.15.1 Area Description and Usage

Areas 20A-East, 20B, 20B-1, and 20C are located in the southwest/central portion of Building 14, south of Areas 2 and 3 and Area 4A/4B. The combined floor dimensions are approximately 60 feet long by 30 feet wide, and the floor area is about 1,800 square feet. These areas are on the ground level, approximately 4 feet lower than the floor in the adjacent western part of Building 14. A trench runs the length of Area 20A-East and continues into Area 20A-West. A drainline at the western end of the trench runs southward from the trench to the sanitary sewer. A sump pit exists next to the trench.

During MED operations, Areas 20A-East and 20B/20B-1/20C were part of the southern portion of Building 14 that was used for pilot plant operations. Historical drawings indicate that this portion housed Furnaces 3 and 4, which were believed to have been used to calcine the acid leach cake at temperatures of approximately 1,050 °C.

During post-MED renovations, the area was divided into two general sub-areas: Area 20A-East and Area 20B/20B-1/20C. The latter area is further divided into individual rooms. Currently, Areas 20A-East and 20B-1 are used for storage. Area 20B is a hallway to 20B-1. Area 20C is a metal structure to the east of 20B-1 and is probably an enclosure for electrical panel equipment. Only the north wall along Areas 2, 3, and 4 and the south exterior wall are original. The other walls are post-MED renovations.

A separate 2-meter grid reference coordinate system was established for the floor of each sub-area (Area 20A-East and Area 20B/20B-1/20C) to facilitate selection of measurement and sampling locations and to provide a mechanism for relocating specific survey points during remediation and subsequent verification.

TNU and Sudhakar conducted the delineation survey, decontamination, and post-remedial survey operations in these areas from February to October 1996. ORNL performed independent verification surveys in October 1996.

4.15.2 Floors

Delineation surveys found contamination at two floor areas in Area 20A-East. A small area along the north wall (grid coordinates E4.0, N4.3 to E.6.0, N4.8) was found to have β/γ activity ranging from 5,118 dpm/100 cm^2 (TNU Survey 129DT033, file 12900817.xls, 7/11/96) to 30,843 dpm/100 cm^2 (TNU Survey 12900468, file 12900468.xls, 3/28/96). The vertical extent of contamination was limited to the floor surface, and remediation was accomplished by chipping the concrete surface. Post-remedial verification survey results ranged from less than background to 473 dpm/100 cm^2 (TNU Survey 129DT033, file 12900686.xls, 7/12/96).

The second area of contamination was found in the southeast corner of Area 20A-East at grid coordinate E17.6, N-4.1. Measured activity at this area was 21,251 dpm/100 cm^2 (TNU Survey 12900468, file 12900468.xls, 3/28/96). The area was decontaminated by chipping the concrete floor and part of the footer away and removing approximately 18 inches of the underlying soil. During remediation, elevated activity was also observed along the floor/wall interface and wall footer of the east wall. This resulted in removal of the concrete floor in the entire eastern section of Area 20A-East (approximately 5-foot by 30-foot section) to gain access to the subsurface contamination. Post-remedial verification survey results showed that direct β/γ activity levels were in the range of 717 to 2,987 dpm/100 cm^2 (TNU Survey 129DT033, file 12900677.xls, 7/10/96). The contaminated surfaces are shown in Figure 4.15-1.

4.15.3 Subsurface Soil and Other Features

Delineation surveys indicated that the entire length of the trench was contaminated, with measured activity levels up to 242,333 dpm/100 cm^2 β/γ (TNU Survey 12900457, file 12900457.xls, 3/26/96, and TNU Survey 12900467, file 12900467.xls, 3/28/96). Chipping hammers, grinders, and a concrete saw were used for removal of the contaminated concrete material, which mainly consisted of removing the sides and bottom of the trench.

During excavation of the trench, an abandoned drainline at the western end of Area 20A-East was uncovered. A historical drawing indicates that the drain leads from the trench south under Room 20B-1 into the sanitary sewer. The drawing also suggests that the drain was abandoned (plugged) during renovations at the time of MED operations. The line was surveyed to determine whether residual contamination was present. Readings were obtained from the bottom and top sections of the pipe at 1-foot increments (up to 22 feet), and activity levels up to 41,094 dpm/100 cm^2 were found at a distance of 12 feet from the pipe entrance. The levels were generally higher on the bottom section of pipe. Although the contamination in the pipe exceeds generic criteria, remediation was determined not to be feasible due to its inaccessibility. The pipe is designated as location LEC-20AE-1.

The sump pit adjacent to the trench was surveyed and found to be free of contamination (TNU Survey 129DT033, file 12900865.xls, 7/3/96). This sump pit is not shown in any of the historical MED drawings and is believed to be a post-MED renovation. However, the pit was removed at the same time as the trench system.

As discussed in the preceding section, most of the concrete floor at the east end of Area 20A-East was removed after extensive contamination was found along the floor/wall interface and footers of the east wall. The subsurface footers were remediated using chipping hammers, and the underlying soil exceeding criteria was excavated.

Following completion of remedial efforts, verification surveys and soil sampling were performed to demonstrate attainment of cleanup levels. All results are below the DOE generic guidelines for average and maximum surface activity. Soil samples were collected from along the bottom of the trench excavation and from around the footers that were decontaminated at the eastern end of Area 20A-East at the locations shown in Figure 4.15-1. Each sample was analyzed for uranium-238, uranium-235, radium-226, radium-228, thorium-228, thorium-232, americium-241, and potassium-40. The analytical results for uranium-235, uranium-238, radium-226, and thorium-

232 are summarized in Table 4.15-1. Results for uranium-235 and uranium-238 ranged from 0.15 to 0.40 pCi/g and 2.00 to 4.30 pCi/g, respectively. Radium-226 was detected at concentrations ranging from 0.50 to 1.50 pCi/g, and thorium-232 was detected at concentrations ranging from 0.16 to 1.10 pCi/g. All detected concentrations of total uranium (sum of uranium-235 and uranium-238) from these borings were below the site-specific criterion of 60 pCi/g above background. All detected concentrations of radium-226 and thorium-232 were below the DOE generic guidelines for soil. Site-specific or generic guidelines have not been established for the other radionuclides that were included as analytes (uranium-235, uranium-238, radium-228, thorium-228, amercium-241, and potassium-40).

4.15.4 Walls

Limited contamination was found at the base of the wall adjacent to contamination found on the floor in the southeast corner of Area 20A-East. At one location (E18.05, N-3.4), a level of 14,318 dpm/100 cm^2 β/γ was noted at 0.5 meter above the floor surface. This area was remediated during decontamination of the eastern floor section and wall footers.

Three electrical panels on the west wall of Area 20C were found to be contaminated at levels ranging from 15,360 to 50,192 dpm/100 cm^2 β/γ (TNU Survey 12900480, file 12900480.xls, 4/10/96). These panels were removed and disposed of. Because all other areas on this wall were at background levels (approximately 498 dpm/100 cm^2), it is believed that these panels were previously contaminated elsewhere and moved into this area.

4.15.5 Overheads

Delineation of the overheads included surveying the ceiling surface, light fixtures, heating ducts and exchangers, pipes, valves, and structural steel beams. With the exception of a "found electrical unit" in Area 20B-1, all overhead structures were found to be free of contamination. Survey results of the electrical unit indicated a level of 44,278 dpm/100 cm^2 β/γ (TNU Survey 12900479, file 12900479.xls, 4/10/96), significantly above all other surrounding overhead structures. This unit was removed and disposed of. It is believed that, similar to the electrical panels on the wall of Area 20C, this electrical unit was previously contaminated elsewhere and moved into this area.

4.15.6 IVC Inspections

Following completion of remedial activities and verification surveys by IDM, ORNL conducted an independent verification survey of Areas 20A-East, 20B, 20B-1, and 20C in October 1996. Additionally, ORNL collected seven soil samples from the eastern portion of Area 20A-E where the concrete floor was removed. Their results, summarized in correspondence from ORNL to DOE dated December 30, 1996, provide third-party verification that the area has been remediated to the appropriate cleanup criteria: "*We have released Areas 20A East, 20B, 20B-1, and 20C as being below Department of Energy Guidelines*."

After clearance from the IVC, the areas were restored to their original condition. The excavated trench was replaced with a new subsurface drainage system and finished to grade. The cement floor was repaired, and new floor tile was installed where it had been previously removed. Equipment that was relocated during the remediation effort was moved back into place.

4.15.7 Locations Exceeding Remedial Action Criteria

As discussed, an abandoned drainline at the west end of the Area 20A-East trench was uncovered during excavation of the trench. A historical drawing indicates that the drain leads from the trench southward under Room 20B-1 into the sanitary sewer, and that it had been abandoned (plugged) during renovations at the time of MED operations. A survey of the line was conducted, with readings obtained from the bottom and top sections of the pipe at 1-foot increments (up to 22 feet). Activity levels up to 41,094 dpm/100 cm^2 were found 12 feet from the pipe entrance (TNU Survey 129DT032, file 12900975.xls, 10/17/96). The levels were generally higher on the bottom section of pipe, with most of the readings from the bottom section exceeding the generic release criteria (5,000 dpm/100 cm^2 average). None of the measurements of the top section of pipe exceeded criteria.

Several alternatives were evaluated for remediating the contaminated drainline (e.g., excavation, hydroblasting, or mechanical abrasion/flushing). Excavation was considered an unacceptable option because it would require removal of the Room 20B-1 foundation and a portion of the wall footer to gain access to the subsurface piping. Excavation activities near the wall footer could have affected the structural integrity of the building. Hydroblasting or mechanical abrasion/ flushing are non-intrusive alternatives that use water pressure or abrasives to loosen the contamination and flowing water to remove it from the pipe. However, since there was no reliable way to contain the effluent at the other end of the pipe (as it was not accessible), there were concerns that these alternatives might flush contamination further into the line, and possibly into the sanitary sewer system (if still connected). This line was abandoned, and it is likely that the contamination in the pipe will remain fixed if left undisturbed. Furthermore, the levels of residual radioactivity are not believed to pose a significant present or future exposure risk. The maximum observed level (41,094 dpm/100 cm^2) is below the maximum level found in Section B of the in-bed drainlines (80,000 dpm/100 cm^2). Dose assessment calculations in support of the application of supplemental limits for the in-bed drainlines demonstrated minimal dose rate exposure for the non-routine maintenance worker and renovation worker as discussed in Section 1.

As shown in Attachment IVb of Calculation 129-CV-029, the contribution of dose rate from Section B under the more conservative Renovation Worker Scenario is 3.1 mrem/yr. By comparison, a cleanup guidance value of 10 mrem/year is provided in New York State Department of Environmental Conservation Technical Administrative Guidance Memorandum (NYSDEC-TAGM) 4003. This scenario assumes exposure from ingestion, inhalation, and direct contact pathways with the residual contamination in the piping. Under the same exposure scenario, Calculation 129-CV-029 also demonstrates that the contribution of dose rate from drainlines with significantly higher residual contamination (140,000 dpm/100 cm^2) is still below 10 mrem/year (5.4 mrem/year).

Based on the evaluation of available alternatives and consideration of exposure potential posed by the residual contamination, it was decided to leave the drainline in place. This drainline is designated as location LEC-20AE-1 and is shown in Figure 4.15-1. The accessible end of the pipe was grouted to prevent future inflow into the pipe and to prevent exposure of the pipe contents to present or future receptors. The area was backfilled, and additional concrete was poured on top of the pipe end in the trench excavation during restoration activities.

4.16 AREA 21

This section describes the present and historical uses of Area 21, presents the results of delineation surveys, discusses the remediation activities conducted in the area, and presents the post-remedial status of the area.

4.16.1 Area Description and Usage

Area 21 is located at the southeast portion of Building 14, adjacent to Area 14-South. This area currently consists of a post-MED metal structure (Butler Building), which has been added onto the south exterior wall of Building 14. Area 21 is approximately 30 feet long by 30 feet wide, and the total area is about 900 square feet. This structure is built on the former locations of Area 21 and Area 22 (hereafter referred to as Former Area 21 and Former Area 22, respectively). The combined dimensions of these two former areas were 60 feet long by 30 feet wide.

During MED operations, Former Areas 21 and 22 were part of the pilot plant operations facility. Historical drawings indicate that this portion of the building contained a "Storage Handling & Mixing Room" and a two-stage below-ground settling tank. Figure 4.16-1 depicts the location of MED features in Area 21 based on this information. A trench system (running east-west on both sides of the tank) appears to have drained into the settling tank. Additionally, a 4-inch drainline from Area 20A-East may have been routed beneath the trench into the tank. Another 4-inch drainline originating from the floor drain in the Storage Handling & Mixing Room appears to also have been routed into the settling tank.

Subsequent to completion of MED operations, the portion of Building 14 that housed Former Areas 21 and 22 was removed (the extent of building demolition activities is unknown). The north wall (which is currently the south exterior wall of Building 14) is the only remaining original wall. Prior to remediation efforts by USACE, the settling tank had been abandoned and filled in place by the tenant. Piping in support of recent facility operations (e.g., water supply) has since been routed through the location of the abandoned tank. For the purposes of this remedial action, Area 21 has been defined by the existing perimeter of the Butler Building. Further characterization and remediation, if warranted, will be addressed as part of another operable unit.

A 1-meter grid reference coordinate system was established for the floor with the origin (A-0) located at the southeast corner of the Butler Building. The grid system was established to facilitate selection of measurement and sampling locations and to provide a mechanism for relocating specific survey points for remediation and subsequent verification.

IDM conducted the delineation survey, decontamination, and post-remedial survey operations in these areas. The delineation surveys were conducted in August 1997; the remediation work and the post-verification surveys followed in January and February 1998.

4.16.2 Floors

The concrete slab under the Butler Building (Area 21) was reported to have been installed fairly recently. As expected, radiological surveys of this new floor surface did not indicate the presence

of contamination. However, some contamination was found on a small strip of concrete remaining from the original foundation. This strip, located on grid coordinates J-6 through J-9, runs adjacent to the Building 14 south exterior brick wall and measures approximately 10 feet long by 5 inches wide (Figure 4.16-1). Contamination in this area ranged from 180 to 300 cpm (background 40 cpm, IDM Survey 811). Needle scaling guns were used to remediate this area. Following completion of remedial efforts, verification surveys were performed to demonstrate attainment of cleanup levels. All results are below the DOE generic guidelines for both average and removable surface activity.

As described in the following section, a sizable portion of the new, uncontaminated concrete slab was removed to gain access to the below-ground settling tank. The undersides of these removed sections of the concrete floor slab were scanned and were not contaminated.

4.16.3 Subsurface Soil and Other Features

The two-stage settling tank is the most prominent MED subsurface feature in Area 21. Constructed of concrete, its dimensions are approximately 20 feet wide by 23 feet long, with a depth that varies from 9 feet at the north end to 12 feet at the south. The tank lies beneath a new concrete foundation (sections of which were removed to gain access to the tank), and the west and south walls of the tank extend slightly beyond the perimeter of the Butler Building. It appears that the tank had been abandoned some time ago and filled in place with soil, gravel, and debris. A series of three cast iron pipes (3 to 6 inches in diameter) now run through the tank (east-west), and a drainline (approximately 10-inch diameter) had also been installed through the eastern section of the tank (north-south). The three pipes are active water supply lines and are encased in a concrete support, which appears to have been poured directly on the bottom of the western section of the tank. The concrete support measures 2 feet wide by 10 feet long. These post-MED features are shown in Figure 4.16-1.

The fill material in the tank was removed to allow radiological surveys of the interior surfaces. The surveys indicated contamination on the majority of the bottom and side surfaces. In the western section of the tank, activities were measured up to 63,000 dpm/100 cm^2. Concentrations of 224,000 dpm/100 cm^2 were found on an inlet valve on the north wall. This valve was removed and disposed of. The settling tank was excavated in two phases: the western section and the eastern section. Prior to the excavation, temporary pipe connections were made for the drainline. The sides and bottom of the tank were broken up with jackhammers, and the debris and surrounding soil were removed by backhoe. Remediation activities were carefully performed to prevent damage to the in-use drainlines and water supply lines. A portion of the western floor was not removed because it supported the concrete pipe foundation described above. Removal of this section of floor was determined not to be feasible because it might undermine the structural integrity of the encased piping. This portion of the floor is designated as location LEC-21-1 and is discussed further in Section 4.16.7. The material beneath the concrete and pipe, composed primarily of 3- to 4-inch-diameter rock, gravel, and some dirt and sludge, was sampled and analyzed for radiological constituents. Total uranium in this sample was 12.32 pCi/g and therefore below the site-specific criteria.

Following completion of remediation activities, several verification soil samples were collected from the sides and bottom of the excavation to demonstrate attainment of cleanup levels. Residual

total uranium activities of composite samples taken from the area of the western section of the settling tank were found to range from 6.16 to 23.7 pCi/g. Residual total uranium activities were found to range from 5.72 to 8.56 pCi/g in the area of the east settling tank excavation. These soil sample results are summarized in Table 4.16-1 and are shown in Figure 4.16-1. All results are below the DOE generic guidelines for residual soil activity.

Soil borings were advanced at five locations within Area 21 and nine locations outside of the Butler Building (Figure 4.16-1) to evaluate the potential for subsurface contamination around the settling tank and general area. Borings varied in depth from 2 to 4 feet, and discrete samples were collected at 1-foot intervals. Each sample was analyzed for uranium-238, total uranium, radium-226, thorium-232, and potassium-40. The summary analytical results for total uranium, radium-226, and thorium-232 are presented in Table 4.16-1. The complete analytical results are provided in Appendix E. Total uranium was detected at concentrations ranging from nondetect (-0.3) to 25.5 pCi/g. Radium-226 was detected at concentrations ranging from 0.39 to 1.51 pCi/g, and thorium-232 was detected at concentrations ranging from 0.08 to 0.76 pCi/g.

All detected concentrations of total uranium from these borings were below the site-specific criterion of 60 pCi/g in excess of background. All detected concentrations of radium-226 and thorium-232 were below the DOE generic guidelines for soil. Site-specific or generic guidelines have not been established for the other radionuclides that were included as analytes (uranium-238 and potassium-40).

During removal of the settling tank, there was no evidence of the trenches believed to have existed on the east and west sides of the tank, or the two 4-inch drainlines that were routed from Area 20A-East and the Storage Handling & Mixing Room. Consequently, it is believed that the trenches and drainlines, at least in the immediate vicinity of the settling tank, may have been removed prior to placement of the new concrete foundation and construction of the Butler Building.

4.16.4 Walls

The only remaining original wall in Area 21 is the north wall (currently, the Building 14 south exterior wall). Radiological surveys of this wall found minor contamination on the brick surfaces of the former window ledges. These areas were decontaminated with needle scaling guns to below 5,000 dpm/100 cm^2.

