Transuranic Waste Inspectable Storage Project (TWISP) Retrieval from Pads 1, 2, and 4 at Technical Area 54

Final Report

February 2002

FWO-Solid Waste Operations

Los Alamos National Laboratory

TRANSURANIC WASTE INSPECTIABLE STORAGE PROJECT (TWISP) FINAL REPORT

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ABSTRACT

The mission of the Transuranic Waste Inspectible Storage Project (TWISP) was to retrieve fiberglass-reinforced plywood crates and metal drums containing solid-form, transuranic (TRU) waste from earthen-covered storage pads; overpack damaged containers; wash all drums; vent and install high-efficiency particulate air (HEPA) filters into drum lids; and place the waste containers into inspectible storage configurations. TWISP operations are located at TA-54, Area G.

The TWISP was considered a hazard category 2 nuclear facility; thus, its authorization basis was initially governed by a Safety Analysis Report (SAR) and finally the Basis of Interim Operations (BIO) and the Technical Safety Requirements (TSRs) "For the Retrieval of Transuranic Waste From Pad 2, at TA-54, Area G".

Description of the Site

Los Alamos National Laboratory (LANL or the Laboratory) is located on the eastern slopes of the Jemez Mountains in northern New Mexico, at altitudes between 7000 and 8000 feet. TA-54, Area G. TA-54 is isolated from the rest of the Laboratory by Los Alamos Canyon, and there is no direct access to the site from other technical areas except by driving east on the Mesita del Buey access road, which parallels Pajarito Road.

Site History

Beginning in 1970, the Atomic Energy Commission (AEC) directed its facilities around the country, including LANL, to begin storing TRU waste in a manner that would allow eventual retrieval for shipment to the Waste Isolation Pilot Plant (WIPP), a deep geologic repository in southern New Mexico. Across the Department of Energy (DOE) complex before this, transuranic waste had been disposed with low-level radioactive waste in shallow landfill cells. At LANL since 1957, such unsegregated radioactive waste was landfilled at Material Disposal Area G (Area G), within TA 54 on Mesita del Buey. However, as a consequence of the DOE order, LANL began segregating transuranic from low-level wastes and dedicating specific storage units at Area G for their management. By the late 1970s, LANL and other DOE facilities affected by the order recognized a need to upgrade transuranic waste management practices to provide a more retrievable configuration—consistent with storage, as opposed to disposal—involving the use of abovegrade, earth-covered storage pads containing densely packed arrays of waste containers.

Thus, in 1979 LANL constructed the first of three aboveground asphalt pads designed to provide a retrievable storage configuration for TRU waste.

Pad 1. Pad 1 was oriented roughly north–south, perpendicular to three closed, low-level radioactive waste (LLW) pits, which it overlaid. It operated from May 29, 1979, to December 29, 1981, and received 4803 standard 208-L (55-gal.) drums, 10 314-L (83-gal.) drums, 3 375-L (99-gal.) drums, and 88 fiberglass-reinforced, polyester-coated plywood (FRP) crates.

Pad 2. Pad 2, located parallel to and east of Pad 1 (also overlying inactive LLW Pits 2, 4, and 5) operated from December 8, 1981, to August 20, 1985. It received 7279 208-L (55-gal.) drums, one 303-L (80-gal.) drum, and 48 FRP crates.

Pad 3. Pad 3, located between Pads 1 and 2, is used for aboveground, dome-covered storage of post-1986, certifiable TRU waste, and is fully inspectible in its current configuration.

Pad 4. Pad 4, the furthest east of the three pads (still overlying Pits 2, 4, and 5), operated from March 18, 1985, to January 3, 1991. It received 4534 208-L 55-gal. drums, 7 303-L (80-gal.) drums, two 314-L (83-gal.) drums, 1 322-L (85-gal.) drum, and 54 FRP crates.

The 55-gal. drums were stacked three to five high (depending on the pad) in dense arrays, with plywood between layers. FRP crates lined the pads, and sometimes separated groups of drums into cells; that is, they occasionally went across the face of the drum stack as well. Each cell was enclosed with plywood and covered with fabric-reinforced plastic tarps for weather protection; the entire configuration was buried with up to three feet of crushed tuff. It was felt that this storage method would adequately protect the drums and crates from deterioration until they were shipped to the WIPP, scheduled then to open in 1988, for permanent disposal.

About 60% of the waste stored on the three pads may be is TRU mixed waste. Most drums contain a cemented chemical treatment sludge from radioactive wastewater treatment operations at the Laboratory. In addition, many drums contain combustible and noncombustible trash, including paper, plastic, and rubber materials generated in past glovebox operations. Some of the waste is known to include asbestos and beryllium. The FRP crates primarily contain individual gloveboxes or portions of gloveboxes and radioactive waste transfer lines from past decommissioning projects.

FACILITY AND PROCESS DESCRIPTION

1.1 Overview

The Transuranic Waste Inspectable Storage Project (TWISP) site is located at the Los Alamos National Laboratory (LANL) TA-54, Area G site. The TWISP consisted of retrieving waste from three pads of waste covered with a dirt overburden. All Pads have been successfully completed.

Retrieval of this waste and placement into an inspectable configuration was required by the New Mexico Environmental Department (NMED). All waste from this pad was required to be in an inspectable configuration by September 2003 or the laboratory would be fined $2,500 per day for the first 14 days and $5,000 each day afterwards.

The Laboratory anticipated that the waste would be retrieved within 20 years, its characteristics would be certified, and it would be shipped to WIPP for permanent emplacement. In 1991, the state of New Mexico (the state) was authorized to regulate mixed waste under the Resource Conservation and Recovery Act (RCRA). In a RCRA Part A permit application for the state, the Laboratory imcluded Pads 1, 2, and 4, rendering the pads subject to RCRA interim status operating standards for container storage units and regulation by the state.

In April 1992, 16 drums were retrieved from Pad 2 foe examination to assist in waste certification activities. These drums exhibited varying stages of both internal and external corrosion and were reported as such to the state. Soil samples demonstrated that no radioactive material had been released. However, because the storage configuration at the pads did not allow inspection or response to emergency conditions, Compliance Order 93-03 was issued in January 1993, by the New Mexico Environment Department (NMED 1993). The compliance order required that the Laboratory bring the storage of the waste into compliance with HWMR-6 requirements. This necessitated the retrieval of all waste stored on Pads 1, 2, and 4.

Waste associated with this Project was received by Area G during the 1979 through 1991 time period. The waste was placed on an asphalt pad in the following basic configuration. Fiberglass Reinforced Plywood crates typically formed the outside boundary of the waste array. Inside this boundary drums were stacked typically 4 high with plywood sheets separating the layers of drums. Typically three fire breaks consisting of crushed tuff were used to separate the waste into four arrays. Once the pad was filled with waste, a plywood enclosure was constructed around the waste array and the enclosed waste was covered with a dirt overburden to protect the waste from the environment.

A general facility layout is shown in Figure 1-16. This drawing shows the location of Pads 1, 2, and 4, the Drum Preparation Facility, and the refueling area.

Figure 1-1. Waste Array Typical Configuration

1.1.1 Applicable ES&H Work Smart Standards

Table 1-1. Applicable ES&H Work Smart Standards

Document/Directives	Document Titles
29CFR1904.1-13	Recording Occupational Injuries
29CFR1905	Variances, Limitations, Tolerances, Exemptions, Etc.
29CFR1910	Occupational Safety and Health Standards
Statue Public Law 91-596, Section 4, 5(a)(1), 6,8	Occupational Safety and Health Act 1970
ACGIH 1997	Threshold Limit Values
ANSI/IEEE C2-1999	National Electrical Safety Code
ANSI N43.3-1993, Sections 4.1, 5.1, 5.1.2, 5.1.4, 5.1.6.3, 5.1.5.2, 5.1.5.7, 9.1, 9.4	Definitions
ANSI Z358.1-1990, except for paragraphs 4.7.1, 5.5.1, 7.5.1, 9.5.1, and Appendix A, paragraph A.1	Emergency Shower and Eyewash Equipment
ANSI Z535.2-1991	Environmental and Facility Safety Signs
ANSI Z535.3-1991	Criteria for Safety Symbols
ANSI Z88.2	Respiratory Protection (most recent addition)
ANSI/ANS 8.1-1981 (R1988)	Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors
ANSI/ANS-8.19-1996	Administrative Practices for Nuclear Criticality Safety
ANSI/ANS-8.20-1991	Nuclear Criticality Safety Training
ANSI/ANS-8.7-1975 (R1987)	Guide for Nuclear Criticality Safety in the Storage of Fissile Materials
ANSI/ASME, 1995 Edition	Boiler and Pressure Vessel Code
National Fire Protection Association (NFPA)	Codes and Standards
Uniform Building code (UBC) 1997 Edition	
AL Supplemental Directive 5481.1b	Safety Analysis and Review System
DOE O 151.1	Comprehensive Emergency Management System
DOE O 414.1	Quality Assurance
DOE O 420.1 paragraphs 4.4 through 4.4.6, and its implementing guide, "Interim Guidelines For The Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Non-Nuclear Facilities."	Facility Safety
DOE O 425.1, Chg. 1: 10-26-95, with the exception of the DOE O 5480.19 citation	Startup and Restart of Nuclear Facilities,
DOE O 5400.5	Radiation Protection of the Public and the Environment
DOE O 5480.20A, 11-15-94	Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities
DOE O 5480.21, 12-24-91	Unreviewed Safety Questions
DOE O 5480.22	Technical Safety Requirements, Change 2: 1-23-96
DOE O 5480.23, Effective Date: 4-30-92	Nuclear Safety Analysis Reports

Document/Directives	Document Titles
DOE O 5820.2A	Radioactive Waste Management
DOE O 6430.1A	General Design Criteria, Division 13
New Mexico Hazardous Materials	NM Hazardous Materials Response Plan and Procedure
LA-WSS 402-870-01	LANL Ergonomics Standard
LANL LPR 240-01-001.1	Facility and Operating Limits and Configuration (Formality of Operations).
LANL LPR 270-02, (currently exists and addresses the philosophy of AL 5480.31)	Perform Assessment of Operating Limits and Start-Up Tests
LANL LIR 405-10-01.0, Sections 6.1 (intra-site) and 6.3 (on-site), issued June 10, 1998	Packaging and Transportation
LANL LIR 402-910-01.0, Section 6.1	Laboratory Fire Protection Program

1.1.2 Historical Data

1.1.2.1 Pad 1

Pad 1 retrieval operations were performed during a 16-month period commencing March 1997. Pad 1 operations were governed under the Safety Analysis Report (SAR) for the retrieval of Transuranic Waste from Pads 1, 2 and 4 at TA-54, Area G (REPORT-54G-011) and the Technical Safety Requirements (TSRs) for the retrieval of Transuranic Waste from Pads 1, 2 and 4 at TA-54, Area G (REPORT-54G-012). Prior to operations the TWISP successfully completed a DOE Operational Readiness Review (ORR).

