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TEST PLAN
LS-UTV-1 Rev. 0
APRIL 1991

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PNL TEST PLAN
UNDERGROUND TANK VITRIFICATION PROJECT:
LARGE-SCALE TESTING

APRIL 1991
RUN NUMBER: LS-UTV-1
PROJECT NUMBER: 15361

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Revised Inserts for Clarification As Requested by
the PNL Oversight Committee

The subject test plan has been revised via the change control procedure defined in the test plan to accommodate requests by the oversight committee. The requested changes involve minor clarifications of terminology and intent and do not in any way effect operations or safety. The original text in the procedure is replaced with text in *italics* and a corrected page inserted.

The primary changes address the following areas:

1) Clarification that the "simulated sludge" used in the tank is not representative of a true refractory sludge since it is composed of only hanford soil and water. Rather, it is representative of a high water content material.

2) Relative to the test objectives, clarify again that the sludge is not representative of a refractory type sludge but represents a high water content material.

3) Clarify the use of and basis for pumice as a fill material.

4) Clarify that for major changes, the project manager and the site supervisor must confer with laboratory safety personnel.

5) Relative to the SOP 58, clarify the starting depth position for the electrodes.

6) Replace the term exclusion zone with the term safety zone where this term is used to describe the roped off safety zone around the hood.

Changes made and approved by Leo E Thompson, Task Leader.

Reference Test Plan LS-UTV-1, Rev. 0, April 1991.

7/11/91

Some changes are red lined rather than replacing pages with italics. 7/11/91

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1.0 INTRODUCTION

1.1 PURPOSE

In situ vitrification (ISV) is a waste remediation technology, developed at Pacific Northwest Laboratory (PNL), which environmentally stabilizes contaminated soils and sludges without exhumation. More than 70 tests of the ISV process ranging from laboratory to full scale have been conducted, generating vitrified blocks weighing from 1 to 900,000 kg. These tests, conducted on a wide range of actual and simulated wastes types and soils, have repeatedly demonstrated the utility of the ISV process as an effective means of immobilizing hazardous chemical- and radioactive-contaminated soils. This demonstration, using the DOE large-scale test equipment, will extend the application of ISV to full-scale sludge-bearing tanks.

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This test plan will be used by PNL to ~~direct the~~ testing of ISV process on an underground storage tank containing a ~~simulated refractory sludge heel~~ high water content soil layer. This test plan describes the procedures to be used to conduct the test at the 300 West large-scale underground tank vitrification (UTV) test site. Included are descriptions of the site, the ISV process, equipment start-up and operation, test parameters, and data analyses and interpretation. The overall objective of the large-scale testing is to demonstrate applicability of ISV for remediation of a full scale underground tank. Specific test objectives are stated below.

1.2 TEST OBJECTIVES

The objectives of this test are as follows:

- Demonstrate the applicability of ISV in remediating a 10 ft diameter (6000 gallon) buried tank which contains a high water content layer representative of a saturated sludge.
- Obtain water balance data to support the theory explaining why volatile components and water soluble components do not migrate away from the melt, rather are drawn to it.
- Characterize the particulate produced during the various stages of the vitrification process to support future off-gas treatment system design.
- Demonstrate the ability of ISV to vitrify the site to depths practical within the context of actual tank remediation activities. Performance will be determined by vertical and lateral dimensions of the vitrified zone. The primary measure of success is to completely vitrify the tank, the tanks contents, and the supporting pad.

- Demonstrate the first large-scale application of an electrode feed system. If successful, this will:
  - allow the system to recover from electrical short circuits when the electrodes are engaged in a molten pool of metal,
  - Eliminate the labor intensive process of installing fixed buried electrodes,
  - reduce worker exposure from the intrusive process of emplacing electrodes into the soil adjacent to a tank,
  - eliminate the secondary wastes generated during electrode placement activities.
- Demonstrate a technique which could be used in an actual remedial operation to fill an underground tank with dry soil. The ability to minimize void spaces in the tank is important to reduce the possibility of transient gas releases from the tank as well as preventing the formation of drain holes which could disrupt the conductive pathway.
- Obtain data for evaluation of hood pressurization mechanisms.

1.3 TEST DESCRIPTION

1.3.1 Process Description

The UTV process, illustrated in Figure 1.1, converts underground tanks and associated hazardous materials to a solid block, immobilizing the contaminated tank, sludge, and surrounding soil in the process. Prior to treatment by ISV, void space in the contaminated underground tanks is filled. A hood for containment of gases and volatilized materials generated during the ISV process is placed over the area to be vitrified. An electrode feed system (EFS) is positioned over the hood and an array of four graphite electrodes is placed in the EFS. Each electrode is initially inserted one to two feet into the ground. Because soil is not electrically conductive when moisture has been driven off, a graphite and glass frit starter material is spread between the electrodes to form a conductive starter path. An electric potential applied to the electrodes establishes an electric current in the starter path. The resultant power heats the starter path, generating temperatures high enough to melt the surrounding soil (typically about 1700°C). The starter path is consumed by oxidation, and the current is transferred to the molten soil, which is electrically conductive.

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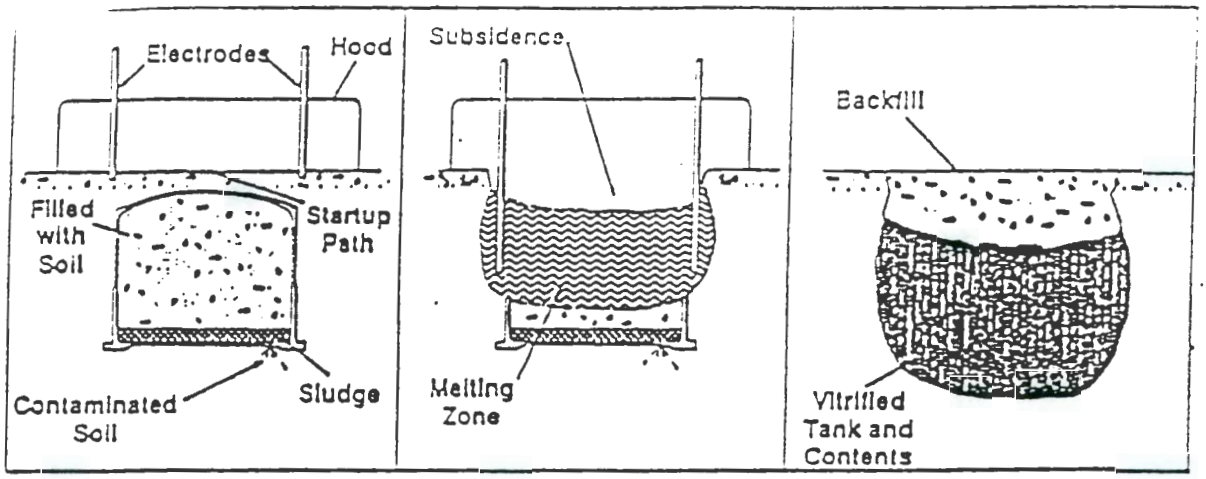

FIGURE 1.1. Operating Sequence for Underground Tank Vitrification

As the molten zone progresses downward, the electrodes move with the melt front. Metal inclusions in the treatment zone (such as the steel tank in this test) melt when contacted by the molten soil. The fluid metal, which has a higher density than the liquid glass, flows to the bottom of the molten pool. Concrete, when contacted by the molten glass, decomposes and dissolves into the molten mass.

In vitrification of an underground tank the molten pool encompasses the soil, steel tank, concrete shell and sludge in the bottom of the tank. The melt may also be allowed to continue downward, if desired, to immobilize contaminated soil below the tank. Radionuclides and nonvolatile hazardous elements such as heavy metals are incorporated into the glass product. Organic components are generally pyrolyzed by the high temperatures experienced in the melt. The pyrolyzed byproducts migrate to the surface of the vitrified zone, where they burn in the presence of air. The metal tank melts and forms ingots near the bottom of the melted mass. Any hazardous materials not captured in the glass or destroyed by the ISV process are removed in the off-gas treatment system.

The product resulting from the ISV process is a glass and crystalline mass resembling natural obsidian and a metal ingot. The ISV block which is only 3 to 11%

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heavier than concrete, possesses about 5 to 10 times the strength of unreinforced concrete in both tension and compression. The ISV block is also extremely inert, with a chemical leach resistance approaching that of Pyrex® glass.

The EFS is used to control movement of the electrodes into the melt. The electrodes can be fed in either a passive or active mode. In the passive mode the electrodes are allowed to gravity feed into the molten glass. The electrodes, which rest on the bottom of the melt, feed into the melt as the melt progresses downward. In the active feed mode the electrodes are gripped and air motors are used to move the electrodes either up or down as required. As the tank melt a molten pool of metal will form at the bottom of the melt zone. Shorting can occurs if electrodes contact the molten metal. If a shorting conditions developes an electrode can be lifted to alleviate the problem. To preclude shorting, when it is known that a large pool of metal exists at the bottom of the melt, the electrodes can be systematically fed into the melt. The EFS, in conjunction with the test configuration, is shown in Figure 1.2.

