2. FACILITY DESCRIPTION

CONTENTS

FIGURES

2. FACILITY DESCRIPTION

2.1 Introduction

This section describes the general design of principal structures, systems, and components (SSCs) used to fulfill the mission of TAN; provides an overview of the equipment and personnel used; and describes the operations performed at the facility. Information presented in this chapter includes the following:

- A listing of requirements
- A brief overview of the TAN facilities and missions
- A description of the structures
- A description of the processes, systems, equipment, instrumentation, and controls
- A description of the safety-support systems
- A description of the utility facilities.

2.2 Requirements

The following Codes of Federal Regulations (CFRs), DOE orders, and other requirements apply to this chapter.

- 10 CFR 830 Subpart B, "Safety Basis Requirements"[1]
- 10 CFR 835, "Occupational Radiation Protection"[2]
- DOE-ID Order 420.D, "Requirements and Guidance for Safety Analysis"[3]
- DOE-STD-3009-94, "Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports"[4]
- DOE Order 420.1A, "Facility Safety."[5]

2.3 Facility Overview

TAN is the northernmost developed area within the INEEL. It was originally established to support the Aircraft Nuclear Propulsion Program, which operated from 1951 to 1961. Since 1961, TAN buildings have been adapted for use by various other programs, such as TANO. This SAR addresses only the buildings and areas within TAN that are managed by TANO.

The mission of TANO has been to safely examine, test, and monitor spent nuclear fuel, storage casks, and radioactive materials as deemed necessary by DOE. TANO also provides interim storage for these items for the program's duration and while these items await final storage disposition by DOE. Current activities include the safe shutdown or decontamination and decommissioning (D&D) of buildings currently managed by TANO.

The general design of the principal SSCs that are managed by TANO are described in this chapter.

2.4 Facility Structure

There are numerous major buildings, plus support structures such as power, water, and disposal installations located within the boundaries of TAN. Figure 2-1 shows the area of TAN that contains the buildings and structures managed by TANO. The nuclear buildings and structures that are discussed in this chapter and analyzed in Chapter 3 are as follows:

- TAN-607. The layout of TAN-607 and attached buildings (TAN-608, TAN-649, and TAN-668) is shown in Figure 2-2. For the purposes of this safety analysis, the areas within TAN-607 are referred to as separate entities, as follows: (a) TAN Hot Shop, which includes TAN-668, Heavy Equipment Cleaning Facility (HECF), the Decon Shop and the special equipment services (SES) room; (b) TAN Hot Cell; (c) TAN Storage Pool, which includes TAN-608, water filtration building, and TAN-649, water filtration building; and (d) TAN Warm Shop.

- TAN-647 and TAN-648. Radioactive Parts Security and Storage Area (RPSSA). This area includes two storage buildings (TAN-647 and TAN-648) and two asphalt storage pads.
- TAN-790. The Three-Mile Island (TMI)-2 Abnormal Waste Storage Pad.

- TAN-791. The Spent Fuel Storage Cask Testing Pad.

- TAN-1703. V-Tanks.

- The office areas in TAN-607, the Hot Cell Annex (HCA) (TAN-633), and the TAN-607A area which are attached to TAN-607, are facilities that have been categorized as less than Hazard Category 3 and are excluded from this SAR.

As indicated earlier, the TANO facility consists of many areas that are significantly interrelated and some areas that are not. The interrelated areas are located in TAN-607. This section addresses these areas of TAN-607 (TAN Hot Shop, TAN Hot Cell, TAN Storage Pool, and TAN Warm Shop) as separate entities.

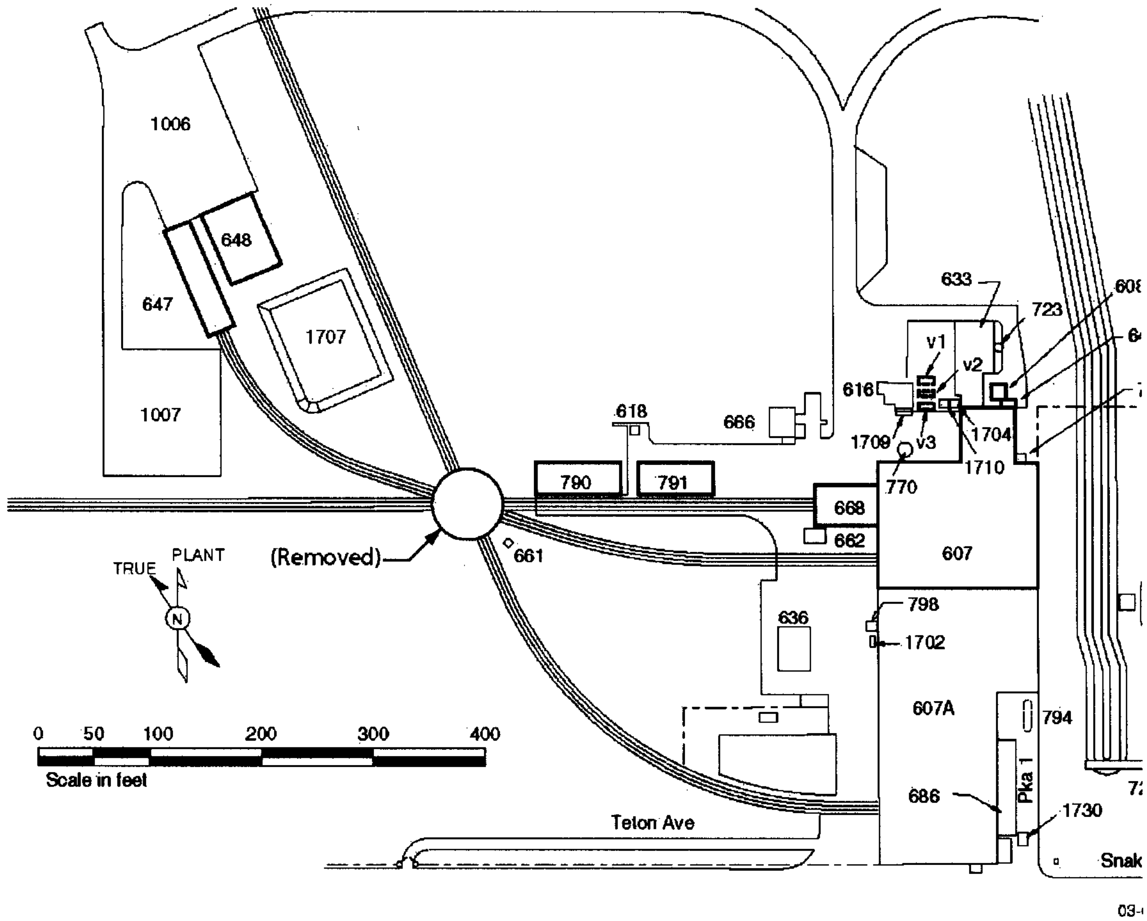

Figure 2-1. Vicinity of TAN in which TANO is located.

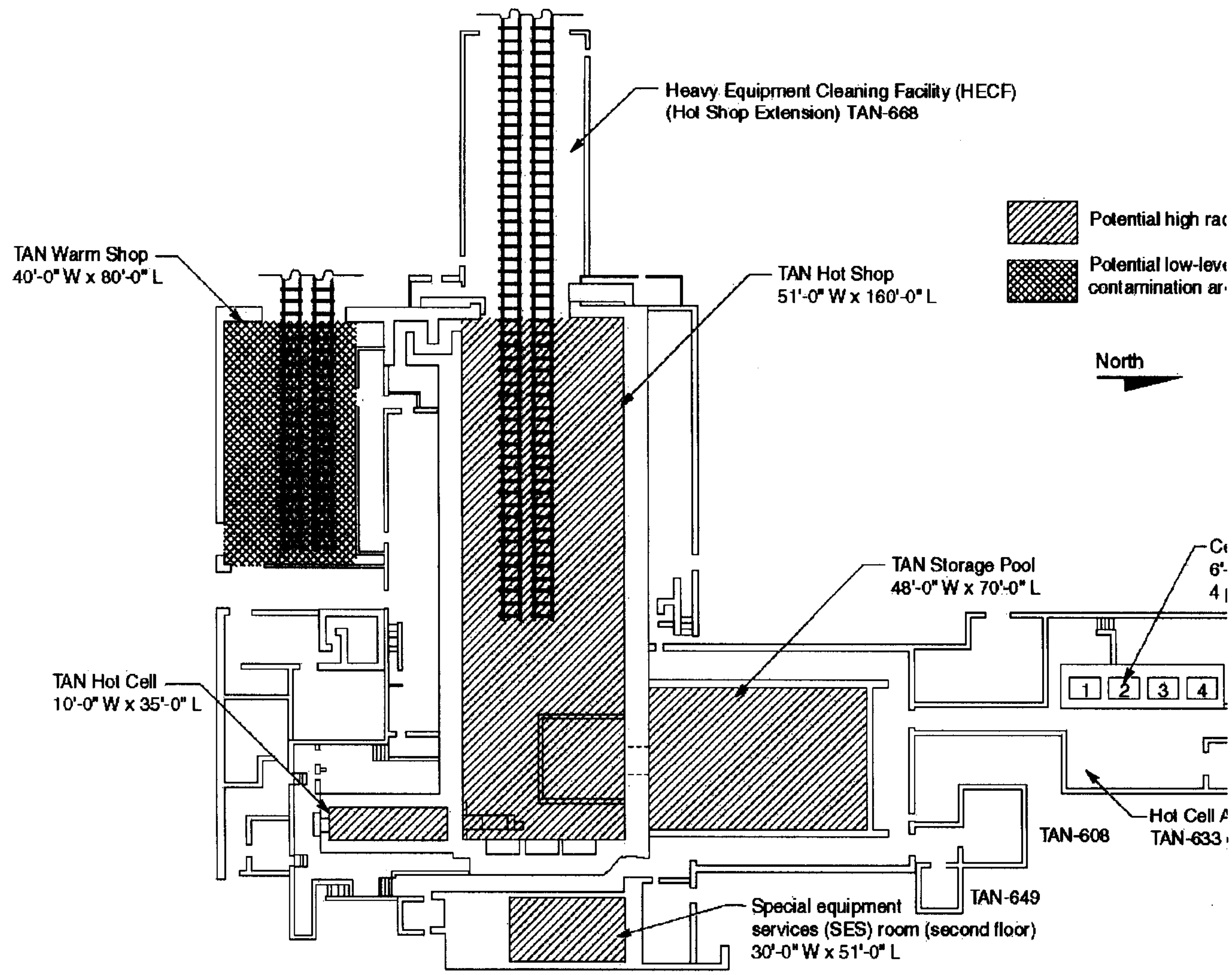

Figure 2-2. Layout of TAN-607 and attached buildings.

2.4.1 TAN Hot Shop

The TAN Hot Shop is a large, shielded high bay with overhead cranes, a large overhead manipulator, auxiliary wall-mounted manipulators, and other equipment for remote handling of radioactive material. A floor plan and sectional view are shown in Figure 2-3.

The walls and ceiling are constructed of reinforced concrete. The walls are 6 ft 10 in. thick up to the lower ledge. Between the lower ledge and upper ledge, the thickness is reduced to 6 ft 8 in. Between the upper ledge and the roof, the walls taper from a thickness of 4 ft 4 in. to 2 ft. The ledges provide support for the overhead crane and manipulator rail tracks.

