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Design Basis Memorandum for Material Disposal Area A, Los Alamos National Laboratory, Los Alamos, New Mexico, Rev. 0

Los Alamos
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Prepared by Environmental Programs–Technical Area 21 Closure Project

Los Alamos National Laboratory (LANL), operated by Los Alamos National Security (LANS), LLC, for the U.S. Department of Energy under Contract No. DE-AC52-06NA25396, has prepared this document to support the investigation and cleanup, including corrective action, of contamination at LANL, as required by the Compliance Order on Consent, signed March 1, 2005. The public may copy and use this document without charge, provided that this notice and any statement of authorship are reproduced on all copies.

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Acronyms and Abbreviations

cpm	counts per minute
DOE	Department of Energy
DP	Delta Prime
DSA	documented safety analysis
EMI	electromagnetic induction
ENV-ERS	Environmental Stewardship–Environmental Remediation and Surveillance Program
EP	Environmental Programs
ERRS	Environmental Remediation Support Services
GPS	global-positioning system
GPR	ground-penetrating radar
HIR	historical investigation report
HSR	Health Safety and Radiation Protection Division
IIS	inventory isolation system
IMP	implementation procedure
IWD	integrated work document
IWM	integrated work management
LANL	Los Alamos National Laboratory
LIG	Laboratory implementation guidance
LIR	Laboratory implementation requirement
MDA	material disposal area
NES	nuclear environmental site
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
QP	quality procedure
RCRA	Resource Conservation and Recovery Act
S&M	surveillance and maintenance
SOP	standard operating procedure
SSHASP	site-specific health and safety plan
SWMU	solid waste management unit
TA	technical area
TSR	technical safety requirement
WCSF	waste characterization strategy form

1.0 GENERAL

1.1 Purpose of Criteria

In November 2004, the Los Alamos National Laboratory (LANL or the Laboratory) submitted a Documented Safety Analysis (DSA) for surveillance and maintenance (S&M) of Nuclear Environmental Sites (NES) in accordance with Chapter 10 of the Code of Federal Regulations Part 830 (10 CFR 830), Sub-Part B, "Safety Basis Requirements," and Section 204 of 10 CFR 830, "Documented Safety Analysis" (LANL 2004, 88713). A safety evaluation report (SER), issued in January 2005, summarizes the basis upon which the Department of Energy (DOE) and the National Nuclear Security Administration (NNSA) approve the Laboratory's DSA and the technical safety requirements (TSRs) for NES in accordance with 10 CFR 830 (DOE 2005, 88752).

To implement the DSA, specific S&M functions are required to ensure that the integrity of the NES is maintained. Current conditions are determined by environmental drilling and sampling to assess the nature and extent of contaminants at the site. The Laboratory's Environmental Programs (EP) for Technical Area (TA) 21, formally a functional group of the Environmental Stewardship Division–Environmental Remediation and Surveillance (ENV-ERS) Program, implements characterization and corrective actions pursuant to the conditions of the Compliance Order on Consent (hereafter, the Consent Order), dated March 1, 2005. Characterization of nature and extent of surface and subsurface contaminants at the MDA A NES are regulated under the Consent Order.

The following sections quantitatively and qualitatively identify system components and design features. Where applicable, results of past investigations, such as geophysical surveys, are added to enhance reader understanding of the site.

1.2 Scope of Work

The scope of work is to define the inventory isolation system (IIS) using the design basis processes defined in Environmental Remediation Support Services (ERSS) quality procedure (QP) 6.1. The design basis fulfills requirements of the DSA for surveillance, maintenance, and inspections. All proposed activities will be conducted in compliance with the requirements of the administrative and access controls established in the S&M DSA to ensure IIS effectiveness against the release of nuclear or hazardous materials.

2.0 BASIC DATA

2.1 Facility Description

MDA A, also designated solid waste management unit (SWMU) 21-014, is one of five MDAs located within TA-21 on Delta Prime (DP) Mesa. MDA A is located south of the North Perimeter Road as depicted in Figure 2.1-1. It is an inactive subsurface disposal area containing two buried steel tanks (the General's Tanks), two unused vertical shafts, a central disposal pit, two eastern disposal pits, and a former (surface) drum storage area. The 1.25-acre facility is enclosed in an access-controlled fenceline and designated a NES. MDA A is designated as a DOE Hazard Category 2 nuclear facility based primarily on inventory of materials in the General's Tanks.

MDA A was used intermittently for waste disposal from 1945 and 1949 and later again between 1969 and 1977. The history of disposal facilities and uses is presented in the historical investigation report for MDA A (LANL 2005, 88052) and is summarized below:

- The General's Tanks were constructed in 1945 and initially filled between 1945 and 1946 (Rogers 1977, 05707).
- The eastern pits were constructed in 1944 and 1945 (Rogers 1977, 05707) and used into 1946, Figure 2.1-2 shows the pits during the active period.
- The central pit was constructed in 1969 to receive demolition debris from TA-21. It was enlarged in 1972 (Rogers 1977, 05707) and used until 1977 (Figure 2.1-3).
- The drum storage area was active during the late 1940s and early 1950s (Gerety et al. 1989, 06893) and was used for surface storage of several hundred 55-gal. drums containing a sodium hydroxide solution and stable iodine solution used to scrub ventilation exhaust air (LANL 1991, 07529, p. 16-244). Corrosion of the drums resulted in liquid releases to the local surface soils (Emelity 1978, 00487). The drums were removed in 1960, and the storage area was paved (LANL 2005, 88052)
- The two vertical shafts were constructed in 1975 (ENG-R-4457 [LASL 1976, 24891) but backfilled with soil in 1977 (Shaw Environmental, Inc., 2004, 87448). No waste was placed in the shafts, and they were never used.
- The MDA A site was decommissioned in 1978 when crushed tuff cover was placed over the entire site. Later surface activities included seeding and applying gravel to the north side (Gerety et al. 1989, 06893).

2.2 Functional Requirements

The waste units at MDA A are described in the DSA for S&M of NES at LANL (LANL 2005, 88713) in the context of an IIS comprised of a series of barriers creating a level of protection for the public and local workforce from exposures to materials buried therein. The barrier components defined are described below.

Primary Containment Vessels. Primary containers help ensure that buried inventory remains in its location and form and can help protect the inventory from intrusion by activities or outside forces.

Configuration of Burial. The configuration of buried inventory affects its vulnerability to activities and outside forces and also can mitigate the amount of material that could be released if containment were breached. For example, pencil tanks (long and thin), with their long axis oriented vertically, offer much less surface area for potential inadvertent intrusion through drilling or other activities. In addition, if they were breached at one spot, because of their geometry, very little of the inventory should be affected.

Burial Depth. Depth of burial provides protection of the waste from surface activities and other external forces. It also limits the amount of direct radiation exposure a receptor on the surface could experience because of the self-shielding provided by the buried inventory and by the clean, interspersed fill material.

Inventory Distribution. Distribution (rather than concentration) of the inventory, primarily serves as a barrier to the release and distribution of concentrated hazardous materials. In sites where the inventory is spread throughout large soil or sediment volumes, the amount of material that could be released by any single event is extremely small. Likewise, where inventory is distributed throughout pits, trenches, and

shafts, it is extremely unlikely that any single event or action could affect more than a fraction of the inventory.

Thickness and Characteristics of Cover Material and Caps. The prime function of cover materials and caps is to ensure that the inventory is not affected by actions or events at the surface. Thicker cover and caps provide more protection than thinner cover/caps made of the same material. Caps of concrete provide greater protection than asphalt caps, which are more robust than packed earth caps. Consideration of the characteristics of thickness and material allow assessment of the relative importance of these features to protect against the suite of hazards at the different sites.

These passive features are important to prevent or mitigate the release of hazardous materials if some aspect of containment is disturbed. Covers, caps, and overburden can also prevent some worker accidents, such as vehicles or workers falling into pits or shafts. The configuration of the IIS is not uniform for the NES and does not always incorporate all of the elements listed above.

2.3 Process Description

2.3.1 Utilities

Figure 2.1-1 identifies utility systems in the vicinity of MDA A, and the structures are briefly described below.

- MDA A currently possesses no known utilities within the fenceline of the area.
- Original power and light poles that existed north of the area around the time of original construction of the General's Tanks were moved south to inside the fenced areas of MDA A between 1948 and 1949, apparently corresponding with the construction/upgrade of the access road along the north side of the area (Gerety et al. 1989, 06893). The light poles and electrical service have since been removed.
- An active 4-in. acid waste transfer line from a sump at the Tritium System Test Assembly facility to Building 21-257 runs along the north side of the area, between the North Perimeter Road and the northern MDA A NES fenceline, along with an associated buried electrical controls circuit conduit.
- An active 6-in. natural gas main, transecting the DP Mesa, passes within 10 ft of the west fenceline of MDA A nearest the General's Tanks. A section of the pipeline exists abovegrade just west of the NES.
- A steam distribution pipeline exists approximately 100 ft south of the NES.
- A pair of east-west-oriented water lines lie 50 ft north of the MDA A northern fenceline, north of North Perimeter Road.

2.3.2 Facility Layout

The MDA A facility layout is provided in Figure 2.1-1. The figure depicts the best estimate of the structures and fencelines based on engineering drawings and photographic evidence. Sometime prior to 1965, based on photographic evidence (Gerety et al. 1989, 06893), the MDA A fenceline boundaries were extended to the east to include the parking lot of removed facility DP-151. Historic photographs of MDA A are provided in Figures 2.3-1 through 2.3-4. The photographs and engineering drawings ENG-C-2076 (LASL 1945, 24448), ENG-C-2078 (LASL 1945, 24450) and ENG-R-4457 (LANL 1976,

24891) have been used to modify the facility map to what is presented in Figure 2.1-1. The map represents the best resolution of available spatial information.

2.3.3 Site Information

The following sections present a brief description of the MDA A site. Additional site information is summarized in the MDA A HIR (LANL 2005, 88052.65).