1.3.2 Tank Description

The configuration of the tank which will be used in this large-scale demonstration was designed to represent actual tanks present at the Oak Ridge National Laboratory (ORNL) site. Characteristics of 33 underground tanks, both vertically and horizontally oriented, at the ORNL site were evaluated. Tank conditions were selected which should represent the most difficult application of ISV. A 10 ft-diameter by 10-ft tall stainless steel tank with a 8 in. thick outer layer of gunite will be used. The tank wall thickness is a nominal 1/4 in. with a conical top and flat bottom. The tank dimensions are representative of actual dimensions of tanks buried at the ORNL site. The tank has been fitted with risers and flanges to simulate actual field conditions, while also serving as ports to fill the tank and insert instrumentation into the tank. As an added measure of safety, a 10 psi rupture disk has been fitted to the bottom of a pipe extending vertically through the tank. The pipe has been drilled with 1/2-in. holes every 1-1/2 in. to provide a pathway for a pressure gradient of greater than 10 psi to be relieved by blowing a rupture disk. The tank configuration is shown in Figure 1.3. Tanks with diameters of 1 ft and 3 ft will have been previously tested to determine processing characteristics and product durability of ISV on scaled tanks.

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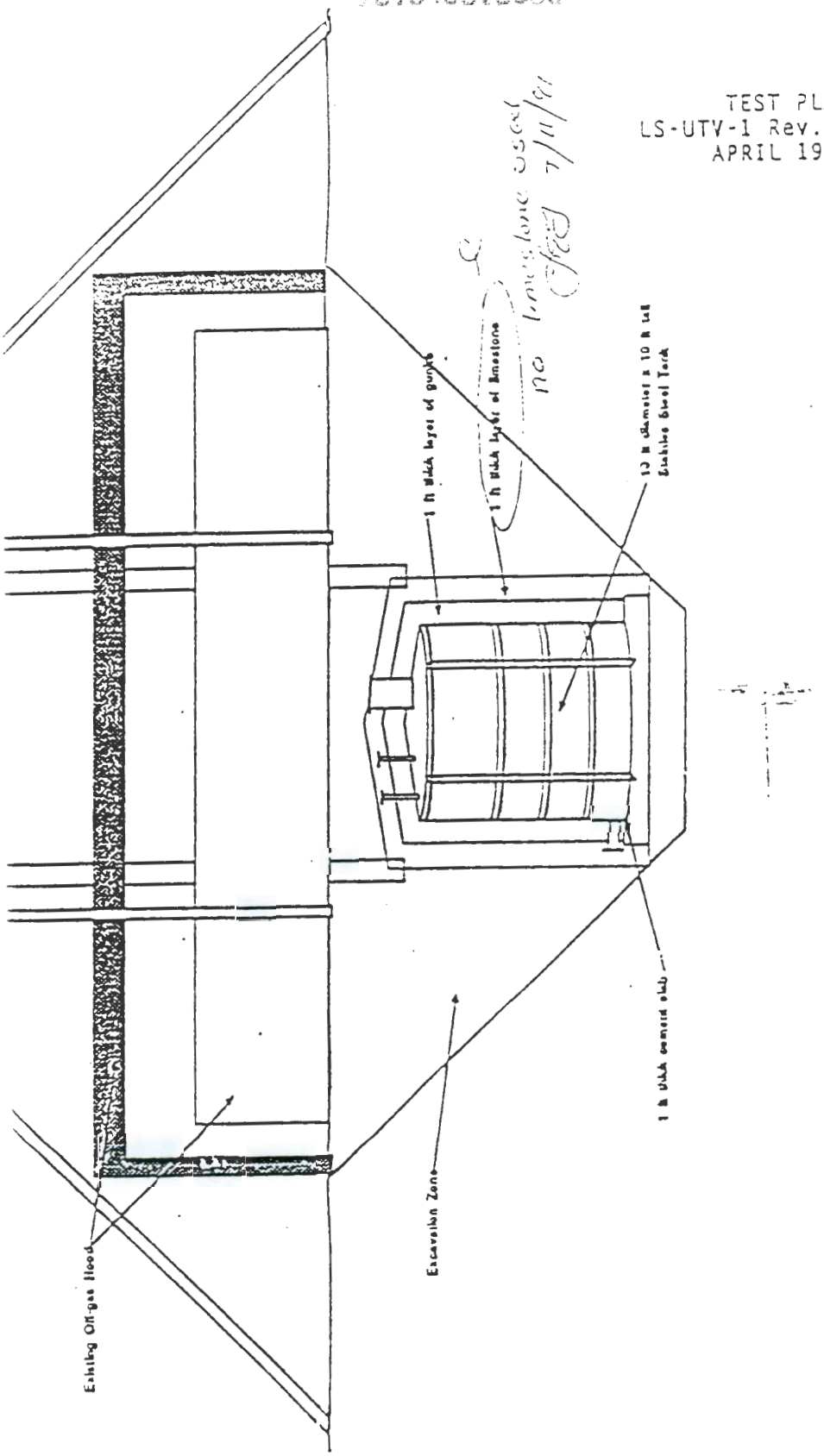

FIGURE 1.2. Large-Scale UTV Test Set Up

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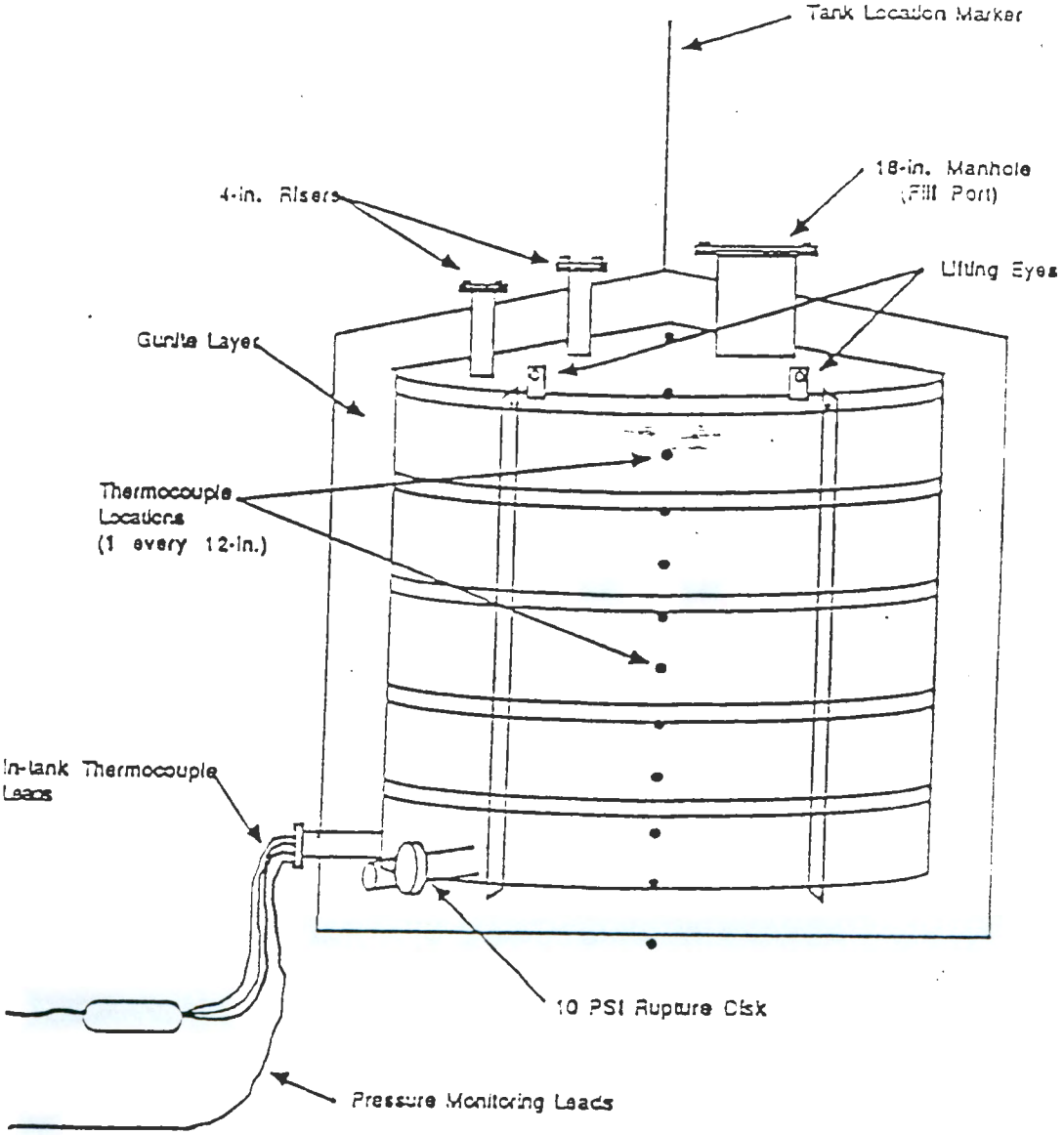

Figure 1.3. Schematic of Tank to be Used In Large-scale Testing

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.3.3 Test Pit Instrumentation

Instrumentation will be placed in the tank that will provide data melt depth, idth and tank pressure during processing. Two vertically oriented type K hermocouple bundles will be used. One will b e placed slighly off-center inside the ank with the TCs starting at 5 ft below grade and placed on one foot centers to 23 t below grade. The second vertical TC bundle will be placed outisde the tank in the lectrode plane. The TCs will start at 4 ft below grade and be positioned every two eet to 14 ft below grade. One bundle of type K thermocouples will be buried 10 ft elow grade with the first TC placed 1 ft from the outside of the gunite wall urrounding the tank and subsequent TCs placed on 2 ft center out to 23 ft. Depth nd melt shape monitoring capabilities will be provided by the thermocouples. As a econdary method of depth determination, the electrode feed system will be fitted ith an electrode travel monitoring system, which ~~will~~ display the vertical travel of he four electrodes. One type C thermocouple will be placed at the bottom of the ank, 15 ft below grade, to measure melt temperature. The tank will contain a inimum of three tubes which will be connected to pressure transducers to monitor the resence of pressure gradients within the tank. The test pit instrumentation layout s illustrated in Figures 1.4 and 1.5.