4.16.5 Ceilings and Overheads

Ceilings and overheads of the present Butler Building addition are a fairly recent post-MED renovation and are not expected to be contaminated. Consequently, no surveys of the overheads were performed. No other overhead structures exist in Area 21.

4.16.6 IVC Inspections and Post-Remedial Action Status

Following completion of remedial activities and verification surveys by IDM, an independent verification survey of Areas 21 was conducted by representatives from ORNL. Their results, summarized in correspondence from ORNL to DOE dated September 21, 1998, provide third-party verification that the area has been remediated to the appropriate cleanup criteria. The letter states: "*Area 21, which at one time housed underground sumps, has been decontaminated and falls below Department of Energy Guidelines for soil contamination as outlined in DOE Order 5400.5*." This letter therefore releases Area 21. A single location for supplemental limits is described in the following section.

After clearance from the IVC, Area 21 was restored to its original condition. Sections of the east and south walls of the Butler Building were reinstalled, and the cement floor was repaired. Equipment that was relocated during the remediation effort was moved back into place.

4.16.7 Locations Exceeding Remedial Action Criteria

As discussed, a small portion of the contaminated floor in the western section of the settling tank was not removed due to concerns that its excavation might affect the integrity of active pipes that run through the area. The series of three pipes (active water supply lines) are encased in a concrete support pad that appears to have been poured directly over rock and gravel in the western tank section. The concrete encasing the pipes is about 1 foot thick. The concrete/rock support pad measures 2 feet wide by 10 feet long and occupies an area of 20 square feet. Surveys did not indicate contamination of the support pad or encased pipes. Removal of this pad to provide access to the underlying contamination was not considered feasible due to probable damage to the lines and disruption of the water supply system. These lines are believed to provide water for fire protection of Building 14 and other portions of the Linde Site. This location is designated as LEC-21-1 and is shown in detail on Figure 4.16-1.

Based on radiological surveys of the area surrounding the bottom of the tank, residual radioactivity on the floor surface underneath this support is estimated to be approximately 26,000 to 39,000 dpm/100 cm^2 (Survey 1185, IDM 1998). Considering the site-specific conditions, the levels of residual contamination on the floor are not believed to pose a significant present or future exposure risk. New, uncontaminated concrete has been poured onto the contaminated floor surface, which has permanently sealed the contamination in place. In this state, it is no longer available for direct exposure. The estimated range of residual contamination (26,000 to 39,000 dpm/100 cm^2) is slightly higher than but comparable to residual levels for floor surfaces (24,976 dpm/100 cm^2) assumed in the dose assessment calculation (Calculation 129-CV-023, Section 1.4). This calculation, which supports the general approach to supplemental limits, also considers simultaneous exposure from contaminated walls (19,006 dpm/100 cm^2) and overheads (19,355 to 26,888 dpm/100 cm^2) to an individual receptor. The results indicated a range of estimated doses from 0.003 to 8.39 mrem/year for various operations scenarios, including exposure to the onsite worker. By comparison, the NYSDEC Technical Administrative Guidance Memorandum (NYSDEC-TAGM) 4003 cleanup guidance is 10 mrem/year. This calculation is considered extremely conservative for this settling tank scenario since there is no contribution from the walls or overheads. Further, the contamination on the floor surface is covered with a tightly

packed rock and gravel mixture, is limited to only 20 square feet, and is separated from receptors by several feet of concrete and fill.

4.17 PROCESS PIPING

As part of the investigation of the Building 14 interior, an extensive survey was conducted of the radiological condition of the process piping within the building. This survey is briefly summarized in this section. The complete process piping report, titled *"Summary Report for the Process Piping Radiological Investigation, Praxair Building 14,"* (ION Technology, Inc. 1997) is included in Appendix F. The report contains all survey and sample analytical results and includes the following sections and attachments:

Sections

1.0 Site and Project Information
2.0 Process Piping Radiological Investigation Approach
3.0 Independent Verification Contractor
4.0 Radiological Survey Findings and Results
5.0 Summary
6.0 References

Attachments

1 B14 Process Piping Investigation Procedure
2 Building 14 Plan View Area Map
3 Process Piping Radiological Surveys
4 HpGe Analytical Reports
5 Radiation Detection Instrumentation
6 Summary of B14 Process Piping LF

4.17.1 Background and Overview

After MED activities ended in 1948, the process equipment used for refinement of the uranium ore and associated piping and ventilation systems were removed from Building 14. No documentation detailing which systems were removed is available; therefore, it is unclear which systems, or portions of systems, currently installed in Building 14 were in service during MED operations and which were installed later.

Because contamination was detected in the ventilation system in Building 14 during previous investigations, a more complete investigation of all process piping, electrical conduits, and the ventilation system was planned as part of the overall Building 14 interior remedial activity.

4.17.2 Scope of Investigation

The scope of this investigation included all process piping within the interior of Building 14. The phrase "process piping" is intended to include all piping (e.g., steam, water, nitrogen lines), electrical conduit, and ventilation system ducts and equipment (HVAC system). The investigation included direct measurements of the external and internal surfaces and the collection and gamma analysis of debris samples within the systems.

4.17.3 Survey Methodology

To guide the investigation, the building areas and process piping systems were first divided into two groups. Group 1 included the operational areas in the building (e.g., Area 1, large hallway, corridor, etc.) and Group 2 included all of the process piping systems. Both groups were then subdivided into areas of high potential and low potential for contamination. The process piping subdivisions are listed in Tables 2.1 and 2.2 of the summary report (Appendix F). This division into high potential and low potential areas or systems allowed the investigation to focus the most intensive surveying and sampling efforts on the locations where contamination was most likely to be present.

All systems were scanned externally, with biased sampling at locations where there was greater potential for or evidence of leakage based on observed discoloration or scale deposits. Based on agreements with the IVC, six high-potential and three low-potential contamination locations were to be opened and surveyed and debris samples collected for analysis. The procedures used to conduct the investigation are described in Attachment 1 of the summary report.

4.17.4 Summary of Survey Results

The results of more than 80 surveys performed are included in Attachment 3 of the summary report. The results of swipe and debris samples are included in Attachment 4 of that report. A total of 365 locations were opened or breached, which was well in excess of the 9 locations agreed upon with the IVC. These breaches are summarized in Table 4.17-1 by type and area in which they occurred.

The piping internals were surveyed, where accessible to the probes, and about 145 samples were collected and analyzed by gamma spectroscopy. The results of these samples are included as Attachment 4 to the summary report. Two remedial actions were conducted based on the results of the internal measurements and samples as described in Section 4.2 of the summary report.

No removable contamination was found on the external surfaces. Fixed contamination was detected at various locations, all of which were successfully decontaminated to below DOE generic surface criteria. Contaminated asbestos pipe insulation was either decontaminated or removed and disposed of in accordance with applicable regulations. The natural gas line in Area 14 Southwest, described in Section 4.1.6 of the summary report, was subsequently removed and replaced.

4.17.5 IVC Inspections

ORNL was the IVC for this remedial action. As part of the verification process, ORNL representatives periodically visited the site to review subcontractor data, take additional radiological measurements, and collect soil samples, when appropriate, to obtain sufficient data to independently assess the radiological condition of the building. When a given area or portion of an area within the building was verified by ORNL as meeting all applicable radiological criteria for release, a letter was issued to that effect. These letters are included in Appendix G along with a detailed summary. The letter that pertains to the process piping is discussed below.

Following a site visit by ORNL representatives, a letter was issued dated January 12, 1998. The letter states: *"Also, a review of the 'Summary Report for the Process Piping Radiological Investigation Praxair Building 14' has been completed by the independent verification contractor… We concur with the results of the summary of the process piping investigation in Building 14 and release this area as below Department of Energy clean up criterion for this site."* This letter therefore releases the process piping system in its entirety.

4.17.6 Locations Exceeding Remedial Action Criteria

All parts of the process piping within Building 14 were removed or successfully decontaminated to below the remedial action criteria.

4.18 RADON SURVEY

DOE Order 5400.5 requires that airborne concentrations of radon decay products meet generic guidelines for existing occupied or habitable structures that are intended for release without restriction. The applicable generic guideline (40 CFR Part 192) is as follows:

Following remediation and restoration activities in Building 14, radon monitoring was conducted throughout the building to demonstrate compliance with the DOE guideline. This section describes the basic methodology to measure radon, select the sample locations and rationale, and present the results.

4.18.1 Methodology

Radon concentrations were measured with "E-Perm" passive Electret Ion Chambers. This instrument consists of an electrostatically charged disk (electret) situated within a small container (ion chamber). During the measurement period, radon diffuses through a filter into the ion chamber, where the ionization produced by the decay of radon and its progeny reduces the charge on the electret. A calibration factor relates the voltage drop, due to the charge reduction, to the radon concentration, following protocol described in EPA-402-R-92-004. The E-Perm detectors were supplied by ORNL, and returned to ORNL for analysis. In most cases, the detectors were left in place for at least 30 days (32 to 33 days) to ensure collection of representative measurements of annual levels compared to 7-day or 14-day collection periods. However, due to restoration activities in Area 14-South which prohibited appropriate access, one detector in this area was left in place for only 18 days. This is not believed to impact the overall data quality because a detector was placed in 14-North over a 33-day period, and both areas (14-North and 14-South) share a common airspace.

4.18.2 Sample Locations

Nineteen E-Perm detectors were placed at 17 locations in areas that were remediated and restored to original condition. Sample locations are shown on Figure 4.18-1 and described in Table 4.18-1. In each area, the detectors were selectively placed (where possible) in a location that was least exposed to significant or prevailing air currents (i.e., away from doorways) to provide conservative measurements of radon concentrations. In cases where adjacent areas or rooms share a common

airspace, a single detector was sometimes placed. Area 21 was not sampled due to the lack of a suitable location (excessive air flow from a large roll-up door).

4.18.3 Results

Results of radon monitoring are presented in Table 4.18-1. Radon levels ranged from 0.4 to 1.6 pCi/L. The radon concentrations were converted to working levels using an assumed equilibrium of 50 percent, per EPA guidance. The radon levels ranged from 0.002 to 0.008 WL when converted. All radon concentrations were below the DOE Order 5400.5 guideline of 0.2 WL.

4.19 IN-BED DRAINLINES

A drainline system in the subsurface beneath Building 14 was likely installed when the building was constructed. This system removes drainage from the floor trench system and runoff from the roof. During the remedial action in Building 14, portions of these drainlines were exposed and found to exceed the generic guidelines for surfaces. Because of the difficulty and expense of remediating these drainlines, supplemental limits were developed based on Calculation 129-CV-029. The assumptions and results of this calculation are discussed in Section 1.4.2.

This section of the PRAR provides a concise description of the in-bed drainlines, a summary of information collected from the lines during the delineation and remedial actions performed, and a more detailed discussion of the application of supplemental limits to the in-bed drainlines.

4.19.1 Description

When Building 14 was originally constructed, a network of below-grade drainlines was installed to receive runoff flow from the floor drains, floor trenches, and the roof. This network appears to have received the drainage from most, if not all, of the building interior, as shown in Linde Air Products Drawing A63726 dated January 15, 1937.

There appear to be three major drainline systems within Building 14, two of which are shown in Drawing A63726 and therefore were probably active during MED operations. These three systems include a 1937-era system that receives runoff from the trench network, pits and sumps, and the roof; a second 1937-era system that captured the flow from the restrooms and locker rooms within the building; and a 1978-era system that provides drainage within Area 9. These three systems are identified within this report as the trench drainline system, sanitary drainline system, and Area 9 drainline system. The drainage systems are shown in Figure 4.19-1. Collectively, they are referred to as the in-bed drainline system. These three systems are described in greater detail below, and estimates of the linear footage of the first two systems are presented. These estimates are based on information obtained from Drawing A63726, and it is possible that some sections of the drains have been removed.

4.19.1.1 Trench Drainline System

This system captures the drainage from all of the floor trenches, pits, and sumps within the building and the drainage from the roof. These observations are based on historical drawings, and it is possible that the drainage channels have been changed during building modifications. The trench drainage system receives flow from most areas within the building including the Area 12

stairwell sump, Area 9 trenches, the cylinder test pit in the large hallway, a floor drain in Area 4A, and the trenches and sumps in Areas 14 South, 14 North, and Areas 12 and 13. The system also appears to have been connected to Area 15 by a side trench running from Area 13 and a drain in the extreme southwest corner of Area 15. Downspouts from the roof appear to have been connected to this system at several locations in Areas 8, 9, and 13. It is likely that other downspouts, not shown in the drawings reviewed, are present in this building. They may be original or of post-MED construction and tie in to this or one of the other drain systems. This system appears to have had two discharge points: The first is a drainline that runs underneath the stairwell at the south end of the first floor offices on the western side of the building. The second is a drainline that runs north to south out the western side of Area 14 South and discharges into a former settling basin in Area 21. The south discharge point receives drainage from the trenches and sumps in Areas 12, 13, 14 North, 14 South, and 15. The west discharge point receives drainage from the remainder of the trench drainline system. The total length of the trench drainline system is estimated to be 734 feet based on the historical drawing. Of this total length, 235 feet is associated with the drainlines discharging to the south and the remaining 499 feet with the drainlines discharging to the west. These drainlines do not appear to be interconnected although the southwest sump in Area 14 North was a common source.

4.19.1.2 Sanitary Drainline System

As shown in Drawing A63726, this system captures the discharges from the restrooms and showers located north of the first floor offices and from the restrooms and showers in Areas 2 and 3. This system discharges to the sanitary sewer system through a drainline running south out of Area 20A East. The total length of the sanitary drainline system is estimated to be 250 feet.

4.19.1.3 Area 9 Drainline System

This system is of much more recent origin, with construction details present on a circa 1978 drawing. This drawing shows three east-west running drainlines, each connected to a series of floor drains or drains associated with fume hoods, laboratory sinks, or other laboratory-related discharge sources. Although it is not clear in the drawing, this drainline system appears to tie into either the trench or sanitary drainline systems.

Not evident in any drawings are the drainline associated with the floor drain underneath the fume hood in Area 9 (designated as LEC-9-4) or any drainlines associated with the trenches in the north end or southeast side of Area 15.

The in-bed drainlines are constructed typically of cast iron pipe of various diameters as noted on the historical drawing. One exception is the drainline connecting to the steam return pit in the corridor, which is clay tile for the first 4 feet and cast iron after that point.

4.19.2 Investigation Results

During the delineation and remedial phases of the remedial action, the endpoints of the trench drainline system were encountered in several areas within the building. Typically, sections of pipe comprising parts of the drainline system were encountered during the investigation or remediation of the sumps, pits, and trenches. When a subgrade pipe was encountered, direct measurements were taken within the accessible portions of the pipe to determine if it exceeded guidelines. If the

pipes exceeding generic surface guidelines could be decontaminated or removed, this was done to the extent possible.

The locations within the building at which delineation data were obtained are summarized in Table 4.19-1. Three of the eight sets of data described in the table were used as the basis to develop Calculation 129-CV-029. The data presented in the table were collected from seven different locations within the building. A review of the data illustrates the conservative nature of the assumptions made in the calculation (i.e., high surface activity levels). The individual surveys from which the data were obtained are listed for further reference. Attempts were made to gain access to the drainlines at other locations, such as clean-out traps, to obtain additional data, but these attempts were unsuccessful because of multiple pipe elbows and obstructions that prevented insertion of the probes into the drainlines.

4.19.3 Remedial Activities

Attempts were made to remediate sections of drainline exceeding generic surface guidelines. Some of these sections were already plugged, most likely deliberately at some point in the past. In some cases, sections of the drainline were removed. However, it was not deemed feasible to remediate all of the pipes because of the excessive cost and construction-related risk associated with excavating the pipes at depths of approximately 8 feet below grade and the difficulty of removing pipes beneath load-bearing walls. The remedial actions taken are described below. Table 4.19-1 refers to segments of the trench drainline system identified by letters A through E, corresponding to the segments identified in calculation 129-CV-029. The drainline system is split into segments identified in this section and in Figure 4.19-1 as segments A through S.

Densely packed sand was encountered 1 foot inside the drainline on the south wall of the Area 12 stairwell. The open portion of the pipe was cleared of sand and plugged with grout. At the steam return pit in the corridor, the 4-foot-long horizontal run of the drainline (Segment B) was removed. The remaining diagonal section was already plugged 5 feet down into the pipe and was therefore plugged with grout and left in place.

In Areas 9 and 14 North, a 59-foot-long section of drainline (most of Segment J) was removed. The pipe in Area 14 North was removed as part of the soil excavation in that area, but only the drainline and surrounding soil were removed in Area 9. A 10-foot-long section at the west end was left in place because it was encased in concrete under the south wall.

About 2 feet of the drainline connecting to the cylinder test pit in the large hallway (Segment E) was removed up to the north wall.

In Areas 13 and 14 North, an estimated 73 feet of segment P was removed, leaving approximately 12 feet at the south end. A 26-foot segment of Segment Q in Area 14 North and Segment N, which runs between sumps in Areas 14 North and 14 South, was also removed.

It is unclear if parts of Segments O and S within Area 14 North were removed during the soil excavation activities. For the purpose of designating supplemental limit locations, it is conservatively estimated that these segments were left in place.

A total of 191 feet of the trench drainline system was removed, leaving an estimated 564 linear feet in place.

4.19.4 Locations Exceeding Remedial Action Criteria

Of the original estimated 755 linear feet of the trench drainline system, 564 feet was left in place. This network of in-bed drainlines is designated as supplemental limit location LEC-B14-1. The application of supplemental standards to the in-bed drainlines has been approved by NYSDEC (letter dated June 3, 1998, PDCC No. 14501-129-T0A-GEV-00018).

The focus of the discussion in this section has been on what has been designated as the trench drainline system because all of the data obtained during the delineation phase and summarized in this report were collected from pipes within this system. As discussed in Section 4.15, however, a section of drainline was investigated within Area 20A-East in 1996 during the remediation of that area. This pipe was investigated to a distance of 22 feet from the excavated trench, and direct β/γ surface activity measurements of up to 41,094 dpm/100 cm^2 were recorded. This section of pipe is believed to be part of the sanitary drainline network and was designated as location LEC-20AE-1. It is the only portion of the sanitary drainline network designated as exceeding the remedial action criteria.