2.3.3.1 Soils

- Pits and excavations at MDA A penetrate into Unit 3 of the Tshirege Member of the Bandelier Tuff, also known as Qbt 3. Fracture joints are generally near vertical to vertical in the area (LANL 2005, 88052.3).
- During excavation of the central pit, soil overlying bedrock was 2 to 5 ft thick (LANL 2005, 88052.3). Loose soils over bedrock materials in the area are derived from the weathered tuff materials.

2.3.3.2 Investigative Surveys

2.3.3.2.1 Geophysical Surveys

- A 1989 geophysical survey (Gerety et al. 1989, 06893) of MDA A utilized a wide array of geophysics techniques, including electromagnetic induction (EMI), resistivity, magnetic methods, self-potential, and ground-penetrating radar (GPR). Only through combination of the techniques were all of the known MDA A disposal units successfully verified. Three undocumented objects were also noted.
- A 2006 geophysical survey (ARM Group Inc. 2006, 92718) of MDA A was successful in verifying the position of and depth to the concrete slab overlying the General's Tanks, the approximate location of the General's Tanks, and the locations of each of the three waste pits. Figures 2.3-5 and 2.3-6 illustrate the GPR and EMI survey results.
- A large near-surface metallic object at the north side of the General's Tanks was identified in the conductivity portion of the 2006 survey. The 1989 survey EMI conductivity quadrature component indicated a similar anomaly.

2.3.3.2.2 Radiological Surveys

- A 2006 radiological surface walkover survey was performed in conjunction with the MDA A investigation (ERG 2006, 92505). Areas north of MDA A and downslope in DP Canyon were also included in the survey. Sodium iodide and FIDLER detectors were used to scan for high and low-energy emissions.
- The survey identified ranges for gamma radiation from 9475 counts per minute (cpm) to 22,369 cpm with a mean value of approximately 16,500 cpm. Alpha radiation ranged from 6097 cpm to 26,909 cpm with a mean of approximately 19,200 cpm. Both alpha and gamma readings were generally greatest in the canyon north of MDA A. Figure 2.3-7 illustrates the FIDLER results for low-energy gamma emitters (e.g., americium-241).

2.3.3.3 Position Surveys

- MDA A was included in 2005 LANL surveys and 2005 flyover photography, surveyed with airborne global-positioning system (GPS) control and inertial measurement unit data and the ground control points acquired under the supervision of a registered surveyor at sufficient density and accuracy to support production of digital orthophotography to the specifications required. Survey controls were collected in New Mexico State Plane, Central Zone, NAD83 and NAVD88.
- On-the-ground measurements taken by the Environmental Stewardship–Environmental Characterization and Remediation Group in March 2006 have confirmed the accuracy of the MDA A fencelines, as represented in the 2005 digital orthophotograph of the area. Table 2.3-1 provides the measured (submeter accuracy) GPS coordinates for the vertices of the NES fence in comparison to the vertices presented by the SER (LANL 2005, 88713). The coordinates correspond to the NES fence coordinates.
- The 2005 flyover orthophotograph is included in Figure 2.1-1 as the background image.

2.3.3.4 Climate and Groundwater

- The semiarid LANL climate provides a low precipitation rate with infrequent soaking rains and a high evapotranspiration rate, which limits the amount of moisture percolating into the waste units at MDA A, subsequently limiting the amount of water available to leach contaminants from the units and transport them in the soil.
- A very thick, relatively dry, unsaturated zone below MDA A helps to limit downward migration of dissolved contaminants to the regional aquifer.
- Per the MDA A investigation work plan, the regional aquifer lies about 1265 ft below the ground surface at MDA A (LANL 2005, 88052.3).

2.3.3.5 HAZMAT

- As a result of materials disposed at MDA A, work activities that generate waste materials from MDA A have the potential to generate wastes governed under a variety of regulatory requirements.
- MDA A chemicals of potential concern include arsenic, cadmium, chromium, copper, lead, manganese, mercury, silver, uranium, vanadium, zinc, americium, plutonium, thorium, tritium, acetone, bis(2-ethylhexyl)phthalate, and methylene chloride (LANL 2005, 88052.65).
- Wastes generated from MDA A soils or materials in contact with disposed wastes are suspect for constituents and characteristics governed under the Resource Conservation and Recovery Act (RCRA) and also for a variety of radionuclides associated with the former TA-21 processes and activities. Until verified non-RCRA, such wastes will be managed in recognized less than 90-day storage areas and transferred to permitted storage as required.
- Appropriate precautions must be taken for protecting workers and the public from exposures to MDA A waste constituents, providing engineered controls as a preference.
- All wastes to be generated from MDA A activities must be identified in advance and documented on a waste characterization strategy form (WCSF), as described in Standard Operating Procedure (SOP) 01.10, Waste Characterization.

2.3.4 Codes, Standards, and Local Ordinances

Work performed at MDA A must comply with applicable codes, standards, and laws. The various designations of MDA A (e.g., Hazard Category 2 Nuclear Facility, NES, and SWMU) reflect the categorization of the area for management under existing requirements of various governing and/or oversight bodies.

2.3.4.1 Codes

In addition to the NMED-promulgated requirements applicable to LANL work, MDA A activities are governed under additional requirements and codes of conduct from the DOE/NNSA and the New Mexico Environment Department (NMED). The following sections highlight applicable governing criteria.

2.3.4.1.1 The Consent Order

The March 1, 2005, Consent Order governs the investigative and remedial action processes to be undertaken at many of the LANL MDAs, including MDA A. Schedules, content guidance, format, and approach are addressed for most aspects of the work to be performed under the Consent Order.

2.3.4.1.2 Investigation Work Plan

The MDA A investigation work plan (LANL 2005, 88052.3) governs the formal investigation activities at MDA A, SWMU 21-014, as required by the Consent Order.

2.3.4.1.3 DOE Orders

DOE Order 5400.4, DOE Guidance 435.1, in accordance with 10 CFR 830 and 10 CFR 835 govern the management of radioactive materials. MDA A radioactive materials and contaminants fall within this realm. The orders and guidance define the management requirements for radioactive materials and contaminants.

2.3.4.1.4 Conduct of Operations

- DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities, defines the elements required for the safe conduct of activities at the NES.
- A conduct of operations applicability matrix, defined for this work, is presented in Appendix A of the TSR implementation plan (LANL 2006, 093256).

2.3.4.2 Client Standards

DOE/NNSA and its prime contractor at LANL are required to manage all work at LANL to a set of policies, orders, standards, and procedures published by both DOE/NNSA and LANL in a requirements flow-down approach. Approved LANL policies and procedures implement DOE/NNSA's requirements.

2.3.4.2.1 DSA/TSR for S&M of LANL NES

- Safety basis requirements for DOE nuclear facilities are addressed in 10 CFR 830. DOE/NNSA requires that for Hazard Category 1, 2, and 3 nuclear facilities the contractor define the scope of the work to be performed; identify and analyze the hazards associated with the work; categorize

the facility consistent with DOE–STD–1027–92; prepare a DSA for the facility; and establish the hazard controls.

- Surveillance and maintenance activities are performed to implement the DSA. S&M is required to ensure that site conditions are maintained and verified in an effort to prevent contaminant migration from their current location.

2.3.4.2.2 Integrated Work Document

- LANL implements DOE/NNSA's Safety Management System Policy and other requirements applicable at the task level through an integrated work management (IWM) process, as defined in Implementation Procedure (IMP) 300.2. For each field work activity a complete an integrated work document (IWD) is required, which includes identifying all activities to be performed. The IWD is used as a work review and authorization tool, supporting multidiscipline reviews and readiness assessment prior to authorization of field work activities.
- All work at MDA A will be conducted in accordance with the applicable IWD.

2.3.4.2.3 Site Specific Health and Safety Plan

- LANL implements the requirements of 29 CFR 1910 and 29 CFR 1926 for work at hazardous waste sites such as MDA A through the prerequisite of a site-specific health and safety plan (SSHASP) document tailored to the specifics of the work to be performed and the location it will be performed.
- All work at MDA A will be conducted under an approved SSHASP.

2.3.4.2.4 Standard Operations Procedures and Quality Procedures

- LANL implements the flowdown of requirements from laws, regulations, executive orders, legal agreements, and client (DOE/NNSA) policies, standards, orders, and guidance in formally published Laboratory implementation requirements (LIRs), Laboratory implementation guidance (LIGs), SOPs and QPs.
- SOPs and QPs are maintained current on the LANL computer intranet, which can be accessed by personnel with authorized access to the LANL intranet.
- Table 2.3-2 includes a list of applicable Director's Instructions, LIGs, LIRs, QPs, and SOPs.

2.4 References and Exhibits

This memorandum incorporates the findings from past investigations, as well as design elements identified in original design documents, if available. The documents relevant to formation of the design basis for the MDA A facilities are summarized in Table 2.4-1.

3.0 DESIGN BASIS

The following is an overview of the system components of each of the disposal units at MDA A, Table 3.0-1 summarizes components of the IIS.

3.1 General's Tanks

The design of the General's Tanks is documented on 1945 design drawings ENG-C-2076 (LASL 1945, 24448) and ENG-C-2078 (LASL 1945, 24450). The drawings generally reflect preconstruction plans for the tanks; however, since the drawings show postconstruction revision dates, they may be considered as-built drawings. No other corroborating information has been located to verify that the construction of the tanks followed the plan. The following text is based on the assumption that the drawings represent as-built conditions in the 1940s. Quantitative tank location and construction information provided in the following sections is derived from examination of the drawings.

Two 50,000-gal. General's Tanks were constructed in the field in two parallel north-south oriented excavations below existing grade into the native volcanic tuff bedrock at what is now described as the western end of MDA A. The excavations were placed such that the finished tanks had a clearance of 20 ft between.