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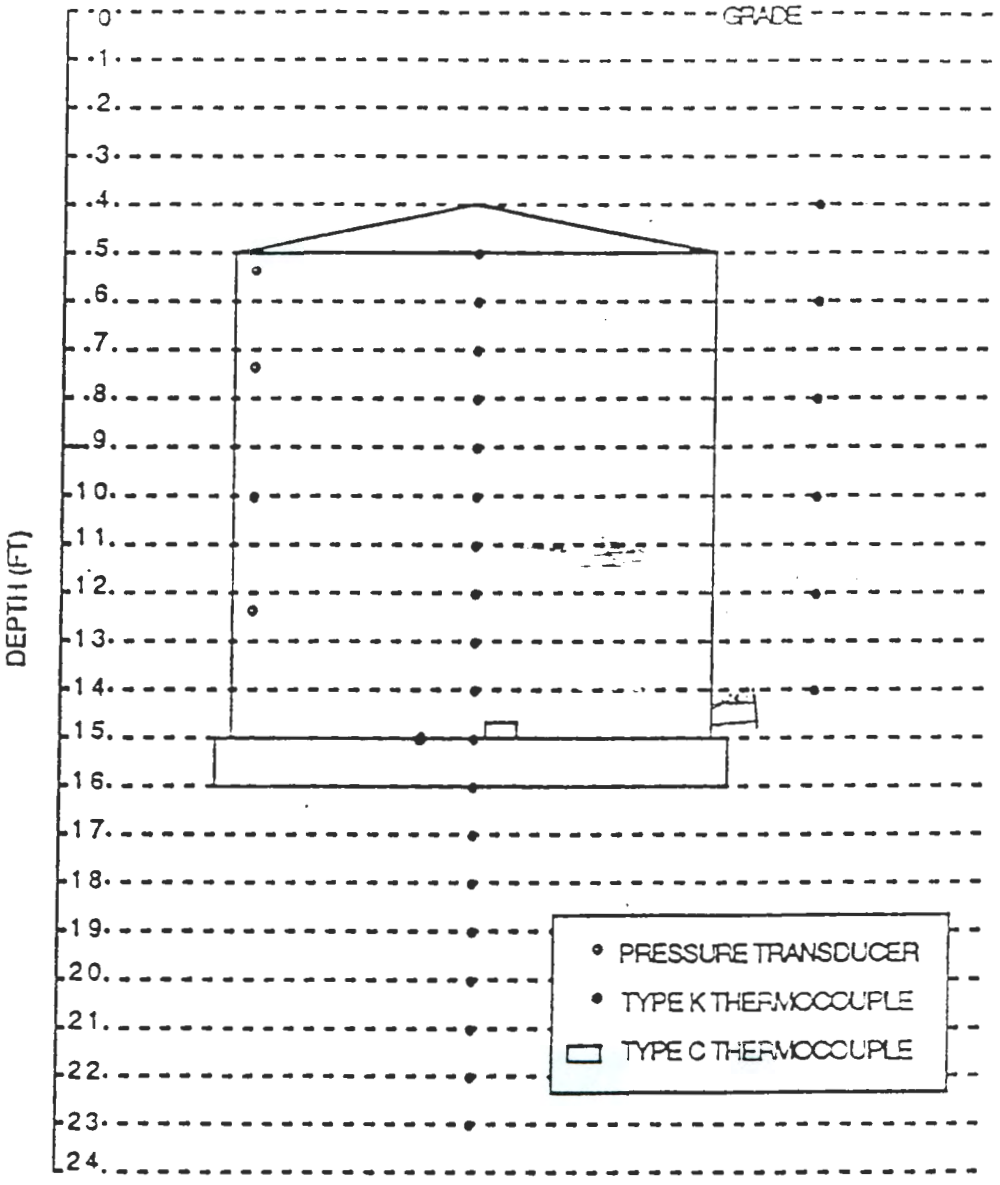

2 type K T/Cs at 15' depth.

2 pres. trans. on the side flange
0-5 psig
0-50 psig
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FIGURE 1.4. Vertical Instrumentation Layout

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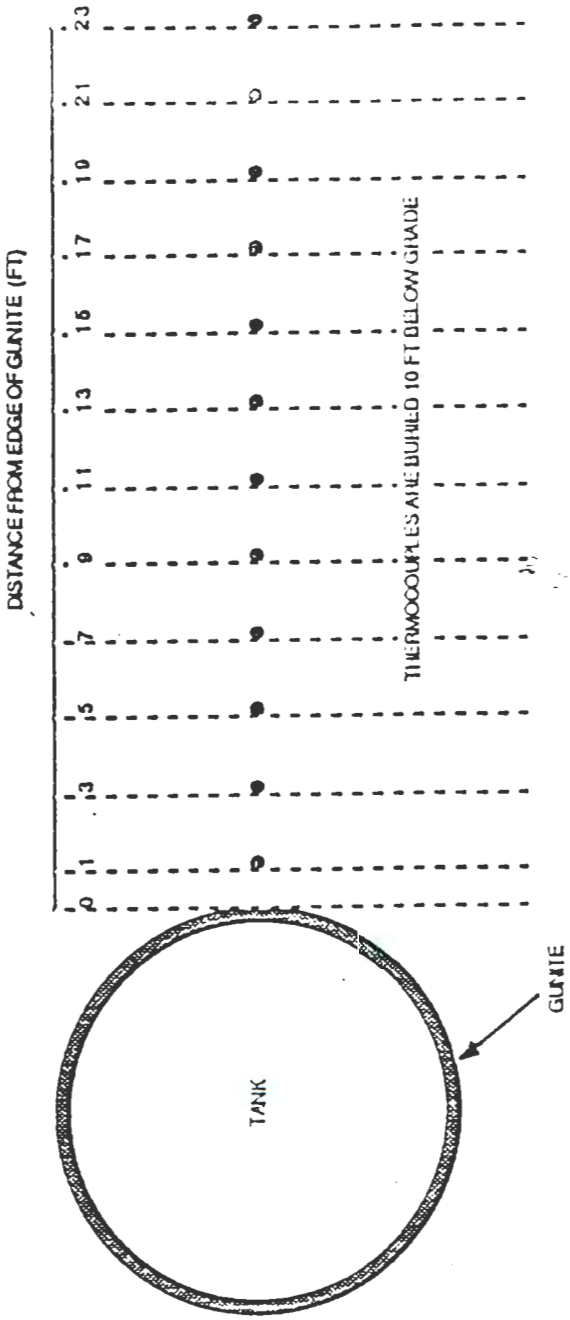


FIGURE 1.5. Lateral Thermocouple Layout

1.3.4 Tank Sludge Simulation

Approximately 15% of the tank volume (~3340 L) will be filled with a ~~simulated~~ wet soil ~~wet refractory sludge~~ layer. An evaluation of ORNL tanks revealed no tanks containing greater than 25 vol% sludge. The "sludge" for this test will be simulated by a mixture of an alumina silica base material (Hanford soil) and water. The composition of Hanford soil is shown in Table 1.1. Typically, sludge heels in the tanks at the ORNL are only a few volume percent of the total tank volume and the tanks will be filled with soil or some other suitable material prior to vitrification.