During TWISP operations on Pad 1, two unreviewed safety questions (USQs) were identified with subsequent Occurrence Reports. These two USQDs were due to the fact that more drums than initially analyzed in the safety analysis contained elevated hydrogen levels; as such the probability of a drum defragration was increased. The other USQ was a result of the stepped working face of the waste array was not always being maintained as assumed in the SAR. This incorrect assumption resulted in an increase in the consequence of a seismic event. Through negotiations with the DOE these USQs were approved with required additional TSR level controls.

Pad 1 operations took place in a retrieval dome. This dome was constructed to meet PC-2 wind loading and seismic events. The dome was supplied with a ventilation system which exhausted to a pre-filter and subsequent high efficiency particulate air (HEPA) filter bank. The exhaust stack was not a monitored stack release point. The dome was equipped with CAMs and fix filter heads for airborne monitoring.

During retrieval operations all CAM alarms were due to either a low flow condition (caused by dust created by overburden removal or retrieval operations) or were the result of naturally occurring radon. The dome structure was identified in the SAR as a Defense in Depth feature.

During retrieval operations performed at Pad 1 four crates were identified as having lost their structural integrity. This resulted in three contamination events. These crates contained various pieces of equipment but due to the lost of integrity soil infiltrated some of the crates. These crates contained activity ranging from 0.6 PE-Ci to 22 PE-Ci. Two of the crates that lost their structural integrity were very large boxes approximately 30 feet in length, the other two boxes were standard size crates (approximately 7’x7’x10’). During these events TWISP personnel took immediate actions to contain this contamination. This included applying a contamination Fixadent to contain the contamination. Each event was successfully accomplished without the spread of contamination to other areas of the dome and no airborne contamination was detected nor did any bioassay results indicate any intakes. All of the other crates (approximately 83 crates) retrieved at this Pad were in surprisingly good condition.

During retrieval operations performed at Pad 1 approximately 5 drums out of 4800 had significant corrosion or pinholes. These drums were immediately overpacked (placed and sealed in an 83-gallon drum) and no contamination or airborne radioactivity was spread. An additional 271 drums were conservatively overpacked based on the presence of corrosion.

1.1.2.2 Pad 4

Pad 4 retrieval activity commenced on or about December 1998 and was completed in December of 1999. Prior to the completion of Pad 1 operations, the TWISP removed the majority of the overburden from this Pad thus exposing the waste array to the environment. Additionally at this time, the TWISP developed a USQ to propose to the DOE that Pad 4 operations be performed outdoors without a dome structure. Through negotiations with the DOE the DOE approved this USQ with associated TSR controls. One of the main reasons the DOE approved this USQ was that the majority of the overburden was removed; thus the Pad was susceptible to failures from seismic events, vehicle accidents, plane crashes, and fires. Based on this the DOE concluded that the time the waste array was exposed was a major contributor to the risk. If a new dome was to be constructed this would increase the time the waste array was at risk by about 8 to 12 months. Additionally, constructing a dome over an exposed waste array posed its own risk. Thus Pad 4 operations were governed under the Safety Analysis Report for the retrieval of Transuranic Waste from Pads 1, 2 and 4 at TA-54, Area G (REPORT-54G-011) and the Technical Safety Requirements for the retrieval of Transuranic Waste from Pads 1, 2 and 4 at TA-54, Area G (REPORT-54G-012) as well as all DOE approved unreviewed safety questions and associated TSR controls.

Prior to operations on Pad 4 the TWISP successfully completed a DOE Readiness Assessment to ensure all TSR controls identified in the USQs were implemented. During Pad 4 retrieval operations, five contamination events occurred. These events are suspected to have been caused by leaking 55-gallon drums, as all crates retrieved on Pad 4 had maintained their structural integrity. These events were not caused by retrieval operation but were the result of container failures while in storage. Contamination level encounter included 1500 $dpm/100cm^2$ removable alpha ($20dpm/100cm^2$ is the limit), and 150,000 dpm fixed alpha (2000dpm is the limit). During these events TWISP personnel took immediate actions to contain this contamination. This included applying a contamination Fixadent to contain the contamination. Each event was successfully accomplished with no spread of contamination off-site above any limits as monitored by the Storm Water Pollution Prevention Program, with no airborne contamination which exceeded any limits as evidenced by area CAMs, Fix Head monitors, and site airborne contamination monitors, and with no personnel intakes as evidenced by personnel bioassay results.

During retrieval operations performed at Pad 4 approximately 150 drum out of 4500 had either significant corrosion or holes ranging from a pinhole to about 2 inches in diameter. These drums were immediately overpacked (placed and sealed in an 83-gallon drum). An additional 800 drums (approximately) were conservatively overpacked based on either the presence of corrosion or the drum tops being pushed in (without a breach) due to the weight of the waste on top of the drums, or the drums tops being pushed out (without a breach) due to pressurization.

All of the crates on Pad 4 were of standard construction size (typically 7’x7’x10’). None of these crates experience integrity failure.

Pad 2

Pad 2 retrieval activity commenced on or about December 2000 and was completed in December of 2001. Unlike Pad 4, the majority of soil around and on top of Pad 2 remained in place and was removed ~ 30 feet at a time during retrieval operations.

Prior to operations on Pad 2 the TWISP successfully completed a DOE Readiness Assessment to ensure that all the requirements in the new Authorization Basis document “Bases for Interim Operations (BIO) were implemented. All TSR controls identified in the USQs` were implemented. During Pad 2 retrieval operations, two contamination events occurred. These events are suspected to have been caused by leaking 55-gallon drums, as all crates retrieved on Pad 2 had maintained their structural integrity. These events were not caused by retrieval operation but were the result of container failures while in storage. Contamination level encounter included 3500 dpm/100cm^2 removable alpha (20dpm/100cm^2 is the limit), and 300,000 dpm fixed alpha (2000dpm is the limit). During these events TWISP personnel took immediate actions to contain this contamination. This included applying a contamination Fixadent to contain the contamination. Each event was successfully accomplished with no spread of contamination off-site above any limits as monitored by the Storm Water Pollution Prevention Program, with no airborne contamination which exceeded any limits as evidenced by area CAMs, Fix Head monitors, and site airborne contamination monitors, and with no personnel intakes as evidenced by personnel bioassay results.

During retrieval operations performed at Pad 2 approximately 2,081 drums out of 7280 had either significant corrosion or holes ranging from a pinhole to about 2 inches in diameter. These drums were either immediately overpacked (placed and sealed in an 83-gallon drum) or wrapped in plastic in order to be vented.

All of the crates on Pad 2 were of standard construction size (typically 7’x7’x10’). None of these crates experience integrity failure.

1.1.3 Analysis of Operational Experience, Dome versus No Dome

Based on discussions with TWISP operations, safety, health physics, and management personnel the following discussion identifies both the Pros and Cons of using a dome structure for retrieval operations.

1.1.3.1 Pros

The use of a dome structure allowed for the following benefits:

- Dome acted to some degree as a confinement during the event of a release of radioactive materials
- Dome allowed retrieval of waste during all weather conditions

- Retrieved waste containers could be staged and protected from the environment in the event that the Drum Preparation Facility was full of drums due to a delay in venting operations

1.1.3.2 Cons

- Increased worker industrial safety concerns due to the collection of carbon monoxide due to vehicle operations; heat stress during the summer months; and high silica in the air as the dome acted to contain dust
- Restricted access to the side of the waste array prevented retrieval of waste array from the sides; this is important if the sides of the waste array became unstable.
- Restricted access to the side of the waste array to shore-up array if the sides became unstable
- Performing operations in the dome limited the visibility of operations, as such normal management walk-arounds for safety were impeded making it more difficult to access continuous implementation of safety and TSR controls
- Domes restricted overhead access
- Dome costs approximately $1 million
- Dome construction would delay project for 8 to 12 months

1.1.3.3 Analysis

Based on the above, the primary safety-related function the dome performed was to aid in the containment of radioactive nuclides in the event of an unplanned event. This safety-related function needed to be balanced against the safety-related restrictions a dome causes; mainly it limited access to the sides of the waste array which can potentially became unstable. This was evident on Pad 4 where the plywood framing around much of the waste array was significantly deteriorated and access to the sides of the waste array was necessary. An additional safety concern was being able to have independent management in the Solid Waste Operations and the Waste Facility Management Groups have unrestricted visibility of the project to ensure management walk-around safety assessments of the project.
The TWISP consisted of an experienced team which successfully remediated all three pads of waste with no operational accidents.