The DSA for S&M of NES at LANL (LANL 2005, 88713) description of the IIS at the General's Tanks utilizes four of the five defined design features of the IIS barrier (primary containment vessels, configuration of burial, burial depth, and thickness and characteristics of cover materials and caps):

3.1.1 Primary Containment Vessel

Unless otherwise noted, the following information can be found in two 1945 Los Alamos Scientific Laboratory engineering drawings (LASL 1945, 24448; LASL 1945, 24450).

- The shells for each of the 12-ft diameter tanks were each welded from 10 rolled steel (mild steel) sections measuring 70¼ in. wide by 226¼ in. long by $^{5}/_{16}$ in. thick.
- The shell dimension after welding is noted as 58 ft $2^{1}/_{8}$ in.
- Steel heads $^{7}/_{16}$ in. and constructed with an 8-ft radius were welded on the ends of the shells to result in an overall tank length of 62 ft 10 in.
- The tanks were sloped 3 in. to the south.
- The tanks were painted on the exterior with one coat of an asphaltic paint (external corrosion protection).
- The excavations were placed such that the finished tanks had a clearance of 20 ft between the tanks.
- The tanks were constructed on packed 1-ft-thick sand beds and strapped to four 2-ft by 2-ft concrete piers poured into bedrock below the excavation (approximately 2 ft additional depth, although the drawing is difficult to read) on either side of the tanks near the extent of the shell length.
- The excavation was backfilled with clean earth and thoroughly compacted, except that loose clean earth fill (approximately 18 in. thick) was used in the areas above the tanks. An interview of a site staff involved in the 1970s project to retrieve liquids from the tanks stated the distance between the slab and tank shell may be as much as 3 ft (Tucker 2003, 92454)
- An 8-in.-thick concrete slab, 56 ft wide by 68 ft 10 in. long, was poured over the tanks.
- Approximately 5-ft of overburden was placed on top of the concrete pad.

- Internal bracing inside the tanks (a design feature not included in the cited pre-construction plan drawings for the tanks) was also described in the interviews (Ritchey 2006, 92455), possibly to provide additional tank support during original construction.

3.1.1.1 Postconstruction Modifications

- The tanks were both accessed in 1974 (LANL 1996, 093290) to support a liquids retrieval and treatment campaign. Overburden soils were removed from the central area of the tanks to expose the concrete slab. Access holes (24 in. in diameter) (Tucker 2003, 92454) were cut in the slab above each tank, soil between the concrete slab and tank removed from the work area and a hole (~18 in. in diameter) was cut through the tank shell for access (Tucker 2003, 92454).
- Interview records (Tucker 2003, 92454) indicate that a rolled steel plate was placed over the opening in each tank before the openings were backfilled in 1985 (LANL 1996, 093290).
- Other known modifications to the tanks have been made over time, including removal of the fill, vent, and level systems (to what extent is not accurately known) and the structure over the south end of the tanks. The date of these alterations is not known, but because the last reported MDA A site modifications were in 1985, these alterations may have occurred then.

3.1.2 Configuration of Burial

The current estimate of the configuration of tanks in the subsurface is shown on Figure 3.1-1 and is described as follows:

- The top of the concrete pad is 5 ft below current ground surface (Figure 2.3-6) (ARM Group, Inc., 2006, 92718).
- A 1.5 ft overburden rests between the base of the concrete pad and the top of the steel tanks.
- The tanks are 12 ft in diameter; the base of each tank is approximately 20 ft below current ground surface.
- Each tank is sitting on four 4-ft-tall piers, each set approximately 2 ft into the base of the excavation, the base of the tank piers are approximately 23 ft below current ground surface.

Tank contents and material configuration are estimated.

- The radioactive waste in the General's Tanks was last known to be in the form of a contaminated sediment or aqueous sludge resting approximately 20 ft below the current ground surface.
- Following completion of the liquids retrieval project, approximately 6 in of sludge was left as a "heel" in each tank (Tucker 2003, 92454), representing an estimated 8656 pounds of sludge in each tank (Clark 2006, 92496).

3.1.2.1 Current Material Condition

The condition of the tanks and the contents is not known. When it was last observed in the 1980s, the tanks were in good condition and the sludge was "the consistency of mud and was red, rusty colored" (Tucker 2003, 92454).

3.1.2.2 Radionuclide Inventory

- The MDA A HIR indicates that 12 to 25 Ci of plutonium was placed in the General's Tanks (LANL 2005, 88052.65).
- Tank-specific radionuclide inventories estimated using 1981 sludge sample data collected (Bucholz 1981, 00459) result in an estimated 78 and 20 plutonium equivalent Ci for the west and east tank, respectively (Clark 2006, 92496). Calculation of the radionuclide inventory of the tanks used appropriate assumptions for unreported species. Table 3.1-1 provides an estimate of the radionuclide inventory of the General's Tanks corresponding to the year 2007.

3.1.2.3 Chemical Inventory

- Tank-specific hydrogen content (resulting from radiolytic processes) has been estimated from radionuclide inventories and assuming the tanks were sealed starting in 1985 (Clark 2006, 92496).
- Tank chemical constituents were reported in 1981 also (Bucholz 1981, 00459), but it is unclear whether the data represented the liquids in the tanks or the sludges at the time. Table 3.1-1 presents these data for each of the General's Tanks.
- Infiltration of the tanks, due to run-in from the surface was identified as one reason the tanks were sealed in 1985, after having been open throughout the liquids retrieval (LANL 1996, 093290). The 1981 sample data may represent tank solids incorporating run-in soils and liquids (Bucholz 1981, 00459).

3.1.3 Burial Depth

Based on the dimensions of the of the tanks and the depth of burial, waste in the General's Tanks was last known to be in the form of a contaminated sediment or aqueous sludge (Tucker 2003, 92454) resting at approximately 17 to 19 ft below the current ground surface. The minimum required depth of burial to provide containment ranges from 7.1 to 11.29 ft, without consideration of the effect of the concrete slab. Evaluation of the concrete slab indicates that the slab alone provides containment, thus the additive effect of the concrete slab and the overlying soil provides an ample margin of safety for the depth of burial (Clark 2006, 92496).

3.1.4 Inventory Distribution

Inventory distribution is not defined as an IIS component applicable to the General's Tanks. However, it impacts the geometry of the inventory, specifically because

- the existing chemical and radiological inventory of the tanks is believed to be distributed among the reported 6-in. heel left in each of the tanks, an estimated volume of approximately 101 ft^3 per tank (Clark 2006, 92496) distributed linearly along the 62 ft north-south axis of each tank, and
- the potential for nuclear criticality in either of the tanks based on reported contents has been evaluated by LANL Health, Safety, and Radiation Protection Division (HSR)-6 personnel and determined to be noncredible, based upon the geometry (McLaughlin 2003, 91859).

3.1.5 Thickness and Characteristics of Cover Material and Caps

3.1.5.1 Bottom Confining Material

- The tanks are constructed in separate trenches excavated from the native volcanic tuff bedrock (LASL 1945, 24448).
- A packed sand bed nominally 1 ft thick underlies each tank in their respective excavation, coming between the tank and the native bedrock (LASL 1945, 24448).
- Bottom confining material is not part of the IIS beyond 1 ft outside of the primary containment vessel (e.g., the tank) (Clark 2006, 92496).

3.1.5.2 Side Confining Material

- The tanks are constructed in separate trenches excavated from the native volcanic tuff rock, measuring approximately 23 ft wide at the top and 15 ft wide at the base (LASL 1945, 24448).
- The minimum clearance between the tanks and the side of the excavation is 3¼ ft.
- Earth fill was thoroughly packed around the tanks as excavation fill.
- Side confining material extends 5 ft beyond the tank wall, ensuring lateral external pressures are maintained (Clark 2006, 92496).

3.1.5.3 Top (Cover) Confining Material

- Loose soil (presumably crushed volcanic tuff) directly overlies each tank in its respective excavation to a depth of 3 ft (by design) between the tank and an overlying reinforced concrete layer.
- An 8-in. thick reinforced concrete slab overlies the loose soil atop the tanks. The slab includes reinforcement in both axial directions (½-in. bars on 18-in. centers running parallel to the tanks and $^5/_8$-in. bars on 6-in. centers running transverse to the tanks). The slab dimensions extend beyond the maximum dimensions of the tanks in each direction and the edges of the slab extend beyond the original excavation dimensions onto the native bedrock materials. The slab measures 56 ft wide by 68 ft 10 in. long.
- Above the slab, approximately 5 ft of earth fill was specified. Surface grading sloped slightly to the north (~2 in. over the length of the tanks). A 16 ft wide gravel driveway was constructed to allow access to the area between the tanks from the south.
- Original penetrations of the concrete slab were made for the vent, fill, and liquid levelometer gauge lines on the south end of each tank and the vent line on the north end of each tank.
- Two 24-in. access holes in the concrete slab were cut for access to the tanks for the liquids retrieval project. There is no evidence that the holes in the concrete were patched when soils were backfilled at the end of the project.
- The IIS is the 1.5 to 3.0 ft soil cover over the tanks, plus the concrete slab (Clark 2006, 92496).
- Where holes have been cut into the tanks and concrete slab, the soil from the tank surface to the ground surface comprises the IIS.

3.2 Central Pit

The central pit was excavated from bedrock materials between the eastern pits and the General's Tanks for demolition debris. The pit was enlarged to its final reported dimensions in 1972 to accommodate the demolition debris from building TA-21-012 (LANL 2005, 88052.65).

The DSA for S&M of NES at LANL description of the IIS at the MDA A central pit incorporates only three of the five defined design features for LANL IIS (configuration of burial, burial depth, and inventory distribution):

3.2.1 Primary Containment Vessel

Not applicable. The central pit is an unlined landfill disposal unit, with only earthen materials for containment.

3.2.2 Configuration of Burial

- The central pit is a deep rectangular disposal unit 172 ft long, 134 ft wide, and 22 ft deep cut directly into native volcanic tuff bedrock (LANL 2005, 88052.65).
- The wastes are layered with backfill soils.