Table 1.1 Hanford Soil Composition

Alkali	Composition, wt %
K_2O	1.80
Na_2O	3.02
Alkaline Earths	
Al_2O_3	13.6
CaO	6.0
Fe_2O_3	9.55
MgO	2.88
SiO_2	60.9
Others	
P_2O_5	0.42
TiO_2	1.61
Total	99.8

A wide range of sludge types were reported in the ORNL report ranging from hard to soft sludges. Specific data regarding water content was not provided. It is estimated that sludge water content could range from 20 wt% to 80 wt%. Water has little impact on the quality of the resulting waste form since all of the water is vaporized and removed to the off-gas treatment system. Water content is primarily a processing concern. Quick release of water vapor from the tank could result in pressurization of the hood and release to the environment. It is anticipated that during actual tank remediation at ORNL, any remaining supernate would be removed from

the tanks prior to vitrification. Water remaining in the sludge constitutes a minor portion of the tank volume and the inert fill material would contain minimal water content to maximize the efficiency of the ISV process. To evaluate the effect of high water content sludges on the ISV process (i.e., tank and hood pressurization, scrub system water accumulation, etc.), a 30 wt% water sludge will be placed in the bottom of the tank and a dried, low density fill material will be used to fill the tank. Sludge placement and tank filling will be performed through an 18-in. manhole that is slightly off-center of the tank.

1.3.5 Tank Fill

and fill material JEJ 7/11/91

An objective of the test is to demonstrate use of existing methods to fill the void space in the tank prior to vitrification. The void space resulting from removal of supernatant liquids in the ORNL tanks would need to be filled prior to treatment with ISV. The presence of large void spaces in a tank could cause a loss of conductive pathway between the electrodes as the molten soil slumps into void areas. As part of the tank fill task a technique will be identified that will minimize void space within the tank. The technique identified will pose no threat of detrimental impact to the environment nor increase hazard to personnel.

Previously completed engineering- and pilot-scale testing has studied the ISV process on tanks surrounded by and filled with ORNL soil. The large-scale test is being conducted using Hanford soil as the material surrounding the tank and a low density fill material for tank fill. Hanford soil was chosen for use due to the economics associated with shipping ORNL soil to the Hanford site. It will also serve to broaden the knowledge base by use of a second soil. If the glass and crystalline product formed from vitrifying a tank in Hanford soil meets the requirements of Toxic Characteristic Leach Procedure (TCLP) testing it is believed that a product formed with ORNL soil will be even more resistant to the leaching of contaminants. The high electrical conductivity of molten Hanford soil causes the system to be amperage limited once a large molten mass is produced. Treatment of ORNL soil, which possesses a lower electrical conductivity than Hanford soil, allows the large-scale system to operate at a more efficient amperage level. Thus, if a tank is processable in Hanford soil, it may be more efficiently and easily treated in ORNL soil.

The low density selected and subsequently tested in an engineering-scale ISV test was pumice from Malad Idaho. The overriding reasons pumice was selected are because it is non hazardous, has a composition similar to soil, and has a density about half that of soil.

As part of the effort to successfully meet the test objective of achieving "depths practical within the context of actual tank remediation activities," low density materials ~~are being evaluated to~~ were evaluated for use in filling the void volume in the tank. The low density materials, in theory, would produce a smaller volume of glass per depth as well as reduce outward growth of the melt resulting in greater melt depth. ~~Four low density fill materials under evaluation are pumice, low density concrete, borosilicate glass microspheres, and vermiculite. An engineering scale test will be conducted on the material selected to determine impact on processing, depth and product quality.~~

1.3.6 Heat Shield and Vent Pipe

Calculations and previous testing indicate the probability of a hood pressure event attributable solely to hot gases released from the melt is very low. However, rapid radiant heating of the hood atmosphere ~~from the~~ melt surface could result in a hood pressurization. To preclude pressurizing the hood due to radiant heating of the of the hood gases, a heat shield will be utilized to buffer heat release from the surface of the melt in the event the cold cap is disrupted. The heat shield will designed to inhibit heat transfer to the hood atmosphere while at the same time allowing adequate ventilation of the volume within the shield for the burning of combustible off-gases. A 12 in.-dia graphite vent pipe installed to depth in the tank will allow for gasses to be released from the tank. The vent had holes a 6, 12, 18, and 24 in up from its base.

1.3.7 Depth Enhancement Techniques

In an effort to demonstrate increased depth capability, several depth enhancement techniques have been incorporated into this test: low density tank fill material, an electrode feed system, dilated tip electrodes, a heat shield, and a modified, covered starter path.

Low Density Tank Fill Material. The low density tank fill material (pumice) is expected to result in increased subsidence and preferential melting in the low density zone. This should enhance depth by increasing the downward melt rate while limiting outward growth. An engineering-scale test utilizing a pumice material demonstrated a greater downward melt rate when compared to a similar test not using the low density fill.

Electrode Feed System. The electrode feed system will eliminate power losses through electrode sements in the soil below the melt zone (fixed electrode design). Electrode feeding has been successfully

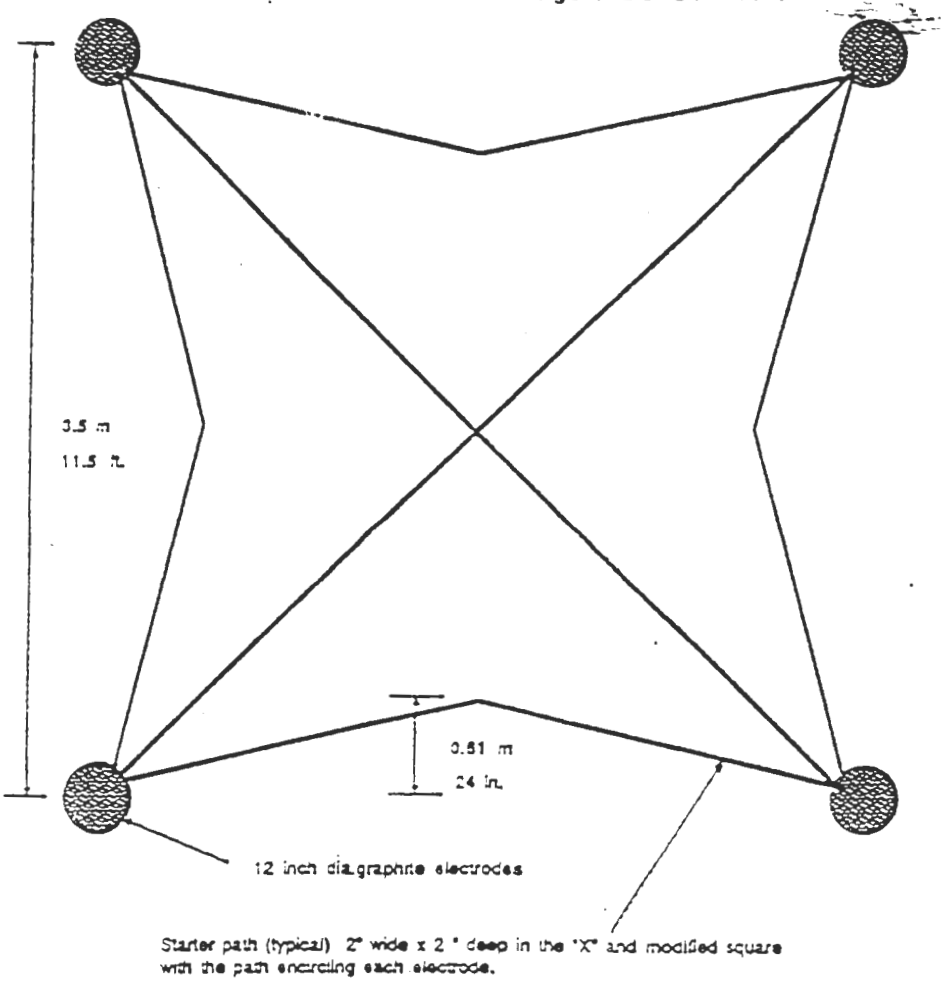
at both engineering- and pilot-scales.

The heat shield is expected to block the radiant shine from the
; release event disrupts the cold cap. This thermal heat source
heat the hood surfaces and suspended particulate which can act to
heat the gas phase in a rapid fashion. Thermal energy from a 1 m
the cold cap can exceed 250,000 watts which is available for

nearer

Configuration. A new starter path configuration will be used to
power ~~nerer~~ the center of the melt and reduce the initial outward
modification does not impact the cross sectional area of the path
angling the center points of the "square" around the electrodes
e center point of the melt as shown below.

Modified Starter Path for the large-Scale UTV Test



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2.0 OPERATIONS AND MAINTENANCE PROCEDURES

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The operation of the large-scale ISV system is governed by Safe Operating Procedure (SOP) 58, ~~Rev. 7,~~ Rev. 3 hereinafter referred to as SOP 58. The procedure includes start-up, operating, and shutdown instructions for the large-scale ISV system and generic instructions for equipment setup and maintenance. Site- and project-specific instructions are included in Sections 3.0 and 4.0 of this test plan.

3.0 TEST SITE AND EQUIPMENT PREPARATION

3.1 TANK PREPARATION

The test site will be initially excavated to a depth of 20 ft for placement of test instrumentation. The hole will be approximately 50 ft across at the surface to account for a required maximum slope of 45 degrees. An 8 in. thick pad of cement will be poured at the bottom of the hole to support the tank such that the top of the pad is 15 ft from grade.