1.2 TWISP Process Description

1.2.1 Overall Process

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Once approval was granted for commencement of retrieval operations, overburden removal begin. Overburden removal was minimized so that only the overburden necessary for retrieval operations and or safe waste array configuration was removed. By minimizing the overburden removal, the material at risk from external and natural phenomena events was reduced.

Once overburden removal was sufficient to commence retrieval operations, retrieval operations began. Waste retrieval operations utilized heavy equipment. Retrieved drums were transferred for washing and venting operations, and crates were transferred directly to Area G for storage. Upon completion of washing and venting of drums, custody of the drums were transferred to Area G operations. This process continued until all waste containers were transferred to Area G at which time TWISP operations were secured.

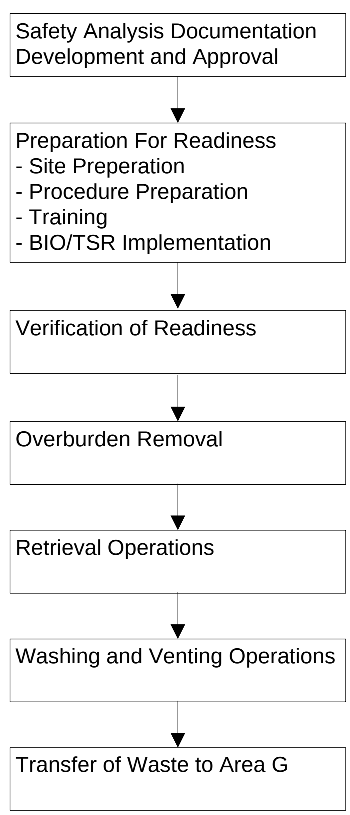


Figure 1-2. Overall TWISP Process

1.2.2 Site Preparation and Maintenance

The TWISP site was prepared for retrieval operations by establishing a controlled access area. The site was posted in accordance with 10 CFR 835 and Resource Conservation Recovery Act requirements. Two main entry points were established: one for heavy equipment and one for personnel. Only authorized personnel were allowed in the retrieval area. The following systems/components were available at the retrieval site or at a nearby location:

- Communication Systems
- Decontamination Shower
- Fire extinguishers for types A, B, C fires
- Fire/Emergency Notification System
- First Aid Kits
- HEPA vacuum equipment
- Industrial Hygiene Monitoring Equipment
- Lightning Protection System
- Overpack Containers
- Personnel Protective Equipment
- Radiation Monitoring Instrumentation per RCT Instructions
- Shoring Material for Waste Array Stabilization
- Spill Clean-up Material

The site was maintained to ensure that combustible loading be maintained as low as reasonably practical. This included the removal of plywood retrieved between the drum layers, removal of the plywood waste array support structure when no longer needed to support the waste array, and the clean up and removal of cleaning/decontamination material. Flammable liquids or gases (other than those used for vehicle operations) were not allowed in the retrieval area, nor was hot work performed in the retrieval area. Refueling operations were performed outside the retrieval area. General housekeeping was performed in order to ensure the safety of worker and protection of workers from trips and falls. These areas of site maintenance were monitored on a periodic basis.

During periods of non-activity or inclement weather the portion of the waste array that has overburden removed was covered with a heavy-duty tarp. This tarp was typically placed over the waste array using an overhead crane. The tarp was of fire resistant construction and primarily used to protect the waste array from rain, snow, and high winds.

Figure 1-3. Site Maintenance

1.2.3 Retrieval

Overburden removal was the first step necessary to retrieve the waste. Prior to overburden removal, soil samples were taken to determine if contaminated soil exists. Soil samples included monitoring for volatile organic compounds (VOCs), gross beta gamma, and gross alpha. All results to date indicated typical background levels for the general site area. If contaminated soil was suspected soil samples were taken and analyzed based on the suspected contaminate and to determine if contamination actually exists. Once this determination was made, a disposition method for the soil was made. Overburden removal was accomplished using heavy equipment as well as manual techniques. The degree of overburden removal was determined by the TWISP Project Leader taking into account the following criteria:

- Overburden removal should be minimized to allow the maximum protection of the waste by the overburden;
- Overburden removal may be required to relieve pressure on the waste array;

- Overburden should be left in place on the sides as appropriate to protect against falling drums during a seismic event or unstable waste configuration.

In addition to overburden removal, the waste array was typically enclosed using plywood framing. This plywood enclosure needed to be removed at the working face to expose the waste. The plywood enclosure was maintained to the extent practical as it aided in the waste array's stability both during operations and during a potential seismic event.

Initial retrieval operations for the day started with a check of the weather conditions. Weather was checked for potential high winds, rain, and snow conditions. If the weather appeared to be acceptable for retrieval operations the tarp was pulled back away from the waste array to expose the waste. The TWISP members along with the safety supervisor visually inspected the waste array to determine the best approach for retrieval for the day. Methods of retrieval toke into consideration the waste array's current configuration and the retrieval philosophy of maintaining waste drums in a stair-stepped configuration as much as practical. The stair-stepped approach was used to minimize the fall distance of any one drum.

1.2.3.1 Drums

The selection of drum handling methods was based on minimizing risk. The method involving the least risk was the method primarily used. Based on container integrity there was varying degrees of risk; thus different handling methods were used. The lowest risk operation was for the drums to be transferred to Dome 33 where they were washed and vented prior to placement in storage. Consideration was given to venting the drums prior to washing as this would reduce the handling events while drums were not vented; however, this option was not chosen since the corrosion inhibitor may actually prevent a proper seal of the vent annulus area thus not allowing the air in this area to be evacuated which could increase the possibility of a drum defragration. Additionally, washing the drums first involved only minor drum movements as the drum washer is in the same dome as the Drum Venting System. As shown in Figure 1-4 there were basically four flow paths a drum could take. These are identified below along with the risks that were avoided as well as the risks that were accepted:

Table 1-2. Drum Handling Philosophy

Drum Handling Method	Risk Reduction	Risk Acceptance
Drum's integrity is acceptable for transportation, washing, and venting	Drum is vented in ASME pressure vessel. Drum can be washed thus allowing a better seal of the vent annulus area during venting.	Drum is washed prior to venting, this represents additional movement prior to venting but this movement is minimal since washing and venting occur in the same building and movement is by manual techniques once delivered to the dome.
Drum's integrity is acceptable to load and transfer for drum washing and venting but needs to be overpacked after venting due to visible corrosion	Drum is vented prior to placement in an overpack for storage and or subsequent movements for characterization/disposal.	Drum having minor corrosion is moved washed and vented prior to overpacking.
Drum's integrity is not acceptable for transportation, washing, and venting; drum is overpacked at the retrieval site	Drum integrity is questionable therefor it is overpacked into a good container	Drum is not vented prior to placement in an overpack for storage and or subsequent movements for characterization/disposal; Overpack is vented
Drum is severely overpressurized and requires remote venting	Drum is able to be vented. Venting process uses an inert gas to minimize the likelihood of a deflagration. Venting is performed with operators at a remote area away from the drum.	Venting of a drum outdoors without a pressure vessel to contain any deflagration. The DVS can not vent bulging drums due to the physical size changes.

Drums were typically retrieved using a forklift with grapplers. The grapplers hug the drums as they are lifted away from the waste array and the drums are then staged for cleaning and surveying. After the drum is safely in the drum staging area, dust and dirt was removed from the drum using HEPA filtered vacuuming or manual cleaning. A thorough radiological survey for contamination was conducted prior to removal of drums from the retrieval site. Should removable surface contamination be detected, worker protective measures were evaluated and contamination-control procedures, such as vacuuming, fixation, or plastic wrapping, were implemented. Additionally, if contamination was found on a drum, the drum grappler were surveyed for contamination in accordance with standard radiological practices. Prior to transporting, the removable surface contamination (if present) was removed or fixed to the drums and the drums were labeled in accordance with radiological and RCRA requirements.

The TWISP database contains the PE-Ci amount for each drum along with the drum ID number. The TWISP extracted this data so that the drum ID number and the associated PE-Ci was know. During operations drum ID numbers were checked to see if they had been identified as a high PE-Ci drum (e.g. >20PE-Ci). Drums identified as containing a high PE-Ci content were tagged with a special red dot label and were processed for transportation, washing, and venting on a priority basis. During transportation only one drum with a high PE-Ci content was transferred per shipment to reduce the consequence of a drum transportation accident. The highest PE-Ci drum (658 PE-Ci) was transferred separately. By limiting the shipment to one high activity drum a conservative estimate of the maximum material at risk for a shipment was made. This was accomplished by assuming the maximum PE-Ci drum (658 PE-Ci) is shipped with 23 other drums (Truck hold 24 waste containers) at the high PE-Ci cut off (20 PE-Ci). Based on this the maximum shipment would be 1118 PE-Ci. As no waste containers contain more than 220 fissile gram equivalents no criticality safety limit was needed for transportation of waste containers.

Drum transfer from Pads 1, 2, and 4 to Bldg 33 where the drums were washed and vented occured over approximately 1400 feet of paved roadway. Drum transfer from washing to venting occured internal to Dome 33. Upon completion of cleaning, surveying, and ensuring the proper labels are attached the drums were lifted on to a vehicle for transportation to the washing and venting area.