Table 4.2-1

Summary of Soil and Miscellaneous Sample Results for Areas 2 and 3

Report No.	Boring No. or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
1	A-1	0	V	2,3	Area 2,3 grid A1 gravel	3/27/97	10.74	1.01	5.69
1	A-1	0 to 1	V	2,3	Area 2,3 grid A1 surface soil	3/27/97	6.03	0.85	2.50
1	A-1	1 to 2	V	2,3	Area 2,3 grid A1 1'-2'	3/27/97	3.74	0.89	1.56
1	A-1	2 to 3	V	2,3	Area 2,3 grid A1 2'-3'	3/27/97	1.12	1.09	0.76
1	A-1	3 to 4	V	2,3	Area 2,3 grid A1 3'-4'	3/27/97	0.97	1.15	0.83
1	B-9	0	V	2,3	Area 2,3 grid B9 surface soil	3/27/97	2.06	0.98	1.31
1	B-9	1 to 2	V	2,3	Area 2,3 grid B9 1'-2'	3/27/97	2.05	1.00	0.94
1	B-9	2 to 3	V	2,3	Area 2,3 grid B9 2'-3'	3/27/97	0.73	1.01	0.76
1	B-9	3 to 4	V	2,3	Area 2,3 grid B9 3'-4'	3/27/97	1.24	1.12	0.74
1	C-12	0	V	2,3	Area 2,3 grid C12 surface soil	3/27/97	4.30	0.98	2.45
1	C-12	1 to 2	V	2,3	Area 2,3 grid C12 1'-2'	3/27/97	3.74	0.94	1.85
1	C-12	2 to 3	V	2,3	Area 2,3 grid C12 2'-3'	3/27/97	2.85	1.03	1.05
1	C-12	3 to 4	V	2,3	Area 2,3 grid C12 3'-4'	3/27/97	1.77	0.99	1.48
1	C-8	0	V	2,3	Area 2,3 grid C8 surface soil	3/27/97	1.66	1.09	1.16
1	C-8	1 to 2	V	2,3	Area 2,3 grid C8 1'-2'	3/27/97	1.87	1.11	0.73
1	C-8	2 to 3	V	2,3	Area 2,3 grid C8 2'-3'	3/27/97	1.07	1.02	0.64
1	C-8	3 to 4	V	2,3	Area 2,3 grid C8 3'-4'	3/27/97	1.59	1.10	0.60
1	E-2	0	V	2,3	Area 2,3 grid E2 surface soil	3/28/97	1.39	1.00	1.05
1	E-2	1 to 2	V	2,3	Area 2,3 grid E2 1'-2'	3/28/97	2.97	0.85	0.81

Table 4.3-1

Summary of Soil Sample Results for Area 4

Report No.	Boring No. or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
5	4-Main, F-0	0 to 1	V	4	Area 4, Grd F0, Gravel 0-1' #226	5/20/97	9.65	0.90	5.24
5	4-Main, F-5	0 to 1	V	4	Area 4, Grd F5, Grav/Clay 0-1' #231	5/20/97	6.80	0.96	3.49
5	4-Main, F-5	1 to 2	V	4	Area 4, Grd F5, Clay/Soil 1-2' #232	5/20/97	3.47	0.98	1.93
5	4-Main, F-5	2 to 3	V	4	Area 4, Grd F5, Clay/Soil 2-3' #233	5/20/97	3.62	0.97	1.70
5	4-Main, F-5	3 to 4	V	4	Area 4, Grd F5, Clay/Soil 3-4' #234	5/20/97	2.54	1.05	0.97
5	4-Main, B-5	0 to 1	V	4	Area 4, Grd B5, Gravel 0-1' #227	5/21/97	10.04	1.02	5.25
5	4-Main, B-5	1 to 2	V	4	Area 4, Grd B5, Clay/Soil 1-2' #228	5/21/97	4.32	0.91	1.16
5	4-Main, B-5	2 to 3	V	4	Area 4, Grd B5, Clay/Soil 2-3' #229	5/21/97	2.14	0.91	0.78
5	4-Main, B-5	3 to 4	V	4	Area 4, Grd B5, Clay/Soil 3-4' #230	5/21/97	1.54	0.88	0.82
5	4-Main, C-1	0 to 1	V	4	Area 4, Grd C1, Clay/Grav 0-1' #253	5/21/97	3.02	0.95	1.47
5	4-Main, C-1	1 to 2	V	4	Area 4, Grd C1, Clay/Soil 1-2' #254	5/21/97	2.59	0.92	1.25
5	4-Main, C-1	2 to 3	V	4	Area 4, Grd C1, Clay/Soil 2-3' #255	5/21/97	2.87	0.91	1.39
5	4-Main, C-1	3 to 4	V	4	Area 4, Grd C1, Clay/Soil 3-4' #256	5/21/97	0.48	0.91	0.62
5	4A/4B, B-3	0 to 1	V	4	Area 4B, Grd B3, Soil/Grav 0-1' #236	5/21/97	0.89	0.27	0.55
5	4A/4B, B-3	1 to 2	V	4	Area 4B, Grd B3, Soil/Grav 1-2' #237	5/21/97	0.65	0.31	0.51
5	4A/4B, B-3	2 to 3	V	4	Area 4B, Grd B3, Sol/Grv/Cly 2-3' #238	5/21/97	1.30	0.27	0.49
5	4A/4B, B-3	3 to 4	V	4	Area 4B, Grd B3, Soil/Grav 3-4' #239	5/21/97	0.94	0.25	0.39
5	4A/4B, D-0/D-1	0 to 1	V	4	Area 4A/4B, Grd D0/D1, Cly/Grv 0-1' #240	5/21/97	2.87	1.10	1.72

Table 4.3-1 (cont'd, page 2 of 2)

Summary of Soil Sample Results for Area 4

Report No.	Boring No. or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
5	4A/4B, D-0/D-1	1 to 2	V	4	Area 4A/4B, Grd D0/D1, Clay 1-2' #241	5/21/97	1.89	1.09	0.83
5	4A/4B, D-0/D-1	2 to 3	V	4	Area 4A/4B, Grd D0/D1, Clay 2-3' #242	5/21/97	2.05	0.96	0.44
5	4A/4B, D-0/D-1	3 to 4	V	4	Area 4A/4B, Grd D0/D1, Clay 3-4' #243	5/21/97	1.00	0.82	0.77
6	4-Main, A-2	0 to 1	V	4	A4 grid A2 0-1' #264	5/21/97	3.38	0.80	1.41
6	4-Main, A-2	1 to 2	V	4	A4 grid A2 1-2' #265	5/21/97	1.26	0.83	0.89
6	4-Main, A-2	2 to 3	V	4	A4 grid A2 2-3' #266	5/21/97	1.00	0.88	0.73
6	4-Main, A-2	3 to 4	V	4	A4 grid A2 3-4' #267	5/21/97	1.45	0.86	0.69

Abbreviations:

pCi/g picocuries per gram
Ra-226 Radium-226

Notes:
a Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b Sample types are: "C" for characterization and "V" for verification.
c The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.

Table 4.2-1 (cont'd, page 2 of 3)

Summary of Soil and Miscellaneous Sample Results for Areas 2 and 3

Report No.	Boring No. or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
1	E-2	2 to 3	V	2,3	Area 2,3 grid E2 2'-3'	3/28/97	0.91	0.99	0.78
1	E-2	3 to 4	V	2,3	Area 2,3 grid E2 3'-4'	3/28/97	3.78	1.04	0.80
1	E-4	0	V	2,3	Area 2,3 grid E4 surface soil	3/28/97	5.01	1.00	1.58
1	E-4	1 to 2	V	2,3	Area 2,3 grid E4 1'-2'	3/28/97	2.44	0.87	0.74
1	E-4	2 to 3	V	2,3	Area 2,3 grid E4 2'-3'	3/28/97	1.62	0.92	0.75
1	E-4	3 to 4	V	2,3	Area 2,3 grid E4 3'-4'	3/28/97	0.31	1.06	0.65
1	F-0	0	V	2,3	Area 2,3 grid F0 surface soil	3/28/97	4.93	0.72	2.32
1	F-0	1 to 2	V	2,3	Area 2,3 grid F0 1'-2'	3/28/97	2.31	0.79	0.96
1	F-0	2 to 3	V	2,3	Area 2,3 grid F0 2'-3'	3/28/97	1.37	0.86	0.92
1	F-0	3 to 4	V	2,3	Area 2,3 grid F0 3'-4'	3/28/97	4.11	0.92	0.62
1	F-9	0	V	2,3	Area 2,3 grid F9 surface soil	3/27/97	5.07	0.77	1.60
1	F-9	1 to 2	V	2,3	Area 2,3 grid F9 1'-2'	3/27/97	2.63	0.89	0.70
1	F-9	2 to 3	V	2,3	Area 2,3 grid F9 2'-3'	3/27/97	1.64	0.96	0.71
1	F-9	3 to 4	V	2,3	Area 2,3 grid F9 3'-4'	3/27/97	0.97	0.71	0.77
5	C-9	0 to 1	V	2,3	Area 2, Grid C9, Clay/Gravel 0-1' #244	5/20/97	1.35	0.95	1.11
5	C-9	1 to 2	V	2,3	Area 2, Grid C9, Clay 1-2' #245	5/20/97	1.54	0.84	0.78
5	C-9	2 to 3	V	2,3	Area 2, Grid C9, Clay 2-3' #246	5/20/97	2.19	0.90	1.10
5	C-9	3 to 4	V	2,3	Area 2, Grid C9, Clay 3-4' #247	5/20/97	3.27	0.70	2.87
23	F-5	~3	V	2/3	724 A2/3 grid F5 column pit	8/30/97	3.32	1.09	0.81

Abbreviations:

MDA	Minimum detectable activity
pCi/g	picocuries per gram
Ra-226	Radium-226

Notes:

a	Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b	Sample types are: "C" for characterization and "V" for verification.
c	The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d	The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.
e	Samples collected from the creteplank.

Table 4.4-1

Summary of Soil and Miscellaneous Sample Results for the Large Hallway

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
paint	na	C	Lhall	Pt Chips Lg Hall O/H (Vert) #251	5/20/97	16.48	0.28	0.81
paint	na	C	Lhall	Pt Chips Lg Hall O/H (Hor) #252	5/20/97	72.76	0.46	0.96
paint	na	C	Lhall	L Hallway paint chips #273	5/20/97	24.59	0.18	0.38
trench	na	C	Lhall	593 L hall trench g C19	8/15/97	73.06	0.39	5.35
trench	na	C	Lhall	594 L hall trench g B19	8/15/97	141.36	1.32	6.19
pit sludge	na	C	Lhall	625 L hall grid B7 sludge	8/15/97	4,029.77	-0.92	45.40
pit soil	na	C	Lhall	626 L hall grid B7 test pit soil	8/16/97	471.92	0.29	3.60
pit	na	C	Lhall	726 L hall test pit west side 0-6"	9/10/97	82.93	1.16	4.63
pipe sludge	na	C	Lhall	727 L hall cyl test pit sludge i/s pipe	9/10/97	1,468.32	0.27	3.39
pipe soil	na	C	Lhall	733 L hall test pit flr under drain line	9/12/97	161.41	0.68	0.77
pipe soil	na	C	Lhall	734 L hall test pit flr under n pipe	9/12/97	61.57	0.83	0.74
wall soil	na	C	Lhall	735 L hall test pit flr under A9 lab	9/13/97	48.88	0.78	0.60
SB-1	0	V	Lhall	Hall grid C19 surface soil	4/9/97	3.95	0.37	0.35
SB-1	1 to 2	V	Lhall	Hall grid C19 1'-2' soil	4/9/97	1.64	1.01	0.74
SB-1	2 to 3	V	Lhall	Hall grid C19 2'-3' soil	4/9/97	2.90	1.16	0.64
SB-1	3 to 4	V	Lhall	Hall grid C19 3'-4' soil	4/9/97	0.37	1.14	0.67
SB-2	0	V	Lhall	Large Hall surface grid A11	4/9/97	11.67	1.14	6.20
SB-2	1 to 2	V	Lhall	Large Hall 1'-2' grid A11	4/9/97	2.51	0.94	1.65
SB-2	2 to 3	V	Lhall	Large Hall 2'-3' grid A11	4/9/97	2.48	1.00	0.96

(Table cont'd)

Table 4.4-1 (cont'd, page 2 of 4)

Summary of Soil and Miscellaneous Sample Results for the Large Hallway

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
SB-2	3 to 4	V	Lhall	Large Hall 3'-4' grid A11	4/9/97	2.84	1.07	0.89
SB-3	0	V	Lhall	Large Hall surface grid A19	4/9/97	22.41	1.36	7.18
SB-3	1 to 2	V	Lhall	Large Hall 1'-2' grid A19	4/9/97	14.87	0.85	0.66
SB-3	2 to 3	V	Lhall	Large Hall 2'-3' grid A19	4/9/97	3.70	0.86	0.82
SB-3	3 to 4	V	Lhall	Large Hall 3'-4' grid A19	4/9/97	4.94	1.05	0.97
SB-4	0	V	Lhall	Large Hall surface grid A22	4/9/97	9.96	1.06	5.25
SB-4	1 to 2	V	Lhall	Large Hall 1'-2' grid A22	4/9/97	5.29	0.94	1.98
SB-4	2 to 3	V	Lhall	Large Hall 2'-3' grid A22	4/9/97	3.74	0.66	0.98
SB-4	3 to 4	V	Lhall	Large Hall 3'-4' grid A22	4/9/97	5.38	1.12	1.82
SB-5	0	V	Lhall	Large Hall surface grid B5	4/9/97	10.34	1.29	5.89
SB-5	1 to 2	V	Lhall	Large Hall 1'-2' grid B5	4/9/97	7.59	1.57	6.06
SB-5	2 to 3	V	Lhall	Large Hall 2'-3' grid B5	4/9/97	12.56	1.24	4.61
SB-5	3 to 4	V	Lhall	Large Hall 3'-4' grid B5	4/9/97	9.92	1.42	4.42
SB-6	0	V	Lhall	Large Hall surface grid B7	4/21/97	30.09	0.30	1.06
SB-6	1 to 2	V	Lhall	Large Hall 1'-2' grid B7	4/21/97	23.72	0.22	0.68
SB-6	2 to 3	V	Lhall	Large Hall 2'-3' grid B7	4/21/97	12.68	0.23	0.56
SB-6	3 to 4	V	Lhall	Large Hall 3'-4' grid B7	4/21/97	15.59	0.17	0.55
SB-7	0	V	Lhall	Large Hall surface grid C0	4/19/97	7.45	1.05	4.33
SB-7	1 to 2	V	Lhall	Large Hall 1'-2' grid C0	4/19/97	1.15	0.89	1.23
SB-7	2 to 3	V	Lhall	Large Hall 2'-3' grid C0	4/19/97	1.90	1.09	1.01

Table 4.4-1 (cont'd, page 3 of 4)

Summary of Soil and Miscellaneous Sample Results for the Large Hallway

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
SB-7	3 to 4	V	Lhall	Large Hall 3'-4' grid C0	4/19/97	-0.25	0.99	0.86
SB-8	0	V	Lhall	Large Hall surface grid C3	4/19/97	10.55	1.54	6.38
SB-8	1 to 2	V	Lhall	Large Hall 1'-2' grid C3	4/19/97	1.78	0.94	0.92
SB-8	2 to 3	V	Lhall	Large Hall 2'-3' grid C3	4/19/97	0.66	0.97	0.88
SB-8	3 to 4	V	Lhall	Large Hall 3'-4' grid C3	4/19/97	0.96	0.96	0.97
SB-9	0	V	Lhall	Large Hall surface grid C16	4/11/97	33.07	1.29	6.04
SB-9	1 to 2	V	Lhall	Large Hall 1'-2' grid C16	4/11/97	6.36	1.21	1.58
SB-9	2 to 3	V	Lhall	Large Hall 2'-3' grid C16	4/11/97	2.28	1.18	0.82
SB-9	3 to 4	V	Lhall	Large Hall 3'-4' grid C16	4/11/97	2.87	0.99	0.72
SB-10	0	V	Lhall	Large Hall surface grid C22	4/11/97	8.14	1.54	5.40
SB-10	1 to 2	V	Lhall	Large Hall 1'-2' grid C22	4/11/97	2.54	1.29	2.01
SB-10	2 to 3	V	Lhall	Large Hall 2'-3' grid C22	4/11/97	2.48	0.98	0.94
SB-10	3 to 4	V	Lhall	Large Hall 3'-4' grid C22	4/11/97	-0.59	1.11	0.83
trench	na	V	Lhall	725 L hall east trench grid B18 1-2'	9/10/97	31.81	1.14	2.90
footer	na	V	Lhall	728 L hall e-w trench grid A18	9/10/97	8.59	1.05	1.33
footer	na	V	Lhall	729 L hall e-w trench grid A20	9/10/97	3.48	0.96	0.80
trench	na	V	Lhall	730 L hall e end trench grid B19	9/10/97	31.91	0.98	3.41
pit	na	V	Lhall	731 L hall test pit grid B-C	9/10/97	38.31	1.02	3.47
pit	na	V	Lhall	732 L hall test pit flr composite	9/12/97	59.62	0.70	1.19

Table 4.4-1 (cont'd, page 4 of 4)

Summary of Soil and Miscellaneous Sample Results for the Large Hallway

Abbreviations:

MDA	Minimum detectable activity
pCi/g	picocuries per gram
Ra-226	Radium-226

Note --- sequence appropriately with general notes

a	Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b	Sample types are: "C" for characterization and "V" for verification.
c	The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d	The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.