The tank will be placed on the pad so that the conical top and tank marker is pointing upwards. Gunite will be sprayed on the outside of the tank to a nominal thickness of 8 in. Rebar will be used around the tank to support gunite. After the gunite has been allowed to cure the test pit will be back-filled to represent a typical tank configuration at ORNL.

3.2 SITE PREPARATION

The site will be leveled per SOP 58 to provide an even surface on which to place the ISV hood and process trailers. The 18 in. manhole and one 4 in. riser will be left accessible for filling the tank.

The off-gas processing trailer, support trailer, and control trailer will be located on site, immediately east of the test site on the outside edge of the *safety zone* perimeter established by the site supervisor. A change room trailer with all necessary protective clothing is present at the 300-W site. Entrance into the safety zone will be controlled through the off-gas treatment trailer. The process control trailer and the electrical supply trailer will remain outside of the *safety* zone. Figure 3.1 illustrates the relative locations of the trailers.

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ISV 300 WEST SITE

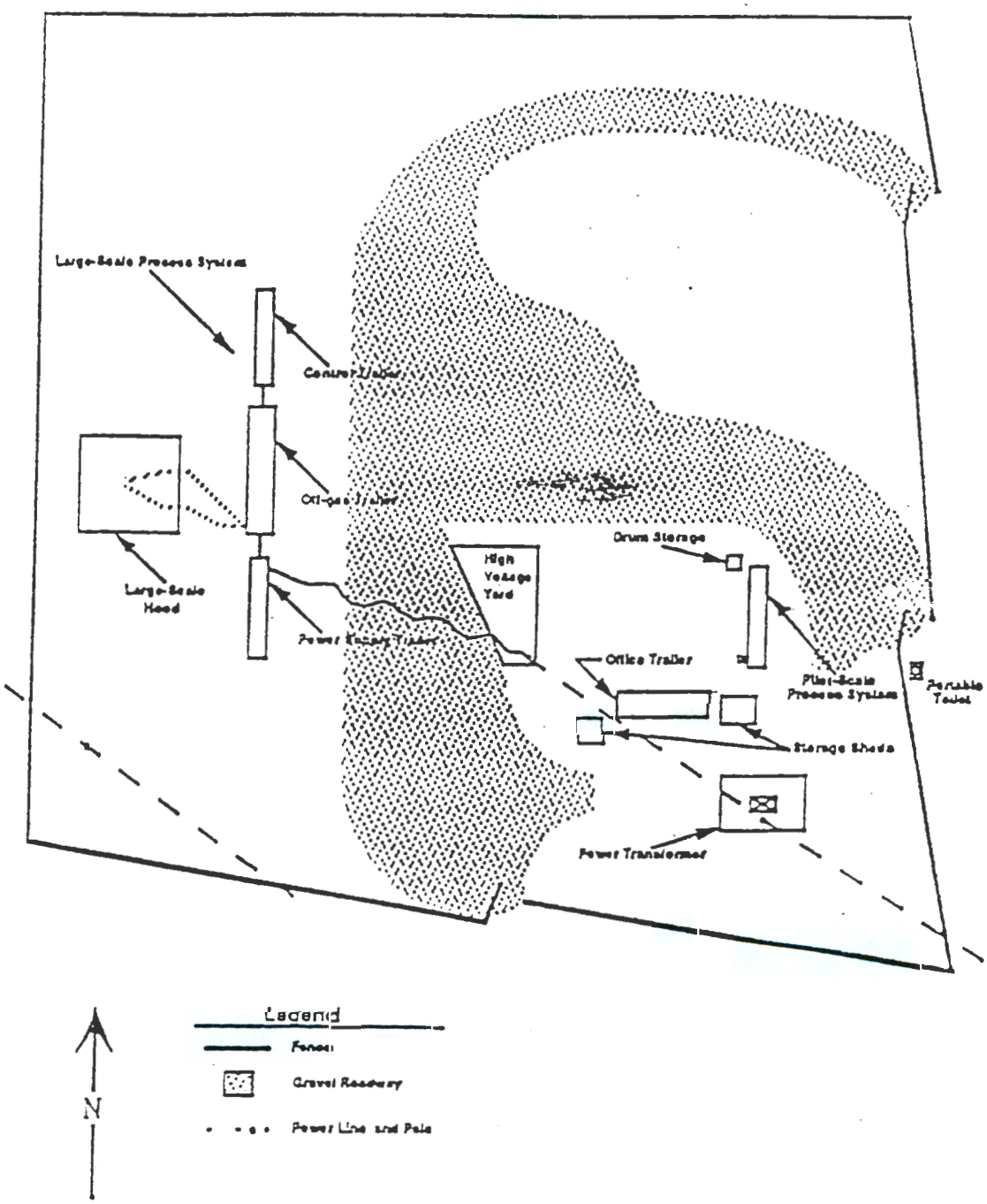

FIGURE 3.1. ISV Equipment Placement for Large-scale UTV Testing

The hood and the electrode feed system will be positioned over the test site. Prior to and after setting the off-gas hood several upgrade and maintenance activities involving the hood will take place. These include:

- Verify that sufficient hood vacuum can be maintained during processing.
- Modify the existing off-gas line so that the electrode feed system will fit over the hood.
- Weld a steel plate skirt around the entire hood to *help reduce the consequences of a subsidence event* reaching the edge of the off-gas hood. The current hood is only 40' x 40' and past testing has shown that this dimension of hood can impact depth.
- Modify the existing two windows to eliminate the "tunnel vision" and install two additional windows on the other two sides of the hood.
- Install lighting in the hood to aid in viewing the melt surface and remote activities conducted inside the hood.

A tank location marker protruding out of the soil covering the tank will identify the center of the tank. The hood will be positioned such that the tank is centered within the electrodes. After positioning the hood, cover soil will be placed around the edge of the hood covering the skirt. The electrode feed system will then be assembled per the assembly plan and placed over the off-gas hood. The off-gas hood will be vacuum tested prior to test initiation.

Installation of the hood and support equipment is detailed in SOP 58.

3.3 TANK FILL

The *"simulated sludge" (actually a wet soil layer representing a high water content layer)* will be prepared by mixing Hanford soil with water to obtain a 30wt% water - *soil layer.* The layer will be mixed by placing the given quantity of soil in the tank and then addition the appropriate amount of water. A low density fill material *(pumice)* will be used to fill the remaining void volume in the tank. The fill material will be placed in the tank through an open riser. *Visual verifications inside the tank will be made to ensure the fill material is uniformly distributed* during the tank fill operation to minimize significant void spaces within the tank.

3.4 ELECTRODE ASSEMBLY AND STARTER PATH INSTALLATION

The electrodes will be positioned and the starter path and the insulating blanket laid per SOP 58 instruction. The electrodes will be positioned in a square configuration with a 3.5 m (11.5 ft) spacing. The electrodes will be initially installed *at a 2 ft. depth* into the ground.

If it becomes necessary to lay a new starter path because electrical conductivity between the electrodes has been lost and cannot be re-established, the cause of start-up failure will be identified prior to restart. Upon approval of the Task Manager and the Site Equipment Supervisor *and in accordance with a confined space entry permit*, fresh soil will be placed over the melt zone and a new starter path and insulating blanket laid per SOP 58.

3.5 PROCESS EQUIPMENT ASSEMBLY AND TESTING

The process equipment will be assembled and tested. Verification that all pre-run activities in SOP 58 have been completed and signed off will be made. The test may be initiated following pre-run verification and successful completion of equipment testing.

4.0 SYSTEM OPERATION

OPERATING INSTRUCTIONS

e off-gas system start-up in accordance with SOP 58. Set the
ure across the scrubbers (DPIC-203) to 50-in. water. Operate scrub
the quencher and tandem scrubber nozzle pressures of 20, 30, and
ely.

.6-M NaOH solution in the pH adjusting tank. Slowly add 100 L of
followed by 40-kg (88-lb) dry NaOH, being careful to watch for
ns. Fill the tank to the 150-L level with water per SOP 58

system 2 temporarily to set the nozzle pressures. Adjust the pH
to between 8 and 11. Collect pretest scrub samples from both
nd set after 30 min of operation. Label the samples with run
er, time and date taken, and operator initials. Shut off scrub pump
g samples, but leave all of the scrubber system 2 valves in their
in case scrub system 2 is activated by the automatic process

system changes, *tank transfers including caustic addition*, as well
servations, in the log book.

OPERATING INSTRUCTIONS

ormer will be operated as outlined in SOP 58. The electrical system
using manual amperage control. Use the graduated power buildup
1 for each electrical phase to control power during start-up.

perating at greater than 25% power, select the appropriate voltage
ower factor on both phases is not less than 0.84 for more than
time. Power factor can be calculated as the ratio of the load
me plate voltage for the given tap.

$$\text{Power Factor} = \frac{\text{load voltage}}{\text{name plate voltage}}$$

transformer tap changes, as well as operational observations, in
eriodically calculate the power factor whenever operating at 25% or
ability and record the result in the log book.