The roof is nominally 1-ft-thick concrete supported by trusses that span the Hot Shop. The concrete floor is supported on beams and is designed to support a 250-lb/ft^2 load distributed uniformly over the entire area.[6] A 18 × 93-ft section of the floor encompassing the double railroad tracks is reinforced to support extremely heavy loads; for example, the shielded locomotive (215 ton),[6] cask transporter (up to 195 ton),[7] and heavy transport truck (up to 100 ton).[8] The other areas of the Hot Shop floor are also capable of supporting concentrated loads, but more care must be taken in placing loads to ensure adequate support. The floor system is made up of vertical piers, horizontal load-supporting grade beams, and the 1-ft-thick reinforced concrete floor slab. Each individual pier under the floor can support a load of approximately 75 ton[9] and the grade beams are proportionally sized. This feature allows large casks and other heavy items to be located off of the reinforced railroad track when specifically analyzed, with the weight properly positioned and distributed. The capacity of the floor over the utility tunnels is less than other areas because of the wider spacing of piers and beams. Use of the spent nuclear fuel cask transporter in the TAN Hot Shop and HECF and placement of heavy loads is procedurally restricted to the areas and locations specifically shown to be acceptable (see Figure 2-4).

The west wall of the Hot Shop contains a doorway that is used as a truck entrance. The biparting doors are made of reinforced concrete, approximately 5 ft thick. Rail tracks pass under the doors and extend into the Hot Shop.[6] There is a 2-in.-square recess for the railroad tracks in the floor under the Hot Shop doors. This gap creates a hole in the shielding through which radiation can stream and affect workers in the HECF, in the event of a criticality in the Hot Shop. These streaming issues are evaluated in Chapters 4 and 6.

Personnel enter the Hot Shop through a shielded labyrinth. Access doors at each end of the labyrinth are interlocked electronically and must be unlocked. In addition, access to the Hot Shop has a manual lock that is used during remote operations to prevent inadvertent entry.

Shielded operating galleries are located at two elevations outside the north and south walls of the TAN Hot Shop. These galleries constitute the control areas for remote operations in the Hot Shop; the operations are viewed through shielded windows.

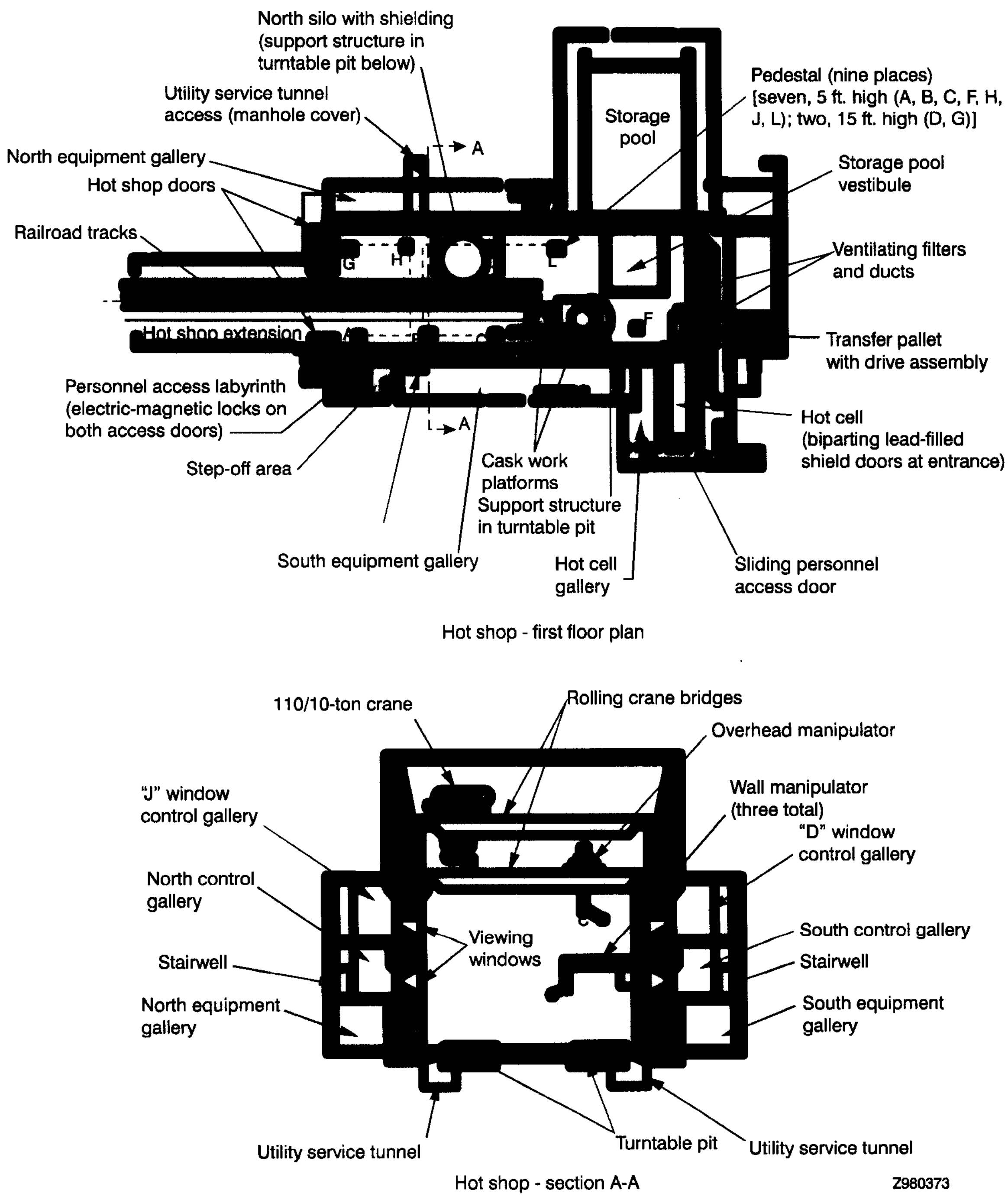

Figure 2-3. TAN Hot Shop floor plan and sectional view.

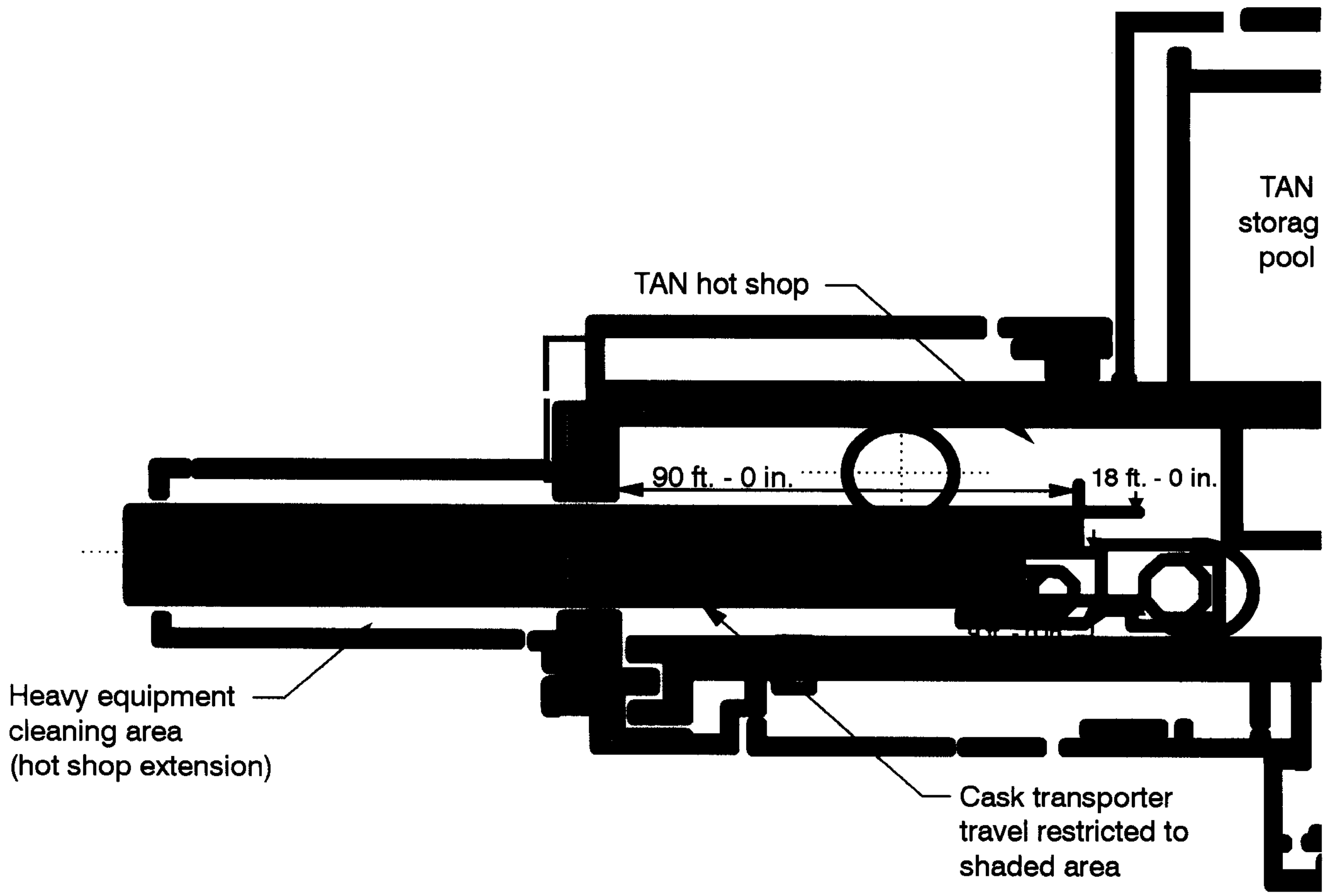

Figure 2-4. TAN Hot Shop transporter travel area.

Twelve ports for the shielding windows are built at different elevations into the north and south TAN Hot Shop walls. Nine of these ports contain windows and three contain high-density concrete shield plugs. These windows are combination-type shielding windows containing mineral oil, zinc bromide, and leaded glass. One window, Window G, contains demineralized water instead of zinc bromide. The shielding capacity of Window G is less than the other shielding windows, because the shielding capability of demineralized water is less than that of zinc bromide. However, adequate attenuation is still provided by this window.[10] The physical construction of the TAN Hot Shop prevents fuel bundles and other high-radiation sources from being moved within 3 ft of Window G.

The windows are flush with the walls on the hot side and sealed into the walls with high-density concrete grout. Steel shot occupies the space between the frames and the windows to prevent any radiation from streaming through the voids. All penetrations through the wall around each window are shielded with steel shot and closed off at each end when a port is not being used. Those penetrations that are used to pass various cables from the operating gallery into the Hot Shop are backfilled with steel or lead shot held in place by steel or lead wool according to TAN requirements.[11] These requirements ensure that if any penetrations are modified, they are properly backfilled to ensure that the Hot Shop will remain well-shielded from streaming radiation in the event of an inadvertent criticality accident.[12]

There are 12 ports around each of the Hot Shop windows from the operating gallery to the Hot Shop through the shield wall.[12] Four of the ports are straight pipes and the other eight ports are offset or Z-pipes. On the equipment gallery level, there are four sets of plugs in each gallery (north and south). Each group consists of two straight-through penetrations and six Z-type penetrations. Four additional penetrations are located (2 each) in the north and south equipment galleries, used for instrument air lines.