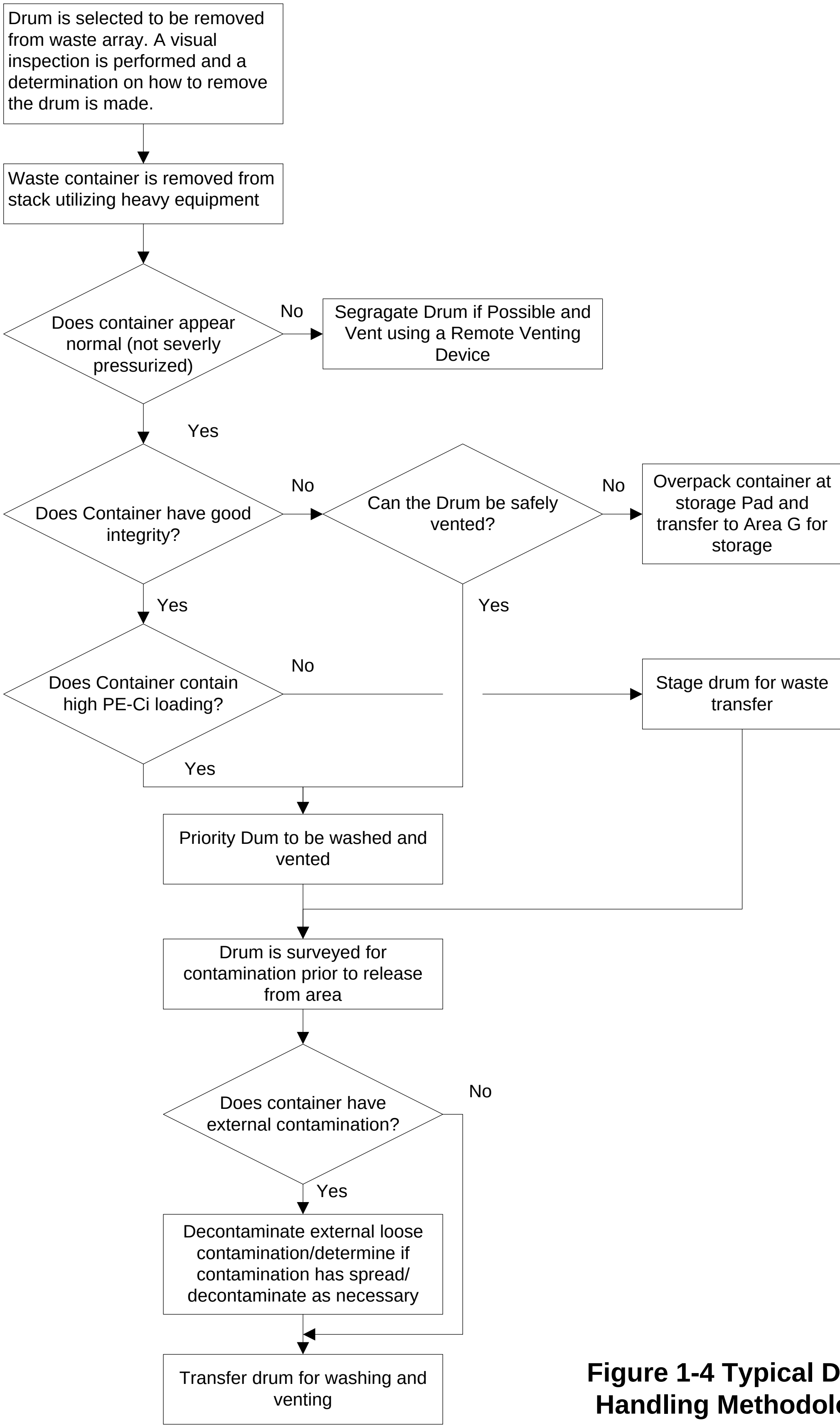


Figure 1-4 Typical Drum Handling Methodology

Figure 1-5. Drum Retrieval Operations

1.2.3.2 Crates

Because FRP crate construction was not standardized when the waste was packaged, crate handling during waste retrieval was handled on a case by case basis. One method for crate retrieval is to remove waste packages around the individual crate, attach a long section of horizontally suspended I-beam (strongback) with fabric slings (which are spread to prevent crushing the top of the container), and lift the crate by strong back with a small crane or a forklift. An alternate method for FRP crate removal may involve using a large capacity forklift. If the bottom of the crate was significantly degraded, a metal sheet could be slid under the crate and the slings would pick the crate up from this new metal base. Damaged crates were handled on a case by case basis. Damaged crates were repaired, overpacked, or repackaged as necessary to support removal from the retrieval area and safe storage in Area G.

Once crates were removed from the waste array they were cleaned to remove excess dirt and then surveyed for contamination and decontaminated as necessary prior to removal from the retrieval area. Crates, unlike drums, were not required to be brought to the Drum Preparation Facility for washing and venting. Once they were surveyed and free from surface contamination they were transferred to Area G where they are stored awaiting processing and subsequent disposal. Storage and repackaging of crates was covered by the Area G Safety Analysis Report and was not the subject to the BIO.

Figure 1-6. Crate Handling

1.2.4 Drum Washing

Prior to placement of drums on Pads 1, 2, and 4, drums were coated with a corrosion inhibitor. This corrosion inhibitor was removed so that the drums can be further examined for corrosion. Removal of the corrosion inhibitor was performed manually or automatically using a drum washer. Manual removal involved coating the drum with a citric solution and removing the corrosion inhibitor with rags or used Anti-Cs as a waste minimization method. Automatic washing of drums was accomplished using one of two Mart Drum Washers. Drum integrity was checked prior to washing and contamination surveys were performed to ensure no external contamination existed. These machines used high pressure (typically 150 psig) and high temperature (typically 150F) water to remove the corrosion inhibitor. This water was supplied through nozzles which atomize the water; thus water jets were not impinging on the drum, which could possibly cause a drum failure. During washing operations, the water contained in a sump at the base of the drum washer was pumped out of the sump through filters and then into the spray nozzles where the drum was located. The system has interlocks to ensure that the drum washing area was closed during washing operations to prevent water spraying with the drum washing area door open. In the event of the water becoming contaminated by a drum, the water was pumped out, transferred to a radioactive liquid waste transport container, and sent to the TA-50 Radioactive Liquid Waste Treatment Facility for processing.

Cleaning water contamination and collection of fissionable materials was minimized by ensuring the drums had been surveyed for contamination prior to placing the drums in the washer. Past contamination events were caused by contamination on the bottom of the drum and lack of surveying the drum's bottoms. To correct this the TWISP developed surveying sticks which allow surveying the bottom of the drum without the need to place a workers hands under the drum. As such, the whole drum could then be surveyed thus reducing the probability of water contamination and the collection of fissionable material.

Additionally, visual inspections were performed on the drums to ensure only drums with good integrity enter the washer. Thus catastrophic drum failure was not expected and did not occur. However, since the corrosion inhibitor was not totally transparent some small pinholes went undetected prior to washing the drum. If a hole was detected water samples were taken in order to determine if the water had become contaminated.

If a drum placed in the washer developed a hole that went undetected and contaminated the water, area surveys and personnel radiation monitoring would provide an effective mechanism to detect that water contamination had occurred. Due to the surveys taken in the area and the personnel radiation monitoring performed was extremely unlikely that fissionable quantities of radioactive materials could collect in the drum washer holding tank. Additionally, if any drum on the Pad inventory developed a hole either during washing or outdoors and water accumulated in the drum the amount of fissile material in any one drum or multiple drums was not sufficient for criticality under any condition, as evaluated by Environmental Safety and Health (ESH)-6. If the drum washing system broke down, drum washing was performed manually.

Figure 1-7. Mart Drum Washer

1.2.5 Drum Venting

1.2.5.1 Drum Venting System Description

The Drum Venting System (DVS) has five main subsystems or components, listed below. The DVS was constructed compliant to Article 670 of the 1996 National Electric Code. With the exception of the motor used for installation of the vent all major electrical components are located outside the glove box and therefore were not required to be rated for explosion.

- **An American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII Containment Vessel (CV).** This pressure vessel was designed for a 50 psi working pressure. It is capable of withstanding a complete deflagration and drum rupture of a waste container with a hydrogen concentration of 30%. A deflagration of this nature could be caused during the filter insertion process and could cause an instantaneous pressure increase of 150 psig in the drum with a resultant drum rupture. The CV has an internal volume that is three times the volume of a standard 55 gallon drum, based on calculations the internal pressure of the CV was not expected to exceed 30 psig during a drum deflagration.
- **A glove box and associated ventilation system** that provides contamination control and access to the CV and vent insertion device (VID). The associated ventilation system keeps the containment vessel and glovebox at a negative pressure with respect to ambient air pressure. HEPA filtration was provided at the ventilation inlet as well as the outlet.
- **A VID** that uses a motor to rotate the drill bit (which is coated to minimize sparking) and the attached HEPA filter and nitrogen pressure to drive the drill bit into the drum lid during HEPA filter insertion.
- **A nitrogen gas and vacuum system and associated piping and controls system** that
  - Evacuated the vent insertion annulus.
  - Purged the vent insertion annulus with nitrogen if elevated levels of hydrogen are detected.
  - Inserted nitrogen into the containment vessel.
  - Controlled lower head horizontal movement.
  - Controlled the closure ring that locks together the upper and lower containment vessel heads.
  - Controlled translational movement of the vent insertion device.
  - Drive pressure for the vent insertion device.

- **A gas detector system** consisting of two hydrogen sensors and one hydrogen analyzer. The system monitors the vent insertion annulus for hydrogen when the drum was being vented. This information was used to determine if purging the vent insertion annulus with nitrogen was required to minimize the chance of a hydrogen deflagration. The vacuum pump mentioned above was used here to collect headspace gases.