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Predicted Time (h)	Maximum Power (kW/phase)	Predicted Time (h)	Maximum Power (kW/phase)
0.0 - 0.5	5	15.0 - 15.5	375
0.5 - 1.0	10	15.5 - 16.0	390
1.0 - 1.5	20	16.0 - 16.5	405
1.5 - 2.0	25	16.5 - 17.0	425
2.0 - 2.5	35	17.0 - 17.5	450
2.5 - 3.0	45	17.5 - 18.0	470
3.0 - 3.5	55	18.0 - 18.5	500
3.5 - 4.0	65	18.5 - 19.0	520
4.0 - 4.5	75	19.0 - 19.5	545
4.5 - 5.0	85	19.5 - 20.0	570
5.0 - 5.5	95	20.0 - 20.5	595
5.5 - 6.0	105	20.5 - 21.0	615
6.0 - 6.5	120	21.0 - 21.5	650
6.5 - 7.0	130	21.5 - 22.0	675
7.0 - 7.5	145	22.0 - 22.5	705
7.5 - 8.0	155	22.5 - 23.0	735
8.0 - 8.5	175	23.0 - 23.5	775
8.5 - 9.0	180	23.5 - 24.0	800
9.0 - 9.5	190	24.0 - 24.5	840
9.5 - 10.0	205	24.5 - 25.0	880
10.0 - 10.5	220	25.0 - 25.5	925
10.5 - 11.0	230	25.5 - 26.0	985
11.0 - 11.5	245	26.0 - 26.5	1030
11.5 - 12.0	260	26.5 - 27.0	1095
12.0 - 12.5	275	27.0 - 27.5	1165
12.5 - 13.0	285	27.5 - 28.0	1250
13.0 - 13.5	300	28.0 - 28.5	1500
13.5 - 14.0	325	28.5 - 29.0	1680
14.0 - 14.5	335	29.0 - 170.0	1680
14.5 - 15.0	350		

TABLE 4.1. Graduated Power Buildup Chart.

4.3 SHUTDOWN INSTRUCTIONS

Refer to SOP 58 for normal and emergency shutdown procedures. Following system shutdown (normal or emergency) continue to monitor the liquid levels in the tanks every other day (excluding weekends) or until the hood is removed. Record the tank liquid levels in the laboratory record book. If an increase in tank level is observed contact the task manager and the site equipment supervisor.

Minimum normal shutdown conditions will be when the melt has reached the bottom of the tank pad (16 ft.). If reasonable progress is being made (e.g., 0.25 in./hr) testing may be directed to be continued to greater depths as directed by the Project manager and Site Equipment Supervisor. Once electrode power is terminated, operate the off-gas system and the MM5 sampler for an additional 48 hours (2 staff per shift) or until the water accumulation rate in the MM5 sampler is trending downward.

Upon test completion unscrew the remaining portions of electrodes (it may be necessary to cut the graphite) and remove with a crane. Disconnect the electrical cables and the electrode feed system (EFS) airlines. Lift the EFS off of the hood. Disassemble the EFS down to its normal storage state.

4.4 PROCESS MONITORING

The ISV off-gas and power-conditioning systems are controlled by computer. The ISV computer is a distributed-control system that is made up of a number of smaller process control units or microprocessors. A centralized operator interface for monitoring and controlling the ISV process is located in the control trailer and consists of two CRT terminals. Operating conditions are monitored electronically by a large number of remote sensors and the results are displayed and recorded by the operator interface. Set the clock on the process control computer <u>before</u> start-up. Do not readjust the clock during the test *unless power is lost to the site and the Baily Process Control System needs to be restarted.* Note the computer clock time vs. actual time once a shift in the laboratory record book.

Part of the operator's duties is to make sure the data are periodically printed out and recorded to diskette. Table 4.2 shows the frequency at which graphic data (Area 7) are printed and archived to the diskette. Critical data will be monitored on a priority data acquisition (PDA) system, which displays and stores priority data once per second. As a minimum, the data which will be monitored and collected on the PDA system will be the off-gas hood vacuum and selected hood temperatures, *and tank pressures.*

Where the process data are fed directly to the computer, and in cases where a data back-up is desired, process data are recorded on data sheets. Manually recorded data are listed in Table 4.2.

TABLE 4.2. Process Measurements and Sample Collection

Measurement	Sample or Information Collected	Collection Interval
Computer Data		
Archive data to diskette	189 data pts	1 set every 12 hrs
Dump screen data to printer	graphics screens, all Area 7 groups	2 ~~1~~ per shift
Priority Data & Fluke Hydros (IBM)	General check of back-up data status	2 per shift
Operator-Logged Data		
Liquid transfer log	volume, pH each tank	before and after each transfer
Power readings	volts, amps, power; power factor each phase	4 per shift and at change in setpoint
Environmental monitor	~~NO, NOX, SOX,~~ O_2, ~~CO_2~~ CO	1 every 2 hours
Depth of vitrification	electrode depth, thermocouple data	1 every 2 hours
Tank Pressures	Tank psig data	1 every hour
System Status	General System data points	1 every 2 hours
Method 5 Sampler (MMS)	General check of impinger volumes, ice, etc., + data collection	1 every 2 hours

5.0 SAMPLING PLAN

5.1 SAMPLING OBJECTIVES

The purpose of the sampling plan is to identify the procedures that will be used to collect, identify, and analyze samples that will be collected from the test site prior to and following the UTV test. Sampling objectives are listed below. Samples needed to meet the stated objectives are identified in Figure 5.1.

- Obtain data for validation of soil gas transport during ISV operations. The soil water processed through the off-gas system will be determined and compared to the estimated quantity of water affected by the melt. Affected volume for the purpose of evaluation will be based on the 100°C isotherm at the time power is shut down.

- Obtain off-gas particle size, composition data for design of new treatment systems.

- Evaluate contamination of scrub solutions from a "clean" melt. Naturally occuring hazardous soil constituents concentrate in the scrub solutions. The data collected will be used to determine methods for minimizing secondary water generation.

5.2 SAMPLES

Table 5.1 lists the sample types, number, analyses, and sample amount to be collected. All samples will be labeled appropriately with sample name, initials and date. Table 5.2 specifies the sample name coding. All sample collection activities will be documented in the laboratory record book and will be consistent with PNL procedures.

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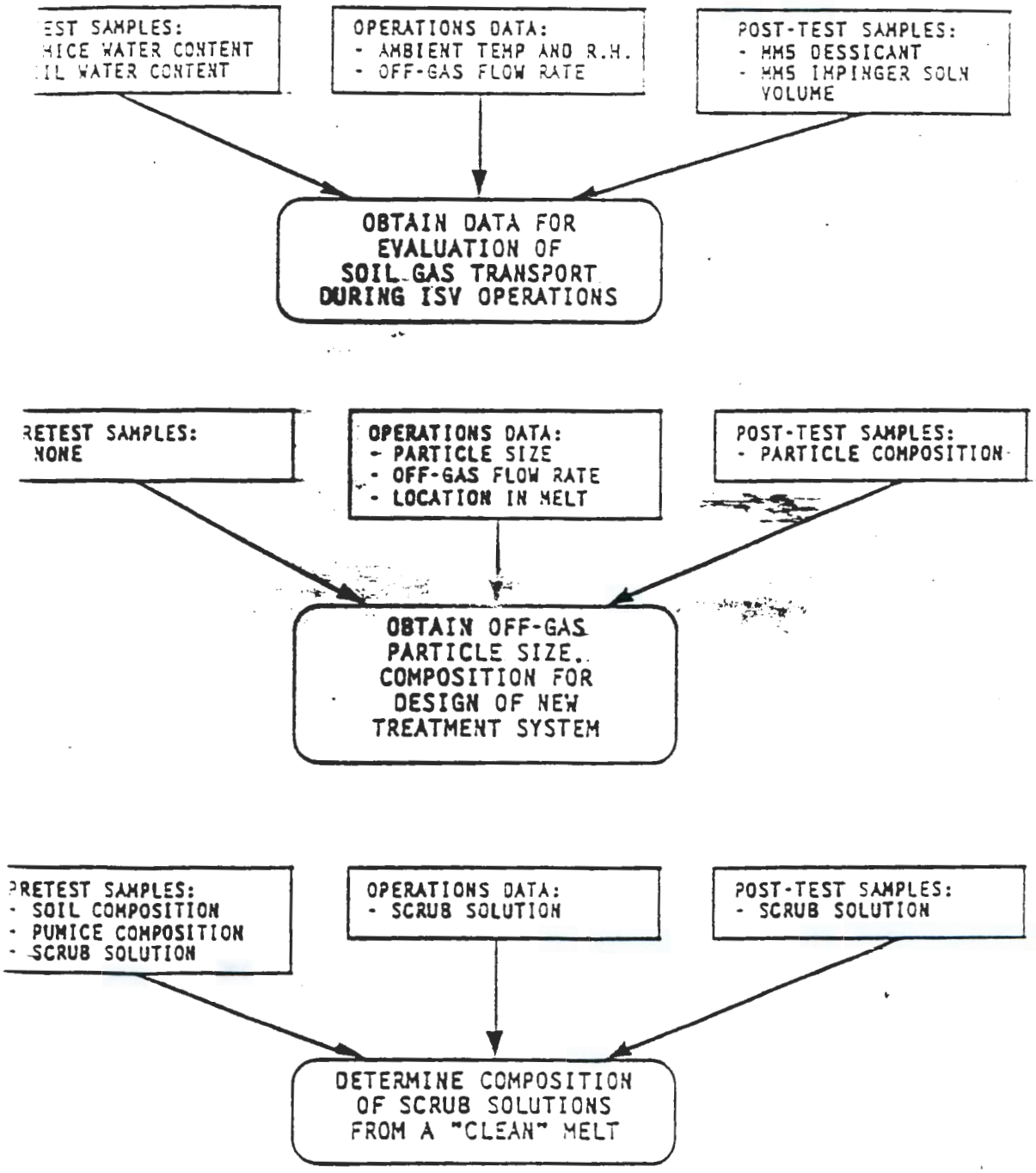