Table 4.5-1

Summary of Soil Samples from the First Floor Offices and Small Hallway

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c, d]	Analysis Date	Total Uranium (pCi/g)	Radium-226[e] (pCi/g)	Thorium-232[e] (pCi/g)
SB-1	0 to 1	V	1stFL	430 1ST FLR Small Hall g F9 0-1'	7/19/97	12.60	0.48	3.12
SB-1	1 to 2	V	1stFL	431 1ST FLR Small Hall g F9 1-2'	7/19/97	9.79	0.97	2.70
SB-2	0 to 1	V	1stFL	432 1ST FLR 5C2 GRID I3 0-1'	7/19/97	10.25	0.94	4.06
SB-2	1 to 2	V	1stFL	433 1ST FLR 5C2 GRID I3 1-2'	7/19/97	6.06	0.98	1.60
SB-2	2 to 3	V	1stFL	434 1ST FLR 5C2 GRID I3 2-3'	7/19/97	1.30	1.42	0.58
SB-2	3 to 4	V	1stFL	435 1ST FLR 5C2 GRID I3 3-4'	7/19/97	2.79	0.72	0.61
SB-3	0 to 1	V	1stFL	436 1ST FLR 5C3 GRID M2 0-1'	7/19/97	5.48	1.09	2.78
SB-3	1 to 2	V	1stFL	437 1ST FLR 5C3 GRID M2 1-2'	7/20/97	3.16	1.21	1.40
SB-3	2 to 3	V	1stFL	438 1ST FLR 5C3 GRID M2 2-3'	7/20/97	1.82	1.13	0.96
SB-3	3 to 4	V	1stFL	439 1ST FLR 5C3 GRID M2 3-4'	7/20/97	0.25	0.82	0.73
SB-4	0 to 1	V	1stFL	440 1ST FLR 5D GRID O3 0-1'	7/19/97	8.10	1.05	2.00
SB-5	0 to 1	V	1stFL	441 1ST FLR 5D GRID P7 0-1'	7/19/97	11.44	1.20	4.21
SB-5	1 to 2	V	1stFL	442 1ST FLR 5D GRID P7 1-2'	7/19/97	4.50	0.64	1.14
SB-5	2 to 3	V	1stFL	443 1ST FLR 5D GRID P7 2-3'	7/19/97	3.12	0.68	0.77
SB-6	0 to 1	V	1stFL	444 1ST FLR 5D GRID O5 0-1'	7/19/97	6.31	0.65	2.62
SB-6	1 to 2	V	1stFL	445 1ST FLR 5D GRID O5 1-2'	7/19/97	1.00	0.76	0.74
SB-6	2 to 3	V	1stFL	446 1ST FLR 5D GRID O5 2-3'	7/19/97	0.06	1.08	0.69
SB-6	3 to 4	V	1stFL	447 1ST FLR 5D GRID O5 3-4'	7/19/97	1.75	1.50	0.87
SB-7[f]	0 to 1	V	1stFL	448 1ST FLR 5D2 GRID Q0 0-1'	7/20/97	6.27	1.25	0.66

Table 4.5-1 (cont'd, page 2 of 5)

Summary of Soil Samples from the First Floor Offices and Small Hallway

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c, d]	Analysis Date	Total Uranium (pCi/g)	Radium-226[e] (pCi/g)	Thorium-232[e] (pCi/g)
SB-8	0 to 1	V	1stFL	449 1ST FLR 5B GRID H7 0-1'	7/20/97	8.60	1.01	3.76
SB-8	1 to 2	V	1stFL	450 1ST FLR 5B GRID H7 1-2'	7/20/97	2.95	0.69	1.39
SB-9	0 to 1	V	1stFL	466 1ST FLR 5A GRID D6 0-1'	7/19/97	7.21	0.98	3.42
SB-9	1 to 2	V	1stFL	467 1ST FLR 5A GRID D6 1-2'	7/19/97	-1.06	0.99	1.22
SB-9	2 to 3	V	1stFL	468 1ST FLR 5A GRID D6 2-3'	7/19/97	-2.36	1.21	1.04
SB-9	3 to 4	V	1stFL	469 1ST FLR 5A GRID D6 3-4'	7/19/97	0.96	0.78	0.63
SB-10	0 to 1	V	1stFL	470 1ST FLR Mens Locker rm g BB9 0-1'	7/18/97	8.00	0.99	3.76
SB-10	1 to 2	V	1stFL	471 1ST FLR Mens Locker rm g BB9 1-2'	7/18/97	2.09	0.82	1.17
SB-10	2 to 3	V	1stFL	472 1ST FLR Mens Locker rm g BB9 2-3'	7/18/97	1.37	0.63	0.73
SB-11	0 to 1	V	1stFL	473 1ST FLR 7B GRID BB3 0-1'	7/18/97	4.27	1.76	1.53
SB-11	1 to 2	V	1stFL	474 1ST FLR 7B GRID BB3 1-2'	7/18/97	2.99	1.11	0.93
SB-11	2 to 3	V	1stFL	475 1ST FLR 7B GRID BB3 2-3'	7/19/97	1.63	1.01	0.75
SB-11	3 to 4	V	1stFL	476 1ST FLR 7B GRID BB3 3-4'	7/18/97	1.50	0.90	0.57
SB-12	0 to 1	V	1stFL	477 1ST FLR 7A GRID W6 0-1'	7/18/97	7.83	0.65	3.32
SB-12	1 to 2	V	1stFL	478 1ST FLR 7A GRID W6 1-2'	7/18/97	2.95	0.88	1.40
SB-12	2 to 3	V	1stFL	479 1ST FLR 7A GRID W6 2-3'	7/18/97	0.38	0.79	0.57
SB-12	3 to 4	V	1stFL	480 1ST FLR 7A GRID W6 3-4'	7/18/97	0.61	0.85	0.65
SB-13	0 to 1	V	1stFL	481 1ST FLR SMALL HALL g CC8 0-1'	7/18/97	2.30	1.12	0.95
SB-13	1 to 2	V	1stFL	482 1ST FLR SMALL HALL g CC8 1-2'	7/18/97	1.28	1.09	0.64
SB-13	2 to 3	V	1stFL	483 1ST FLR SMALL HALL g CC8 2-3'	7/18/97	2.93	1.31	0.64

Table 4.5-1 (cont'd, page 3 of 5)

Summary of Soil Samples from the First Floor Offices and Small Hallway

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c, d]	Analysis Date	Total Uranium (pCi/g)	Radium-226[e] (pCi/g)	Thorium-232[e] (pCi/g)
SB-13	3 to 4	V	1stFL	484 1ST FLR SMALL HALL g CC-8 3-4'	7/18/97	4.03	0.58	0.41
SB-14	0 to 1	V	1stFL	485 1ST FLR SMALL HALL g Z8 0-1'	7/20/97	9.32	0.77	2.38
SB-14	1 to 2	V	1stFL	486 1ST FLR SMALL HALL g Z8 1-2'	7/18/97	2.70	0.56	0.92
SB-15	0 to 1	V	1stFL	489 1ST FLR OFF HALL N9 0-1'	7/20/97	7.53	1.16	3.18
SB-15	0 to 1	V	1stFL	490 1ST FLR OFF HALL H9 0-1'	7/20/97	10.24	0.54	3.63
SB-16	1 to 2	V	1stFL	491 1ST FLR OFF HALL H9 1-2'	7/20/97	5.24	0.96	1.76
SB-16	2 to 3	V	1stFL	492 1ST FLR OFF HALL H9 2-3'	7/20/97	3.47	0.73	0.96
SB-16	3 to 4	V	1stFL	493 1ST FLR OFF HALL H9 3-4'	7/20/97	2.79	0.84	1.11
SB-17	0 to 1	V	1stFL	494 1ST FLR OFF HALL A9 0-1'	7/20/97	9.78	0.66	3.49
SB-17	1 to 2	V	1stFL	495 1ST FLR OFF HALL A9 1-2'	7/20/97	3.68	1.13	2.09
SB-17	2 to 3	V	1stFL	496 1ST FLR OFF HALL A9 2-3'	7/20/97	3.27	1.02	1.33
SB-17	3 to 4	V	1stFL	497 1ST FLR OFF HALL A9 3-4'	7/20/97	-0.22	0.78	1.06
SB-18	0 to 1	V	1stFL	498 1ST FLR OFF HALL V9 0-1'	7/20/97	9.03	0.95	4.33
SB-18	1 to 2	V	1stFL	499 1ST FLR OFF HALL V9 1-2'	7/20/97	4.04	0.84	3.37
SB-18	2 to 3	V	1stFL	500 1ST FLR OFF HALL V9 2-3'	7/20/97	1.94	1.08	0.80
SB-18	3 to 4	V	1stFL	501 1ST FLR OFF HALL V9 3-4'	7/20/97	2.62	1.20	1.11
SB-19	0 to 1	V	1stFL	502 1ST FLR womens rr g T4 0-1'	7/20/97	9.15	1.04	4.78
SB-19	1 to 2	V	1stFL	503 1ST FLR womens rr g T4 1-2'	7/20/97	3.61	0.93	2.34
SB-19	2 to 3	V	1stFL	504 1ST FLR womens rr g T4 2-3'	7/20/97	1.41	1.35	1.45
SB-20	2 to 3	V	1stFL	451 1ST FLR OFF 5B GRID H7 2-3'	7/21/97	-0.01	0.61	1.02

Table 4.5-1 (cont'd, page 4 of 5)

Summary of Soil Samples from the First Floor Offices and Small Hallway

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c, d]	Analysis Date	Total Uranium (pCi/g)	Radium-226[e] (pCi/g)	Thorium-232[e] (pCi/g)
SB-20	3 to 4	V	1stFL	452 1ST FLR OFF 5B GRID H7 3-4'	7/21/97	4.09	0.55	0.61
SB-21	0 to 1	V	1stFL	453 1ST FLR OFF 5A GRID C4 0-1'	7/21/97	5.30	1.29	1.63
SB-21	1 to 2	V	1stFL	454 1ST FLR OFF 5A GRID C4 1-2'	7/21/97	2.96	1.09	0.68
SB-21	2 to 3	V	1stFL	455 1ST FLR OFF 5A GRID C4 2-3'	7/21/97	7.51	0.52	2.33
SB-21	3 to 4	V	1stFL	456 1ST FLR OFF 5A GRID C4 3-4'	7/21/97	1.50	0.43	1.14
SB-22	0 to 1	V	1stFL	457 1ST FLR OFF 5B GRID H2 0-1'	7/21/97	3.19	1.03	0.60
SB-22	1 to 2	V	1stFL	458 1ST FLR OFF 5B GRID H2 1-2'	7/21/97	0.98	1.22	0.76
SB-22	2 to 3	V	1stFL	459 1ST FLR OFF 5B GRID H2 2-3'	7/21/97	0.71	1.19	0.67
SB-23	0 to 1	V	1stFL	461 1ST FLR OFF 5C GRID L6 0-1'	7/20/97	5.90	1.11	1.82
SB-23	1 to 2	V	1stFL	460 1ST FLR OFF 5C GRID L6 1-2'	7/20/97	12.11	0.89	3.69
SB-24	0 to 1	V	1stFL	462 1ST FLR OFF 5C GRID I6 0-1'	7/20/97	11.71	0.95	3.81
SB-24	1 to 2	V	1stFL	463 1ST FLR OFF 5C GRID I6 1-2'	7/20/97	< 3.8	1.05	0.90
SB-24	2 to 3	V	1stFL	464 1ST FLR OFF 5C GRID I6 2-3'	7/20/97	1.28	0.29	0.86
SB-24	3 to 4	V	1stFL	465 1ST FLR OFF 5C GRID I6 3-4'	7/21/97	0.17	1.33	0.66
SB-25	0 to 1	V	1stFL	505 1ST FLR SMALL HALL GRID B8 0-1'	7/21/97	11.41	1.35	4.84
SB-25	1 to 2	V	1stFL	506 1ST FLR SMALL HALL GRID B8 1-2'	7/21/97	2.41	0.75	1.22
SB-25	2 to 3	V	1stFL	507 1ST FLR SMALL HALL GRID B8 2-3'	7/21/97	2.08	0.59	0.59
SB-26	0 to 1	V	1stFL	508 1ST FLR GRID A4 0-1'	7/21/97	5.44	1.29	0.65
SB-26	1 to 2	V	1stFL	509 1ST FLR GRID A4 1-2'	7/21/97	2.67	0.84	0.65
SB-26	2 to 3	V	1stFL	510 1ST FLR GRID A4 2-3'	7/21/97	< 5.4	0.78	0.91

Table 4.5-1 (cont'd, page 5 of 5)

Summary of Soil Samples from the First Floor Offices and Small Hallway

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c, d]	Analysis Date	Total Uranium (pCi/g)	Radium-226[e] (pCi/g)	Thorium-232[e] (pCi/g)
SB-27	0 to 1	V	1stFL	511 1ST FLR SMALL HALL GRID U2 0-1'	7/21/97	9.42	1.28	4.97
SB-27	1 to 2	V	1stFL	512 1ST FLR SMALL HALL GRID U2 1-2'	7/21/97	1.51	0.84	0.88
SB-27	2 to 3	V	1stFL	513 1ST FLR SMALL HALL GRID U2 2-3'	7/21/97	3.65	0.82	1.17

Abbreviations:

MDA Minimum detectable activity
pCi/g picocuries per gram
Ra-226 Radium-226

Notes:

a Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b Sample types are: "C" for characterization and "V" for verification.
c The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d Soil boring locations do not match the grid locations included in the Sample Identification because they were collected using a preliminary set of grids that subsequently changed for the delineation and verification surveys.
e The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.
f Sample collected from 0 to 1 foot interval in SB-7 is referenced to the exterior ground surface.

Table 4.7-1

Summary of Soil and Miscellaneous Sample Results for Area 8, 10 and 11

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
TR-1	na	C	8	Floor trench grid C6 area 8	3/27/97	131.88	0.33	0.45
TR-2	na	V	10	Floor trench comp area 8,10,11	3/27/97	5.75	0.42	0.45
SB-2	0 to 1	V	8	A8 grid A4 0-1' #260	5/21/97	2.00	0.73	1.55
SB-2	1 to 2	V	8	A8 grid A4 1-2' #261	5/21/97	0.63	0.76	0.63
SB-2	2 to 3	V	8	A8 grid A4 2-3' #262	5/21/97	1.09	0.77	0.69
SB-2	3 to 4	V	8	A8 grid A4 3-4' #263	5/21/97	1.13	0.88	0.74
SB-3	0 to 1	V	10	A10 grid A10 0-1' #259	5/21/97	5.11	0.88	1.88
SB-3	1 to 2	V	10	A10 grid A10 1-2' #260	5/21/97	0.77	0.79	0.71
SB-3	2 to 3	V	10	A10 grid A10 2-3' #261	5/21/97	2.50	0.71	0.65
SB-3	3 to 4	V	10	A10 grid A10 3-4' #266	5/20/97	0.95	0.68	0.71
SB-4	0 to 1	V	10	A10 grid B11 0-1' #263	5/20/97	2.59	1.05	2.43
SB-4	1 to 2	V	10	A10 grid B11 1-2' #264	5/20/97	2.75	0.64	0.68
SB-4	2 to 3	V	10	A10 grid B11 2-3' #265	5/20/97	1.07	0.73	0.69
SB-4	3 to 4	V	10	A10 grid B11 3-4' #262	5/21/97	1.04	0.67	0.71
SB-5	0 to 1	V	11	A11 grid L6 0-1' #269	5/20/97	3.51	0.86	1.63
SB-5	1 to 2	V	11	A11 grid L6 1-2' #270	5/20/97	1.38	0.87	0.99
SB-5	2 to 3	V	11	A11 grid L6 2-3' #271	5/20/97	0.19	0.88	0.70
SB-5	3 to 4	V	11	A11 grid L6 3-4' #272	5/20/97	2.06	0.86	0.57

(Table cont'd)

Abbreviations:

MDA	Minimum detectable activity
pCi/g	picocuries per gram
Ra-226	Radium-226

Notes:

a	Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b	Sample types are: "C" for characterization and "V" for verification.
c	The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d	The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.

Table 4.8-1

Summary of Soil and Miscellaneous Sample Results for the Corridor

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
I-16[e]		C	Corr	Corr Ceiling, Cretplk, Grd I-16, 0-.5" #248	5/20/97	8.66	<0.5	25.63
I-16[e]		C	Corr	Corr Ceiling, Cretplk, Grd I-16, .5-1" #249	5/20/97	9.72	<0.5	30.45
D-14[e]		C	Corr	Corr Ceiling, Cretplk, Grid D-14 old #235	5/20/97	22.39	<0.5	30.48
E-17[e]		C	Corr	Corr Ceiling, Cretplk, Grd E-17, 0-.5" new #250	5/20/97	0.47	0.07	0.16
Drain pipe		C	Corr	714 Corridor g I13 4' drain pipe	8/30/97	9.52	0.95	0.83
SB-6	0	V	Corr	Corridor grid A14 surface soil	4/9/97	2.61	0.84	1.07
SB-6	1 to 2	V	Corr	Corridor grid A14 1'-2'	4/9/97	2.49	1.00	1.32
SB-7	0	V	Corr	Corridor grid B15 surface soil	4/9/97	9.99	1.02	1.91
SB-7	1 to 2	V	Corr	Corridor grid B15 1'-2'	4/9/97	3.34	0.95	1.13
SB-7	2 to 3	V	Corr	Corridor grid B15 2'-3'	4/9/97	1.77	0.95	0.79
SB-7	3 to 4	V	Corr	Corridor grid B15 3'-4'	4/9/97	2.73	0.92	0.68
SB-8	0	V	Corr	Corridor grid D14 surface soil	4/9/97	3.17	0.93	0.86
SB-8	1 to 2	V	Corr	Corridor grid D14 1'-2'	4/9/97	2.44	0.90	0.84
SB-9	0	V	Corr	Corridor grid D16 surface soil	4/9/97	7.50	0.73	1.53
SB-9	1 to 2	V	Corr	Corridor grid D16 1'-2'	4/9/97	7.32	0.90	1.13
SB-9	2 to 3	V	Corr	Corridor grid D16 2'-3'	4/9/97	3.06	1.08	0.98
SB-9	3 to 4	V	Corr	Corridor grid D16 3'-4'	4/9/97	2.02	0.75	0.61

Table 4.8-1 (cont'd, page 2 of 2)

Summary of Soil and Miscellaneous Sample Results for the Corridor

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
SB-10	0	V	Corr	Corridor grid F16 surface soil	4/9/97	-0.01	1.12	0.79
SB-10	1 to 2	V	Corr	Corridor grid F16 1'-2'	4/9/97	1.10	0.99	0.75
SB-10	2 to 3	V	Corr	Corridor grid F16 2'-3'	4/9/97	1.74	0.91	0.88
SB-10	3 to 4	V	Corr	Corridor grid F16 3'-4'	4/9/97	1.37	0.79	0.75
SB-11	0	V	Corr	Corridor grid H13 surface soil	4/9/97	10.74	1.21	5.28
SB-11	1 to 2	V	Corr	Corridor grid H13 1'-2'	4/9/97	6.42	1.47	3.17
SB-11	2 to 3	V	Corr	Corridor grid H13 2'-3'	4/9/97	3.95	0.97	2.64
SB-12	0	V	Corr	Corridor grid I15 surface soil	4/9/97	9.65	1.34	4.69
SB-12	1 to 2	V	Corr	Corridor grid I15 1'-2'	4/9/97	7.41	1.28	3.64
SB-12	2 to 3	V	Corr	Corridor grid I15 2'-3'	4/9/97	9.64	1.03	3.50

Abbreviations:

MDA Minimum detectable activity
pCi/g picocuries per gram
Ra-226 Radium-226

a Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b Sample types are: "C" for characterization and "V" for verification.
c The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.
e Samples collected from ceiling creteplank panels.