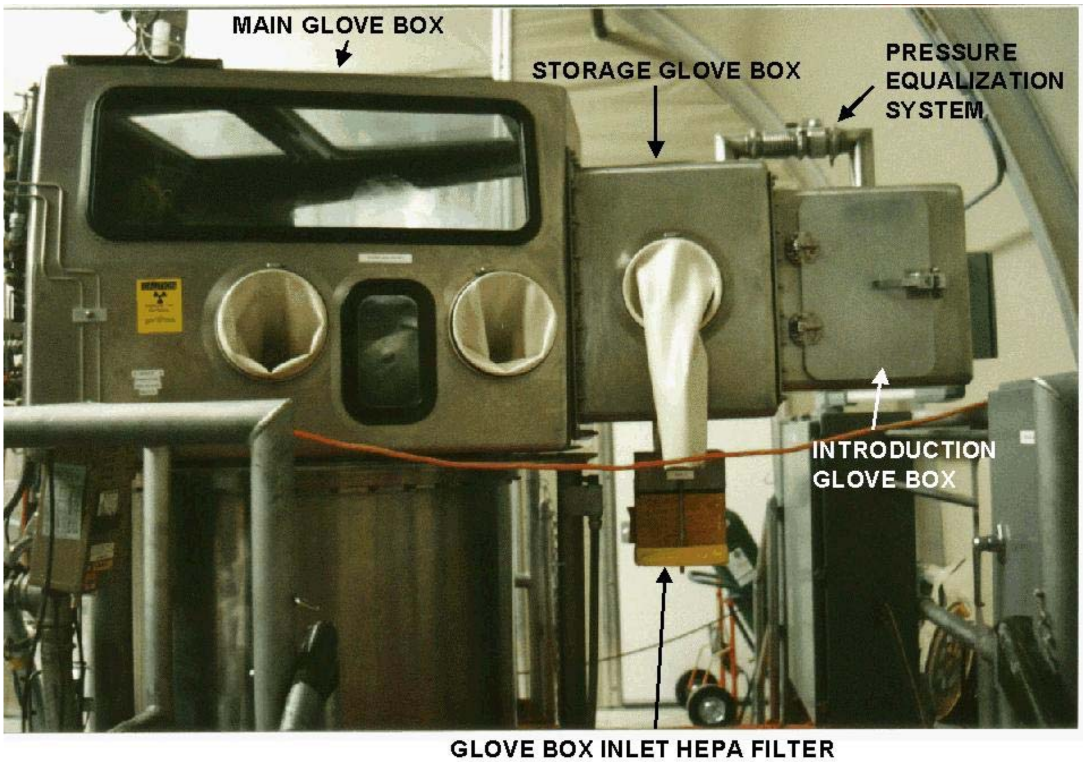


Figure 1-8. Drum Venting System

Venting Operations: The technician prepared the DVS for operation by energizing the system and opening the nitrogen supply valve to the system, below is a description of the system operation.

- **Positioning of the Drum on the Lower Head:** The drum was lifted via a lifting rig and hoist and placed on the CV lower head. Silicon grease was applied to the sealing area where the drum contacted the upper containment vessel gasket to form the vent insertion annulus.
- **Loading of the Drum:** The CV lower head with the drum on top moved horizontally on tracks under the lifted upper head. Motive force for moving the lower head was provided by compressed nitrogen acting on a nitrogen cylinder. A limit switch was utilized to correctly position the drum under the CV upper head. Once the drum was correctly positioned, the ASME screw motor lowered the CV upper head over the drum. The upper head has a centering ring to ensure the drum was placed in the correct position for venting. A limit switch turned off the motor drive when the upper head had completely been lowered. The control system then actuates a solenoid valve, aligning compressed nitrogen to two nitrogen cylinders. This caused the closure ring to rotate locking the CV upper and lower heads together. Limit switches secure nitrogen pressure upon ensuring the closure ring has closed. Once the closure ring was locked in place, nitrogen pressure was supplied to the air spring located within the CV lower head, lifting the drum up against the CV upper head seal and forming the vent annulus area. A load cell in the lower head determined the nitrogen pressure required to lift the drum.

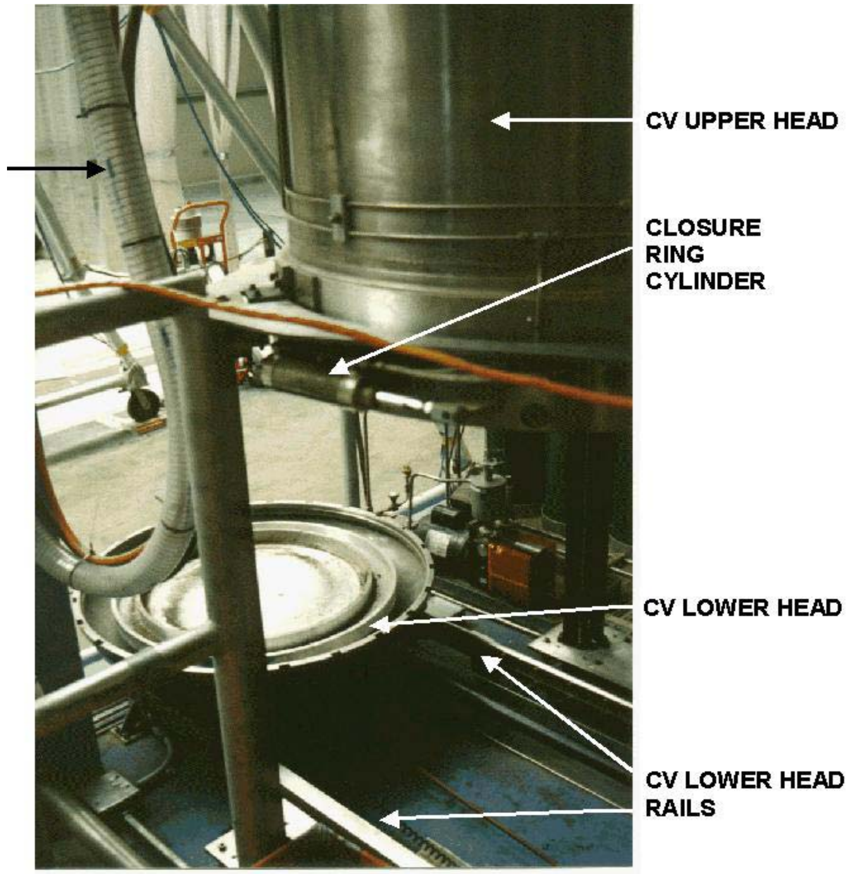


Figure 1-9. Drum Venting System Ready for Drum Loading

- **Sampling and Venting:** After the VID drilled into the drum, the gases contained in the vent annulus area were evacuated through the vent annulus sample line and through the hydrogen analyzer. If the analyzer indicated that the hydrogen concentration were above the lower explosive limit, the system began a series of nitrogen purge and evacuation cycles to dilute the explosive mixture. Nitrogen was supplied to the vent annulus area via solenoid valve. Next, the VID was raised and the filter installation inspected.

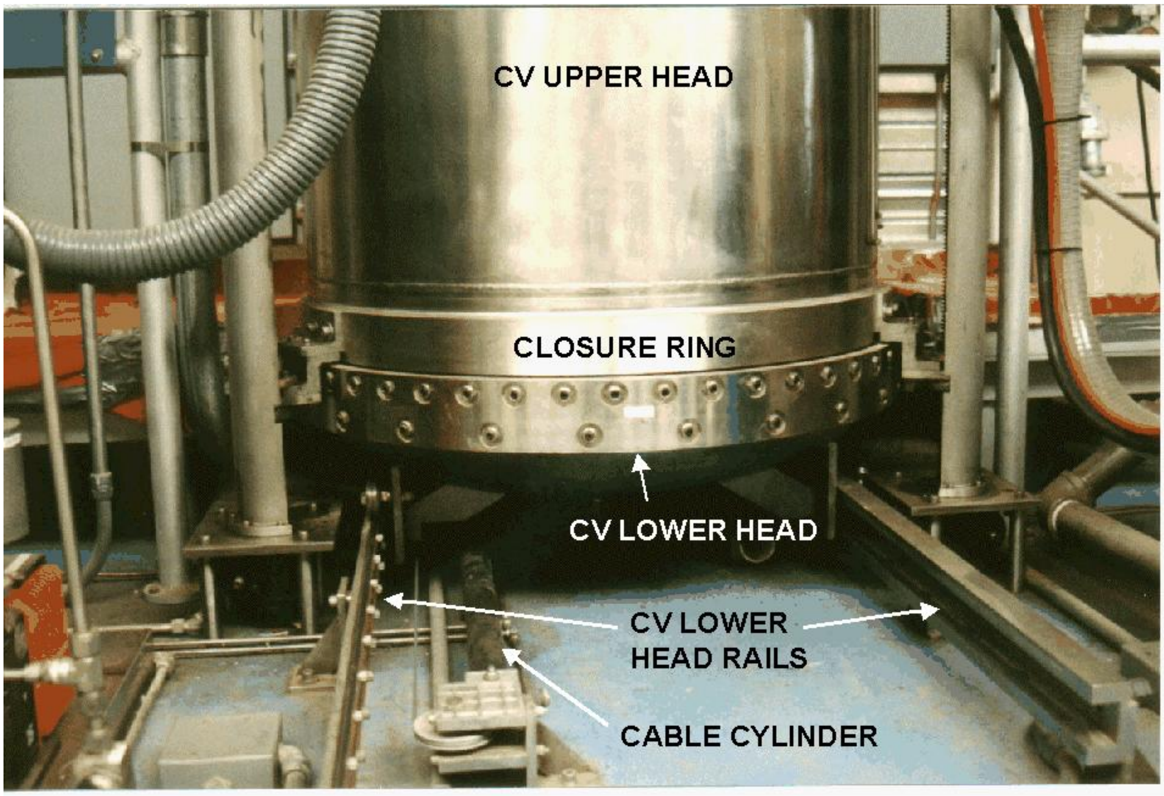


Figure 1-10. Drum Venting System in the Closed Position

- **Drum Removal:** The drum was lowered within the CV by relieving the nitrogen pressure in the air spring. The closure ring was actuated to open, unlocking the upper and lower heads of the containment vessel. The CV upper head was raised and the lower head with the drum was moved horizontally from under the upper head, enabling the vented drum to be removed from the DVS and placed in storage. Drums were surveyed for contamination prior to transferring custody to Area G operations.