FIGURE 5.1. Samples and Objectives Correlation

TABLE 5.1. Sample Matrix

Sample Material	Sample Type	Number of Samples	Sample Size	Component of Interest	Sample Container	Container Size	Preservation	Holding Time	Preparation	Analysis
Soil	pre-test	2	fill jar	total composition	widemouth glass w/Teflon lined cap	250 ml	N/A	180 days	microwave dissolution	6010 ICP/MS
Pumice	pre-test	3	fill jar	total composition	widemouth glass w/Teflon lined cap	250 ml	N/A	180 days	microwave dissolution	6010 ICP/MS
Melt Particulate	test operation	10	N/A	total composition	widemouth glass w/Teflon lined cap	250 ml	N/A	180 days	microwave dissolution	6010 ICP/MS
Scrub Solution	pre-test	4	N/A	total composition	widemouth polyvinal	250 ml	N/A	180 days	N/a	6010 ICP/MS
	test operations	~20	N/A	total composition	widemouth polyvinal	250 ml	N/A	180 days	N/a	6010 ICP/MS
	post-test	4	N/A	total composition	widemouth polyvinal	250 ml	N/A	180 days	N/a	6010 ICP/MS

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TABLE 5.2. Sample Name Coding

Sample Name	Type of Sample
LS-UTV-1-S-#	Soil
LS-UTV-1-P-#	Pumice
LS-UTV-1-D-#	MM5 Dessicant
LS-UTV-1-IM-#	MM5 Impinger Solution
~~LS-UTV-1-PS-#~~	~~Particle Size Analyzer Particulate~~
LS-UTV-1-SS-#	Scrub Solution Samples

NOTE: Replace # with a number on the sample label.)

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5.2.1 Soil Samples

Two soil samples will be taken during ~~test~~ pit preparation. The samples will be taken at approximately 10 ft depth. These samples will be used to determine soil moisture, as well as, soil oxide composition..

5.2.2 Pumice Samples

Three pumice samples will be taken prior to placement of pumice in the tank. The pumice is located in a pile next to the test site. The samples will be taken from three different locations in the pile. Samples should be taken below the surface of the pile to ensure better representation of the pumice.

5.2.3 MM5 Dessicant

The MM5 sampler will be used to evaluate the quantity of water vapor present in the off-gas. The dessicant samples will be collected to determine the quantity of water absorbed, if any ~~and analyzed.~~ The resultant data will be adjusted for ambient humidity throughout the test and should provide a good approximation of the amount of water transfered from the affected soils. A prefilter will be used with this system to collect particulate and a portion of these filters may be used for particulate size analyses via SEM or equivalent.

5.2.4 Particle Size

A Model PC-2 Quartz Crystal Microbalance (QCM) cascade impactor will be used to analyze particle size distribution of particulate generated from the melt. Quartz crystals are used in each stage as mass monitors to provide real-time mass collection data. The particulate collected will be analyzed for composition.

5.2.5 Scrub Solution Samples

No hazardous materials will be utilized in this test. Scrub solution samples will be taken prior to startup, during operations and following test shutdown. These samples ~~will~~ may be analyzed to evaluate concentration of naturally occuring heavy metals in the scrub solution. Two samples from each tank will be taken prior to test startup. One sample will be taken approximately every day from each of the two tanks during operations. Two samples from each tank will be taken immediately following test shutdown. Determination of which samples (if any) will be analyzed will be made after test shutdown. JEJ 7/11/91

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5.3 SAMPLING METHOD

5.3.1 Soil Samples

All soil samples collected will be placed into precleaned 500-mL, wide-mouth glass jars capped with Teflon-lined lids. Sample locations, any observations, and the results of the field tests will be recorded in the laboratory record book.

5.3.2 Pumice Samples

All pumice samples collected will be placed into precleaned 500-mL, wide-mouth glass jars capped with Teflon-lined lids. Sample locations, any observations, and the results of the field tests will be recorded in the laboratory record book. Samples will be taken using a grab sampler.

5.3.3 MM5 Dessicant

The dessicant in the MM5 sampler will be monitored and changed as needed to preclude water carryover. Each time the dessicant is changed out the weight of the wet dessicant will be measured and recorded in the LRB and the weight of the new dessicant will be measured and recorded in the LRB prior to placement in the MM5 sampler.

5.3.4 Particle Size

The PC-2 operates at a flow rate of 240ml per minute. Due to the low flow rate the connection to the sample source should be less than 1 ft long. An important operating parameter for the PC-2 is the sampling time. The sensitivity of the instrument is 1.5 nanograms of mass impacted per hertz. The optimum sampling time is therefore that time which is sufficient to impart a frequency change of 20 to 30 hertz with a tolerance of -5 to +10 hertz. A longer sampling time which causes a frequency change of more than 50 hertz is undesireable. Initial sample duration should be short (~3 to 5 sec) with adjustments for subsequent samples made

accordingly. If following a sampling the Δf's in the stages with the highest concentrations are between 20 and 30 Hz, the samples time used was optimum. If the Δf's are less than 5 Hz the sampling time was too short. An approximate guide to particulate concentration is given in Table 5.3. Refer to the PC-2 QCM Cascade Impactor Operations Manual for exact instruction on how to operate the device. The 50% cut-off sizes (Dp50) for the standard ten-stage PC-2 instrument are listed in Table 5.4.

TABLE 5.3. Approximate Particulate Concentrations

Concentration (μg/m³)	Time (sec)	Δf (Hz)
10	480	20
100	30	15
1,000	5	25
10,000	2	100
50,000	1	250

TABLE 5.4. 50% Cut-Off Sizes (Dp50) for PC-2

STAGE	Dp50
1	25.0μm
2	12.5μm
3	6.4μm
4	3.2μm
5	1.6μm
6	0.80μm
7	0.40μm
8	0.20μm
9	0.10μm
10	0.050μm

Ten jars, corresponding to the ten collection stages will be in place for collection of the particulate from the stages. When the sampling trays require cleaning the particulate should be placed in the appropriate sample collection jar.

.5 Scrub Solution Samples

Process scrub solution samples will be collected in wide-mouth 250-mL ;vinyl sample bottles. All samples will be properly labeled, dated, and stored to ıre sample integrity.

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6.0 DATA MANAGEMENT

6.1 QUALITY ASSURANCE

This test will be conducted in strict accordance with the requirements outlined in this test plan, in SOP 58, and QA plan WTC-014 in accordance with the PNL QA Program, which is based on ANSI/ASME NQA-1, 1986, Quality Assurance Program Requirements for Nuclear Facilities.

A QA engineer assigned from PNL's Process Quality Department provides independent oversight of project activities and will monitor activities to ensure compliance with established requirements during test preparations, testing, and subsequent sampling.

6.2 LABORATORY RECORD BOOKS

The laboratory record book (LRB) is the primary method of recording day-to-day project activities. The LRB is intended to provide information with sufficient thoroughness to permit an independent person of equivalent technical background to understand the work and evaluate the technical soundness of the work, continue unfinished work, and/or be able to replicate the work. All activities involved with this project will be recorded in LRB BNW-53697, BNW-53698, or in data sheets referenced by the LRBs.

6.3 DATA SHEETS

Pertinent data gathered before, during, and after processing will be entered on data sheets. The following data sheets will be used during the test:

- ~~Scrub Solution Samples~~ JEJ 7/11/91
- ~~Solution Transfer Log~~
- Large-Scale Power Readings
- Electrode Depth Readings
- Environmental Monitoring
- Thermocouple Readings
- Tank Pressure Readings JEJ 7/11/91
- MMS Sampler

Sample copies of data sheets are provided in Appendix A.

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ITER-GENERATED DATA

Much of the process data from the ISV test will be in the form of magnetic
he large-scale ISV system provides automatic data logging at intervals
by the operator. The computerized data include process conditions
ure, flow rates, etc.) and environmental monitor output, such as from the
~~oxide~~ gen and carbon monoxide monitors. The accuracy of the data is dependent
libraries of the instruments used to obtain the data.