Table 4.9-1

Summary of Soil and Miscellaneous Sample Results for Area 9

Boring No. or Grid Location[a]	Sample Depth (feet)	Sample Type	Area	Sample Identification[b]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[c] (pCi/g)	Radium-226[c] (pCi/g)
SB-1	0 to 1	C	9	627 A9 #1 g A6 0-1'	8/15/97	8.15	1.13	4.67
SB-1	1 to 2	C	9	628 A9 #1 g A6 1-2'	8/15/97	4.52	0.92	2.42
SB-1	2 to 3	C	9	629 A9 #1 g A6 2-3'	8/15/97	1.95	0.93	0.87
SB-1	3 to 4	C	9	630 A0 #1 g A6 3-4'	8/15/97	1.71	0.87	0.71
SB-3	0 to 1	C	9	631 A9 #3 g Q16 0-1'	8/16/97	8.81	1.09	4.33
SB-3	1 to 2	C	9	632 A9 #3 g Q16 1-2'	8/16/97	4.85	0.91	1.77
SB-3	2 to 3	C	9	633 A9 #3 g Q16 2-3'	8/16/97	2.53	0.88	1.32
SB-3	3 to 4	C	9	634 A9 #3 g Q16 3-4'	8/16/97	2.95	0.94	1.09
SB-2	0 to 1	C	9	635 A9 #2 g F16 0-1'	8/15/97	1.69	0.54	0.53
SB-2	1 to 2	C	9	636 A9 #2 g F16 1-2'	8/15/97	1.69	0.74	0.69
SB-2	2 to 3	C	9	637 A9 #2 g F16 2-3'	8/15/97	0.78	0.61	0.63
SB-2	3 to 4	C	9	638 A9 #2 g F16 3-4'	8/15/97	1.11	0.76	0.61
Drain	1	C	9	887 9 Lab, rm-9D, 4" drain, 1'	6/8/98	39.19	0.20	0.46
Trench	NA	C	9	914 A9 grid B1 trench soil	7/16/98	1.96	0.96	0.77
SB-8	0 to 1	C	9	652 A9 #8 grid K11 0-1'	8/23/97	6.38	0.69	2.32
SB-8	1 to 2	C	9	653 A9 #8 grid K11 1-2'	8/23/97	6.26	0.81	2.05
SB-8	2 to 3	C	9	654 A9 #8 grid K11 2-3'	8/23/97	4.85	0.99	1.60
SB-8	3 to 4	C	9	655 A9 #8 grid K11 3-4'	8/23/97	2.54	0.86	0.99
SB-7	0 to 1	C	9	648 A9 #7 grid K8 0-1'	8/23/97	8.46	1.03	4.40
SB-7	1 to 2	C	9	649 A9 #7 grid K8 1-2'	8/23/97	5.32	0.97	3.59
SB-7	2 to 3	C	9	650 A9 #7 grid K8 2-3'	8/23/97	3.70	0.88	1.78
SB-7	3 to 4	C	9	651 A9 #7 grid K8 3-4'	8/23/97	5.97	0.86	3.01
SB-6	0 to 1	C	9	644 A9 #6 grid O21 0-1'	8/23/97	4.92	1.05	3.96
SB-6	1 to 2	C	9	645 A9 #6 grid O21 1-2'	8/23/97	5.55	0.69	2.49
SB-6	2 to 3	C	9	646 A9 #6 grid O21 2-3'	8/23/97	4.45	1.12	1.52
SB-6	3 to 4	C	9	647 A9 #6 grid O21 3-4'	8/23/97	4.19	0.69	1.38

Table 4.9-1 (cont'd, page 2 of 3)

Summary of Soil and Miscellaneous Sample Results for Area 9

Boring No. or Grid Location[a]	Sample Depth (feet)	Sample Type	Area	Sample Identification[b]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[c] (pCi/g)	Radium-226[c] (pCi/g)
SB-13	0 to 1	C	9	672 A9 #13 grid B19 0-1'	8/23/97	4.06	0.57	1.65
SB-13	1 to 2	C	9	678 A9 #13 grid B19 1-2'	8/23/97	5.59	0.54	1.52
SB-15	2 to 3	C	9	679 A9 #15 grid R18 0-1'	8/23/97	6.26	0.76	2.23
SB-15	3 to 4	C	9	680 A9 #15 grid R18 1-2'	8/23/97	3.29	0.87	2.71
SB-5	0 to 1	C	9	640 A9 #5 grid N16 0-1'	8/23/97	7.31	1.10	2.84
SB-5	1 to 2	C	9	641 A9 #5 grid N16 1-2'	8/23/97	5.07	0.88	1.84
SB-5	2 to 3	C	9	642 A9 #5 grid N16 2-3'	8/23/97	1.63	0.67	0.97
SB-5	3 to 4	C	9	643 A9 #5 grid N16 3-4'	8/23/97	0.79	0.55	1.54
SB-9	0 to 1	C	9	656 A9 #9 grid I18 0-1'	8/23/97	5.39	1.16	3.35
SB-9	1 to 2	C	9	657 A9 #9 grid I18 1-2'	8/23/97	6.67	0.98	3.20
SB-9	2 to 3	C	9	658 A9 #9 grid I18 2-3'	8/23/97	1.85	0.94	2.02
SB-9	3 to 4	C	9	659 A9 #9 grid I18 3-4'	8/23/97	1.52	0.91	1.13
SB-10	0 to 1	C	9	660 A9 #10 grid E18 0-1'	8/23/97	8.24	1.19	2.35
SB-10	1 to 2	C	9	661 A9 #10 grid E18 1-2'	8/23/97	2.10	1.03	2.68
SB-10	2 to 3	C	9	662 A9 #10 grid E18 2-3'	8/23/97	0.85	1.12	1.74
SB-10	3 to 4	C	9	663 A9 #10 grid E18 3-4'	8/23/97	1.10	1.08	1.44
SB-12	0 to 1	C	9	668 A9 #12 grid B11 0-1'	8/23/97	11.05	1.10	3.91
SB-12	1 to 2	C	9	669 A9 #12 grid B11 1-2	8/23/97	8.51	1.06	4.23
SB-12	2 to 3	C	9	670 A9 #12 grid B11 2-3	8/23/97	15.53	1.29	3.93
SB-12	3 to 4	C	9	671 A9 #12 grid B11 3-4'	8/23/97	7.13	0.85	1.60
SB-11	0 to 1	C	9	664 A9 #11 grid E9 0-1'	8/24/97	2.98	0.92	1.59
SB-11	1 to 2	C	9	665 A9 #11 grid E9 1-2'	8/24/97	3.95	1.10	2.61
SB-11	2 to 3	C	9	666 A9 #11 grid E9 2-3'	8/24/97	4.59	1.00	2.25
SB-11	3 to 4	C	9	667 A9 #11 grid E9 3-4'	8/24/97	2.42	0.98	1.40
SB-14	0 to 1	C	9	674 A9 #14 grid P8 0-1'	8/24/97	12.84	1.50	4.39
SB-14	1 to 2	C	9	675 A9 #14 grid P8 1-2'	8/24/97	8.61	1.28	3.98

(Table cont'd)

Table 4.9-1 (cont'd, page 3 of 3)

Summary of Soil and Miscellaneous Sample Results for Area 9

Boring No. or Grid Location[a]	Sample Depth (feet)	Sample Type	Area	Sample Identification[b]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[c] (pCi/g)	Radium-226[c] (pCi/g)
SB-14	2 to 3	C	9	676 A9 #14 grid P8 2-3'	8/24/97	6.20	0.82	2.30
SB-14	3 to 4	C	9	677 A9 #14 grid P8 3-4'	8/24/97	-1.29	1.04	0.70
SB-16	0 to 1	C	9	680 A9 #16 grid S2 0-1'	8/24/97	4.40	0.90	2.66
SB-16	1 to 2	C	9	681 A9 #16 grid S2 1-2'	8/24/97	6.75	0.79	2.71
SB-16	2 to 3	C	9	682 A9 #16 grid S2 2-3'	8/24/97	4.16	0.88	1.31
SB-16	3 to 4	C	9	683 A9 #16 grid S2 3-4'	8/24/97	5.62	0.79	2.77

Notes:

a Identifies sample location.

b The sample identification includes the IDM sample number at the beginning and is identical to the description provided by IDM.

c The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix XXX.

Abbreviations:

MDA Minimum detectable activity

NA Not applicable

pCi/g picocuries per gram

(Table cont'd)

Table 4.10-1

Summary of Soil and Miscellaneous Sample Results from Areas 12 and 13

Report No.	Sample No.	Sample Type[a]	Area	Sample Identification[b]	File Name	Analysis Date	Total Uranium (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Comment
Characterization Soil Samples – Floor/Soil Borings										
10	16	C	12	302-4 Area 12 grid T4 3-4'	prx_m292	6/21/1997	4.19	0.79	0.54	none
10	17	C	12	303-1 Area 12 grid W3 0-1'	prx_m304	6/21/1997	33.89	0.43	0.46	none
10	18	C	12	304-1 Area 12 grid S8 0-1'	prx_m285	6/21/1997	14.83	0.52	0.74	none
10	19	C	12	304-2 Area 12 grid S8 1-2'	prx_m286	6/21/1997	12.58	0.66	0.52	none
10	20	C	12	304-3 Area 12 grid S8 2-3'	prx_m287	6/21/1997	21.24	0.93	0.72	none
10	21	C	12	304-4 Area 12 grid S8 3-4'	prx_m288	6/21/1997	19.04	0.72	0.48	none
10	22	C	12	305-1 Area 12 grid W6 0-1'	prx_m281	6/21/1997	13.04	0.27	0.83	none
10	23	C	12	305-2 Area 12 grid W6 1-2'	prx_m282	6/21/1997	56.84	0.49	0.85	none
10	24	C	12	305-3 Area 12 grid W6 2-3'	prx_m283	6/21/1997	138.61	1.32	0.98	none
10	25	C	12	305-4 Area 12 grid W6 3-4'	prx_m284	6/21/1997	67.47	0.82	1.11	none
10	26	C	12	306-1 Area 12 grid T1 0-1'	prx_m269	6/21/1997	11.72	1.18	0.77	none
10	27	C	12	306-2 Area 12 grid T1 1-2'	prx_m270	6/21/1997	17.55	1.25	0.89	none
10	28	C	12	306-3 Area 12 grid T1 2-3'	prx_m271	6/21/1997	7.88	0.95	0.61	none
10	29	C	12	306-4 Area 12 grid T1 3-4'	prx_m272	6/21/1997	1.88	0.83	1.14	none
10	30	C	12	307-1 Area 12 grid G7 0-1'	prx_m303	6/21/1997	3.65	0.03	0.15	none
10	31	C	12	308-1 Area 12 grid J0 0-1'	prx_m297	6/21/1997	98.02	1.84	2.20	none
10	32	C	12	308-2 Area 12 grid J0 1-2'	prx_m298	6/21/1997	644.86	0.48	4.87	none
10	33	C	12	309-1 Area 12 grid R1 0-1'	prx_m265	6/21/1997	33.25	1.02	1.41	none
10	34	C	12	309-2 Area 12 grid R1 1-2'	prx_m266	6/21/1997	16.30	0.93	0.82	none
10	35	C	12	309-3 Area 12 grid R1 2-3'	prx_m267	6/21/1997	185.25	1.09	0.71	none
10	36	C	12	309-4 Area 12 grid R1 3-4'	prx_m268	6/21/1997	545.79	1.38	0.74	none
10	37	C	12	310-1 Area 12 grid H0 0-1'	prx_m299	6/21/1997	91.05	1.38	2.71	none
10	38	C	12	310-2 Area 12 grid H0 1-2'	prx_m300	6/21/1997	124.72	2.12	2.33	none
10	39	C	12	311-1 Area 12 grid O0 0-1'	prx_m301	6/21/1997	408.74	2.23	2.12	none
10	40	C	12	311-2 Area 12 grid O0 1-2'	prx_m302	6/21/1997	306.43	0.85	3.85	none

Table 4.10-1 (cont'd, page 2 of 7)

Summary of Soil and Miscellaneous Sample Results from Areas 12 and 13

Report No.	Sample No.	Sample Type[a]	Area	Sample Identification[b]	File Name	Analysis Date	Total Uranium (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Comment
10	43	C	12	320-3 Area 13 grid W10 2-3'	prx_m245	6/20/1997	77.36	0.43	1.01	none
10	44	C	12	321-1 Area 12 grid J8 0-1'	prx_m277	6/21/1997	56.31	0.73	0.58	none
10	45	C	12	321-2 Area 12 grid J8 1-2'	prx_m278	6/21/1997	37.74	0.52	0.74	none
10	46	C	12	321-3 Area 12 grid J8 2-3'	prx_m279	6/21/1997	15.70	0.87	0.61	none
10	47	C	12	321-4 Area 12 grid J8 3-4'	prx_m280	6/21/1997	13.43	0.73	0.59	none
10	41	C	13	320-1 Area 13 grid W10 0-1'	prx_m243	6/20/1997	156.64	0.73	1.15	none
10	42	C	13	320-2 Area 13 grid W10 1-2'	prx_m244	6/20/1997	173.07	0.39	1.16	none
10	48	C	13	322-1 Area 13 grid U10 0-1'	prx_m246	6/20/1997	137.17	0.85	2.89	none
10	49	C	13	322-2 Area 13 grid U10 1-2'	prx_m247	6/20/1997	2.61	0.61	0.67	none
10	50	C	13	322-3 Area 13 grid U10 2-3'	prx_m248	6/20/1997	0.63	1.29	0.54	none
10	51	C	13	323-1 Area 13 grid R10 0-1'	prx_m249	6/21/1997	9.91	0.76	3.09	none
10	52	C	13	323-2 Area 13 grid R10 1-2'	prx_m250	6/21/1997	26.96	0.90	0.95	none
10	53	C	13	323-3 Area 13 grid R10 2-3'	prx_m251	6/21/1997	44.93	0.80	0.69	none
10	54	C	13	323-4 Area 13 grid R10 3-4'	prx_m252	6/21/1997	54.81	0.72	0.65	none
10	55	C	13	324-1 Area 13 grid W13 0-1'	prx_m225	6/20/1997	4.10	1.07	2.00	none
10	56	C	13	324-2 Area 13 grid W13 1-2'	prx_m226	6/20/1997	2.00	0.91	0.57	none
10	57	C	13	324-3 Area 13 grid W13 2-3'	prx_m227	6/20/1997	3.76	0.94	0.55	none
10	58	C	13	324-4 Area 13 grid W13 3-4'	prx_m228	6/20/1997	2.50	0.61	0.83	none
10	59	C	13	325-1 Area 13 grid F17 0-1'	prx_m257	6/21/1997	6.17	0.99	2.45	none
10	60	C	13	325-2 Area 13 grid F17 1-2'	prx_m258	6/21/1997	-0.90	0.99	0.88	none
10	61	C	13	325-3 Area 13 grid F17 2-3'	prx_m259	6/21/1997	3.30	1.38	0.81	none
10	62	C	13	325-4 Area 13 grid F17 3-4'	prx_m260	6/21/1997	2.00	1.37	0.88	none
10	63	C	13	326-1 Area 13 grid T12 0-1'	prx_m239	6/20/1997	5.78	0.91	1.78	none
10	64	C	13	326-2 Area 13 grid T12 1-2'	prx_m240	6/20/1997	-0.79	1.03	0.70	none
10	65	C	13	326-3 Area 13 grid T12 2-3'	prx_m241	6/20/1997	1.52	0.58	0.77	none
10	66	C	13	326-4 Area 13 grid T12 3-4'	prx_m242	6/20/1997	1.75	0.56	0.91	none
10	67	C	13	327-1 Area 13 grid G10 0-1'	prx_m233	6/20/1997	85.76	1.30	1.45	none

Table 4.10-1 (cont'd, page 3 of 7)

Summary of Soil and Miscellaneous Sample Results from Areas 12 and 13

Report No.	Sample No.	Sample Type[a]	Area	Sample Identification[b]	File Name	Analysis Date	Total Uranium (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Comment
10	68	C	13	327-2 Area 13 grid G10 1-2'	prx_m234	6/20/1997	36.34	0.87	0.72	none
10	69	C	13	327-3 Area 13 grid G10 2-3'	prx_m235	6/20/1997	17.59	1.04	0.89	none
10	70	C	13	327-4 Area 13 grid G10 3-4'	prx_m236	6/20/1997	7.13	0.97	0.63	none
10	71	C	13	328-1 Area 13 grid T14 0-1'	prx_m261	6/21/1997	6.94	1.53	1.16	none
10	72	C	13	328-2 Area 13 grid T14 1-2'	prx_m262	6/21/1997	2.88	0.95	0.34	none
10	73	C	13	328-3 Area 13 grid T14 2-3'	prx_m263	6/21/1997	1.43	1.04	0.51	none
10	74	C	13	328-4 Area 13 grid T14 3-4'	prx_m264	6/21/1997	1.16	0.82	0.61	none
10	75	C	13	329-1 Area 13 grid H15 0-1'	prx_m229	6/20/1997	7.58	0.97	3.54	none
10	76	C	13	329-2 Area 13 grid H15 1-2'	prx_m230	6/20/1997	0.44	1.18	0.87	none
10	77	C	13	329-3 Area 13 grid H15 2-3'	prx_m231	6/20/1997	0.59	0.52	0.67	none
10	78	C	13	329-4 Area 13 grid H15 3-4'	prx_m232	6/20/1997	0.91	0.66	0.68	none
11	1	C	13	332-1 A13 grid L17 0-1'	prx_m305	6/27/1997	3.52	0.99	1.43	none
11	2	C	13	332-2 A13 grid L17 1-2'	prx_m306	6/27/1997	1.95	0.95	0.78	none
11	3	C	13	332-3 A13 grid L17 2-3'	prx_m307	6/27/1997	1.32	0.89	0.71	none
11	4	C	13	332-4 A13 grid L17 3-4'	prx_m308	6/27/1997	-0.15	0.85	0.95	none
11	5	C	13	333-1 A13 grid P18 0-1'	prx_m312	6/27/1997	30.97	1.27	1.29	none
11	6	C	13	333-2 A13 grid P18 1-2'	prx_m313	6/28/1997	1.63	0.79	0.64	none
11	7	C	13	333-3 A13 grid P18 2-3'	prx_m314	6/28/1997	0.72	0.70	0.60	none
11	8	C	13	333-4 A13 grid P18 3-4'	prx_m315	6/28/1997	3.52	0.28	0.52	none
11	9	C	13	334-1 A13 grid J10 0-1'	prx_m316	6/28/1997	666.04	0.63	1.15	none
11	10	C	13	334-2 A13 grid J10 1-2'	prx_m317	6/28/1997	201.51	0.82	1.04	none
11	11	C	13	334-3 A13 grid J10 2-3'	prx_m318	6/28/1997	18.98	0.50	0.88	none
11	12	C	13	334-4 A13 grid J10 3-4'	prx_m319	6/28/1997	27.23	0.75	0.78	none
11	21	C	13	343-1 A13 grid O15 0-1'	prx_m325	6/28/1997	20.25	0.93	0.77	none
11	22	C	13	343-2 A13 grid O15 1-2'	prx_m326	6/28/1997	14.12	1.16	0.63	none
11	23	C	13	343-3 A13 grid O15 2-3'	prx_m327	6/28/1997	5.54	0.66	0.62	none
12	3	C	13	351 A13 grid M11 4' composite	prx_m333	7/3/1997	155.93	1.03	0.58	none