There are two boroscope penetrations: one from the south gallery located between Window E and Window F.[12] The other is an abandoned boroscope penetration located through the north wall next to Window G. The abandoned penetration has been repaired according to TAN requirements to ensure that the shielding remains adequate.[11]

Visual inspections were completed for both inside and outside the Hot Shop and the SES room for new penetrations, penetrations that appear to have been modified, and the condition of existing penetrations. A verification of all existing penetrations that involved either physical inspection or a radiation survey has been completed.[11] Only those penetrations and window areas that visually appear to not have been modified do not contain cable bundles, and have no unacceptable radiation measurements (from the spent fuel assembly verification) are assumed to be filled with steel or lead shot.

2.4.1.1 Special Equipment Service Room. The SES room is an extension on the east end of the TAN Hot Shop. The finished floor elevation of the SES room is approximately 13 ft above the Hot Shop floor, and a 5-ft-thick concrete parapet, separating the SES room from the Hot Shop, rises another 13 ft above the SES room floor.[12] A set of 5-ft-thick biparting concrete shield doors isolate the SES room from the Hot Shop. These doors extend from the parapet to the roof.

The south wall of the SES room has three straight-through penetrations leading into the SES operating room. Two of the three penetrations have been filled with steel shot to ensure that sufficient shielding is present to ensure personnel are not exposed to unacceptable radiation fields.[12] The last one is used as a breathing air line. The 3-ft-thick concrete slab that forms the floor of the SES room also covers a personnel access tunnel connecting the equipment and work areas on the south side of the TAN Hot Shop to the Storage Pool area. A service pit in the southeast corner of the SES room extends through the floor slab down to the Hot Shop floor level. This pit contains a high-efficiency particulate air (HEPA) filter bank used for exhausting the SES room.

2.4.1.2 Heavy Equipment Cleaning Facility. The HECF, also known as the Hot Shop extension, provides a waiting area for trucks and components scheduled to enter the TAN Hot Shop. The HECF may also be used as a temporary storage of waste and other materials used during operations provided these materials are stored in accordance with INEEL procedures. A vehicle door at the west end offers clearance identical to the Hot Shop doors. The entire facility provides a weather break to allow the Hot Shop doors to be open during inclement weather conditions.

A high-pressure cleaning unit is available to wash heavy equipment and cask assemblies. This unit is also used to de-ice heavy equipment during the winter. Water from this system drains through a french drain to a sanitary treatment facility. A snorkel system in the facility vents vehicle exhaust to the outside.

2.4.1.3 110/10-Ton Overhead Crane. The 110/10-ton overhead crane is the major lifting device for handling casks and other heavy equipment in the TAN Hot Shop. The 110/10-ton crane bridge runs on building rails mounted on the upper ledges of the TAN Hot Shop and SES room walls. The rails run the full length of the Hot Shop and SES room. The rails are hinged at the entrance to the SES room and swing out to allow the SES room shielding doors to close, and are interlocked to prevent crane operations over open rails.

The 110/10-ton overhead crane consists of a bridge spanning the full width of the TAN Hot Shop, a trolley mounted on the bridge, and two hoists mounted on that trolley. The larger hoist is rated for 110 ton and the other is rated for 10 ton. Both the 110- and 10-ton hooks are continuously free-swiveling and designed for use underwater in the Storage Pool vestibule. The 110/10-ton crane hooks and emergency-load-release mechanisms have been designed for remote operation.

2.4.1.4 Overhead Manipulator. The overhead manipulator (O-man) is a heavy-duty, bridge- and trolley-mounted, remote electromechanical manipulator. A set of rails mounted on a wall ledge below the 110/10-ton overhead crane carries the manipulator bridge the full length of the TAN Hot Shop and SES room. Bridge rails, supporting a trolley, carry the O-man the full width of the shop. The O-man is capable of handling up to a 400-lb load. It can grasp and manipulate tools, and has a shoulder hook that can support up to 5,000 lb to a height of approximately 30 ft.[6] The O-man's reach covers the entire Hot Shop. The O-man is controlled at Hot Shop and SES window control stations. The control stations are electrically interlocked to prevent simultaneous control from more than one station.

2.4.1.5 Wall-Mounted Manipulators. Three wall-mounted, electromechanical manipulators in the TAN Hot Shop are capable of performing tasks throughout most of the Hot Shop, excluding the SES room. The hoist provided for each manipulator is an extending tube crane. At the end of the crane, a heavy-duty gearbox acts as a shoulder pivot. An extension is attached to the gearbox. The entire manipulator is capable of lifting 150 lb in any position.

2.4.1.6 Service Pedestal. Floor-mounted service pedestals, one in front of each window, provide various utilities to the Hot Shop. In addition to the service pedestals, there are ports ranging in size from 2 to 12 in. surrounding each window. These are normally plugged and sealed, but could be used for providing additional services to the TAN Hot Shop. Another 56 normally plugged and sealed ports penetrating the walls between the equipment galleries and the Hot Shop could also be used for bringing in services.

2.4.1.7 TAN Hot Shop/Cell Transporter. The Hot Shop/Cell transporter system is designed to remotely move objects between the Hot Shop and the TAN Hot Cell. It consists of a load-carrying pallet supported on rollers and propelled by a rack-and-pinion-drive system. The transporter system is limited to a load of 4,000 lb.

2.4.2 TAN Hot Cell

The TAN Hot Cell, located adjacent to the southeast corner of the TAN Hot Shop, is a conventional, shielded, remote-manipulator laboratory used for specialized disassembly, inspection, and examination. The walls are 4 ft thick, and are made of high-density reinforced concrete and lined with stainless-steel sheets.

There are five identical viewing windows in the TAN Hot Cell. The shielding provided by the windows is nominally the same as the 4-ft-thick, high-density concrete walls. Spaces between the panes of the windows are filled with mineral oil for viewing clarity, which means the shielding calculations did not take credit for the oil. Voids around the windows are filled with steel shot to shield radiation streaming.

Personnel can enter through a 4-ft-thick door in the south wall of the cell. An enclosure has been built around this shield door to prevent the spread of contamination when the door is used. Through the shield wall and above each of the five viewing windows, two ports are provided for mounting hand-operated master-slave manipulators. The ports above the four windows on the west wall are equipped with seven master-slaves. Two master-slaves are provided at the viewing window on the east side of the cell. Two bridge-mounted, electromechanical manipulators span the TAN Hot Cell on the same set of rails. A 2-ton-capacity chain hoist is also provided on each bridge.

The Hot Cell has not yet been shown to be well shielded from an inadvertent criticality and thus must be restricted to masses less than that required for an inadvertent criticality in any geometry.

2.4.3 TAN Storage Pool

The 24-ft-deep TAN Storage Pool, which was used for underwater storage of fissile and radioactive materials, is located in TAN-607, adjacent to the north side of the TAN Hot Shop. The primary shielding for these items is the water covering them; thus, the Storage Pool room is not constructed as shielding, but shelters the Storage Pool from the environment. Plan and elevation views are shown in Figure 2-5.

A work area for personnel surrounds the pool (except on the south end), providing access to the pool parapet and cranes in the Storage Pool room. Two cranes serve the Storage Pool area: a 15-ton bridge crane and a 30-ton tram hoist. An interlock for the 15-ton bridge crane is connected to a radiation area monitor (RAM), which disables the "up" motion if the RAM setpoint is exceeded. An override-key switch is provided to continue the "up" motion if conditions permit or if the situation requires such action.

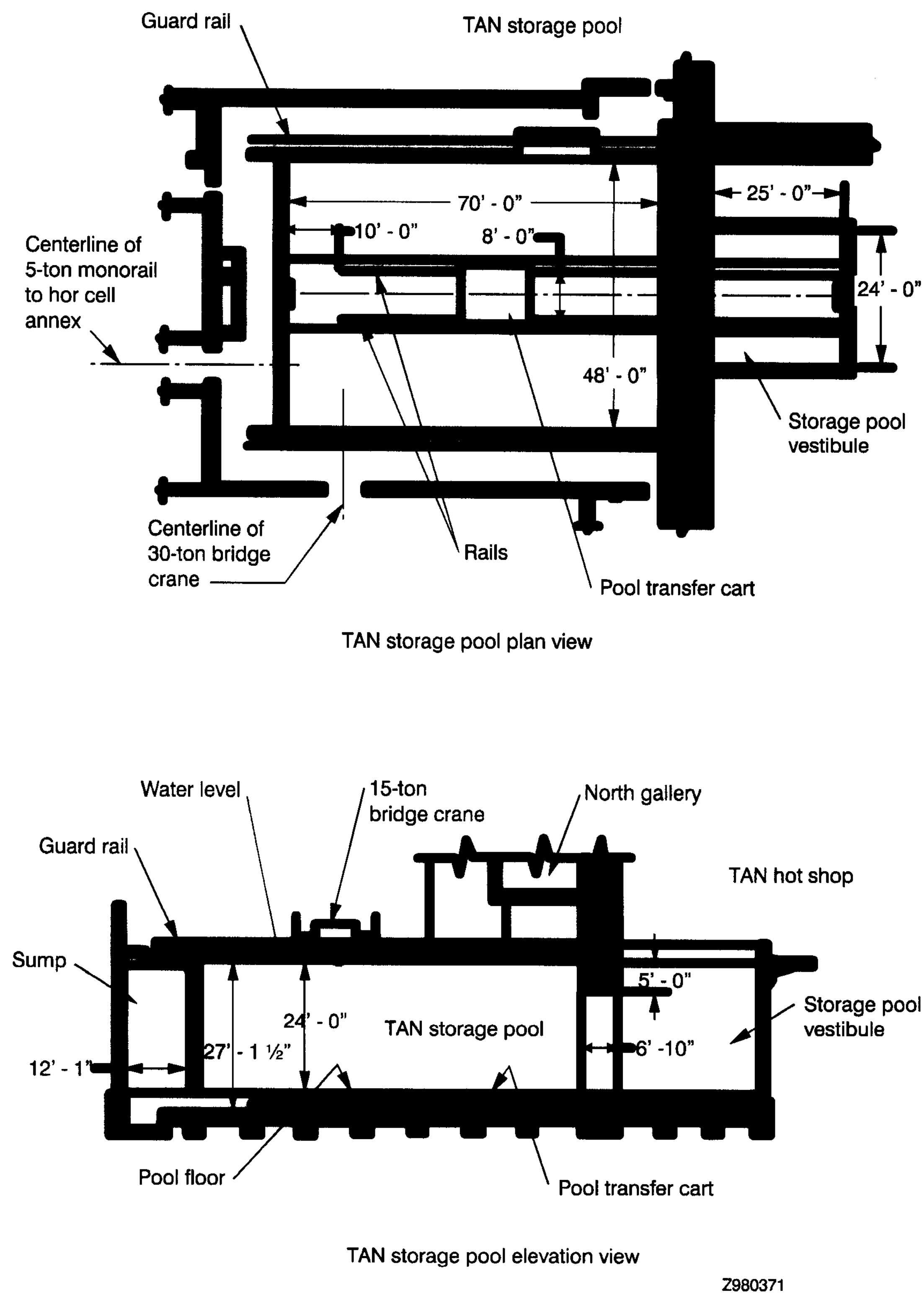

Figure 2-5. Plan and elevation view of TAN Storage Pool.

A submerged passageway under the Hot Shop wall connects the main Storage Pool to a deep pool vestibule of the same depth, located in the northeast corner of the TAN Hot Shop. The north wall of the Hot Shop extends down 5 ft into the pool to shield the pool area against radiation sources in the Hot Shop. An underwater rail system and pool transfer cart connects the TAN Storage Pool and Storage Pool vestibule. The cart is rated for 60 ton. Materials are loaded on and off the pool transfer cart using the 110/10-ton overhead crane in the Hot Shop and 15-ton bridge crane within the Storage Pool area.