3.2.2.1 Radionuclide Inventory

Debris contaminated with transuranic elements at less than 10 nCi/g (LASL 1973, 08902, p. 29). The total inventory is not known (LANL 2005, 88052.65).

3.2.2.2 Chemical Inventory

The total inventory is not known. There is potential for buried pressurized gas cylinders in the waste matrix (LANL 2005, 88052.65).

3.2.3 Burial Depth

- Although some of the waste in the central pit may be buried relatively near the surface, the 22 ft depth of the pit means that 75% of the wastes in the pit are buried 5.5 ft or more below the surface.
- Photographic documentation of site activities (Figure 2.3-2; Gerety et al. 1989, 06893, Figure 16, p. 48) and current geophysical survey results (ARM Group, Inc., 2006, 92718) indicate that material was generally debris and that it was pushed or dumped into the disposal area without segregation.

3.2.4 Inventory Distribution

- The solid debris materials, thought to comprise the majority of the pit contents, may be surface-contaminated with plutonium and potentially with hazardous chemicals from TA-21 facilities. Contaminants would thereby be distributed widely within the pit.
- Figure 2.1-3 (originally published in Gerety et al. 1989, 06893, Figure 12, p. 44) supports that debris is the primary disposed waste form in the central pit.

- Debris was layered with backfill soils in the pit.
- No radiological materials inventory or chemical contaminant estimates are available for waste in the pit.

3.2.5 Thickness and Characteristics of Cover Material and Caps

- The cover over the waste was reported in the DSA SER report (LANL 2005, 88713) as thin (perhaps 6 to 12 in. thick), inconsistent in thickness, and possibly slightly contaminated in some locations; however, this description is inconsistent with current geophysical survey results (ARM Group, Inc., 2006, 92718). Available information indicates that the cover is approximately 3 ft thick across the central pit and is an effective barrier to the release of material under approved S&M activities.
- The entire cover thickness to within 6 in. of the ground surface comprises the IIS.

3.2.5.1 Bottom Confining Material

- The disposal unit was directly excavated into the native tuff bedrock.
- The bottom of the IIS consists of a minimum of 1 ft of unexcavated bedrock.

3.2.5.2 Side Confining Material

- The sides of the disposal unit are composed of the original unexcavated tuff bedrock.
- The IIS consists of a minimum of 1 ft of unexcavated bedrock providing existing confinement lateral earth pressures are maintained.

3.2.5.3 Top Confining Material

- Cap materials are composed of crushed tuff.
- The entire cover thickness to within 6 in. of the ground surface comprises the IIS.

3.3 Eastern Pits

The DSA for S&M of NES at LANL description of the IIS at the MDA A eastern pits incorporates only three of the five defined design features for LANL IIS (configuration of burial, burial depth, and inventory distribution):

3.3.1 Primary Containment Vessel

Not applicable. The eastern pits are unlined landfill format disposal units, with native earthen materials for containment.

3.3.2 Configuration of Burial

The eastern pits are rectangular disposal units measuring 125 ft long, 18 ft wide, and 12.5 ft deep, excavated directly into native volcanic tuff bedrock (LANL 2005, 88052.65).

3.3.2.1 Radionuclide Inventory

The total inventory is not known. The pits are thought to contain solid wastes with alpha contamination accompanied by slight amounts of beta and gamma. Both polonium and plutonium-239 were described as potential contaminants (Rogers 1977, 05707).

3.3.2.2 Chemical Inventory

The total inventory is unknown.

3.3.3 Burial Depth

- Although some of the waste in the eastern pits may be buried relatively near the surface, the 12.5 ft depth of the pit indicates that 70% of the wastes in the pits were buried 4 ft or more below the original land surface.
- Photographic documentation of site activities (Figure 2.1-3; Gerety et al. 1989, 06893, Figure 16, p. 48) and current geophysical survey results (ARM Group Inc., 2006, 92718) indicate that the waste is below approximately 3 ft of crushed tuff.

3.3.4 Inventory Distribution

- The solid materials, thought to comprise the majority of the pit contents, are contaminated with plutonium and potentially with hazardous chemicals from TA-21 operations. Contaminants would thereby be distributed widely within the pit.
- Photos published in the Gerety et al. (1989, 06893) support solid materials as the primary disposed waste form in the eastern pits.
- No radiological materials inventory or chemical contaminant estimates are available for waste in the pit.

3.3.5 Thickness and Characteristics of Cover Material and Caps

Cover over the waste was reported as thin (perhaps 6 to 12 in. thick), inconsistent in thickness, and may be slightly contaminated in some locations in the DSA SER report (LANL 2005, 88713); however, this is inconsistent with photographic documentation of site activities (Figure 2.1-3; Gerety et al. 1989, 06893, Figure 16, p. 48) and current geophysical survey results (ARM Group, Inc., 2006, 92718). Available information indicates that the cover is approximately 3 ft thick across the eastern pits and is an effective barrier to the release of material under approved S&M activities.

3.3.5.1 Bottom Confining Material

- The disposal unit was directly excavated into the native tuff bedrock.
- The bottom of the IIS consists of a minimum of 1-ft. of unexcavated bedrock.

3.3.5.2 Side Confining Material

- Sides of the disposal units are composed of the original unexcavated tuff bedrock.
- The IIS consists of a minimum of 1 ft of unexcavated bedrock providing existing confinement lateral earth pressures are maintained.

3.3.5.3 Top Confining Material

- Cap materials are composed of crushed tuff.
- The entire cover thickness to within 6 in. of the ground surface comprises the IIS.

3.4 Former Surface Drum Storage Area

The former surface drum storage area is located at the eastern end of the original (pre-1970s) MDA A area between the eastern pits and the former MDA A fence, based on photographic evidence (Figure 2.3-1; Gerety et al. 1989, 06893, Figure 6, p. 38). The location corresponds to the end of the access road constructed to provide waste dumping access for the eastern pits. Drums containing a caustic iodide solution were stored aboveground between the two eastern pits from approximately 1949 through 1960, based on available photographic evidence. The MDA A HIR indicates possible leak of the drums' contents (LANL 2005, 88052.65). The leaked materials may have contained plutonium and uranium from scrubber liquids.

The area is not a waste disposal facility and was therefore not addressed by the DSA for S&M of NES at LANL. Further, since the area represents a suspected release point for contaminated materials, no design basis is associated with the area. There is no physical dimension based IIS for this area. The current grade may represent subsequent surface grading activities rather than original contours.

3.5 Vertical Shafts

Since no waste disposal was performed in the shafts (Shaw Environmental, Inc., 2004, 87448), the shafts are not considered in the DSA for S&M of NES at LANL and have no IIS components. The vertical shafts were back-filled with soil in 1977 (Shaw Environmental, Inc., 2004, 87448). The exact location of the shafts has not been determined, however, bare spots in several of the photographic figures of the Gerety et al. report may be the capped remnants of the shafts to the southeast of former structure 21-040 to the southeast of the buried General's Tanks. No IIS is required for this area.

4.0 REFERENCES

ARM Group Inc., June 9, 2006. "Geophysical Investigation of Material Disposal Area A, Los Alamos National Laboratory," ARM Project 06195, ARM Group, Hershey, Pennsylvania (ARM Group, Inc., 2006, 92718)

Bucholz, J. January 27, 1981. "Additional Information on Old WP Waste/General's Tanks Sludge," Analytical results #81064, J. Bucholz, Los Alamos National Laboratory, Los Alamos, New Mexico (Bucholz 1981, 00459)

Clark, T.R., Memorandum to Engineering File June 9, 2006. "General's Tanks Radio-Chemical Environment and Associated Hazards," Pro2Serve Professional Project Services, Inc., correspondence file number 7958-033, Los Alamos, New Mexico. (Clark 2006, 92496)

Emelity, L.A., April 20, 1978. "Your Memo of 23 March 1978," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (Emelity 1978, 00487)

ERG (Environmental Restoration Group, Inc.), May 2006. "GPS-Radiological Survey, Los Alamos National Laboratory Technical Area 21 MDA-A," Albuquerque, New Mexico. (ERG 2006, 92505)

Gerety, M., J. Nyhan, and R. Oliver, October 1989. "History and Geophysical Description of Hazardous Waste Disposal Area A, Technical Area 21," Los Alamos National Laboratory report LA-11591-MS, Los Alamos, New Mexico. (Gerety et al. 1989, 06893)

LANL (Los Alamos National Laboratory), May 1991. "TA-21 Operable Unit RFI Work Plan for Environmental Restoration, Vol II," Los Alamos National Laboratory document LA-UR-91-962, Los Alamos, New Mexico. (LANL 1991, 07529)

LANL (Los Alamos National Laboratory), 1996. "A History of Radioactive Liquid Waste Management at Los Alamos," Los Alamos National Laboratory document LA-UR-96-1283, Los Alamos, New Mexico. (LANL 1996, 093290)

LANL (Los Alamos National Laboratory), January 2005. "Historical Investigation Report for the Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014," Los Alamos National Laboratory document LA-UR-05-0095, Los Alamos, New Mexico. (LANL 2005, 88052.65)

LANL (Los Alamos National Laboratory), January 2005. "Investigation Work Plan for Material Disposal Area A at Technical Area 21, Solid Waste Management Unit 21-014," Los Alamos National Laboratory document LA-UR-05-0094, Los Alamos, New Mexico. (LANL 2005, 88052.3)

LANL (Los Alamos National Laboratory), January 2005. "Safety Evaluation Report, Documented Safety Analysis and Technical Safety Requirements (TSRs) for Surveillance and Maintenance of Nuclear Environmental Sites at Los Alamos National Laboratory," Los Alamos National Laboratory documents LA-UR-04-7505 and LA-UR-04-7504, Los Alamos, New Mexico. (LANL 2005, 88713)