Table 4.10-1 (cont'd, page 4 of 7)

Summary of Soil and Miscellaneous Sample Results from Areas 12 and 13

Report No.	Sample No.	Sample Type[a]	Area	Sample Identification[b]	File Name	Analysis Date	Total Uranium (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Comment
11	13	C	13	335 A13 E wall flr grid 18S-X #1	prx_m320	6/28/1997	1.86	1.32	1.90	
11	14	C	13	336 A13 flr grid 18M-R #2	prx_m321	6/28/1997	21.78	1.35	1.37	
11	15	C	13	337 A13 N flr grid F10-11 #3	prx_m322	6/28/1997	177.65	2.47	1.74	
11	16	C	13	338 A13 wall flr grid 9A-T #4	prx_m309	6/27/1997	177.67	1.47	1.96	
11	17	C	13	339 A13 flr grid 14-17/M-X #5	prx_m310	6/27/1997	6.40	0.75	0.87	
11	18	C	13	340 A13 grid 9-12/S-V #6	prx_m311	6/27/1997	20.02	0.47	0.59	
11	19	C	13	341 A13 flr grid M16 #7	prx_m323	6/28/1997	4.27	2.15	1.45	
11	20	C	13	342 A13 flr under platform grid J15 #8	prx_324	6/28/1997	5.83	0.75	1.21	
Verification Soil Samples – Floor										
14	18	V	13	428 A13 grids N3/E3 9 pt comp	prx_m352	7/10/1997	70.39	0.75	0.62	none
14	9	V	13	419 A13 grids N5/E5 9 pt comp	prx_m346	7/9/1997	3.56	0.94	0.62	none
14	10	V	13	420 A13 grids N4/E5	prx_m344	7/9/1997	4.88	0.81	0.72	none
14	11	V	13	421 A13 grids N3/E5	prx_m345	7/10/1997	2.33	1.18	0.90	none
14	12	V	13	422 A13 grids N2/E5 9 pt comp	prx_m346	7/10/1997	8.42	0.57	0.73	none
14	13	V	13	423 A13 grids N5/E4 9 pt comp	prx_m347	7/10/1997	4.77	0.51	0.74	none
14	14	V	13	424 A13 grids N4/E4 9 pt comp	prx_m348	7/10/1997	21.40	0.80	1.08	none
14	15	V	13	425 A13 grids N5/E3 9 pt comp	prx_m349	7/10/1997	8.00	0.87	0.67	none
14	16	V	13	426 A13 grids N4/E3 9 pt comp	prx_m350	7/10/1997	15.45	0.60	0.88	none
14	17	V	13	427 A13 grids N3/E4 9 pt comp	prx_m351	7/10/1997	13.58	0.92	0.82	none
15	1	V	13	430 A13 N0/E4 comp	prx_m354	7/10/1997	3.38	0.63	0.66	none
15	2	V	13	431 A13 N0/E3	prx_m355	7/10/1997	9.51	1.26	0.66	none
15	3	V	13	432 A13 N1/E2	prx_m356	7/10/1997	27.70	0.84	0.51	none
15	13	V	13	442 A13 N1/E3	prx_m366	7/10/1997	57.29	0.87	0.66	none
15	14	V	13	443 A13 N2/E4	prx_m367	7/10/1997	30.02	0.80	0.78	none
15	15	V	13	444 A13 N2/E3	prx_m368	7/10/1997	41.69	1.11	0.61	none
15	16	V	13	445 A13 N1/E4	prx_m369	7/10/1997	16.13	0.72	0.58	none
15	4	V	12	433 A12 N2/E2	prx_m357	7/10/1997	54.14	0.70	1.00	none

Table 4.10-1 (cont'd, page 5 of 7)

Summary of Soil and Miscellaneous Sample Results from Areas 12 and 13

Report No.	Sample No.	Sample Type[a]	Area	Sample Identification[b]	File Name	Analysis Date	Total Uranium (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Comment
15	5	V	12	434 A12 N0/E2	prx_m358	7/10/1997	31.41	1.11	0.88	none
15	6	V	12	435 A12 N3/E2	prx_m359	7/10/1997	49.60	1.14	0.39	none
15	7	V	12	436 A12 N0/E1	prx_m360	7/10/1997	10.27	1.05	0.94	none
15	8	V	12	437 A12 N1/E1	prx_m361	7/10/1997	17.91	0.54	0.67	none
15	9	V	12	438 A12 N2/E1	prx_m362	7/10/1997	33.75	0.23	0.49	none
15	10	V	12	439 A12 N3/E1	prx_m363	7/10/1997	25.92	0.62	0.46	none
15	11	V	12	440 A12 N0/E0	prx_m364	7/10/1997	5.49	0.90	0.65	none
15	12	V	12	441 A12 N1/E0	prx_m365	7/10/1997	22.95	0.89	0.60	none
17a	43	V	12	487 A12 g N5/E0 composite	prx_m404	7/19/1997	31.54	0.77	0.55	none
Post-IVC Verification Soil Samples - Floor, underneath temporary gravel ramp										
14	3	V	12	413 A12 grids U,V/5,6,7 post excav comp	prx_m338	7/9/1997	32.43	0.50	0.80	none
14	4	V	12	414 A12 grids W/5,6,7 post excav comp	prx_m339	7/9/1997	39.06	0.28	0.71	none
14	5	V	12	415 A12 grids S,T/5,6,7 post excav comp	prx_m340	7/9/1997	15.52	0.94	0.63	none
14	6	V	12	416 A12 grids T,U,V,W/6,7 0-6" excav	prx_m341	7/9/1997	27.30	0.72	0.71	none
Post-IVC Verification Soil Samples - Floor										
17a	44	V	12	488 A12/A13 g n2/e2,3 + n3/e2,3 comp	prx_m405	7/19/1997	36.88	1.00	0.52	none
17b	25	V	12	514 a12/a13 grids k,l,m/10,11,12 composite	prx_m454	7/22/1997	33.29	0.93	0.77	None
17b	26	V	12	515 a12/a13 grids n,o,p/10,11,12 composite	prx_m455	7/22/1997	20.32	0.65	0.69	None
17b	27	V	12	516 a12/a13 grids q,r,s/10,11,12 composite	prx_m456	7/22/1997	38.07	0.81	0.72	None
17b	28	V	13	517 a13 grids k,l,m/10,11,12 composite	prx_m457	7/22/1997	31.46	0.63	0.70	None
17b	29	V	13	518 a13 grids n,o,p/10,11,12 composite	prx_m458	7/22/1997	18.12	0.88	0.65	None
17b	29	V	13	519 a13 grids q,r,s/10,11,12 composite	prx_m459	7/22/1997	26.48	0.93	0.65	None

Table 4.10-1 (cont'd, page 6 of 7)

Summary of Soil and Miscellaneous Sample Results from Areas 12 and 13

Report No.	Sample No.	Sample Type[a]	Area	Sample Identification[b]	File Name	Analysis Date	Total Uranium (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Comment
Characterization Soil Samples - West Knee Wall										
12	17	C	12	365 A12 L/M0 west wall	prx_p40	7/3/1997	3,750.25			d
14	19	C	12	429 A12 west wall footer sub comp	prx_m353	7/10/1997	225.0	0.63	0.49	none
12	9	C	13	357 A12 G/H/I0 west wall	prx_p32	7/6/1997	2,629.73			
12	4	C	12	352 A12 grid I0	prx_p27	7/6/1997	17,909.62			d
14	7	C	12	417 A12 grids T,U,V/0 clay under black	prx_m342	7/9/1997	35	1.13	0.72	none
11	24	C	12	344 A12 grid G0 under footing 0-1'	prx_m328	6/28/1997	54	1.18	0.91	none
11	26	C	12	346 A12 grid H0 under footing 0-1'	prx_m330	6/28/1997	144.1	0.59	0.70	none
Characterization Soil Samples - South Wall										
12	5	C	12	353 A12 grid F0 under 8" slab	prx_p28	7/6/1997	3,613.91			d
12	14	C	12	362 A12 F1 south wall	prx_p37	7/3/1997	218.01			d
12	15	C	12	363 A12 F7 south wall	prx_p38	7/3/1997	815.05			d
12	12	C	13	360 A13 F10 south wall	prx_p35	7/6/1997	205.70			
12	20	C	13	368 A13 south wall 6-12" F9-F14	prx_m334	7/3/1997	52.64	0.99	0.73	none
11	15	C	13	337 A13 N flr grid F10-11 #3	prx_m322	6/28/1997	177.65	2.47	1.74	none
12	19	C	12	367 A12 south end F0-F8 6-12" comp	prx_m335	7/3/1997	37.92	1.24	0.70	none
Stairwell Sump/Drainline Samples										
30	1	V	12	830 A12 sump 0-1' (corebore)	prx_m703	2/13/1998	1.18	0.72	0.59	
30	2	V	12	831 A12 sump 1'-2'	prx_m704	2/13/1998	1.50	0.78	0.61	
30	3	V	12	832 A12 sump 2'-3'	prx_m705	2/13/1998	1.38	0.72	0.63	
30	4	V	12	833 A12 sump 3'-4'	prx_m706	2/13/1998	0.66	0.80	0.60	
24	12	C	12	751 A12 tunnel sump sludge	prx_m634	9/12/1997	99.14	0.17	2.03	none
6	1	C	12	A12 NW drain line #268	prx_m154	5/20/1997	710.95	0.93	4.75	
26	26	C	12	752 A12 sump pit sludge	prx_m664	9/20/1997	331.33	0.20	2.83	
27	4	C	12	790 A12 sump N pipe internal scale	prx_p068	10/5/1997	6,573.48			

Table 4.10-1 (cont'd, page 7 of 7)

Summary of Soil and Miscellaneous Sample Results from Areas 12 and 13

Report No.	Sample No.	Sample Type[a]	Area	Sample Identification[b]	File Name	Analysis Date	Total Uranium (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)	Comment
SE Corner Platform Samples										
11	20	C	13	342 A13 flr under platform grid J15 #8 *(horizontal core)*	prx_m324	6/28/1997	5.83	0.75	1.21	none
Summary of Soil and Miscellaneous Sample Results from Areas 12 and 13										
2	1	C	13	Rust/paint crane rail area 13	prx_p1	3/27/1997	601.70	0.51	1.63	none
17b	30	C	12	520 A12/A13 Baseline FLO-FILL matl	prx_m461	7/23/1997	2.17	0.97	0.84	None
17b	31	C	12	521 A12/A13 Baseline FLO-FILL matl	prx_m460	7/22/1997	1.77	0.92	0.73	None
12	1	C	12	349 A12 grid I7 *(hotspot)*	prx_m331	7/3/1997	149.65	0.94	0.80	none
11	17	C	13	339 A13 flr grid 14-17/M-X #5 *(pre-verif.)*	prx_m310	6/27/1997	6.40	0.75	0.87	none
11	18	C	13	340 A13 grid 9-12/S-V #6 *(pre-verif.)*	prx_m311	6/27/1997	20.02	0.47	0.59	none
11	19	C	13	341 A13 flr grid M16 #7 *(pre-verif.)*	prx_m323	6/28/1997	4.27	2.15	1.45	none
6	22	C	12	A12 storm drain #267	prx_p014	5/20/1997	745.96	3.29	1.56	

Table 4.10-1 (cont'd, page 8 of 7)

Summary of Soil and Miscellaneous Sample Results from Areas 12 and 13

Notes:

a Sample types are: "C" for characterization and "V" for verification.
b The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
c The error and MDA are reported, where available, for Ra-226 and Th-232 in Appendix XXX.
d Missing blank Ra-226/Th-232 analysis due to low volume matrices
e Composite sample 488 taken from verification grid sample cells indicated to confirm potential elevated area remaining following excavation.
f Samples 514, 515, 516 collected after initial excavation and immediately prior to additional removal of soil from the sampled area; samples 517, 518, 519 collected after excavation of one additional foot.

Abbreviations:

MDA	Minimum detectable activity
pCi/g	picocuries per gram
Ra-226	Radium-226
Total-U	Total Uranium

Table 4.11-1

Summary of Soil and Miscellaneous Sample Results from Area 14 North

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
SB-1	0 to 1	C	14N	551 A14 sample #1 0-1' g K7	8/8/97	19.89	0.95	0.88
SB-1	1 to 2	C	14N	552 A14 sample #1 1-2'	8/8/97	4.23	0.79	0.86
SB-1	2 to 3	C	14N	553 A14 sample #1 2-3'	8/8/97	3.11	0.60	0.95
SB-1	3 to 4	C	14N	554 A14 sample #1 3-4'	8/8/97	1.33	0.62	0.77
SB-2	0 to 1	C	14N	555 A14 sample #2 0-1' g i4	8/9/97	6.40	1.45	1.29
SB-3	0 to 1	C	14N	556 A14 sample #3 0-1' g F6	8/9/97	48.86	1.53	1.35
SB-3	1 to 2	C	14N	557 A14 sample #3 1-2'	8/9/97	28.64	1.30	1.11
SB-3	2 to 3	C	14N	558 A14 sample #3 2-3'	8/9/97	14.44	1.06	1.03
SB-3	3 to 4	C	14N	559 A14 sample #3 3-4'	8/9/97	7.37	0.82	1.03
SB-4	0 to 1	C	14N	561 A14 #4 0-1' g G0	8/13/97	33.43	3.92	1.25
SB-4	1 to 2	C	14N	562 A14 #4 1-2'	8/13/97	27.43	4.17	1.21
SB-4	2 to 3	C	14N	563 A14 #4 2-3'	8/13/97	684.32	3.44	0.92
SB-11	0 to 1	C	14N	579 A14 #11 0-1' g b1	8/13/97	46.05	1.52	1.24
SB-11	1 to 2	C	14N	580 A14 #11 1-2'	8/13/97	59.15	2.21	0.74
SB-11	2 to 3	C	14N	581 A14 #11 2-3'	8/13/97	667.79	2.57	1.45
SB-11	3 to 4	C	14N	582 A14 #11 3-4'	8/13/97	270.27	1.37	0.97
SB-12	0 to 1	C	14N	583 A14 #12 0-1' g h9	8/13/97	3.14	1.61	1.30
SB-12	1 to 2	C	14N	584 A14 #12 1-2'	8/13/97	5.04	1.30	0.91
SB-12	2 to 3	C	14N	585 A14 #12 2-3'	8/13/97	1.08	1.15	0.75
SB-12	3 to 4	C	14N	586 A14 #12 3-4'	8/14/97	2.72	0.99	0.92

(Table cont'd)

Table 4.11-1 (cont'd, page 2 of 4)

Summary of Soil and Miscellaneous Sample Results from Area 14 North

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
SB-6	0 to 1	C	14N	566 A14 #6 0-1' g L16	8/15/97	5.98	2.29	1.39
SB-6	1 to 2	C	14N	567 A14 #6 1-2'	8/15/97	3.12	2.56	1.33
SB-6	2 to 3	C	14N	568 A14 #6 2-3'	8/15/97	5.61	2.03	1.08
SB-6	3 to 4	C	14N	569 A14 #6 3-4'	8/15/97	4.16	0.94	0.85
SB-8	0 to 1	C	14N	570 A14 #8 0-1' g f15	8/15/97	266.97	1.42	0.88
SB-8	1 to 2	C	14N	571 A14 #8 1-2'	8/15/97	281.60	1.53	1.72
SB-8	2 to 3	C	14N	572 A14 #8 2-3'	8/15/97	157.86	1.18	1.19
SB-8	3 to 4	C	14N	573 A14 #8 3-4'	8/15/97	15.53	0.62	0.70
SB-19	0 to 1	C	14N	604 A14 #19 0-1' g k11	8/16/97	2.77	2.02	1.48
SB-19	1 to 2	C	14N	605 A14 #19 1-2'	8/16/97	3.53	1.70	1.34
SB-19	2 to 3	C	14N	606 A14 #19 2-3'	8/16/97	6.42	1.68	1.11
SB-19	3 to 4	C	14N	607 A14 #19 3-4'	8/16/97	0.59	0.64	0.84
SB-22	0 to 1	C	14N	710 A14 g B8 #22 0-1'	8/30/97	6.02	1.46	1.09
SB-22	1 to 2	C	14N	711 A14 g B8 #22 1-2'	8/30/97	23.16	1.12	0.77
SB-22	2 to 3	C	14N	712 A14 g B8 #22 2-3'	8/30/97	21.07	1.35	1.00
SB-22	3 to 4	C	14N	713 A14 g B8 #22 3-4'	8/30/97	10.24	0.67	0.72
west wall	variable[f]	C	14N	844 A14N knee wall (composite)	2/13/98	1,287.40	2.21	0.87
northwall	variable[f]	C	14N	876 A14N subsurface wall comp	03/15/98	14.93	1.00	0.96
northwall	variable[f]	C	14N	877 A14N subsurface ash w wall comp	03/15/98	247.29	1.80	1.23
Area 14A	0 to 1	C	14N	299-1 Area 14A grid C2 0-1'	6/21/97	287.48	1.82	1.19

Table 4.11-1 (cont'd, page 3 of 4)