2.4.4 TAN Warm Shop

The TAN Warm Shop is located adjacent to the south wall of the TAN Hot Shop and has a usable floor area that is approximately 40 ft wide. The four-track railroad system extends approximately 75 ft into the Warm Shop from the west biparting doors. The floor of the Warm Shop is of similar construction to the Hot Shop and has a high load capacity on the railroad track area. An analysis was conducted that shows that the track area will support a cask of up to 75 ton centered on the rails.[13] The analysis also shows that the cask transporter, with a combined load and vehicle weight of 132.5 ton, can be operated in an area centered on the tracks, as shown in the Warm Shop floor plan (Figure 2-6). A bridge crane containing two hooks services the Warm Shop area. The capacity of the main hook is 30 ton and the capacity of the auxiliary hook is 5 ton.

The TAN Warm Shop is an established hazardous waste accumulation area. Also, the Warm Shop is operated as a fissile material control area. Up to 350 g of U-235 may be handled in this area with no restrictions other than mass.

2.4.5 Decon Shop (TAN-607 Rooms 159, 160, and 160A)

Rooms 159, 160, and 160A are located in the southwest corner of TAN 607. From 1957 to 1987, Room 159 was used to decontaminate equipment, Room 160 was an anticontamination clothing change room, and Room 160A contained ventilation, electrical, and steam distribution equipment for Room 159. All three rooms were taken out of service in 1987. Recent remediation efforts involved removing decontamination equipment from Room 159, decontaminating the room and equipment, which included replacing the HEPA filters in the HEPA bank, and removing asbestos-containing material from the steam pipes. Some fixed contamination in Room 159 has been painted over on the floor and up to 8 ft high on the walls.

Current and planned uses for Room 159 are storage of contaminated and noncontaminated materials, and storage, handling, and repackaging of mixed hazardous wastes. D&D activities will also begin in the near future. One planned D&D activity is the excavation and removal of the waste lines from the TAN-607 decontamination shop to TAN-616. The activity includes the decontamination of the piping under the floor, decontamination of the sump, and decontamination and removal of the piping from just outside of the decontamination room to the vicinity of Valve Box #2. This D&D activity is being performed in conjunction with the Resource Conservation and Recovery Act (RCRA)-regulated closure of TAN-616.

2.4.6 V-Tanks

TAN-616 consists of several underground waste tanks, an evaporator facility, and associated piping. The plant operated between the mid-1950s and 1985. TAN-616 is currently undergoing remediation and is covered by a separate safety analysis.

Several waste tanks are associated with TAN-616, but are not considered part of TAN-616 and are included in this SAR. The associated tanks include three 10,000-gal, horizontal stainless-steel tanks located approximately 10 ft underground and one 400-gal stainless-steel tank (V-9) approximately 7 ft underground. The three liquid waste storage tanks (V-1, V-2, V-3), collectively referred to as TAN-1703 (see Figure 2-7), located approximately 10 ft east of TAN-616, were in service until 1985. Each tank is

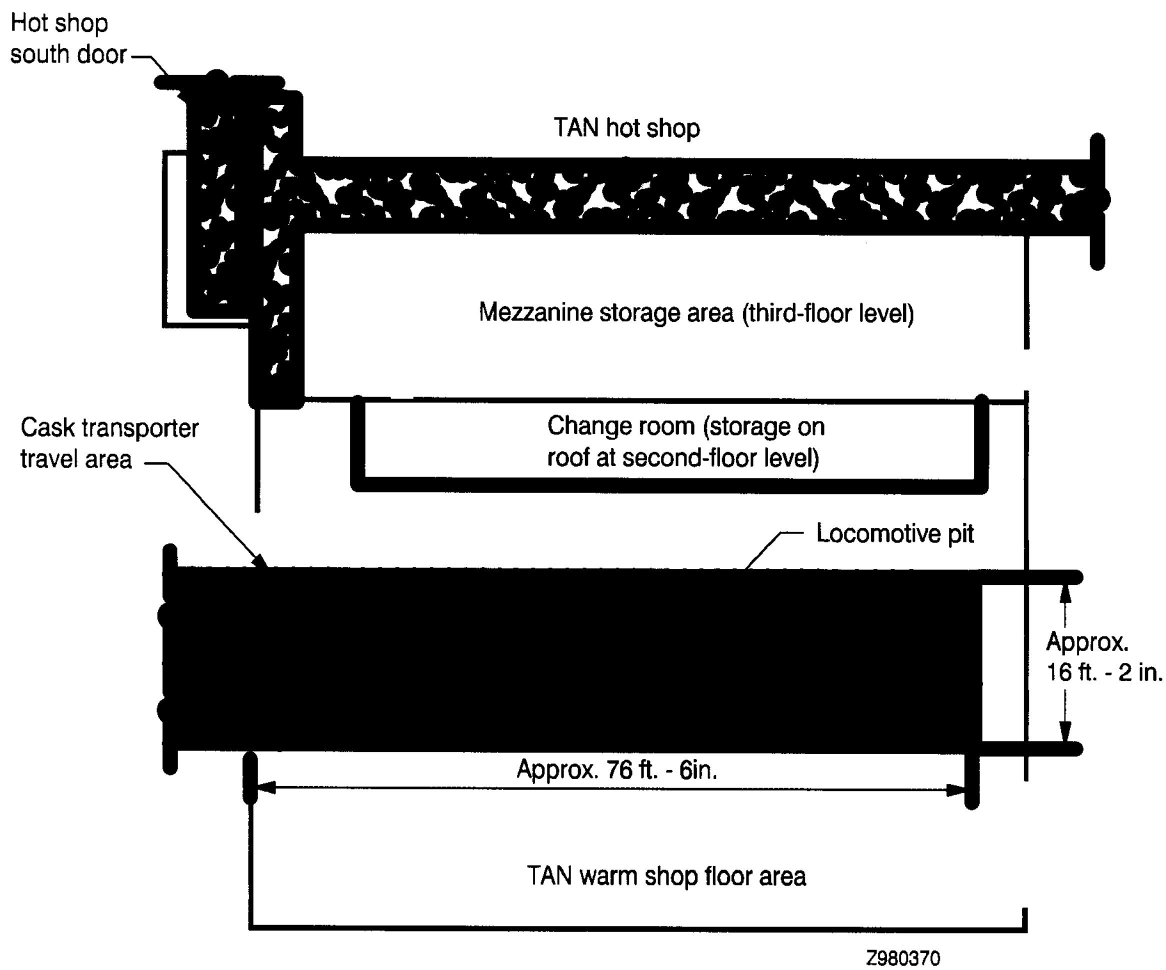

Figure 2-6. Floor plan of the TAN Warm Shop.

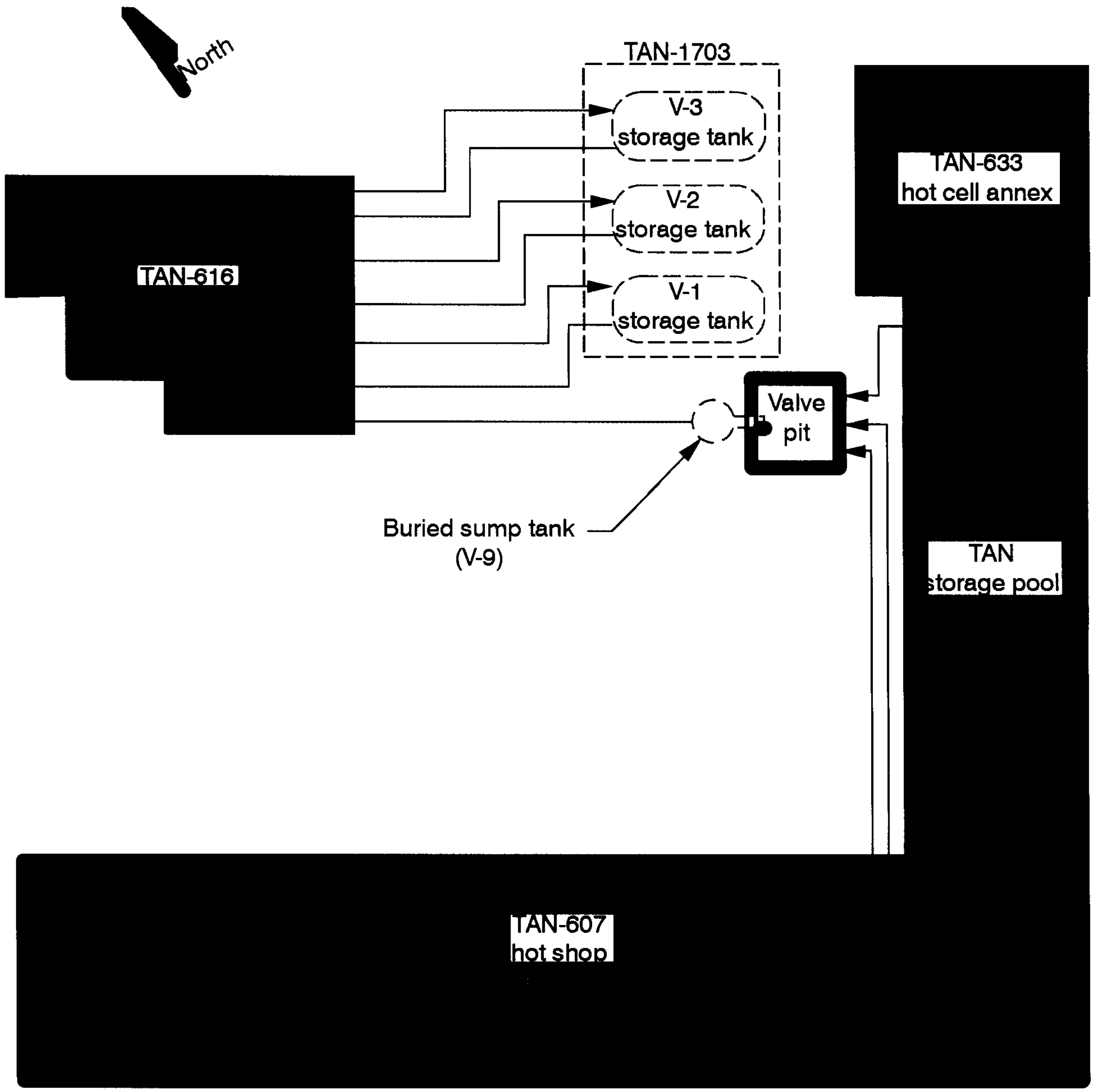

Figure 2-7. Location of TAN-1703 (V-tanks).

10 ft in diameter and 16 ft long, seam to seam. A 20-in. manhole in the top of each tank is accessible from the surface through a 6-ft-diameter culvert. Approximately 30 ft east of TAN-616 is Tank V-9. The tank is accessible through a 6-in. standpipe. Tanks V-13 and V-14 are located approximately 300 ft west northwest of the TAN-616 and parallel to Snake Avenue in an area known as PM-2A. V-13 and V-14 are 55 ft long and 12.5 ft in diameter and accessible through a manhole 5.5 ft in diameter. The V-tanks are isolated/valved out and scheduled to undergo environmental remediation.

2.4.7 Radioactive Parts Service and Storage Area

The RPSSA consists of two buildings (TAN-647 and TAN-648), two asphalt storage pads, and the adjoining railroad track area around the two buildings. Items stored in the RPSSA typically cannot be stored in other facilities because of the radiological condition or size, or because these items are awaiting disposition. Items are packaged to contain any radioactive material, resist deterioration, and provide the lowest possible fire loading.