LANL (Los Alamos National Laboratory), June 2006, "Technical Safety Requirements Implementation Plan for Characterization Activities at Technical Area 21, Material Disposal Area A," Los Alamos National Laboratory document LA-UR-06-3794, Los Alamos, New Mexico. (LANL 2006, 093256)

LASL (Los Alamos Scientific Laboratory), January 24, 1945. Engineering Drawing ENG-C-2076, sheet number 1 of 3, Los Alamos, New Mexico. (LASL 1945, 24448)

LASL (Los Alamos Scientific Laboratory), January 24, 1945. Engineering Drawing ENG-C-2078, sheet number 3 of 3, Los Alamos, New Mexico. (LASL 1945, 24450)

LASL (Los Alamos Scientific Laboratory), July 1, 1973. "Radioactive Waste Management Site Plans," Los Alamos Scientific Laboratory Report, Los Alamos, New Mexico (LASL 1973, 08902)

LASL (Los Alamos Scientific Laboratory), March 24, 1976. Engineering Drawing ENG-R-4457, Los Alamos, New Mexico. (LASL 1976, 24891)

McLaughlin, T.P., April 24, 2003. "Criticality Safety Issues Associated with Characterization and Remediation Activities at the General's Tanks at TA-21, Material Disposal Area A," Los Alamos National Laboratory memorandum to B. Criswell from T.P. McLaughlin, Los Alamos, New Mexico. (McLaughlin 2003, 91859)

Ritchey, J.D., Interview of David Salazar, March 3, 2006. "Questions for and Responses from Dave Salazar, NWIS-RLW," Pro2Serve Professional Project Services, Inc., Los Alamos, New Mexico. (Ritchey 2006, 92455)

Rogers, M.A., 1977. "History and Environmental Setting of LASL Near-Surface Land Disposal Facilities for Radioactive Wastes (Areas A, B, C, D, E, F, G, and T)," Los Alamos Scientific Laboratory document LA-6848-MS, Los Alamos, New Mexico. (Rogers 1977, 05707)

Shaw Environmental, Inc., November 12, 2004. "Telephone conversation with David Moss regarding the date the vertical shafts adjacent to the General's Tanks at Material Disposal Area A (MDA A) were filled," interview performed for the Environmental Restoration Program at Los Alamos National Laboratory, Los Alamos, New Mexico. (Shaw Environmental, Inc., 2004, 87448)

Tucker, K., Interview of David Salazar, April 9, 2003. "Questions Pertaining to the Logistics of Liquid Pumping Exercises Conducted at the General's Tanks in Order to Determine the Physical Characteristics of the Tanks, Tank Contents, and the Surrounding Site," Duratek Federal Services, Inc., Los Alamos, New Mexico. (Tucker 2003, 92454)

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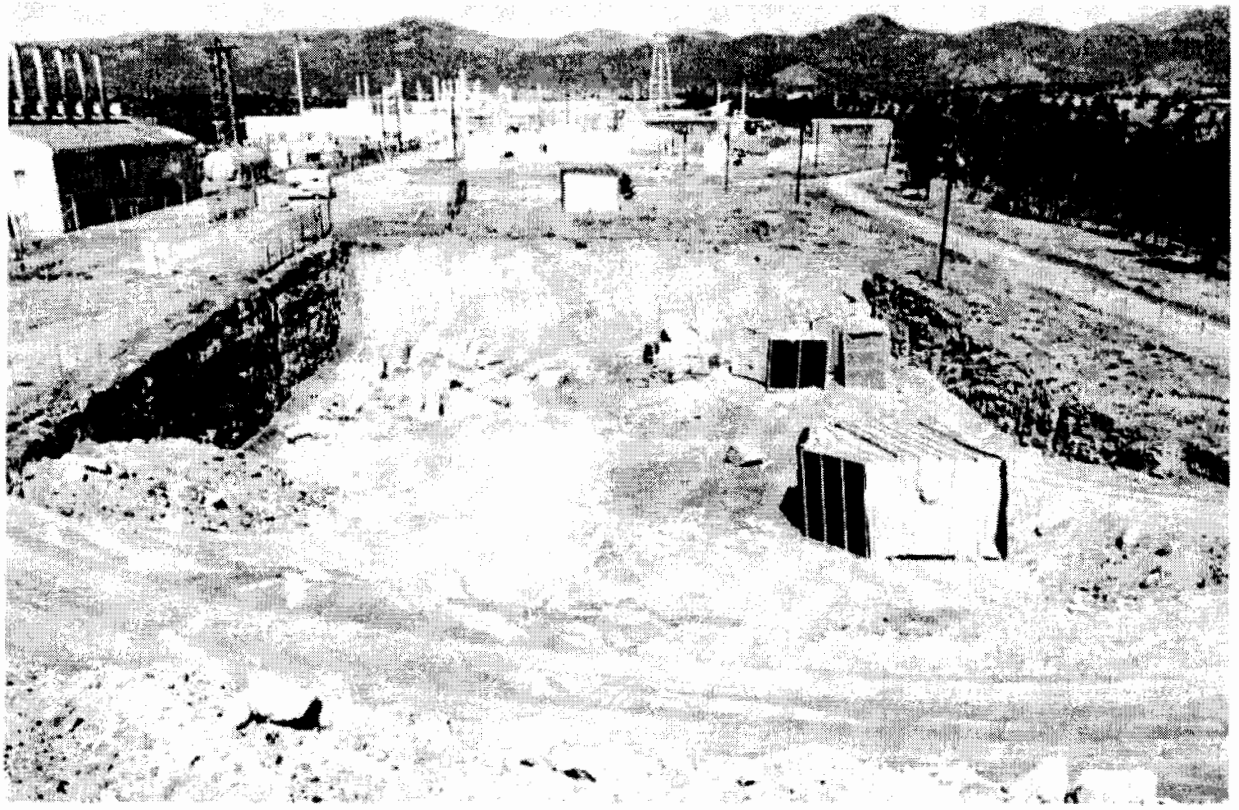
Figure 2.1-1. MDA A facility layout, including utilities

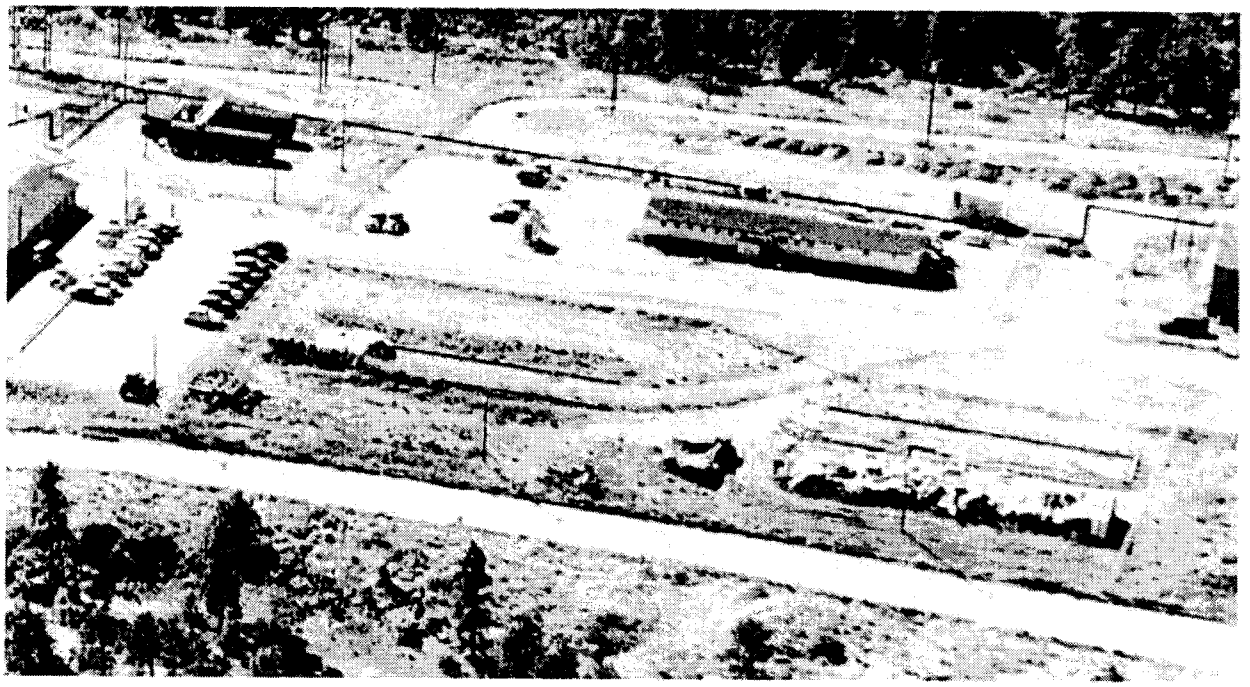
Source: History and Geotechnical Description of Radioactive Waste Disposal Area A, Technical Area 21 (Gates and al., 1995, 1996), Figure 4.1-36

Figure 2.1-2 Photograph (1945 or 1946) showing waste in the two eastern pits at MDA A



Source: History and Geophysical Description of Hazardous Waste Disposal Area A, Technical Area 21" (Gerety et al. 1989, 06693, Figure 12, p. 44)

Figure 2.1-3. Photograph (1973) showing burial of building demolition materials in the central disposal pit at MDA A