Summary of Soil and Miscellaneous Sample Results from Area 14 North

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
Area 14A	1 to 2	C	14N	299-2 Area 14A grid C2 1-2'	6/21/97	81.58	1.53	1.89
Area 14A	2 to 3	C	14N	299-3 Area 14A grid C2 2-3'	6/21/97	231.24	1.20	0.96
Area 14A	3 to 4	C	14N	299-4 Area 14A grid C2 3-4'	6/21/97	46.93	0.43	0.89
N0/E3	excav.[e]	V	14N	849 A14S grid N0/E3 soil	2/27/98	16.97	0.81	0.85
N2/E1	excav.[e]	V	14N	850 A14S grid N2/E1 soil	2/28/98	9.14	0.64	0.82
N0/E4	excav.[e]	V	14N	851 A14N grid N0/E4 soil	2/28/98	7.78	0.68	0.75
N0/E5	excav.[e]	V	14N	852 A14N grid N0/E5 soil	3/1/98	2.91	0.68	0.72
N1/E1	excav.[e]	V	14N	853 A14N grid N1/E1 soil	3/1/98	5.52	0.74	0.90
N1/E2	excav.[e]	V	14N	854 A14N grid N1/E2 soil	3/2/98	11.01	0.83	0.84
N1/E4	excav.[e]	V	14N	855 A14N grid N1/E4 soil	3/2/98	5.80	0.79	1.00
N1/E3	excav.[e]	V	14N	856 A14N grid N1/E3 soil	3/2/98	17.61	0.82	0.87
N1/E5	excav.[e]	V	14N	857 A14N grid N1/E5 soil	3/2/98	4.45	0.81	0.97
N2/E2	excav.[e]	V	14N	858 A14N grid N2/E2 soil	3/2/98	5.12	0.71	0.93
N2/E4	excav.[e]	V	14N	859 A14N grid N2/E4 soil	3/2/98	6.90	0.91	0.90
N2/E3	excav.[e]	V	14N	860 A14N grid N2/E3 soil	3/2/98	6.21	0.80	0.98
N2/E5	excav.[e]	V	14N	861 A14N grid N2/E5 soil	3/2/98	2.77	0.74	0.98
N2/E1	excav.[e]	V	14N	864 14N g N2/E1 clay	3/4/98	-0.02	0.54	0.73
N2/E0	excav.[e]	V	14N	865 14N g N2/E0 clay	3/4/98	1.00	0.59	0.70
N1/E0	excav.[e]	V	14N	866 14N g N1/E0 clay	3/4/98	-0.31	0.65	0.78
N0/E0	excav.[e]	V	14N	867 14N g N0/E0 clay	3/4/98	4.52	0.74	1.04

Summary of Soil and Miscellaneous Sample Results from Area 14 North

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
N0/E1	excav.[e]	V	14N	868 14N g N0/E1 clay	3/5/98	2.99	0.76	1.02
N0/E2	excav.[e]	V	14N	869 14N g N0/E2 clay	3/5/98	1.35	0.70	0.86
N3/E0	excav.[e]	V	14N	870 14N g N3/E0 clay	3/5/98	1.17	0.65	0.69
N3/E1	excav.[e]	V	14N	871 14N g N3/E1 clay	3/5/98	2.49	0.61	0.74
N3/E2	excav.[e]	V	14N	872 14N g N3/E2 clay	3/5/98	0.58	0.73	0.87
N3/E3	excav.[e]	V	14N	873 14N g N3/E3 clay	3/5/98	0.53	0.60	0.69
N3/E4	excav.[e]	V	14N	874 14N g N3/E4 clay	3/5/98	0.81	0.56	0.70
N3/E5	excav.[e]	V	14N	875 14N g N3/E5 clay	3/5/98	1.08	0.74	0.87
W. wall footer	variable[f]	C	14	878 A14N/A14S subsurface w wall comp	03/16/98	78.91	0.77	0.77
W. wall footer	variable[f]	C	14	879 A14N/A14S subsurface w wall comp	03/16/98	87.85	0.67	0.79

Abbreviations:

MDA Minimum detectable activity
pCi/g picocuries per gram
Ra-226 Radium-226

Notes:

a Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b Sample types are: "C" for characterization and "V" for verification.
c The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.
e Verification samples were collected from a depth of 6 to 12 inches below the base of the excavation.
f Subsurface composite samples underneath the north wall and west knee wall were taken from multiple locations at variable depths.

Table 4.12-1

Summary of Soil and Miscellaneous Sample Results from Area 14 South

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
SB-5	0 to 1	C	14S	564 A14 #5 0-1' g H0	8/13/97	10.04	1.72	1.23
SB-5	1 to 2	C	14S	565 A14 #5 1-2'	8/13/97	89.94	0.98	0.98
SB-9	0 to 1	C	14S	574 A14 #9 0-1' g b1	8/13/97	2.66	1.55	1.06
SB-9	1 to 2	C	14S	575 A14 #9 1-2'	8/13/97	3.40	1.41	1.10
SB-9	2 to 3	C	14S	576 A14 #9 2-3'	8/13/97	5.68	0.75	0.92
SB-9	3 to 4	C	14S	577 A14 #9 3-4'	8/13/97	4.54	0.94	0.91
SB-10	0 to 1	C	14S	578 A14 #10 0-1' g g17	8/13/97	30.51	0.20	0.09
SB-14	0 to 1	C	14S	587 A14 #14 0-1' g c14	8/13/97	147.61	2.25	1.24
SB-14	1 to 2	C	14S	588 A14 #14 1-2'	8/13/97	50.39	1.07	0.89
SB-14	3	C	14S	588A A14 #14 3' oil/water	8/14/97	0.01	1.15	0.12
SB-15	0 to 1	C	14S	589 A14 #15 0-1' g c10	8/14/97	3.13	1.54	1.31
SB-15	1 to 2	C	14S	590 A14 #15 1-2'	8/14/97	3.15	1.56	1.27
SB-15	2 to 3	C	14S	591 A14 #15 2-3'	8/14/97	5.10	1.33	1.14
SB-15	3 to 4	C	14S	592 A14 #15 3-4'	8/14/97	2.72	1.02	0.98
SB-16	0 to 1	C	14S	595 A14 #16 0-1' g g22	8/16/97	2.96	1.32	1.27
SB-16	1 to 2	C	14S	596 A14 #16 1-2'	8/16/97	2.67	1.38	1.23
SB-16	2 to 3	C	14S	597 A14 #16 2-3'	8/16/97	3.80	1.16	1.15
SB-16	3 to 4	C	14S	598 A14 #16 3-4'	8/16/97	2.10	0.92	0.99
SB-17	0 to 1	C	14S	599 A14 #17 0-1' g e6	8/16/97	5.96	0.90	0.87

Table 4.12-1 (cont'd, page 2 of 4)

Summary of Soil and Miscellaneous Sample Results from Area 14 South

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
SB-17	1 to 2	C	14S	600 A14 #17 1-2'	8/16/97	0.12	0.80	0.75
SB-17	2 to 3	C	14S	601 A14 #17 2-3'	8/16/97	3.89	0.54	0.82
SB-17	3 to 4	C	14S	602 A14 #17 3-4'	8/16/97	4.84	0.78	0.71
SB-18	0 to 1	C	14S	603 A14 #18 0-1' g h3	8/16/97	10.39	0.10	0.10
SB-20	0 to 1	C	14S	608 A14 #20 0-1' g e26	8/16/97	1.68	1.44	1.33
SB-20	1 to 2	C	14S	609 A14 #20 1-2'	8/16/97	3.41	1.36	1.03
SB-20	2 to 3	C	14S	610 A14 #20 2-3'	8/17/97	1.82	0.93	0.95
SB-20	3 to 4	C	14S	611 A14 #20 3-4'	8/17/97	2.09	1.02	0.91
SB-21	0 to 1	C	14S	706 A14 g I12 #21 0-1'	8/30/97	83.17	1.73	1.57
SB-21	1 to 2	C	14S	707 A14 g I12 #21 1-2'	8/30/97	82.31	1.82	1.42
SB-21	2 to 3	C	14S	708 A14 g i12 #21 2-3'	8/30/97	18.49	0.84	0.80
SB-21	3 to 4	C	14S	709 A14 g I12 #21 3-4'	8/30/97	14.05	0.74	0.76
SB-2	0 to 1	C	14S	788 A14S core #2 0-1' g d23	9/20/97	9.12	1.11	0.83
SB-2	1 to 2	C	14S	789 A14S core #2 1-2'	9/20/97	5.72	0.78	0.77
SB-1	0 to 1	C	14S	784 A14S core #1 0-1' g c23	9/21/97	-0.43	1.60	1.33
SB-1	1 to 2	C	14S	785 A14S core #1 1-2'	9/21/97	0.92	0.49	0.80
SB-1	2 to 3	C	14S	786 A14S core #1 2-3'	9/21/97	-0.95	0.38	0.79
SB-1	3 to 4	C	14S	787 A14S core #1 3-4'	9/21/97	1.26	0.69	0.92
W. Wall footer	na	C	14	878 A14N/A14S subsurface w wall comp	03/16/98	78.91	0.77	0.77
W. Wall footer	na	C	14	879 A14N/A14S subsurface w wall comp	03/16/98	87.85	0.67	0.79

Table 4.12-1 (cont'd, page 3 of 4)

Summary of Soil and Miscellaneous Sample Results from Area 14 South

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
misc. sample	na	C	14S	795 A14S o/h dust composite	10/5/97	52.60	1.08	1.13
misc. sample	na	C	14S	796 A14S crane rail rust/grease	10/5/97	2,468.33		
misc. sample	na	C	14S	797 A14S crane rail rust/grease	10/5/97	2,311.70		
misc. sample	na	C	14S	802 A14S brick and mortar	10/17/97	1,566.45	0.66	0.70
misc. sample	na	C	14S	803 A14S brick surface	10/17/97	27,566.12		
misc. sample	na	C	14S	804 A14S s wall mortar	10/17/97	2,088.21		
N1/E0	na	V	14SW	862 14S g N1/E0 clay	3/4/98	0.92	0.64	0.78
N1/E2	na	V	14SW	863 14S g N1/E2 clay	3/4/98	-0.04	0.72	0.85
misc. sample	na	C	14SE	793 A14S sump east half 85% rust	10/5/97	2.97	0.12	0.08
misc. sample	na	C	14SE	794 A14S se sump west half 10% rust	10/5/97	4.92	0.35	0.22
misc. sample	na	C	14SE	798A A14 grid E-22-GG	10/10/97	241.97	1.77	1.03
misc. sample	na	C	14SE	798B A14 grid E-22-GG	10/10/97	241.18	38.57	0.15
D-14	na	C	14SE	905 A14se grid D14 soil	7/9/98	118.75	1.80	1.56
D-14	na	C	14SE	906 A14se grid D14 soil	7/9/98	77.65	1.70	1.60
D-13	na	V	14SE	907 A14se grid D13 soil	7/9/98	24.08	1.58	1.49
F-11	na	V	14SE	908 A14se grid F11soil	7/9/98	5.28	1.90	1.56
D-11	na	V	14SE	909 A14se grid D11soil	7/9/98	3.14	2.19	1.79
D-14	na	V	14SE	910 A14 grid D14 under slab	7/12/98	20.22	1.85	1.69
C-15	0 to 0.5	V	14SE	911 A14 grid C15 0-6"	7/13/98	9.57	1.82	1.65
A-18	1	V	14SE	912 A14 grid A18 12" clay	7/11/98	12.29	0.57	0.67

Table 4.12-1 (cont'd, page 4 of 4)

Summary of Soil and Miscellaneous Sample Results from Area 14 South

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Radium-226[d] (pCi/g)	Thorium-232[d] (pCi/g)
N0/E3	excav.[e]	V	14SE	915 A14SE g B10 N0/E3	7/16/98	13.18	0.86	0.75
N1/E3	excav.[e]	V	14SE	916 A14SE g E10 N1/E3	7/16/98	9.04	1.10	1.03
N2/E3	excav.[e]	V	14SE	917 A14SE g H10 N2/E3	7/16/98	14.50	1.56	1.18
N2/E4	excav.[e]	V	14SE	918 A14SE g H13 N2/E4	7/16/98	18.26	0.99	0.67
N2/E5	excav.[e]	V	14SE	919 A14SE g H16 N2/E5	7/16/98	19.67	1.27	0.85
N1/E4	excav.[e]	V	14SE	920 A14SE g E13 N1/E4	7/16/98	6.92	1.00	0.91
N0/E5	excav.[e]	V	14SE	921 A14SE g B16 N0/E5	7/16/98	10.37	0.73	0.76
N0/E1	excav.[e]	V	14SW	847 A14S grid N0/E1 soil	2/27/98	4.05	0.62	0.75
N1/E1	excav.[e]	V	14SW	848 A14S grid N1/E1 soil	2/27/98	25.10	0.71	0.80

Abbreviations:

MDA Minimum detectable activity
pCi/g picocuries per gram
Ra-226 Radium-226

Notes:
a Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b Sample types are: "C" for characterization and "V" for verification.
c The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.
e Verification samples were collected from a depth of 6 to 12 inches below the base of the excavation.

Table 4.13-1

Summary of Soil and Miscellaneous Sample Results for Area 15

Report No.	Sample No.	Sample Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
8	1	Cable pit	na	C	15	297-1 Area 15 cable pit Z7/Z3		56.36	0.20	3.28
8	2	Cable pit	na	C	15	297-2 Area 15 cable pit Z7/Z3		61.46	0.27	2.99
8	3	Cable pit	na	C	15	297-2 Area 15 cable pit Z7/Z3		61.09	0.45	3.15
8	4	crane rail	na	C	15	Area 15 w crane rail g FF0		141.57	0.05	1.37
8	35	trench	na	C	15	Area 15 grid P2 trench fill		0.84	0.17	0.69
27	9	sump	na	C	15	799 A15 sump sludge	10/25/97	79.97	0.15	3.33
28	6	sump	na	C	15	805 A15 s sump pit debris	10/17/97	2.50		
28	7	trench	na	C	15	806 A15 center trench debris	10/17/97	2.77	0.34	0.40
10	79	wall	na	C	15	330 Area 15 top west wall south end	6/20/97	2.15	0.38	0.15
7	1	trench	na	V	15	Area 15 grid N17/E17 trench fill 5-9"	5/30/97	1.72	0.27	0.39
7	3	SB-1		V	15	Area 15 grid N6/E0 0-1'	5/30/97	4.29	1.07	1.19
7	4	SB-1		V	15	Area 15 grid N6/E0 1-2'	5/30/97	1.09	0.86	0.77
7	5	SB-1		V	15	Area 15 grid N6/E0 2-3'	5/30/97	0.71	0.91	0.76
7	6	SB-1		V	15	Area 15 grid N6/E0 3-4'	5/30/97	2.10	0.83	0.64
7	7	SB-2		C	15	Area 15 grid N12/E1 0-1'	5/30/97	60.19	1.21	1.42
7	8	SB-2		V	15	Area 15 grid N12/E1 1-2'	5/30/97	0.20	0.85	0.87
7	9	SB-2		V	15	Area 15 grid N12/E1 2-3'	5/30/97	2.20	0.77	0.88
7	10	SB-2		V	15	Area 15 grid N12/E1 3-4'	5/30/97	1.76	0.88	0.77
7	11	SB-3		V	15	Area 15 grid N10/E0 0-1'	5/30/97	2.97	0.94	0.87

(Table cont'd)

Table 4.13-1 (cont'd, page 2 of 4)

Summary of Soil and Miscellaneous Sample Results for Area 15

Report No.	Sample No.	Sample Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
7	12	SB-3		V	15	Area 15 grid N10/E0 1-2'	5/30/97	1.29	1.02	0.89
7	13	SB-3		V	15	Area 15 grid N10/E0 2-3'	5/30/97	1.77	0.88	0.75
7	14	SB-3		V	15	Area 15 grid N10/E0 3-4'	5/30/97	1.43	0.78	0.68
8	5	SB-4		V	15	Area 15 grid AA2 0-1'		2.58	0.74	1.01
8	6	SB-4		V	15	Area 15 grid AA2 1-2'		1.60	0.70	0.56
8	7	SB-4		V	15	Area 15 grid AA2 2-3'		2.17	0.85	0.57
8	8	SB-4		V	15	Area 15 grid AA2 3-4'		0.29	0.76	0.64
8	9	SB-5		V	15	Area 15 grid N4 0-1'		0.68	0.49	0.60
8	10	SB-5		V	15	Area 15 grid N4 1-2'		0.00	0.54	0.39
8	11	SB-6		V	15	Area 15 grid V0 0-1'		2.65	0.57	0.75
8	12	SB-6		V	15	Area 15 grid V0 1-2'		0.31	0.42	0.69
8	13	SB-6		V	15	Area 15 grid V0 2-3'		0.90	0.28	0.56
8	14	SB-6		V	15	Area 15 grid V0 3-4'		-0.25	0.36	0.44
8	15	SB-7		V	15	Area 15 grid N17/E6 0-1'		1.25	0.93	0.79
8	16	SB-7		V	15	Area 15 grid N17/E6 1-2'		2.12	0.85	0.73
8	17	SB-7		V	15	Area 15 grid N17/E6 2-3'		1.70	0.95	0.72
8	18	SB-7		V	15	Area 15 grid N17/E6 3-4'		0.44	0.80	0.56
7	2	SB-8	na	V	15	Area 15 grid N19/E6 between slabs 5-8"	5/30/97	1.15	1.01	1.26
8	19	SB-8		V	15	Area 15 grid N19/E6 0-1'		2.52	0.64	1.04
8	20	SB-8		V	15	Area 15 grid N19/E6 1-2'		0.03	0.89	0.89

Table 4.13-1 (cont'd, page 3 of 4)

Summary of Soil and Miscellaneous Sample Results for Area 15

Report No.	Sample No.	Sample Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
8	21	SB-8		V	15	Area 15 grid N19/E6 2-3'		0.13	0.79	0.66
8	22	SB-8		V	15	Area 15 grid N19/E6 3-4'		-0.10	0.83	0.60
8	23	SB-9		V	15	Area 15 grid N0/E7 0-1'		0.74	1.09	1.02
8	24	SB-9		V	15	Area 15 grid N0/E7 1-2'		0.50	0.65	0.58
8	25	SB-9		V	15	Area 15 grid N0/E7 2-3'		-1.65	0.75	0.74
8	26	SB-9		V	15	Area 15 grid N0/E7 3-4'		0.41	0.86	0.83
8	27	SB-10		V	15	Area 15 grid N6/E7 0-1'		3.64	1.08	1.22
8	28	SB-10		V	15	Area 15 grid N6/E7 1-2'		-1.45	0.95	0.58
8	29	SB-10		V	15	Area 15 grid N6/E7 2-3'		1.31	0.86	0.61
8	30	SB-10		V	15	Area 15 grid N6/E7 3-4'		2.19	0.86	0.67
8	31	SB-11		V	15	Area 15 grid DDO 0-1'		3.03	0.96	1.93
8	32	SB-11		V	15	Area 15 grid DDO 1-2'		-0.86	0.84	1.39
8	33	SB-11		V	15	Area 15 grid DDO 2-3'		2.11	0.76	0.78
8	34	SB-11		V	15	Area 15 grid DDO 3-4'		1.69	0.49	0.76
8	36	SB-12		V	15	Area 15 grid P2 0-1'		1.90	0.60	1.03
8	37	SB-12		V	15	Area 15 grid P2 1-2'		2.57	0.93	0.65
8	38	SB-12		V	15	Area 15 grid P2 2-3'		1.97	0.63	0.57
8	39	SB-12		V	15	Area 15 grid P2 3-4'		1.05	0.76	0.57
10a	1	na	na	C	15	312 Area 15 overhead plaster	6/23/97	23.5		
10a	2	na	na	C	15	313 Area 15 overhead paint chips	6/23/97	1,657.9		

Table 4.13-1 (cont'd, page 4 of 4)

Summary of Soil and Miscellaneous Sample Results for Area 15

Report No.	Sample No.	Sample Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
10a	3	na	na	C	15	314 Area 15 grid 2-4-II I beam paint horiz	6/23/97	38.7		
10a	4	na	na	C	15	315 Area 15 grid 2-4-II I beam paint vert	6/23/97	2.1		
10a	5	na	na	C	15	316 Area 15 paint vert grid D-6-II	6/23/97	8.1		
10a	6	na	na	C	15	317 Area 15 paint hor grid D-6-II	6/23/97	89.5		
10a	7	na	na	C	15	318 Area 15 F-7-FF paint top plate	6/23/97	222.5		
10a	8	na	na	C	15	319 F-8-FF crane rail ledge paint	6/23/97	246.8		

Abbreviations:

pCi/g picocuries per gram
Ra-226 Radium-226

Notes:
a Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b Sample types are: "C" for characterization and "V" for verification.
c The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.