In general, items are stored in TAN-647 or TAN-648, rather than outside on the pads, because of the protection provided by the buildings against the elements. TAN-647 is designated for radioactive, hazardous, and mixed hazardous material storage. Materials prohibited from storage in TAN-647 and TAN-648 include explosive material, shock-sensitive material, and pressurized containers. Ignitable, corrosive, reactive, or toxic materials as defined by 40 CFR 261 are allowed for storage only in the RCRA-permitted section of TAN-647. For fire prevention precautions, combustible materials in TAN-647 and TAN-648 are limited to those necessary for packaging and containment.

The two buildings were constructed in the 1950s to the then-current criteria published in the Atomic Energy Commission Manual, Chapter 6301. TAN-647 is a 34 × 142-ft unheated building constructed of corrugated sheet metal on a steel frame and containing a dry-pipe fire protection system. The north 48 ft of the floor is industrial concrete with a capacity of 6,000 lb/ft^2; the remainder is constructed of 3 ft of select, compacted material to a 100% density with a rated capacity of 4,000 lb/ft^2. TAN-648 is a 69 × 96-ft building constructed of corrugated sheet metal on a steel frame. The entire floor is a concrete slab with a rated capacity of 2,500 lb/ft^2. Personnel access doors are located on both the north and south walls of each building. Electrically operated equipment doors are located on the north wall of each building and also on the south wall of TAN-647.

Access to both buildings is by a deteriorated asphalt road from the north. TAN-647 is also accessed by a double railroad track from the south, which extends part way into the building and connects to the TAN railroad system.

2.4.8 Cask Pads

The following sections contain information on the TMI-2 Abnormal Waste Storage Pad (TAN-790) and the Spent Fuel Storage Cask Testing Pad (TAN-791), including casks associated with these pads and other casks used elsewhere in the facility.

2.4.8.1 TMI-2 Abnormal Waste Storage Pad (TAN-790). The TMI-2 Abnormal Waste Storage Pad is located approximately 350 ft west of TAN-607, near the existing railroad bed (see Figure 2-8). The pad is constructed of 8-in.-thick reinforced concrete. The pad is sloped slightly to enhance run-off. A gutter on the north side of the pad drains to a single outlet. A small basin near the outlet provides a collection point for water samples for radiological analysis.

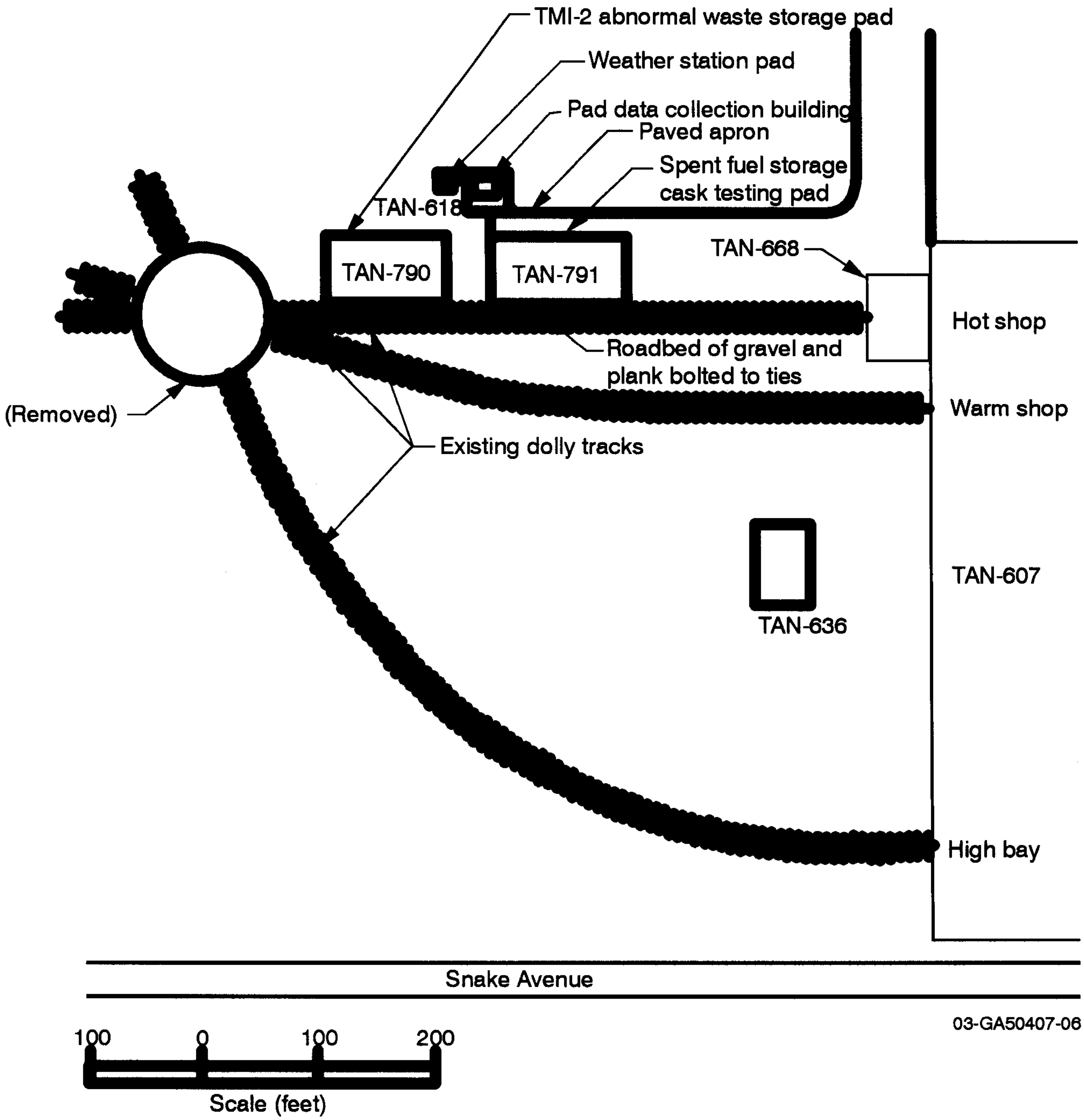

Figure 2-8. Location of the cask pads.

The pad is divided into two sections, with the east half containing the three abnormal waste temporary storage casks (TSCs), one of which contains three contaminated filter vessels (see Section 3.3.2.1.1). The west half contains an assortment of materials and equipment awaiting disposition. A fence surrounds the section of the pad with the TSCs to prevent inadvertent intrusion.

Each storage cask is constructed of 2-ft-thick reinforced concrete. The concrete has a minimum compressive strength of 4,000 psi and satisfies the requirements of American Concrete Institute (ACI)-318-77. Each storage cask is approximately 9 ft in diameter and 9.5 ft high, with a recessed, reinforced concrete lid weighing 4.75 ton. The total weight of each cask is approximately 34.5 ton empty and 40 ton loaded. Each TSC has a 1/8-in., 700-lb, carbon-steel rain cover with sufficient overlap to prevent windblown rain from entering the TSC. The rain covers are painted with white epoxy to inhibit corrosion and are compatible with design snow loads at TAN.

Separate vent and drain capabilities are provided for the casks by external openings near the top of the cask cavity. Both vent and drain systems are provided with outside plugs. The drain system is designed so that the liquid level can be measured, but pumping is required to remove any liquid. The need to remove liquid is assessed on a case-by-case basis.

2.4.8.2 Spent Fuel Storage Cask Testing Pad (TAN-791). The Spent Fuel Storage Cask testing pad is located approximately 200 ft west of TAN-607, near the existing railroad bed (see Figure 2-8). The south boundary of the testing pad is at approximately the same level as the railroad bed. The testing pad is constructed of 2-ft-thick reinforced concrete. It is sloped slightly to enhance run-off.

Casks are transferred between the testing pad and the TAN Hot Shop using the spent fuel cask transporter (see Section 2.4.8.3). There are six different types of casks located on the testing pad. These are discussed in the following paragraphs.

2.4.8.2.1 GNS CASTOR V/21 Cask—The General Nuclear Systems (GNS) CASTOR V/21 cask is a thick-walled, modular cast-iron cylinder, approximately 7.9 ft in diameter; it weighs approximately 113 ton. The cask has a cylindrical cavity that holds a fuel basket designed to accommodate up to 21 pressurized-water reactor (PWR) spent nuclear fuel assemblies.[14] The cask cavity is approximately 5 ft wide and 13.8 ft long, with walls 1.3 ft thick. The fuel basket is made of borated (1.0 wt% boron) stainless-steel plates. The basket plates are approximately 0.20 in., 0.39 in., or 0.79 in. thick, depending upon the location. The thicker plates are in the center of the cask to reduce neutron interaction between the storage positions. Fuel assemblies are physically separated and maintained at specified separation distances by the fuel basket with nominally 8.5-in. square storage positions. The contents of the CASTOR V/21 cask are given in Section 3.3.2.1.1 of this SAR.

The internal heat transfer medium of the cask is an inert gas (helium or nitrogen). The cast-iron wall of the cask, which includes sections of neutron-moderating material, shields gamma and neutron radiation. Gas intake and exhaust air are accommodated via a valve in the primary shield cover. The cover system is fitted with a leak-testing device and has a multiple seal consisting of metal and elastomer O-rings. The main components of the GNS CASTOR V/21 cask are described by the CASTOR V/21 Topical Safety Analysis Report (TSAR).[14]

The GNS CASTOR V/21 cask was designed and analyzed to withstand a 5-ft drop in any orientation without loss of integrity or loss of separation of fuel within fuel basket ports. The GNS CASTOR V/21 cask can resist tipping from the vertical position for wind speeds up to 360 mph and seismic horizontal accelerations of up to 0.5 g.

2.4.8.2.2 Transnuclear (TN)-24P Cask—The Transnuclear (TN)-24P cask is used for storage of up to 24 PWR spent nuclear fuel assemblies or 24 canisters of consolidated nuclear fuel rods.[15] The total weight of the cask when fully loaded is approximately 86 ton.[17] The overall containment vessel is 16.6 ft long and the side wall is 9.5 in. thick. The cylindrical cask cavity is 13.8 ft long and 4.8 ft in diameter. The contents of the TN-24P cask are given in Section 3.3.2.1.1 of this SAR.

The TN-24P has a multiple-confinement barrier system consisting of a primary lid, a neutron shield, and a protective cover. The primary lid is the innermost barrier with a double metallic O-ring gasket. Pressure transducers (three for redundancy) provide pressure measurement for leak testing capability. The neutron shield is a polyethylene disc attached to the primary lid. The protective cover includes an elastomer O-ring seal and is bolted to the cask providing weather protection.

Fuel assemblies are physically separated and maintained at specified separation distances by means of fuel storage compartments. The fuel basket is made of borated (3.0 wt% boron, 2.5 wt% minimum) aluminum-steel plates. The basket plates are 1.0 cm thick and are copper-coated for improved heat transfer.

The basic structure of the TN-24P cask is a cask body of thick-walled forged steel, with an integrally welded forged bottom and a flanged and bolted forged top. The spent nuclear fuel is stored in an inert gas atmosphere. Heat generated by the spent nuclear fuel assemblies is transferred to the surrounding air by convection and radiation. No forced cooling or cooling fins are required. A neutron shield drum is installed on the cask lid to provide extra shielding. A protective cover is installed as a weather shield during storage.