1.2.5.2 Remote Venting

As drums associated with the TWISP were stored at the site for over a decade, the possibility exists that the drums would become pressurized. The exact cause of the pressurization is unknown, however, radiolytic decomposition of organic constituents; water/reactive metal reactions, or volatile components in the waste, may all be causes of the over pressurization. Examples of drums that have experienced pressurization are shown in Figure 1-11.

Based on studies (Larranaga & Volz, 1998) pressurized open-top 55-gallon steel drums exhibit the following characteristics when pressurized:

- bulge only occurred at the top and bottom ends
- audible pinging was noticeable between 15 and 20 psig
- drum body seams (top to bottom) experienced no visible distortion or apparent weakening
- drums appear to vent immediately adjacent to the nut and bolt fastener on the ring
- and 100% of the drums tested self-vented at pressures at or below 32 psig

It is important to note that a distorted drum top or bottom only indicates that the drum has been pressurized at one time, it may or may not be currently pressurized. Based on test results, minor deformation of a drum lid (which may or may not be visible to the naked eye) could indicate that the drum contained pressure in excess of 5 psi. Based drum lid distortion meter was developed that can detect an approximately 1.5 cm deformation of the lid. This distortion meter was used as a go/no go for remote venting of drums.

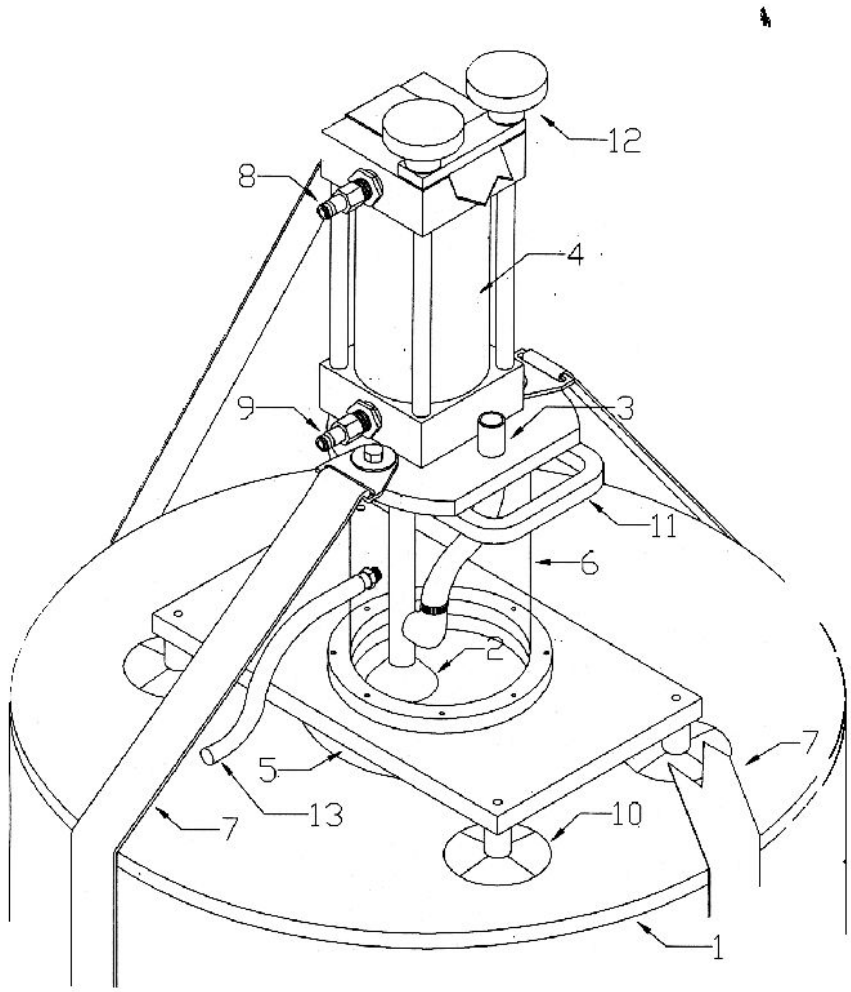
Figure 1-11. Examples of Pressurized 55-Gallon Open-Top Metal Drums

In order to minimize personnel hazards, these drums required venting and filter installation as soon as practical with little to no movement. Movement of a pressurized drum increased the possibility of an uncontrolled venting, therefore an in-situ method of venting drums was necessary. A description of the devices and methods used to accomplish this in-situ venting is found below.

Remote Venting Device: In order to relieve the drum overpressure and provide protection for personnel while venting, a remote venting device (RVD) was developed and is used though out the Laboratory. This device allows personnel to vent and sample the gas space of the drum from a safe distance.

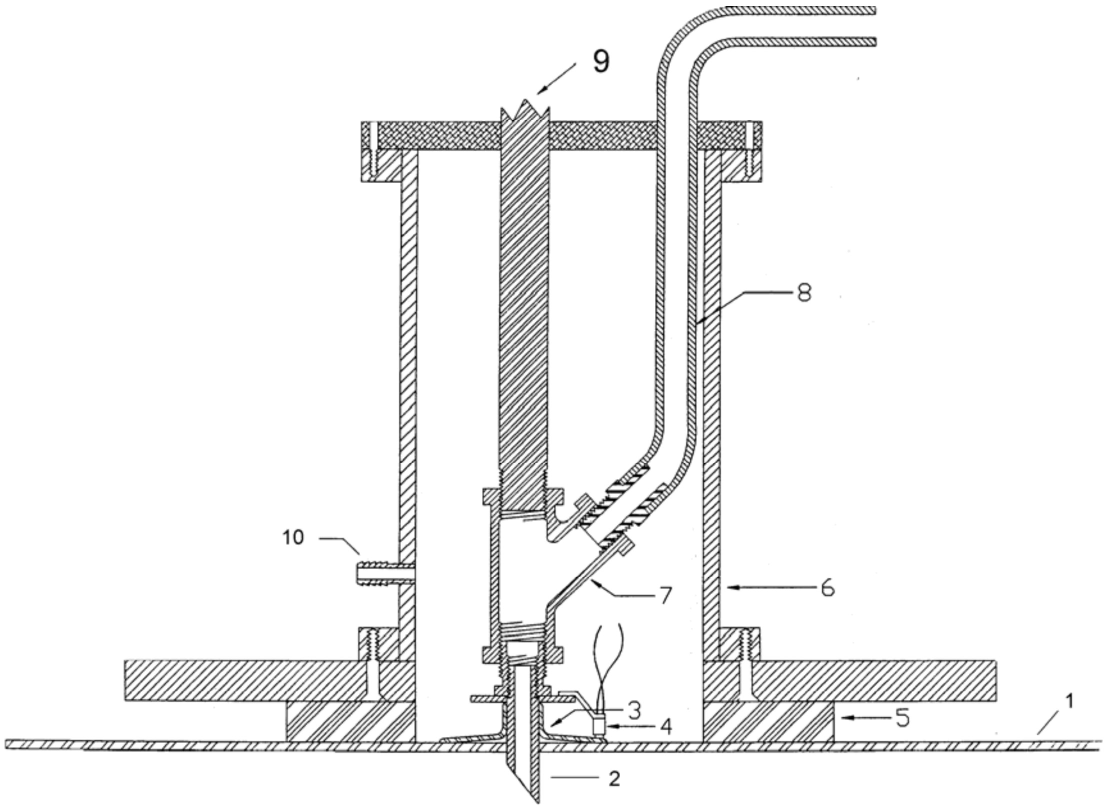
Figure 1-12 depicts a typical RVD on a drum and points out salient features. Note the RVD may be placed on top, bottom or side of the drum. Figure 1-13 depicts a typical cut-away of a RVD and points out design features. As shown on Figure 1-13 the RVD in installed to the top of the drum using straps, if the RVD was to be installed on the side these straps would be relocated to around the sides of the drum. The RVD is light enough as to not topple the drum on a side installation. Figure 1-14 depicts a typical control unit. Note actual control units will vary in composition and construction, but they will all perform the same tasks.

The air hose connections on the control unit and the RVD have been sized to ensure that the air hose connections could not be hooked-up incorrectly. If inert gas is used, the inert gas tank will also required a reducer and additional hose lines.