Table 4.14-1

Summary of Soil Sample Results for Area 20A-West

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
SB-1	0 to 1	V	20A	760 A20A west core #1 0-1'	9/21/97	3.77	1.03	2.82
SB-1	1 to 2	V	20A	761 A20A west core #1 1-2'	9/20/97	-0.34	0.85	0.45
SB-1	2 to 3	V	20A	762 A20A west core #1 2-3'	9/20/97	-0.94	0.91	0.52
SB-1	3 to 4	V	20A	763 A20A west core #1 3-4'	9/20/97	-0.49	0.67	0.70
SB-2	0 to 1	V	20A	764 A20A west core #2 0-1'	9/20/97	0.43	0.99	0.98
SB-2	1 to 2	V	20A	765 A20A west core #2 1-2'	9/20/97	2.97	0.96	0.80
SB-2	2 to 3	V	20A	766 A20A west core #2 2-3'	9/20/97	0.23	0.96	0.80
SB-2	3 to 4	V	20A	767 A20A west core #2 3-4'	9/20/97	2.69	0.93	0.57
SB-3	0 to 1	V	20A	768 A20A west core #3 0-1'	9/20/97	2.66	0.89	1.72
SB-3	1 to 2	V	20A	769 A20A west core #3 1-2'	9/20/97	-0.73	0.77	0.71
SB-3	2 to 3	V	20A	770 A20A west core #3 2-3'	9/20/97	1.17	0.65	0.65
SB-4	0 to 1	V	20A	771 A20A west core #4 0-1'	9/20/97	1.50	0.67	0.75
SB-4	1 to 2	V	20A	772 A20A west core #4 1-2'	9/20/97	1.49	0.74	0.60
SB-4	2 to 3	V	20A	773 A20A west core #4 2-3'	9/20/97	1.95	0.96	0.62
SB-4	3 to 4	V	20A	774 A20A west core #4 3-4'	9/20/97	-0.85	1.11	0.67
SB-5	0 to 1	V	20A	775 A20A west core #5 0-1'	9/21/97	1.68	0.82	0.73
SB-5	1 to 2	V	20A	776 A20A west core #5 1-2'	9/21/97	2.40	0.82	0.58
SB-5	2 to 3	V	20A	777 A20A west core #5 2-3'	9/21/97	-1.19	0.78	0.66
SB-5	3 to 4	V	20A	778 A20A west core #5 3-4'	9/21/97	2.61	0.88	0.61

Abbreviations:

pCi/g	picocuries per gram
Ra-226	Radium-226

a	Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b	Sample types are: "C" for characterization and "V" for verification.
c	The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d	The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.

Table 4.15-1

Summary of Soil Samples from Areas 20A-East, 20B, 20B-1, and 20C

Report No.	Boring No. or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Uramium-235 (pCi/g)	Uramium-238 (pCi/g)	Thorium-232 (pCi/g)	Radium-226 (pCi/g)
96-07-002	E3.0, N0.3	0 to 0.5[d]	V	20A-East	Area 20A-East, E3.0, N0.3, 0-0.5' #LIN0410	7/9/96	0.15	2.00	0.37	0.50
96-07-002	E6.0, N0.3	0 to 0.5[d]	V	20A-East	Area 20A-East, E6.0, N0.3, 0-0.5' #LIN0411	7/9/96	0.40	3.80	0.64	0.93
96-07-002	E9.0, N0.3	0 to 0.5[d]	V	20A-East	Area 20A-East, E9.0, N0.3, 0-0.5' #LIN0412	7/9/96	0.25	3.60	0.60	1.10
96-07-002	E12.0, N0.3	0 to 0.5[d]	V	20A-East	Area 20A-East, E12.0, N0.3, 0-0.5' #LIN0413	7/9/96	0.33	4.30	1.10	1.50
96-07-002	E15.0, N0.3	0 to 0.5[d]	V	20A-East	Area 20A-East, E15.0, N0.3, 0-0.5' #LIN0414	7/9/96	0.16	2.20	0.16	0.68
96-10-129	composite[e]	0 to 0.5[d]	V	20A-East	Area 20A-East, 0-0.5', #LIN0732	10/25/96	0.25	3.00	0.53	0.61

Abbreviations:

pCi/g picocuries per gram
Ra-226 Radium-226

Notes:
a Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b Sample types are: "C" for characterization and "V" for verification.
c The sample identification includes the IDM sample number at beginning and is identical to the description provided by IDM.
d Sample depth is referenced to bottom of excavation.
e Twenty-five location composite sample over east area (13 m^2).

Table 4.16-1

Summary of Soil Sample Results for Area 21

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
C-4	0 to 1	C	21	688 A21 #3 grid C4 0-1'	8/23/97	5.83	0.20	0.81
C-4	1 to 2	C	21	689 A21 #3 grid C4 1-2'	8/23/97	4.32	0.10	0.58
B-0	0 to 1	C	21	686 A21 #2 grid B0 0-1'	8/23/97	0.24	0.08	0.46
B-0	1 to 2	C	21	687 A21 #2 grid B0 1-2'	8/23/97	0.86	0.11	0.40
A-2	0 to 1	C	21	684 A21 #1 grid A2 0-1'	8/23/97	1.53	0.11	0.44
A-2	1 to 2	C	21	685 A21 #1 grid A2 1-2'	8/23/97	1.90	0.10	0.45
G-7	0 to 1	C	21	690 A21 #4 grid G7 0-1'	8/23/97	25.51	0.20	0.55
G-7	1 to 2	C	21	691 A21 #4 grid G7 1-2'	8/23/97	16.02	0.26	0.74
SB-1	0 to 1	C	21	692 o/s B14/B21 #1 0-1'	8/29/97	5.49	0.30	0.66
SB-1	1 to 2	C	21	693 o/s B14/B21 #1 1-2'	8/29/97	14.75	0.48	1.15
SB-2	0 to 1	C	21	694 o/s B14/B21 #2 0-1'	8/29/97	2.59	0.24	0.55
SB-2	1 to 2	C	21	695 o/s B14/B21 #2 1-2'	8/29/97	17.36	0.54	1.32
SB-3	0 to 1	C	21	696 o/s B14/B21 #3 0-1'	8/30/97	1.25	0.50	0.77
SB-3	1 to 2	C	21	697 o/s B14/B21 #3 1-2'	8/30/97	2.65	0.61	1.12
SB-3	2 to 3	C	21	698 o/s B14/B21 #3 2-3'	8/30/97	7.28	0.87	0.78
SB-3	3 to 4	C	21	699 o/s B14/B21 #3 3-4'	8/30/97	10.76	0.76	0.90
SB-4	0 to 1	C	21	700 o/s B14/B21 #4 0-1'	8/29/97	9.42	0.76	1.13
SB-4	1 to 2	C	21	701 o/s B14/B21 #4 1-2'	8/29/97	19.91	0.73	0.84
SB-5	0 to 1	C	21	702 o/s B14/B21 #5 0-1'	8/30/97	2.67	0.31	0.60

(Table cont'd)

Table 4.16-1 (cont'd, page 2 of 3)

Summary of Soil Sample Results for Area 21

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
SB-5	1 to 2	C	21	703 o/s B14/B21 #5 1-2'	8/30/97	5.59	0.22	0.75
SB-6	0 to 1	C	21	704 o/s B14/B21 #6 0-1'	8/30/97	8.67	0.38	0.89
SB-6	1 to 2	C	21	705 o/s B14/B21 #6 1-2'	8/30/97	10.93	0.38	1.51
SB-7	1 to 2	C	21	716 o/s A21 #7 1-2'	8/30/97	-0.35	0.32	0.55
SB-7	2 to 3	C	21	717 o/s A21 #7 2-3'	8/30/97	9.72	0.43	1.01
SB-7	3 to 4	C	21	718 o/s A21 #7 3-4'	8/30/97	13.99	0.39	0.84
SB-7	0 to 1	C	21	719 o/s A21 #7 0-1'	8/30/97	0.24	0.28	0.46
SB-8	0 to 1	C	21	720 o/s A21 #8 0-1'	8/30/97	1.38	0.21	0.66
SB-8	1 to 2	C	21	721 o/s A21 #8 1-2'	8/30/97	1.70	0.63	0.90
SB-8	2 to 3	C	21	722 o/s A21 #8 2-3'	8/30/97	2.49	0.48	0.50
SB-8	3 to 4	C	21	723 o/s A21 #8 3-4'	8/30/97	0.68	0.20	0.62
SB-9	0 to 1	C	21	753 A21 core #1 0-1'	9/20/97	16.52	0.62	0.84
SB-9	1 to 2	C	21	754 A21 core #1 1-2'	9/20/97	1.92	0.18	0.44
SB-9	2 to 3	C	21	755 A21 core #1 2-3'	9/20/97	-0.09	0.10	0.39
SB-10	1 to 2	C	21	757 A21 core #2 1-2'	9/21/97	17.53	0.58	0.96
SB-10	2 to 3	C	21	758 A21 core #2 2-3'	9/21/97	10.60	0.72	0.88
SB-10	3 to 4	C	21	759 A21 core #2 3-4'	9/21/97	13.91	0.57	0.92
SB-10	0 to 1	C	21	756 A21 core #2 0-1'	9/20/97	0.51	0.18	0.63
Comp[e]	2 to 12	V	21	816 A21 w tank w wall s 2-12'	1/26/98	17.50	0.76	1.12
Comp[e]	12	V	21	817 A21 w tank s floor 12'	1/26/98	4.74	0.66	0.73

Table 4.16-1 (cont'd, page 3 of 3)

Summary of Soil Sample Results for Area 21

Soil Boring or Grid Location[a]	Sample Depth (feet)	Sample Type[b]	Area	Sample Identification[c]	Analysis Date	Total Uranium (pCi/g)	Thorium-232[d] (pCi/g)	Radium-226[d] (pCi/g)
Comp[e]	0 to 9	V	21	820 A21 nw pit n wall 9 pts	1/28/98	6.16	0.66	0.77
Comp[e]	0 to 12	V	21	821 A21 nw pit floor 9 pts	1/28/98	6.32	0.74	0.78
Comp[e]	0 to 12	V	21	822 A21 nw pit w wall 9 pts	1/28/98	23.73	0.71	0.88
Comp[e]	0 to 9	V	21	823 A21 E pit NE n wall 9 pts	2/2/98	5.72	0.81	0.70
Comp[e]	0 to 12	V	21	826 A21 E pit E wall 9 pts	2/6/98	8.56	0.64	0.86
Comp[e]	12	V	21	827 A21 E pit S wall 9 pts	2/6/98	6.16	0.65	0.63
Comp[e]	0 to 12	V	21	828 A21 E pit S floor 9 pts	2/6/98	7.07	0.62	0.91
Comp[e]	0 to 9	V	21	829 A21 E pit N floor 9 pts	2/6/98	6.06	0.78	1.03

Abbreviations:

MDA Minimum detectable activity
pCi/g picocuries per gram
Ra-226 Radium-226

Notes:

a Identifies sample location. Locations with a "SB" prefix are characterization soil borings, "C-2" indicates a grid cell, "N1/E3" indicates a soil verification composite location.
b Sample types are: "C" for characterization and "V" for verification.
c The sample identification includes the IDM sample number at the beginning and is identical to the description provided by IDM.
d The error and MDA are reported, where available, for radium-226 and thorium-232 in Appendix D.
e Composite sample collected from 9 points.

Table 4.17-1

Summary of Process Piping Breaches

High Potential (HP) Areas/Systems	Large Hallway	Corridor	Area 2/3	Area 4	Area 8	Area 9	Area 10	Area 11	Area 12	Area 14N	Area 14S	Area 15	Area 20A	Total
Steam	2	0	7	4	1	4	9	4	5	2	5	1	3	47
Condensate	2	0	2	2	0	4	2	0	1	0	5	1	2	21
Airducts	6	0	10	8	7	25	8	8	4	0	10	2	0	88
Low Pressure Air	0	1	6	9	4	0	4	3	5	7	6	7	2	54
Total HP Breaches	10	1	25	23	12	33	23	15	15	9	26	11	7	210
Low Potential (LP) Areas/Systems														
Chill Water				1						1				2
Hot Water			5	1	3	2	2	2	1		2	1	1	20
Cold Water			6	2	3	3	4	4	3	4	3	1	2	35
Natural Gas			7	8	2	3	7	4	3	3	3	1	0	41
Oxygen			1	0		3			3	2	3			12
Nitrogen (gas)			1	9	2	3			3	5	3	2	1	29
Nitrogen (liquid)												3		3
Argon									2			4		6
High Pressure Air			1							2		4		7
Total LP Breaches	0	0	21	21	10	14	13	10	15	17	14	16	4	155
Total All Breaches	10	1	46	44	22	47	36	25	30	26	40	27	11	365

Table 4.18-1

Summary of Radon Monitoring Locations and Results
Linde Site Building 14

Sample Location	Sample Identification	Start Date	End Date	Monitoring Period	Radon Concentration (pCi/L)	Radon Concentration (WL)
Area 13	SR5233	05/28/98	06/29/98	32 days	0.9	0.0045
Area 13 (duplicate)	SR5199	05/28/98	06/29/98	32 days	0.8	0.004
Area 8	SR5182	05/28/98	06/29/98	32 days	1.2	0.006
Small Hallway	SR5168	05/28/98	06/29/98	32 days	0.5	0.0025
Areas 2 and 3	SR5034	05/28/98	06/29/98	32 days	1.1	0.0055
Area 4B	SR5119	05/28/98	06/29/98	32 days	1.5	0.075
Area 20A-West	SR5013	05/28/98	06/29/98	32 days	0.7	0.0035
Area 20B	SR5225	05/28/98	06/29/98	32 days	0.5	0.0025
Area 20A-East	SR5229	05/28/98	06/29/98	32 days	1.2	0.006
Area 15	SO6126	05/28/98	06/29/98	32 days	0.7	0.0035
1st Floor Offices, Room 5C3	SO6152	05/28/98	06/29/98	32 days	0.6	0.003
1st Floor Offices, Room 5C2	SO6122	05/28/98	06/29/98	32 days	1.2	0.006
1st Floor Offices, Room 5B	SR5026	05/28/98	06/30/98	33 days	0.4	0.002
1st Floor Offices, Room 5A	SO6225	05/28/98	06/29/98	32 days	0.7	0.0035
Area 9	SO6149	08/26/98	09/28/98	33 days	1.1	0.0055
Area 9 (duplicate)	SO6275	08/26/98	09/28/98	33 days	0.8	0.004
Corridor	SO6323	08/26/98	09/28/98	33 days	1.2	0.006
Area 14-North	SO6157	08/26/98	09/28/98	33 days	0.6	0.003
Area 14-South	SO6245	09/10/98	09/28/98	18 days	1.6	0.008

Abbreviations:

pCi/L picocuries per liter
WL working level

Table 4.19-1

Summary of In-Bed Drainline Delineation Data

Area	Location Surveyed	Survey(s)	Investigation Data Summary and Comments[a]
Large Hallway	Drainline connected to the cylinder test pit	747	Survey results within the drainline range from 5,480 to 25,800 dpm/100 cm^2 between 0 and 2 feet of the pit. An obstruction was encountered within the line after this point. The results in Survey 747 were used as the basis for Section 'B' of the in-bed drainlines in calculation 129-CV-029.
Corridor	Drainline connected to steam return pit – horizontal section	217 373 403	Survey 217 reported 30,000 to 160,000 dpm/100 cm^2 within the drainline between 0.5 and 3.0 feet of the pit. Survey 373 reported 15,000 to 64,000 dpm/100 cm^2 within the drainline between 1 and 3 feet of the pit. Survey 403 reported 56,000 to 80,000 dpm/100 cm^2 within the drainline between 0.5 and 3.0 feet of the pit. This section was removed for disposal. The results in Survey 403 were used as the basis for Section 'B' of the in-bed drainlines in calculation 129-CV-029.
Corridor	Drainline connected to steam return pit – diagonal section	687	Survey results from the top of the drainline in the first 5 feet ranges from 16,000 to 32,000 dpm/100 cm^2, and on the bottom of the drainline from 45,000 to 56,000 dpm/100 cm^2. This section was plugged and left in place. An obstruction was encountered inside the line after 5 feet.
Area 9	West end of drainline on south side area	1670	Point No. 4 of the survey represents the end of this drainline where it was exposed during the excavation of the trench. An internal measurement of 37,000 dpm/100 cm^2 was recorded.
Area 12	Drainline discharging from south wall of stairwell.	403	Direct measurement were 9,800, 28,000 and 140,000 dpm/100 cm^2 at 1inch, 6 inches, and 12 inches into pipe, respectively. Measurements may be biased high due to the presence of residual amounts of sand in the pipe. The sand contained 874 pCi/g of total uranium. The results in Survey 403 were used as the basis for Section 'A' of the in-bed drainlines in calculation 129-CV-029.
Area 14 North	Drainlines connected to west sump	1040	Survey results for internal drainline measurements were 34,000 and 19,000 dpm/100 cm^2 for the west and east drainlines, respectively.
Area 14 North	Drainline connected to east sump	1040	Survey results for internal drainline measurement were 52,000 and 19,000 dpm/100 cm^2 for west and east drainlines, respectively.
Area 14 South	Drainlines connected to west sump	1040	Survey results for internal drainline measurements were 60,000, 42,000 and 12,000 dpm/100 cm^2 for the west, north, and south drainlines, respectively.

Abbreviations:
dpm/100 cm^2 disintegrations per minute per 100 square centimeters
pCi/g picocuries per gram

Notes:
a All surface survey measurements are direct β/γ activity measurements.