The TN-24P cask was designed to provide confinement, shielding, and structural integrity. The confinement barriers were designed to ensure a maximum leak rate of 6.5E-7 L/sec. The shielding walls and ends were designed to provide a maximum outside surface exposure rate of less than 100 mR/h for a fuel loading of 24 PWR assemblies with an out-of-reactor time of 5 yr and maximum burnup of 35,000 MWd/MTU. Although the cask wall thickness varies over the length of the cask, with less shielding at the ends, design basis radiation levels are less than 100 mR/h at all locations (see cask functional description in Section 4.4.2.3).

Structural design and analyses are detailed in the TN-24P TSAR.[15] Analysis has shown that the TN-24P cask and fuel cask will maintain its confinement, during a drop of 20 in. onto a flat surface.[16] The TN-24P cask can resist tipping from the vertical position for wind speeds up to 409 mph, seismic horizontal accelerations of up to 0.31 g, and floods with water flowing at up to 19.7 ft/s. The TN-24P cask has a design pressure of 250 psi. A more detailed description of the TN-24P cask is provided by the TN-24P TSAR[15] and supporting documentation.[17]

2.4.8.2.3 Westinghouse MC-10 Cask—The Westinghouse MC-10 cask is used for storage of up to 24 spent nuclear fuel assemblies. The MC-10 cask consists of 24 stainless-steel cells in an aluminum basket structure. Each cell consists of an enclosure, neutron poison material, and limiter blocks. The enclosure is formed to provide an 8.8-in.-inside square envelope for spent nuclear fuel assembly storage.[18] The contents of the MC-10 cask are given in Section 3.3.2.1.1 of this SAR. When fully loaded, the total weight of the MC-10 cask is approximately 113.3 ton.

The cask vessel is a forged-steel container with an integrally welded, forged-steel bottom. The cask cavity is 188 in. long, 88 in. in diameter, and has a side wall thickness of 10 in. Stainless-steel neutron-absorbing material jackets the outside surfaces of the vessel wall and base. Twenty-four nickel-plated fins project through the jacket on the vessel walls to increase heat dissipation from the cask.[18]

The vessel closure system is a series of four covers: (1) a shield cover, a 5 × 75.5-in. plate of low-alloy steel bolted to the cask vessel; (2) a primary cover, a 3.5 × 85.88-in. plate of carbon steel located atop the shield; (3) a seal cover, a 1 × 87.12-in. plate of carbon steel mounted over the other two covers; and (4) a closure cover, a 5 × 94.5-in. stainless-steel weldment containing neutron-absorbing shielding material placed atop the seal cover.[18]

The MC-10 cask was designed and analyzed to withstand a 5-ft drop in any orientation without loss of integrity or loss of separation of fuel within fuel basket ports. The MC-10 cask can resist tipping from the vertical position for wind speeds up to 360 mph and seismic horizontal accelerations of up to 0.5 g. A more detailed description of the MC-10 cask is provided by the MC-10 TSAR.[18]

2.4.8.2.4 VSC-17 Cask—The following descriptive information was obtained from the Ventilated Storage Cask (VSC)-17 TSAR[19] and the VSC-17 Operation and Maintenance Manual.[20] The contents of the VSC-17 cask are given in Section 3.3.2.1.1 of this SAR.

The VSC-17 cask is a dry storage system using a concrete storage cask and a steel, multiassembly sealed basket (MSB) to safely store canisters of consolidated irradiated spent nuclear fuel. The VSC system can hold 17 PWR assemblies or 17 consolidated spent nuclear fuel canisters. This is the only type of fuel approved for storage in this cask without further analysis. The dry storage cask has one design feature for criticality prevention, fuel assemblies are physically separated and maintained at specified separation distances by means of fuel storage compartments (9.375 in. square, with a 3/16-in. wall thickness).

The VSC-17 cask structure consists of an outer shell assembly fabricated from pressure vessel steel, a weather cover, and a shielding lid. Concrete walls provide structural support and enough shielding to limit the exterior surface radiation dose rates to 50 mrem/h or less. Natural convection inside the cask allows decay heat to be removed from around the metal walls of the cask liner and MSB. A 0.75-in.-thick steel-disk weather cover is bolted to the metal inner liner of the concrete shell of the cask, with an elastomer gasket between the two, to prevent water intrusion.[19] The shield lid is made of one 4.5-in.-thick steel disk and one 6-in.-thick disk, that sandwich a 2-in.-thick section of neutron shielding. These assemblies are welded together to produce one lid.

The internal cavity of the concrete cask is formed by a 3.5-in.-thick steel cylinder. The MSB is a welded assembly fabricated from square steel tubes. The MSB is fabricated from 0.5-in. carbon steel and coated with a nonorganic, radiation-resistant, high-temperature, hard surface coating to prevent oxidation. A 0.375-in.-diameter metal O-ring and a 0.275-in.-diameter ethylene propylene dimonomer (EPDM) O-ring located in the MSB shielding lid ensure closure of the MSB.

The VSC-17 cask was designed and analyzed to withstand an 18-in. vertical drop without loss of integrity or loss of separation of fuel within fuel basket ports. The VSC-17 cask can resist tipping from the vertical position for wind speeds up to 360 mph and seismic horizontal accelerations of up to 0.25 g. A more detailed description of the VSC-17 cask is provided by the cask TSAR and cask Operating and Maintenance Manual.[19,20]

2.4.8.2.5 REA-2023 Dry Storage Cask—The REA-2023 cask is a lead-shielded dry storage cask. A complete description of this cask is contained in the REA-2023 TSAR.[21] The REA-2023 cask was originally designed to store up to 52 intact boiling-water reactor (BWR) spent fuel assemblies, decayed five years or more after irradiation, generating up to 0.4 kW of heat per assembly. The REA-2023 cask design incorporates four top, two middle, and two bottom trunnions such that the cask can be handled in either the horizontal or the vertical orientation, and can be pivoted between these two orientations. The REA-2023 cask is an approximately 16-ft-high × 8-ft-diameter stainless-steel cylinder weighing approximately 100 ton. The contents of the REA-2023 cask are given in Section 3.3.2.1.1 of this SAR.

The internal cavity is 61 in. in diameter. Radiation shielding is provided by a 0.75-in.-thick layer of stainless steel surrounded by a 4.25-in. layer of lead, which in turn is surrounded by a 3-in.-thick stainless-steel plate. The shielding on the bottom of the cask is provided by a 2-in.-thick layer of stainless steel, followed by a 3.25-in.-thick layer of lead, followed by a 2-in.-thick layer of stainless steel. The primary top cover (lid) of the cask consists of a 1-in.-thick layer of stainless steel, followed by a 3-in.-thick layer of lead, followed by another 2-in.-thick layer of stainless steel. The original design included a secondary cover (lid) consisting of a 2-in.-thick plate of stainless steel welded to the cask body. The secondary lid is not welded, but is installed and secured using the REA-2023 secondary cover clamp.

The REA-2023 was designed to withstand a 5-ft drop in any orientation without any loss of sealing integrity. The structural analyses[21] concluded that for the drop accidents and natural phenomena hazards (NPHs), although some damage to the cask may occur (such as lead slump, flattening, deformation), the primary barrier (primary lid) remains intact and no radioactive contents would escape. The REA-2023 cask can resist tipping from the vertical position for wind speeds up to 360 mph. Missile penetration analyses conclude that the cask maintains integrity and containment of all solid contents for a massive missile (3,968-lb) impact, for a penetrating missile (276-lb, 8-in.-diameter sphere) impact, and for a protective barrier impact (1-in. steel sphere), all impacting with a velocity of 126 mph. The cask response for a tipover is bounded by the response described above for a corner drop from 5 ft, and therefore, even if it did tipover, the cask primary barrier would remain intact and no radioactive contents would escape. A separate analysis[22] was performed and concluded that the cask will not tip over for a Performance Category (PC)-2 seismic event.

The original design of the REA-2023 included a fuel basket constructed of copper, stainless-steel, and Boral neutron absorbing plates. A new cask insert has been installed to provide the necessary spacing for criticality safety. The insert is constructed of 0.25-in.-thick stainless steel. The insert has the same length as the internal cavity of the cask to provide a spacing of 0.25 in. between fuel assemblies for the length of the fuel assembly for criticality safety. The cask insert weighs approximately 4,700 lb.[23] Although the REA-2023 cask has been designed for both horizontal and vertical storage orientations, the new cask insert has been designed for vertical handling and storage only. A seismic analysis[24] also concludes that the cask insert is PC-2 qualified; that is, the cask insert 0.25-in. thick wall thickness is maintained for a PC-2 seismic event while fuel is in the cask insert in the REA-2023 cask.

The primary lid is attached to the cask body using 36 high-strength 1.25-in.-diameter lid bolts, fabricated from American Society for Testing and Materials (ASTM)-A193 B7 steel, and two elastomer O-ring gaskets provide the seal between the primary lid and the cask. The cask primary lid is installed in accordance with the REA-2023 SAR configuration.[21] The REA-2023 cask has two drain penetrations and one vent/sampling penetration. In addition, there are four instrumentation penetrations with housings near the top of the cask.

The storage devices that Loss-of-Fluid Test (LOFT) FP-1 and FP-2 were previously stored in the Storage Pool are also used in the REA-2023 cask. The LOFT FP-1 assembly is contained in a fully enclosed/sealed 198-in.-long cylindrical storage can in the modified six-pack. The LOFT FP-2 remnants and cutting fines are contained in 12 stainless-steel containers that are 10.54 in. square and 12.57 in. high with 0.12-in.-thick walls and lid, and a 1.0-in.-thick bottom. The LOFT FP-2 metallurgical samples are contained in 3 stainless-steel containers that are 10.54 in. square and 13.72 in. high. A lifting handle is attached to each can that is 1.5 in. high (included in the container overall height). A storage sleeve in the modified six-pack box, which is 11.3 in. square by 192 in. long, houses these 15 containers. The sleeve extends approximately 36 in. above the top of the six-pack main body. The top and bottom openings of the sleeve are capped with expanded metal covers.

Six commercial fuel assemblies and one fuel shipping basket module are contained in overpacks within the REA-2023 cask. The overpack is a stainless-steel box with a lid designed to contain the strongback and fuel. The overpack is constructed of 0.25-in.-thick stainless steel on three sides with a lid along the fourth side, also constructed of 0.25-in.-thick stainless steel. The lid is secured to the overpack with eight capture bolts.

2.4.8.2.6 NuPac 125B-2 Cask—The NuPac 125B-2 fuel shipping cask is a rail cask designed to transport up to seven canisters containing portions of the TMI core, and was licensed and used for that purpose in the 1980s, as authorized by the cask Safety Analysis Report for Packaging (SARP).[25] The NuPac 125B-2 cask consists of an inner vessel and outer (lead-shielded) cask. The outer cask exterior dimensions have a 65.5-in. diameter and a 207.5-in. length, consisting of concentric Type 304 stainless-steel shells (1.0-in.-thick inner shell and 2.0-in.-thick outer shell) which sandwich a cast-lead shell (3.88 in. thick). The outer cask containment boundary consists of the 7.5-in.-thick stainless-steel bottom, the 1.0-in.-thick stainless-steel inner shell, the upper forging, and the 7.5-in.-thick cask lid, complete with two neoprene O-ring seals.[25] The outer cask cavity is 51.25 in. in diameter by 192.5 in. long. The outer cask has two lifting and four tie-down trunnions. The inner vessel structure is a hub, spoke, and wheel arrangement, consisting of a Type 304 stainless-steel containment boundary made up of seven individual tubes (14.5 in. inside diameter) with 1.81-in.-thick bottom plates, a top forging to which the tubes are welded, and a 5-in.-thick closure lid, complete with two neoprene O-ring seals.[25] Twenty-four A320 carbon-steel closure bolts secure the inner vessel lid to the inner vessel body. On the closure lids of both the inner vessel and the outer cask are a seal test port, a combination vent/sampling port, and a rupture disc to preclude catastrophic damage to the package, should inadvertent overpressurization occur. For gas monitoring of the cask cavity during interim storage, the inner vessel vent/sampling port will remain open. The contents of the NuPac 125B-2 cask are given in Section 3.3.2.1.1 of this SAR. The weight of the cask loaded with the two TMI-2 canisters containing epoxy, without external overpacks, is approximately 70 ton.