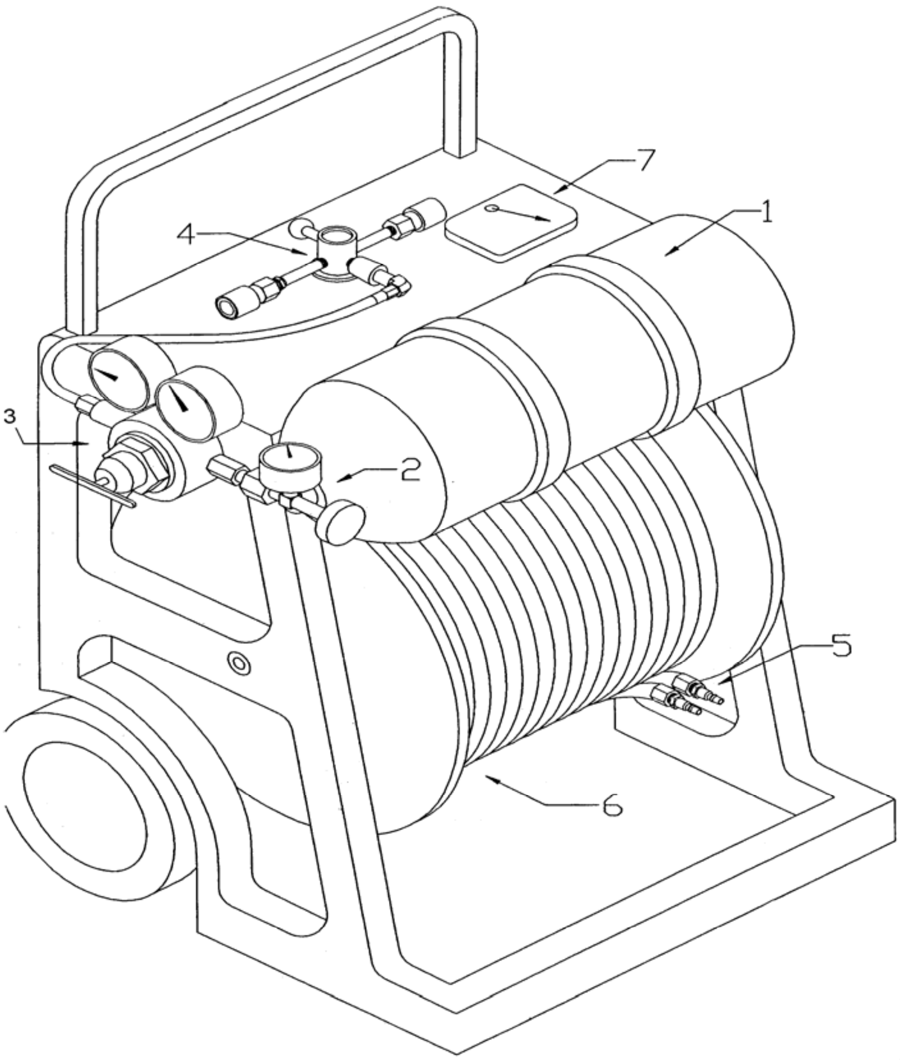
1. Drum or container to be vented.
2. Rubber primary seal.
3. Vapor and liquid vent hose.
4. Pneumatic cylinder
5. Foam rubber secondary seal.
6. Clear polycarbonate secondary housing.
7. Adjustable straps for securing the Drum Device to the container being vented.
8. Pneumatic connection to control unit (figure X.X-4 item #5)
9. Pneumatic connection to control unit (figure X.X-4 item #5)
10. Rubber mounts.
11. Carrying handle.
12. Clamp down screws for centering the RCSD.
13. Inert gas entry hose.

Figure 1-12. Typical RVD Mounted on a Drum



1. Surface of barrel or container being sampled.
2. Hollow sampling needle.
3. Rubber primary seal.
4. Ram travel contact switch (optional).
5. Rubber secondary seal.
6. Clear polycarbonate secondary containment.
7. Drum head space vent and sampling connection.
8. Hose to external collection tank or sampling device.
9. Pneumatic ram shaft
10. Connection for inert gas line.

Figure 1-13. Cut-Away View of Typical RVD Below Ram Cylinder



1. Compressed air tank.
2. Tank valve and pressure gauge.
3. Pressure regulator.
4. Control valve.
5. Air hose fittings. Note one end of each hose (2 hoses) is attached to the control unit (figure X.X-2 items #, 8 and 9) and the other end is attached to the control valve, #4 above.
6. Air hose reel to hold 2 air hoses.
7. Ram travel indicator.

Figure 1-14. Typical Control Unit

Remote Venting Device Operations: Upon discovery of an over pressurized drum all work within the retrieval area stopped to address the over pressurized drum. The drum's condition was assessed for both corrosion and location. Corrosion was assessed to determine possible locations to attach the RVD and assess the effect of attaching the RVD. The drum location was assessed to determine if the RVD could be installed without moving the drum from the waste array or whether due to the drums location on the waste array it was necessary to remove the drum to allow for worker safety when installing the RVD. In either case, moving of the drum while not vented was minimized. Identification of over pressurized drum was performed both visually by inspecting for gross bulging and by using a lid defection device. Next the RVD was secured to the drum using the hold down straps. The system was assembled for operation, this included connection of the innerting gas and the control unit. The control unit and all personnel involved in the venting process were located approximately 100 feet from the drum being vented. All unnecessary personnel were greater than 100 feet from the drum being vented. The vent area or secondary containment space was inerted now if required. The control unit was set up at a safe distance from the drum. The control unit was then pressurized, applying high-pressure air to the top of the ram lowering the sampling needle and venting the drum. A sample was then taken using the sampling line. To retract the ram, high-pressure air was directed to the underside of the ram while the high-pressure air above the ram was bled. The RVD and air hoses were inspected for contamination. The air hoses wase removed and the RVD unstrapped from the drum. The sampling needle was inspected for contamination and cleaned or disposed of as required. The puncture hole was either plugged or a venting device installed.

1.3 Facility Description

This section provides a description of Building 54-33 and the site support systems.

1.3.1 Drum Preparation Facility, Building 54-33

The Drum Preparation Facility (Building 54-33) is a single-story, aluminum arch-frame-supported, membrane-covered dome with an attached cement block annex. This building was erected in 1989 and was enlarged in 1994. Building 54-33 has a gross floor area of approximately 465 m^2 (5000 ft^2) with 350 m^2 (3750 ft^2) covered by the aluminum arch-frame building and 116 m^2 (1250 ft^2) covered by the annex building. The perimeter of the dome is provided with a concrete curb except at the dome access doorways, which are ramped. The layout of Building 54-33 is shown in Figure 1-15.

The dome is separated from the building annex by non-fire-rated, motorized roll-up doors set in concrete block construction. The fabric covering the aluminum arch frame serves as the interior and exterior wall and roof/ceiling membrane. This portion of the building was used to stage containerized waste and housed the transportable drum venting system.

Conditioned air is provided to the dome by a forced return convection system installed outside the dome. Dome heating is provided by overhead mounted infrared heaters**.** The hot water supply used for drum washing is also electrically heated.

The dome portion of the building has no partitions and there are two wash bays at the east end for decontamination of waste containers, vehicles, and other equipment. Drum venting was performed in the dome. Access into the dome is provided through large clamshell type doors, one at the west end and one at the southeast end. Access into the annex is through two smaller roll-up doors. There are personnel access doors to both the annex and the dome.

The Building 54-33 floor surfaces are sloped to direct liquids through a series of trenches that lead to a solids separator unit. The liquid is pumped automatically to two adjacent 18,925-l (5000-gal) enclosed steel tanks. When these tanks are full, the liquid is tested for applicable RCRA constituents and gross alpha and beta activity and transferred by tank truck to TA-50 for treatment. The entire liquid-collection system in Building 54-33 is contained in a cement catch basin that has a capacity greater than that of the tanks and the solids separator unit. The content level in the tank is monitored with a high-level indicator cutoff switch to the pump.