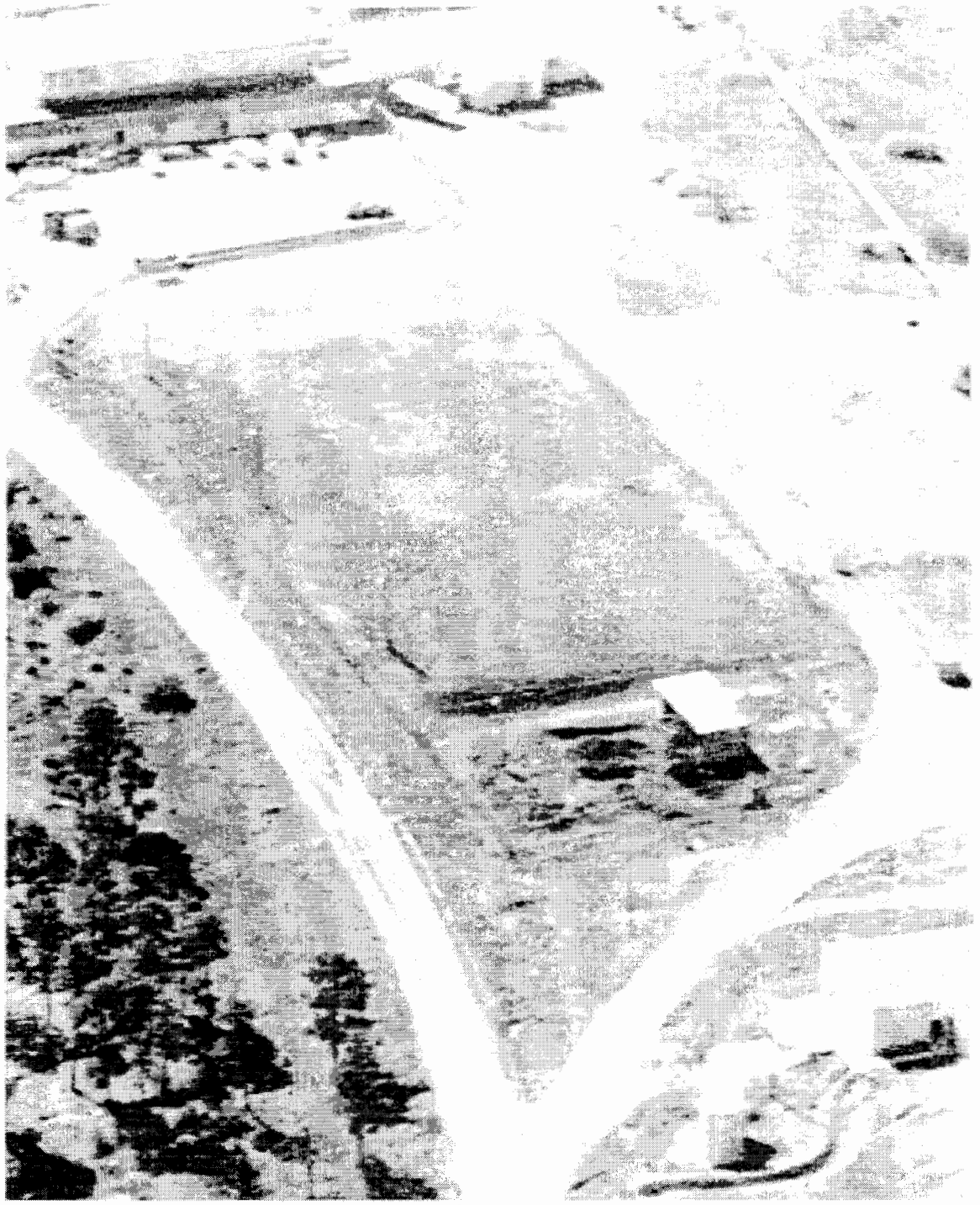


Source: History and Geophysical Description of Hazardous Waste Disposal Area A, Technical Area 21" (Gerety et al. 1989, 06893, Figure 6, p. 38)

Figure 2.3-1. Photograph (January 1949) showing stored drums between the MDA A eastern pits

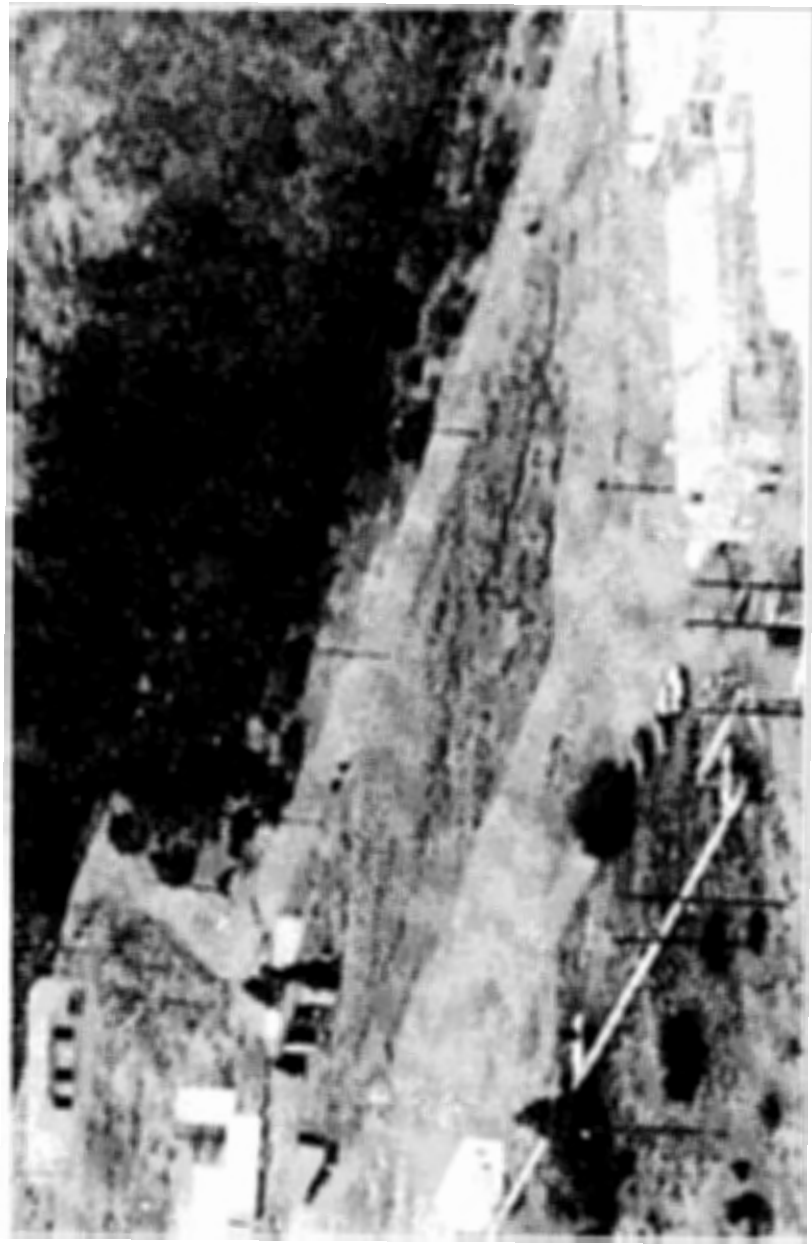
Source: History and Geophysical Description of Hazardous Waste Disposal Area A, Technical Area 21" (Gerety et al. 1989, 06893, Figure 16, p. 48)

Figure 2.3-2. Photograph (1974) showing stockpiled backfill at MDA A



Source: History and Geophysical Description of Hazardous Waste Disposal Area A, Technical Area 21" (Gerety et al. 1989, 08693, Figure 19, p. 51)

Figure 2.3-3. Photograph (1979) showing the surface characteristics of MDA A



Source: History and Geophysical Description of Hazardous Waste Disposal Area A, Technical Area 21" (Gerety et al. 1989, 06893, Figure 22, p. 54)