For rail transport, the cask design includes two external overpacks (energy absorbers) to limit the impact loads for hypothetical transportation accidents. These external overpacks are not used for the interim storage activities for the TMI-2 fuel canisters containing epoxy. The inner vessel design includes the use of stainless-steel-encased aluminum honeycomb energy-absorbing impact limiters at the bottom of each tube, integral shield plug/impact limiters at the top of each tube, and neutron moderator and poisoning materials within the interstices of the tubes. For storage, the honeycomb absorbers are in place for the two TMI-II debris canisters.

The maximum expected exposure rate on contact with a fully loaded cask is less than 100 mr/h.[25] The maximum expected internal normal operating pressure for the cask is 125 psig.

2.4.8.3 Spent Fuel Cask Transporter. The spent fuel cask transporter is used to hydraulically lift and move (via towing) various sizes of storage casks between the storage pads and the TAN Hot Shop, TAN buildings and areas, and other facilities at the INEEL. The cask transporter design, safety features, and operations meet the standards listed in the specifications for the INEL/TAN Dry Spent Fuel Storage Cask Transporter.[26] A detailed description and instructions for operation and maintenance of the cask transporter is in the Dry Spent Fuel Storage Cask Transporter Operation and Maintenance Manual.

2.5 Process Description

The following sections contain the process description for the various TANO facilities or activities.

2.5.1 TAN Hot Shop

The TAN Hot Shop is equipped for remote handling, and has functioned as a place to receive radioactive or fissile materials that need to be examined, tested, packaged, or placed in interim storage. Receipt of any item is basically performed in the same manner. The container or cask in which the radioactive or fissile material was shipped to TAN is brought into the Hot Shop through the HECF on a flatbed truck or some special transporting equipment, such as the cask transporter. The container or cask was moved into place using the 110/10-ton overhead crane. The 110/10-ton overhead crane and O-man were also used to move items within the Hot Shop.

Radioactive materials, such as reactor components, filter resins, sintered metal filters, and waste packaged for disposal may also be received in the TAN Hot Shop. The contaminated equipment currently located in the Hot Shop will be packaged and sent to an approved disposal or storage site. Sampling activities will take place to quantify the extent of the contamination in the Hot Shop.

The storage casks located on Pads TAN-790 and TAN-791 may be brought into the Hot Shop periodically for maintenance and examination. No fuel will be removed from the cask during these maintenance operations.

2.5.2 Special Equipment Services Room

Operations in the SES room are similar to those discussed in Section 2.5.1 for the TAN Hot Shop. The ability to isolate the SES room from the rest of the Hot Shop by closing the shield doors allows the SES room to be used for repairing certain Hot Shop equipment. This is particularly valuable for maintenance of the 110/10-ton overhead crane or O-man in situations when the rest of the Hot Shop might be in a remote condition.

Future work inside the SES room will consist mainly of characterizing the radioactive contamination that remains and subsequent D&D cleanup.

2.5.3 TAN Hot Cell

The TAN Hot Cell was used to remotely perform activities, such as inspection, disassembly, cutting, testing, metallurgical sample preparation and packaging, involving radioactive parts, sources, fuel assemblies, fuel rods, etc. These items were remotely transferred between the Hot Shop and Hot Cell using the Hot Shop/Cell transporter system. Once in the Hot Cell, the items were remotely handled using the equipment in the Hot Cell.

Future work inside the Hot Cell will consist mainly of characterizing the radioactive contamination that remains in the cell and subsequent cleanup. Personnel may enter the Hot Cell when necessary; however, special precautions must be taken. Each entry is evaluated on a case-by-case basis.

2.5.4 TAN Storage Pool

All spent nuclear fuel items that were previously stored in the TAN Storage Pool, with the exception of two ion exchange columns, have been removed. These two ion exchange columns are temporarily stored in the TAN Storage Pool. The ion exchange columns were part of the TMI-2 dewatering operation. The two ion exchange columns are designated as the old ion exchange column (452242-1) and the new ion exchange column (503443-X). The old ion exchange column (452242-1) was determined to have the potential for the accumulation of amounts of fissile material that, under certain circumstances, were not critically safe.[27] This potential led to the redesign of the ion exchange columns. The old ion exchange (452242-1) column was not used during dewatering of canisters with a total of more than 2 kg of fissile material.

The new ion exchange column, 503443-X, has been designed to be critically safe under all conditions of fissile content and moderation. The new ion exchange column is constructed of two stainless-steel cylinders, nominally 10 in. inside diameter and 35 in. tall, with a wall thickness of 0.365 in. These cylinders are structurally connected to ensure a nominal cylinder surface-to-surface separation of 8.75 in. The cylinders are plumbed so that they can be externally connected individually (normal operation), in parallel, or in series. The entire assembly is encased in a reinforced concrete block 42.5 in. square and 60 in. in length; the assembly provides a minimum 9.62-in. separation between the outside surface of either cylinder and any adjacent component neutronically isolated. The cylinders and structure are oriented diagonally within the concrete block (estimated total weight of 9,160 lb). The only visible external features (besides labeling) are four lifting lugs, two inlet fittings, and two outlet fittings.

The water and components in the Storage Pool will be removed and transported to an approved treatment or disposal facility. As the water level is lowered, the walls and floor will be decontaminated and, if needed, sealed to control any contamination. Prior to draining the Storage Pool, the two ion exchange columns will be removed.

2.5.5 TAN Warm Shop

The TAN Warm Shop is a high-ceiling area where test assemblies with minor radioactivity or contamination can be examined, tested, or temporarily stored. Preventive and emergency maintenance of equipment, and receipt and preparation of shipping and storage casks can be performed in the Warm Shop. Also, mockups of jobs that are to be performed in the Hot Shop, providing hands-on training for Hot Shop operators, are prepared in the Warm Shop.

Items are brought into the Warm Shop on a vehicle, such as a flatbed truck or rail car. The items are removed from the vehicle and placed in the Warm Shop using the Warm Shop bridge crane. Once an item is positioned in the Warm Shop, the specific processes or operations are performed.

2.5.6 V-Tanks

The Liquid Waste Treatment Plant (TAN-616) was used to store radioactive wastes from the Initial Engine Test Facility, the TAN Hot Shop, and the TAN Hot Cells from 1958 to 1970. The system, which is no longer operational, consists of several underground waste tanks (V-1, V-2, V-3, V-9, V-13, and V-14), an evaporator facility (TAN-616), and associated underground piping. The underground waste tanks are divided into the V-tanks (V-1, V-2, V-3, and V-9) and the PM-2A tanks (V-13 and V-14). TAN-616, which is currently undergoing D&D activities, is covered under a separate safety analysis.[28]

Radioactive wastes were gravity-fed through valve boxes and V-9 to V-1, V-2, or V-3 tanks, via a 6-in. header in TAN-616. The radioactive waste collected in these tanks was then fed into the evaporator system. The radioactive waste volume was reduced in the evaporator, and the overhead (vapor) was condensed and disposed of. The concentrated waste in the evaporator (bottom) was transferred to V-13 and V-14. In 1968, V-2 tank was taken out of service when a large quantity of oil was transferred to the tank. When the evaporator system failed in 1970, the radioactive waste was routed directly to V-13 and V-14. In 1981, oil was removed from the V-2 tank. In 1982, the V-tanks (V-1, V-2, V-3 and V-9) were pumped down, leaving a residual liquid and sludge heel. In order to prevent additional liquid transfers to the V-tanks, the valve pit was modified and the waste transfer route was connected to TAN-666, in 1985. No radioactive waste has been added to the liquid waste treatment plant since 1985.

Work is currently underway to remove the V-tanks. V-9 will be isolated from the other V-tanks and TAN-616. Tank contents may be sampled or consolidated in preparation for waste remediation. The 6-in. header connecting V-9 to the other tanks will be cut and capped. Two incoming lines to V-9 will also be isolated from the tank. Before isolating V-9, any contents in the 6-in. line and header may be flushed or transferred if required.

2.5.7 Radioactive Parts Service and Storage Area

The processes associated with the RPSSA are typical of warehousing operations. Material handling at the RPSSA is limited to hand-operated and mobile mechanical equipment, because there are no permanently installed cranes or hoists. Items are limited in weight and size to that which can be safely handled by personnel or that are within the rated capacity of the available lifting equipment to reduce the risk of personal injury, material damage, or loss of contamination control.

2.5.8 Cask Pads

2.5.8.1 TMI-2 Abnormal Waste Storage Pad (TAN-790). The processes associated with TAN-790 are cask transport, storage, inspection, and maintenance. As the storage casks are positioned on the pad, radiation surveys are performed. Individual and collective cask readings are logged for future reference. The readings are obtained at the cask surface, 1 ft away, and general area readings for comparison. Also, thermoluminescent dosimeters (TLDs) are installed on the fence around the pad and analyzed to record exposure in the area.

The casks are routinely inspected during storage. This includes visual inspection for any signs of deterioration or loss of containment. Direct radiation surveys and smears of casks and the pad are conducted by a radiological control technician (RCT). The data collected during surveillances may be compared to initial values so that operating personnel can be alerted to cask conditions that may require action. Changing cask conditions are handled on a case-by-case basis.

Continuous cask monitoring for vented radioactivity is not anticipated because the waste containers in the storage casks are either plugged or filtered to prevent release of radioactivity. Because the storage cask vents and drains are not filtered, the cask lids are not sealed, and the raincovers are vented, contamination surveys are obtained from locations near accessible external openings to assess and monitor for any contamination spread. Any increase in contamination levels may indicate venting of gas from the contents of the cask. The casks are designed so that a monitoring system can be installed if surveillance results indicate a need.

Periodic maintenance on the casks is performed at TAN-790 if possible. If not, the cask is transported using the cask transporter to the TAN Hot Shop for maintenance and then returned to the pad.

2.5.8.2 Spent Fuel Storage Cask Testing Pad (TAN-791). The Spent Fuel Storage Cask Testing and Storage Program consists of three phases requiring different cask configurations: (a) test phase, during which time internal gas sampling is conducted, (b) short-term storage phase, during which time spent nuclear fuel can be stored on the pad for a period of less than 5 years and fuel movement is expected, and (c) interim storage phase, during which time spent nuclear fuel is stored and no fuel movement is anticipated. This program is in the interim storage phase and cask performance data are collected as required by the project surveillance requirements. The program involves the CASTOR V/21, TN-24P, MC-10, and VSC-17 casks containing fuels from Surrey and Turkey Point.

The TAN-791 cask storage pad is also the interim storage location for LOFT and commercial fuels (stored in the TN-24P and REA-2023 casks) and the two TMI-2 fuel canisters containing epoxied fuel (contained in the NuPac 125B-2 cask), pending final disposition of these fuels.