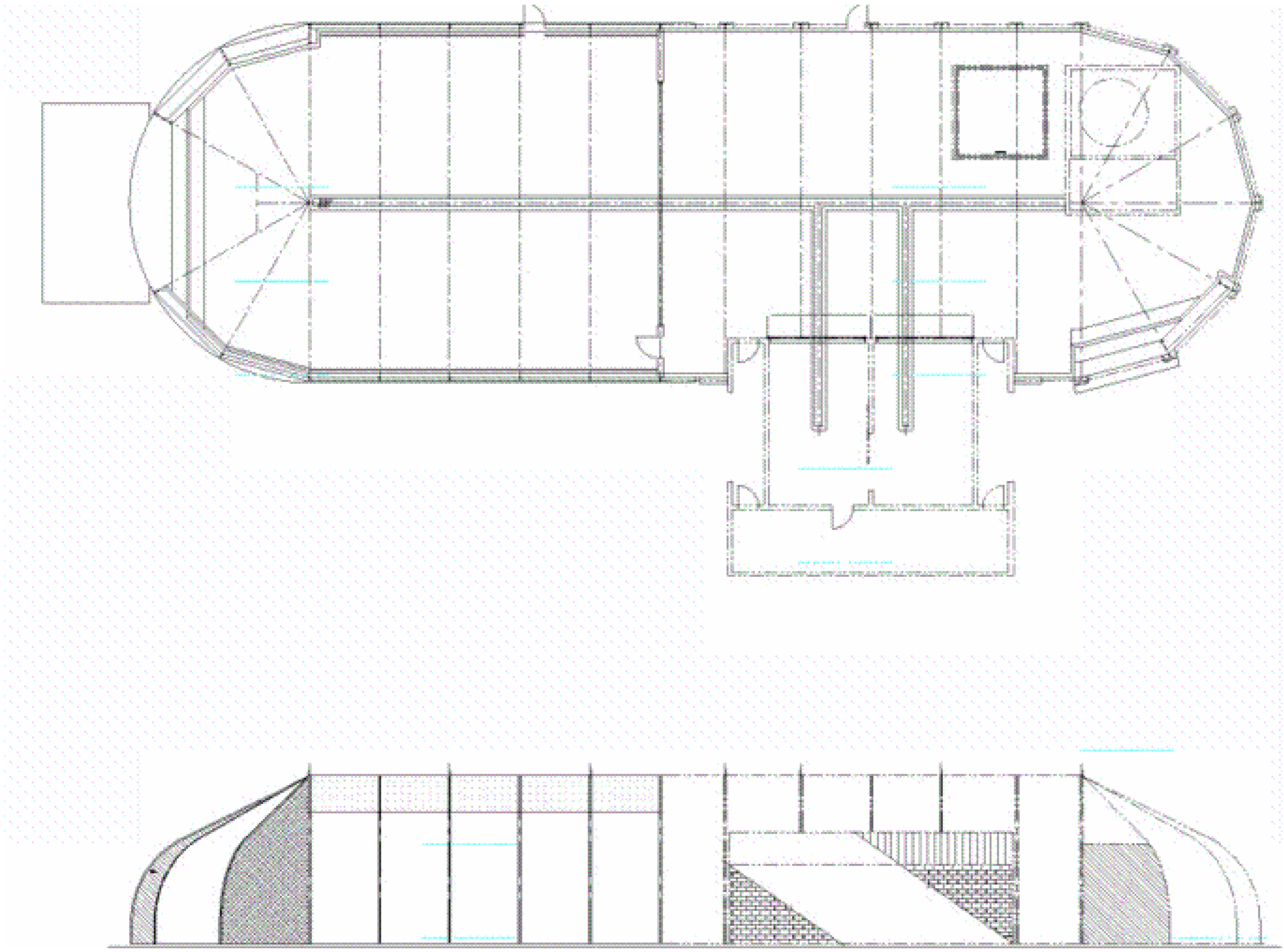


Figure 1-15. Building 54-33 Layout

A dry pipe fire suppression system is installed in Building 54-33. The system includes a sprinkler system with detection and notification capabilities.

The fabric used to cover the domed portion of Building 54-33 is similar to that used to cover each of the Area G domes. Fire testing of these fabrics under the criteria of NFPA 701, *Standard Methods of Fire Tests for Flame-Resistant Textiles and Films*, and American Society for Testing and Materials (ASTM) E-84-89a, *Report of Tests: Surface Burning Characteristics of Building Materials* (UST 1991) indicates that they are fire resistant. Based on the testing, the dome fabrics have a flame spread index of no more than 25 and a smoke development of no greater than 450, which satisfies the criteria of a Class A interior finish under NFPA 101 and is evaluated under NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

Information obtained from dome manufacturers indicates that the heat of combustion for the dome fabrics used at Area G varies from 17.9 MJ/kg (7,700 Btu/lb) for the polyvinyl chloride (TEDLAR™) content to 21.7 MJ/kg (9350 Btu/lb) for the polyvinyl fluoride content. NFPA 220 limits the potential heat value (heat of combustion) of limited-combustible materials to 8.1 MJ/kg (3500 Btu/lb). Because the potential heat value of the dome fabrics used at Area G exceeds the established NFPA 220 limit, these fabrics are not considered to be limited combustibles. However**,** because of the limited amount of fabric used per unit area of dome and considering the fire resistance of these materials (Class A), these fabrics are not expected to significantly contribute to a building's combustible loading or provide a propagation path for fire within dome-covered areas. However, the potential heat value of these fabrics classifies Building 54-33 as Type V, combustible construction under the UBC, and Type V (000), combustible construction under NFPA 220.

The construction of the building annex is concrete block on a concrete slab with a flat, built-up roof on a steel deck. The annex building is partitioned by two tee-configured walls and is constructed of concrete-block that is not fire-rated. The north-south wall separates two wash bays. The wash bays provided an area to clean equipment or decontaminate waste containers. The east-west wall in the south end of the building separates the wash bays from an equipment room. The ceiling of the annex is constructed of painted gypsum board. The interior finish of the building annex consists of painted concrete block, gypsum board, and finished concrete surfaces, which is considered Class A under NFPA 101. The construction of this portion of this building is Type II-N noncombustible construction under the UBC, and Type II (000) noncombustible construction under NFPA 220.

Decontamination of vehicles, equipment and metal waste containers may be performed in the annex. Steam is available for cleaning equipment or externally contaminated waste containers, and all water is collected and drained to a holding tank. Contaminated water is sampled and sent to an appropriate off-site facility for processing.

Drums could also be sanded and painted in Building 54-33 Annex. Sanding consists of using hand held sanding paper to remove tarnish, light corrosion, and small rusty areas from drums determined to be of sound integrity. Drums contained waste during the activity. If a drum's integrity was suspect, the drum may be discarded from use if empty, or overpacked if it holds waste.

1.3.2 Site Utilities and Support Systems

1.3.2.1 Radiation Monitoring

Radiation monitoring devices, located throughout Area G, consisted of continuous air monitors; fixed-head air monitors; portable alpha, beta/gamma, and neutron detectors; tritium monitors; and personnel monitors. These systems served to monitor and alert personnel to the presence of airborne contamination, elevated direct radiation, or contamination.

1.3.2.2 Fire Protection

All buildings and domes at Area G are equipped with portable fire extinguishers, manual alarm pull stations, and notification appliances. Fire hydrants are located throughout Area G in a manner that ensures that there are at least two hydrants within 300 feet of each dome. Fire protection is provided in accordance with applicable NFPA requirements. Fire alarm signals are transmitted to the Los Alamos Fire Department (LAFD) through panel 48 via the BRASS system. No fire-fighting brigade or support vehicles are resident at Area G. Response to fire emergencies included the Laboratory Fire Protection Office and the LAFD.

1.3.2.3 Lightning Protection

Lightning protection is provided to the power-pole grid distribution system. The lightning protection coverage includes all of the important facilities in Area G. All facilities not equipped with a power pole grid system have air terminals, down leads, and counterpoise systems. These systems meet the requirements of NFPA 780, *Standards for the Installation of Lightning Protection Systems.*

1.3.2.4 Communications

The communication and emergency notification system at Area G consists of multiple, independent systems to ensure prompt personnel notification in the event of a site emergency. This system includes telephones, radios, evacuation alarms and strobes, and a public address system. Both building and pole-mounted telephones are available at Area G and phone locations have a listing of emergency response numbers. The public address system consists of a transmitting station and pole-mounted speakers located throughout Area G. In addition, windsocks are provided throughout the area to inform personnel of wind flow patterns to aid in route selection for emergency escape and retreat during airborne release of radioactive or hazardous materials.

1.3.2.5 Miscellaneous

Area G is surrounded by an industrial exclusion fence topped with razor wire. Traffic and personnel entry to the site was permitted through a monitored access control gate at the west end of the complex; another gate is located at the east end of Area G for access by TWISP project personnel.

Vehicle traffic is moderate at the site and includes vehicles varying in size from very small utility trucks to large earth moving equipment. Roadways are kept in good condition and the area has a posted limit of 20 mph. During waste receipt and offloading times, additional traffic restrictions were sometimes employed as a safety precaution.

Decontamination and emergency showers, eyewash stations, and PPE are available throughout the site area. The domes are equipped with skylights (i.e., light colored panels) and are not supplied with emergency lighting.

There are three emergency muster stations strategically located within the Area G to provide personnel accountability and controlled communications in the event of emergencies. An emergency crash gate is located at each of the stations along the south fence line that heads to a marked trail that leads to a designated pick-up area on Pajarito Road.

Cost and Schedule

Cost

TWISP FUNDING AND COSTS - FY94 - FY98

FY	FUNDING	COSTS
94	7,433,374	2,682,877
95	6,563,451	7,075,532
96	4,843,226	3,274,168
97	5,650,290	5,101,082
98	5,921,000	3,973,674
99	4,672,673	5,391,774
00	3,890,500	3,005,017
01	4,405,400	4,271,193
02*	4,800,000	920,099
03*	4,700,000	0
04*	785,000	

FUNDING (FY94 Through FY99)	35,084,014	35,695,416	**Costs projected for FY02**
***ANTICIPATED FUNDING (FY00 Through FY04)**	18,580,900		

TOTAL TWISP FUNDING (Projected)	53,664,914	**TOTAL TWISP COSTS (Projected)**	35,695,416

TWISP COST SAVINGS (Projected)	17,969,49

Retrieval of drums completed December 2001 and drum venting will be completed in 2nd Quarter FY02

Schedule

The New Mexico Environment Department (NMED) Consent Agreement called for the following schedule.

Waste from this pad . . .	will be placed into storage by . . .
1	September 30, 1998
4	September 30, 2000.
2	December 8, 2003.

Lessons Learned

Acknowledgements

The author would like to acknowledge the technical supervision provided for SWO-FWO by Charlie Villarela, contractor support by William Gonzales, Ken Shisler, and Robert Baran, health physics coverage by Robby Ruby and Cheryl Olson, Group support by Ray Hahn and the SWO team, Division support by Anthony Stanford and Beverly Ramsey, Program Office support by Kenneth Hargis and Beverly Martin, OLASO support by David Gurule, Joe Vozella, Chris Steel, James Nunz and Chris Murnane, DOE-AL support by James Orbin, and Joel Grimm, Nuclear Operations support by Davis Christensen, Rick Martinez, Gabriel Valdez, Rodney Zamora and all the TRU storage team, Authorization Basis by Carl Schepens and Eric Johnson, Facility support by Dennis McLain and all the WFM support team, Integrated Project Management Support by Debbie Lewis, Connie Brown, and

Fernando Quintana, the New Mexico Environment Department, and finally the JCNNM TWISP crew who made it happen. The report was capably edited by Bruce Swanton.

1.5 References

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