Figure 2.3-4. Photograph (1983) showing MDA A vegetation

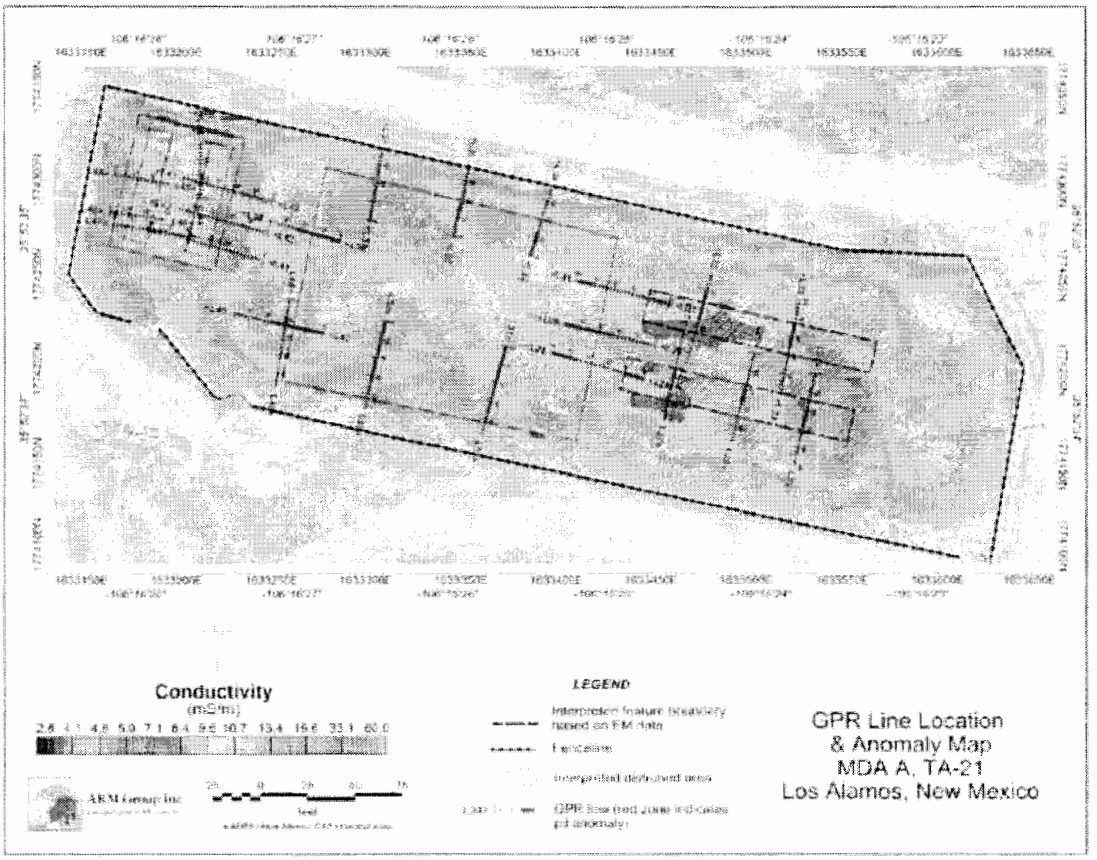


Figure 2.3-5. Ground penetrating radar location and anomaly map, MDA A

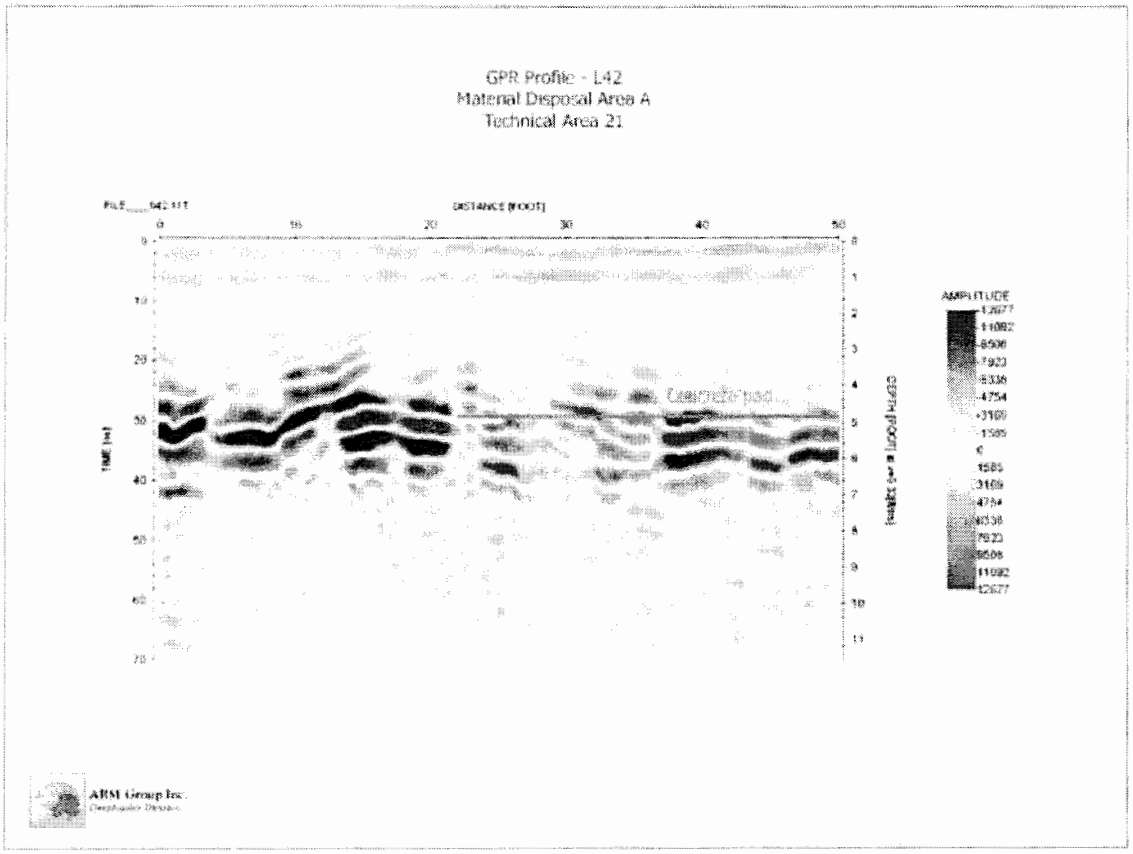


Figure 2.3-6. Ground penetrating radar profile L42, MDA A General's Tanks, east side

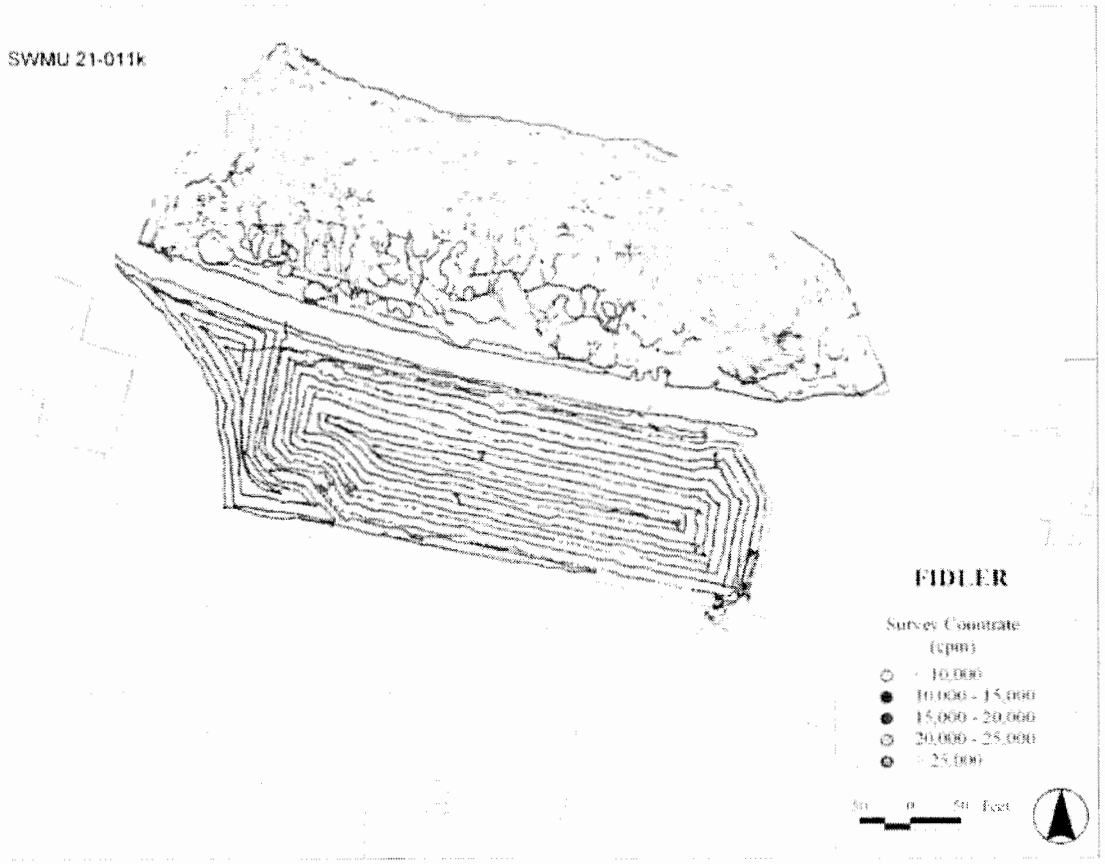
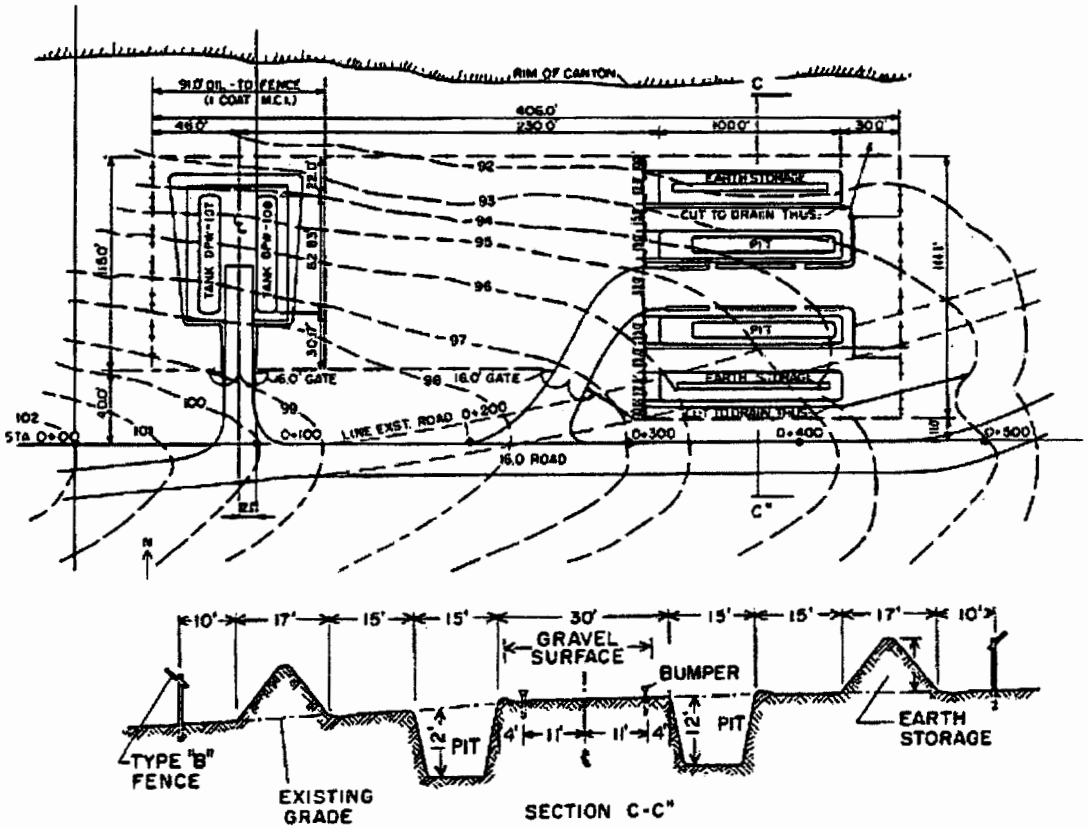


Figure 2.3-7. MDA A FIDLER radiological walkover survey results



Source: History and Environmental Setting of LASL Near-Surface Land Disposal Facilities for Radioactive Wastes (Areas A, B, C, D, E, F, G, and T)" (Rogers 1977, 05707, Figure A-3, p. A-6)

Figure 3.1-1. Construction plan for MDA A, January 24, 1945

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Table 2.3-1
MDA A Boundary Survey Vertices

Location	NES Boundary Vertex Coordinates*	
	Northing	Easting
1	1633160.6971	1774353.9932
2	1633551.5727	1774265.3685
3	1633621.6665	1774261.2433
4	1633651.7911	1774199.6185
5	1633631.4780	1774087.8673
6	1633214.4151	1774179.9920
7	1633187.7901	1774216.4925
8	1633156.9774	1774222.9923
9	1633140.5714	1774247.3676

*Starting at the northern-most point, then clockwise (LANL 2005, 88713).