The processes associated with TAN-791 are cask transport, storage, inspection, and maintenance. Cask transport within TAN-791 and between TAN-791 and TAN-607 is accomplished using the spent fuel cask transporter (see Section 2.4.8.3). Casks are placed in the vertical position on the testing pad without impact limiters. A minimum space of 5 ft is maintained between adjacent casks to promote heat dissipation and to allow access for surveillance and maintenance.

Routine visual inspections of the casks indicate any potential concerns, which are noted and reported. Radiation data are collected using the appropriate instrumentation. TLDs are installed on the fence around the pad, and are analyzed to record radiation levels in the area.

Cover gas samples may be taken at various times as determined by the project during the residence of a cask on the pad. A radiological work permit and monitoring by an RCT are required for gas sampling. The RCT will assess the need to use temporary enclosures, shielding, lead-lined gloves, or special tools to adequately handle the sampling train. The technicians will receive a personal survey before exiting the pad. No gas release is planned at the pad during this process.

Data collected during surveillance of the spent nuclear fuel storage casks will be compared to expected values so that the project manager can alert operating personnel to cask conditions that may require action. Changing cask conditions will be handled on a case-by-case basis.

2.6 Confinement Systems

The confinement systems used throughout TANO are a combination of physical confinement and maintaining negative pressure. As discussed earlier in this chapter, physical structures such as walls, windows, and doors provide shielding from radiation and confinement for radioactive contamination. In addition to these physical structures, there are ventilation systems, which maintain negative pressure, and HEPA filter systems.

2.6.1 TAN Hot Shop/SES Room System

During normal operation, air is continuously supplied, exhausted through separate prefilters and HEPA filters, and then discharged out the TAN stack. A fan speed control system compensates for changes in Hot Shop/SES room negative pressure by speeding up the fan as the negative pressure decreases. If all fans are shut off, air infiltrates into the TAN Hot Shop and SES room, due to a natural draft created by the TAN stack.

2.6.2 TAN Hot Cell System

The Hot Cell is maintained at a negative pressure with respect to the Hot Shop atmosphere. Air drawn from the general building area enters the cell through the manipulator ports and other penetrations, and is exhausted through a roughing filter bank. The air is then ducted to the fan room, filtered through three banks of HEPA filters (the last of which is tested in place), and then released through the TAN Hot Shop stack.

2.7 Safety Support Systems

This subsection identifies and describes the principal systems that perform safety support functions.

2.7.1 Fire Protection System

Fire protection within TANO is accomplished by a combination of (a) observation by operating personnel, (b) fire suppression systems (both automatic and manual), and (c) activation of fire alarms. The fire mitigation systems within TANO for each of the buildings and areas that could contain radiological inventories are as follows:

All of the automatic sprinkler systems and the deluge systems are tied into the alarm system and the TAN local emergency notification alarm system. When activated, they will alarm at the fire stations and an announcement will be made to the TAN area. INEEL Fire Station No. 3 is operated full-time and is located approximately one-half mile south of TAN-607, outside the TAN fenced area.

Water for the fire sprinkler and deluge systems is provided by the TAN-TSF firewater distribution system. Water is stored in a 500,000-gal tank and transferred via two 1,000-gpm electric automatic fire pumps, operating at 100 psi. The pumps take suction from the storage tank to supply the fire main system. The storage tanks are supplied from deep wells at TAN. A 1,500-gpm, diesel-driven fire pump provides water pressure if commercial electrical power is lost.

Automatic wet-pipe sprinkler systems protect all areas of TAN-607, except the TAN Hot Shop/SES room, TAN Storage Pool, TAN Hot Cell, and Hot Shop north gallery. The Hot Shop and SES room are protected by a manually operated deluge-type fire sprinkler system and portable fire extinguishers. The deluge system is composed of four zones, each controlled by a deluge valve. Three deluge zones cover the Hot Shop and one deluge zone covers the SES room. Fire detection is by infrared flame detectors with remote alarms and by visual observation. The three manually operated deluge valves for the Hot Shop are located in the south, operating gallery. The deluge valve for the SES room is in Room 220. There are two 8-in. control valves in the main supply line to the deluge valves located in the Warm Shop. A tamper switch that sends a trouble alarm to INEEL Fire Station No. 3, if the valve is closed supervises the control valve.

The TAN Hot Cell is protected by a combination dry-chemical/dry-powder system. The Hot Cell operating gallery (Room 110) and access area (Room 107) are protected by wet-pipe automated sprinklers and portable extinguishers. Each discharge nozzle has a restricted orifice to prevent overpressurization.

The dry-chemical system, consisting of separate tanks of ABC dry-chemical (for all fires other than combustible metal fires) and dry-powder (for pyrophoric metal fires only) extinguishing agents can be activated from pull stations above Window P or Window R. The extinguishing agents are piped through a common manifold that penetrates the cell wall to a discharge hose in the cell. The master-slave manipulators are used to direct the application hose and apply the agent on the fire.

Fire protection for the TAN Storage Pool area consists of hand-held extinguishers: one carbon-dioxide extinguisher located in the southeast corner of the room, and two multipurpose dry-chemical fire extinguishers (one in the southwest corner and one in the northwest corner). Other portable extinguishers can be brought from adjacent areas less than 50 ft away. TAN-647 and TAN-648 are protected with dry-pipe fire suppression systems.

2.7.2 Radiation Monitoring

The radiation monitoring system is an integrated system composed of the stack monitor, continuous air monitors (CAMs), and RAMs, which alarm locally and, in some cases, remotely. The radiation monitoring system is powered from the standby section of the motor control center, which automatically picks up power from the standby diesel generator when commercial power is lost.

Exhaust air streams from the TAN Hot Shop and Hot Cell are exhausted up a common 150-ft-high stack (TAN-734). The air is sampled continuously for radioactive particulate contaminants through an isokinetic side stream sampling loop.

CAMs may be used throughout TANO to indicate airborne radioactivity. The placement of these CAMs is based on the guidelines provided in the INEEL Radiological Control Manual.

The RAM system consists of a network of strategically located low-range and high-range radiation detectors that warn of potential high radiation fields. The monitors are located near potential sources of radiation and in areas where a buildup of radioactive material may result in excessively high radiation levels. Low-range detectors may be located in the operating areas associated with the Hot Shop, Hot Cell, and Storage Pool. The high-range detectors are located in the Hot Shop and SES room, and have readouts at the appropriate window operating stations. Some Hot Shop RAMs have portable heads and can be repositioned remotely within a 50-ft radius, using manipulators.

2.8 Utility Distribution Systems

TAN receives its electrical power from the INEEL Site Power System. The INEEL Site Power System comprises seven major substations. One substation, Scoville, is the point at which off-site power is fed to the INEEL and delivered to the east and west buses, energizing the site power loop, which then supplies power to the other six substations, one of which serves the TAN area.

A diesel generator provides the backup power supply for all essential equipment needed within TANO. The 900-kW generator is connected to the appropriate electrical buses through an automatic transfer switch. In the event of commercial power failure, these buses will be automatically switched to the diesel generator supply. When commercial power is restored, the buses will automatically return to that supply.

In the event that all electrical power is lost, wall-mounted, battery-powered emergency lights provide emergency lighting in the operating areas. Similar emergency lighting is not available in the Hot Cell. Provisions for portable emergency lighting for safe egress from these areas are administratively controlled.

2.9 References

1. 10 CFR 830 Subpart B, "Safety Basis Requirements," *Code of Federal Regulations*, Office of the Federal Register, January 10, 2000.

2. 10 CFR 835, "Occupational Radiation Protection," *Code of Federal Regulations*, Office of the Federal Register, January 10, 2001.

3. DOE-ID Order 420.D, "Requirements and Guidance for Safety Analysis," U.S. Department of Energy, July 17, 2000.

4. DOE-STD-3009-94, "Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports," July 1994 (including Change 1, January 2000; and Change 2, April 2002).

5. DOE Order 420.1A, "Facility Safety," U.S. Department of Energy, May 20, 2002.

6. *TAN Hot Shop and Satellite Facilities*, IDO-17032, Phillips Petroleum Company, Atomic Energy Division, November 1964.

7. NMEO-EDF-105-87, "Calculations and Analyses of the Floor, Grade Beams and Piles," S. A. Jensen, April 9, 1987.

8. V. J. Balls letter to C. K. Mullen, "Analyze Loads on TAN Hot Shop Floor and Associated Members When Loaded with 150-Ton Cask and 1968 Gutecar Tractor with 1958 Peerless Trailer," VJB-1-84, November 19, 1984.

9. T. G. Rahl letter to C. K. Mullen, "Additional Analysis of the TAN-607 Hot Shop Floor," TER-8-84, October 30, 1984.

10. EDF-TANO-94-32, "TAN-607 Shielding Calculations for SAR Upgrade," R. W. Jones, July 1994.

11. EDF-1433, "TAN-607 Penetration Filling Requirements," Rev. 0, G. G. Anderson, February 2001.

12. *Radiation Dose Calculations to a Postulated Criticality Event in the TAN Special Equipment Service Room and the Hot Shop*, INEEL/INT-2000-00557, May 2000.

13. EDF-100-87, "Calculations and Analysis of the Floor, Pit Area, Grade Beams and Piles," V. J. Balls, April 17, 1987.

14. General Nuclear Systems, Inc., "Topical Safety Analysis Report for the CASTOR V Cask Independent Spent Fuel Storage Installation (Dry Storage)," December 1983.

15. Transnuclear Inc. TN-24 *Dry Storage Cask Topical Report,* August 1995.

16. EDF-3900, *Evaluation of Accidental Vertical Drop of TN-24P Cask from 20 Inches,* Rev. 0, J. L. Coleman, June 18, 2003.

17. C. E. Hardy, *TN-24P Cask-Cradle Onsite Transportation Plan*, WM-PD-86-001, October 1985.

18. Westinghouse Electric Corporation, *Topical Safety Analysis Report for the Westinghouse MC-10 Cask for an Independent Spent Fuel Storage Installation (Dry Storage)*, WCAP-10740, December 1984.

19. Pacific Sierra Nuclear Associates, "Topical Report on Ventilated Storage Cask System for Irradiated Fuel," February 1989.

20. Pacific Sierra Nuclear Associates, *VSC-17 Irradiated Fuel Storage Cask Operation and Maintenance Manual*, WEP-114-006, June 1990.

21. Ridihalgh, Eggers, and Associates, Inc., "Topical Report: REA 2023 Dry Storage Cask for BWR Spent Fuel," April 6, 1983.

22. EDF-2039, "REA-2023 Cask Seismic Analysis – 2000 IBC Code," Rev. 0, K. B. Phillips, March 18, 2002.

23. EDF-2959, "REA-2023 Cask Insert Analysis," D. T. Clark, Rev. 1, March 2002.

24. EDF-2089, "Seismic Evaluation of REA-2023 Cask Insert," Rev. 0, P. E. Murray, March 2002.

25. Nuclear Packaging, Inc., "Consolidated Safety Analysis Report For The NuPac 125-B Fuel Shipping Cask," Docket No. 71-9200, April 1991.

26. EG&G Idaho, Inc., *Specification: INEL/TAN Dry Spent Fuel Storage Cask Transporter*, ES-51092 B, September 25, 1986.

27. J. T. Taylor letter to S. E. LeRoy, "Criticality Safety Path Forward for TMI Dewatering System," JTT-02-99, March 8, 1999.

28. ASA-106, "Auditable Safety Analysis for the Decontamination and Dismantlement of the TAN-616 Liquid Waste Treatment Facility," Rev. 0, December 20, 2001.