Table 2.3-2
LANL Guidance Documents

LANL Guidance Document	Document Title
DI 05-007	Management Self Assessment (supercedes LIR 307-01-03.2, 3/28/05)
LIG 402-10-01A	Lightning Safety
LIG 404-00-04.1	Chemical Waste Disposal Request Guidance
LIR 230-03-01	Facility Management Work Control
LIR 300-00-01.4	Safe Work Practices
LIR 300-00-07	Non-Nuclear Facility Safety Basis
LIR 300-00-06.5	Nuclear Facility Safety Basis
LIR 402-100-00.5	Performance Requirement: Worker Health and Safety
LIR 402-100-01	Signs, Labels, and Tags
LIR 402-100-02.1	Hazardous Waste Operations and Emergency Response Management
LIR 402-130-01	Abnormal Events
LIR 402-510-01.2	Chemical Management
LIR 402-530-01	Biological Safety
LIR 402-600-01	Electrical Safety
LIR 402-700-01	Occupational Radiation Protection Guidance
LIR 402-700-01.2	Radioactive Sealed Source Accountability and Control
LIR-402-880-01	Excavation/Soil Disturbance Permit Process
LIR-402-880-02.1	Penetrations
LIR 402-1120-01.1	Cranes, Hoists, Lifting Devices and Rigging Equipment
LIR 402-1110-01	Forklifts, and Powered Industrial Trucks
LIR 402-1200-01	Pressure, Vacuum and Cryogenic
LIR 402-1320-01	Vehicle and Pedestrian Safety
LIR 404-00-02	General Waste Management Requirements
LPR 300-00-00/LIR 403-00-01	Los Alamos National Laboratory Emergency Management/Integrated Safety Management
SOP 1.01	General Instructions for Field Investigations
SOP 1.02	Sample Container and Preservation
SOP 1.03	Handling, Packaging and Transporting Field Samples
SOP 1.04	Sample Control and Field Documentation, and Live Orientation
SOP 1.05	Field Quality Control Samples
SOP 1.06	Management of ER Project Wastes
SOP 1.08	Field Decontamination of Drilling and Sampling Equipment
SOP 1.10	Waste Characterization
SOP 1.12	Field Site Closeout Checklist
SOP 3.11	Coordinating and Evaluating Geodetic Surveys
SOP 4.04	Contract Geophysical Logging
SOP 5.03	Monitoring Well and Borehole Abandonment
SOP 5.07	Operation of LANL Owned Borehole Logging Trailer

Table 2.3-2 (continued)

LANL Guidance Document	Document Title
SOP 6.09	Spade and Scoop Method for the Collection of Soil Samples
SOP 6.10	Hand Auger and Thin-wall Tube Sampler
SOP 6.24	Sample Collection from Split-spoon Samplers and Shelby Tube Samplers
SOP 6.26	Core Barrel Sampling for Subsurface Earth Materials
SOP 6.31	Sampling of Subatmospheric Air
SOP 6.33	Headspace Vapor Screening with a Photoionization Detector
SOP 7.05	Subsurface Moisture Measurements using a Neutron Probe
SOP 9.10	Field Sampling of Core and Cuttings for Geological Analysis
SOP 10.01	Screening for PCBs in Soil
SOP 12.01	Field Logging, Handling and Documentation of Borehole Materials
SOP 15.09	Chain of Custody for Analytical Data Packages
QMP	Quality Management Plan
Quality Program Orientation	Live Quality Orientation Training with ER QA Staff
QP 2.1	Documenting Personnel Qualifications and Selection Process
QP 2.2	Personnel Training Management
QP 2.3	Personnel Entry and Exit Processes
QP 4.12	Documenting Oral Communications
QP 4.13	Developing a TSR Implementation Plan at NES
QP 4.3	Records Management
QP 4.4	Records Transmittal to the Records Processing Facility
QP 4.5	Document Control
QP 4.9	Document Development and Approval Process
QP 5.18	Readiness Planning and Review for Nuclear Environmental Sites
QP 5.2	Control of Measuring and Test Equipment
QP 5.3	Readiness Planning and Reviews
QP 5.7	Notebook Documentation for Environmental Restoration Technical Activities
QP 5.10	Change Control for Spatial Features
QP 5.12	Integrating Work with Other Organizations
QP 5.13	Analytical Data Verification /Validation Process
QP 8.1	Inspection and Acceptance Testing
QP 9.1	Activity Review Process for Nuclear Environmental Sites
QP-10.3	Stop Work and Restart

Table 2.4-1
MDA A IIS Reference Documents

Reference Document/Source	Reason for Reference	Date	Comments
General's Tanks			
Engineering Drawings			
ENG-C-2076	Preconstruction design	1/31/45	LASL 1945, 24448
ENG-C-2078	Preconstruction design	2/19/45	LASL 1945, 24450
Past Boreholes/Samples			
LANL Environmental Studies Group, May 1974	4 35-ft boreholes in the vicinity of the GTs	May 1974	HIR § 3.2.2; No lateral migration detected at depth
1983	6 30-ft boreholes in the vicinity of the GTs	1983	HIR § 3.2.4; Pu above background detected in several boreholes at depth
Safety Basis			
DSA for S&M of NES at LANL	Identifies the barrier system components of the IIS	November 2004	Appendix A, Table A-1
Vertical Shafts			
n/a*	n/a	n/a	No nuclear or hazardous waste disposed, so no IIS exists
Central Pit			
Engineering Drawings			No as-built drawings located to address the central pit design.
Safety Basis			
DSA for S&M of NES at LANL	Identifies the barrier system components of the IIS relative to hazard type	November 2004	Appendix A, Table A-4
Eastern Pits			
Engineering Drawings			
ENG-C-2076	Pre-construction design	1/31/45	(LASL 1945, 24448).
Safety Basis			
DSA for S&M of NES at LANL	Identifies the barrier system components of the IIS relative to hazard type	November 2004	Appendix A, Table A-4
Drum Storage Area			
N/A	n/a	n/a	Area is a potential release site, not a waste disposal area – no IIS exists
MDA A Area-Wide			
Engineering Drawings			
ENG-R-4457	Overall layout of MDA A and boundary coordinates	3/24/76	(LASL 1976, 24891).

Table 2.4-1 (continued)

Reference Document/Source	Reason for Reference	Date	Comments
Geophysical Surveys			
1989 Gerety, et al.	Geophysical investigation performed in MDA A	1989	HIR § 3.1.1 & Figure 3.1-1. (Gerety et al. 1989, 06893)
1996 Geophex, Ltd.	Electromagnetic survey	June 1996	HIR § 3.1.2
1999 Summer of Applied Geophysical Experience	Geophysical investigation performed at MDA A	June 1999	HIR § 3.1.3
2003 Advanced Geological Services, Inc.	Integrated geophysical survey performed at MDA A	September 2003	HIR § 3.1.4
Past Boreholes/Samples			
1980	3 MDA A locations sampled	1980	HIR § 3.2.3; Pu above background in all samples.
Photographs			
1989 Gerety, et al.	Early MDA A views through 1980s	Various	Figures 3 through 22 (Gerety et al. 1989, 06893)

*n/a = Not applicable.

Table 3.0-1
Summary of MDA A IIS Components

MDA A Unit	IIS Components	IIS Physical Attributes
General's Tanks	• Primary Containment Vessel • Configuration of Burial • Burial Depth • Thickness and Characteristics of Cover Material and Caps	• Tank metal • Contaminants in the form of a sludge or wet sediment • Contents 5 ft minimum below the surface • Soil, concrete, and soil overburden layers
Vertical Shafts	Not applicable	Not applicable
Central Pit	• Configuration of Burial • Burial Depth • Inventory Distribution	• Contaminants, if present, likely on surface of solid debris waste forms • 75% of materials buried at least 5.5 ft deep to 22 ft deep • Widely dispersed in pits based on waste form types
Eastern Pits	• Configuration of Burial • Burial Depth • Inventory Distribution	• Contaminants, if present, likely on surface of solid debris waste forms • 70% of materials buried at least 4 ft deep to 12.5 ft deep • Widely dispersed in pits based on waste form types
Drum Storage Area	Not applicable	Not applicable

Table 3.1-1
Estimated and Reported Chemical Constituents of the General's Tanks

Constituent	West Tank	East Tank
^{239}Pu Equivalence		
^{239}Pu Equivalent (Ci)	78	20
^{239}Pu Equivalent (g)	1279	335
Estimated Headspace Hydrogen		
H_2 gas (g-mol)	296.4	77.56
H_2 gas (% of headspace gases)	4.42	1.16
Sludge Constituents		
NH_4-N (µg/ml)	24.6	18,000
Na^+ (µg/ml)	3800	9300
Cl^- (µg/ml)	3609	4998
K^+ (µg/ml)	36,000	7300
$SO_4^=$ (µg/ml)	2533	1369
I^- (µg/ml)	611	560
TDS (µg/ml)	87,780	233,480
Ca (µg/mL)	Data unreadable	9500
NO_3-N (µg/mL)	6590	34,500
Al (µg/mL)	16	1.1
pH	11.4	8.3