A priority data system that accumulates data every second will be used to
critical data points. Data monitored by this system will include tank
, hood pressure and hood plenum temperature data. Data from this system are
an internal hard drive.

HIVE RECORDS MANAGEMENT

The identification, maintenance, storage, and final disposition of records
rned by PNL QA procedures. Project records will be maintained by PNL through
of the project and then transferred to a Records Holding Facility for
. The specified retention period will be ~~not less than 40 years.~~ in accordance with the Records Inventory and Disposition Schedule

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7.0 DATA ANALYSES AND INTERPRETATION

A purpose of the test plan is to define the criteria for determining the success of the test, and describe how the results of the test will be measured against these criteria. The test objectives and criteria for successful achievement for the large-scale UTV test are the following:

1. Demonstrate the applicability of ISV in remediating a 10 ft diameter buried tank which contains a high water content layer representative of a saturated sludge.

The criteria for successful attainment of this test objective is to completely vitrify the buried tank and tank contents. Determination of melt size and whether the criteria has been met will be based on thermocouple and electrode depth measurement data. Thermocouples will be placed vertically below the tank and radially outward from the tank. Temperature measurements obtained from the thermocouples will provide a reasonable estimate of melt size.

2. Obtain water balance data to support the theory explaining why volatile components and water soluble components do not migrate away from the melt, rather are drawn to it.

A water balance will be performed to compare the amount of water given off from the melt to the amount of water that was displaced by the melt out to the 100°C isotherm prior to vitrification. This objective will be met by demonstrating that vaporized water within the melt zone does not migrate away from the melt.

Following completion of the 115-B-6A test, significant amounts of water coming out of the melt were observed for two days after shutting off power. To obtain defensible water balance data the off-gas system will be operated for two days following power shutdown.

3. Characterize the particulate produced during the various stages of the vitrification process to support future off-gas treatment system design.

A gravimetric sampler will be used to determine particle size distribution of particulate produced during ISV system operation. The data obtained will be used to support development of future off-gas treatment systems. This objective will be achieved by successfully obtaining the desired data.

4. Demonstrate the ability of ISV to vitrify the site to depths practical within the context of actual tank remediation activities.

The primary measure of success is to completely vitrify the tank, the tank

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d by the project manager and site equipment supervisor
ew of operations data once the 16 ft. minimum
ieved.

upporting pad. For the ISV technology to be considered a
technology for buried tanks, it must be capable of immobilizing
to depths greater than the bottom of the tanks, which may be up
cale of equipment. The specific performance criteria for
gainst this test objective is the ability of the ISV system to
a depth below the tank or at which soil contamination from a
to background levels. For this test, vitrification will continue
th, if possible, to further test the capability of the system. The
is limited to a maximum depth by the current capacity of the
ystem. The depth of the vitrified zone will be monitored via
asurements and thermocouples placed vertically in and below the
st.

e first large-scale application of an electrode feed system.

icability of using an EFS on a site containing a buried metal tank
from the ability to feed 12 in. graphite electrodes down to the
itrification and minimize binding situations. Successful
he electrode feed system will:

low the system to recover from electrical short circuits when the
ectrodes are engaged in a molten pool of metal,

iminate the labor intensive process of installing fixed
ried electrodes,

duce worker exposure from the intrusive process of
placing electrodes into the soil adjacent to a tank,

iminate the secondary wastes generated during electrode
acement activities.

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technique which could be used in an actual remedial operation to
d tank ~~with dry soil~~. The ability to minimize void spaces in the
to reduce the possibility of transient gas releases from the tank
ting the formation of drain holes which could disrupt the conductive

l field applications, it will be necessary to fill a tank with fill
the void space. This will have to be performed so that both
azardous contamination is not spread to the environment or endanger
at the site. This test will investigate different methods to
mplish filling an actual waste tank.

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7. Obtain data for evaluation of heat shield effectiveness in reducing or eliminating hood pressurizations.

Previous testings indicates hood pressurization could be caused by disruption of the melt cold cap resulting in rapid radiant heating of the dust laden atmosphere in the hood. A heat shield will be used to inhibit direct heat transfer from the surface of the melt to the hood atmosphere. Pressure transducers will be used to obtain tank and hood pressure data. The hood, tank and surrounding soil have been instrumented with thermocouples to provide temperature data. These data will be used to evaluate the radiant heat expansion theory and the resultant effect of the heat shield on hood pressure stability.

8.0 HEALTH AND SAFETY

It is the goal of this project to take every practical precaution to protect the health of PNL employees, subcontractors, and visitors from any adverse effect that might result from activities conducted during large-scale UTV testing. SOP 58 details the hazards associated with operation of the large-scale ISV system. This section of the test plan describes potential hazards associated with this test not covered in SOP 58.

8.1 POTENTIAL HAZARDS

8.1.1 Site and System Preparation

Site preparation activities include the following:

- pit excavation
- placement of tank
- application of gunite to tank
- tank fill
- backfilling around the tank
- site leveling
- transport of the ISV trailers
- connecting off-gas lines
- placement of the hood and electrode feed system

These activities will involve the use of heavy equipment and the hazards associated with their operation. Care must be taken and appropriate personnel protective equipment (PPE) used when operating equipment or when working near equipment being operated. Appropriate safeguards shall be taken when excavating the test pit. Pit walls shall be adequately angled or shored to prevent collapse. No personnel shall be allowed in the pit without PPE (hardhat). During operations involving movement of the tank care shall be taken not to place personnel in a position where injury could result from sudden, unexpected movement of the tank. During application of gunite to the tank appropriate PPE shall be used (safety glasses, respiratory masks, hard hats, etc.). Prior to backfilling around the tank a walkthrough will be made to verify that no personnel are in or near the edge of the pit. During all operations involved in moving and positioning the off-gas lines, containment hood and electrode feed system care shall be taken not to place personnel in positions where injury could result from unexpected movement of the equipment. Special care shall be taken during

operations requiring the lifting of equipment overhead. All personnel will wear the required PPE (hard hats, etc.) during these operations.

8.1.2 Post Test Activities

As with the site preparation activities, the post test activities will involve the use of heavy equipment in removal of the hood and electrode feed system. The subsidence that occurs from the densification of soil as it melts will require backfilling at the completion of the test. Precautions as described in section 9.1.1 shall be taken during all post test activities.

8.1.3 Ionizing Radiation (external, internal)

There are no radioactively decaying material present in this test, however there may be residual material in filter housings or off-gas piping from previous radioactive testing. The radiation work procedure (RWP) provides specific measures necessary to minimize radiation exposure based on sampling and monitoring. Any external contamination present on the off-gas hood or off-gas trailer will be controlled through the use of personal protective clothing as specified in the RWP.

8.1.4 Chemical Exposure (inhalation, ingestion, absorption)

During processing off gases from ISV are collected in the hood and passed through the treatment system. A wind direction indicator will be posted during sampling activities and ISV operations. To the extent feasible, personnel will be positioned upwind of any site activity to prevent the inhalation of dust or exhaust from the off-gas treatment trailer. Previous ISV operations have shown that the concentration of toxic gases generated by melting soil and exhausted from the treatment trailer (NO_x and SO_2) has been within acceptable levels. However, the ISV exhaust will be monitored for ~~toxic contaminants~~ air quality (O_2 and CO). JEJ 7/11/91

To prevent ingestion of any toxic materials, eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material will be prohibited within the controlled area.

Protective clothing and gloves will be worn as necessary to prevent contact with chemical contaminants. Impermeable gloves will be required when handling soil samples and soil tools.

8.1.5 Noise

Noise levels from equipment and operations will be measured and hearing protection used when required. Heavy equipment activities may generate operating noise levels as high as 100 dB at the site. High noise levels also exist in the off-gas trailer blower room. Operators entering this area are required to wear hearing protection when the ISV off-gas blower is operating.

8.1.6 Electrical Hazards

The large-scale ISV electrical system is designed to minimize the potential for electrical shock. The electrodes and cables are insulated from the off-gas hood, electrode feed system and other possible contact points. No additional hazard is posed during operation with precipitation or moisture present. Electrical shock hazards during ISV setup, operation, and maintenance will be further controlled by separation of operations from overhead power lines and insulation of conductors. Insulation of conductors will be inspected and tested. Only authorized personnel using electrical gloves and rubber shoe covers will be permitted in the controlled area during ISV operations. Lock and tag procedures and protective equipment are discussed in the SOP 58 for work on electrical systems. Eye protection will be worn during electrical maintenance and inspection to protect against ejection of molten metal in case of arcing.

Occupational Safety and Health Administration (OSHA)-required clearances of 10 ft between derricks and power lines will be maintained. No personnel shall be near cranes or drilling rigs during electrical storms.

During ISV start up, arcing may occur within the starter materials on the surface of the soil. Use of a welder mask or appropriate attenuating filters will be used by start-up observers.

No personnel will be allowed on the electrode feed system platform or on the off-gas hood when power is applied to the electrodes. Once the electrode cables are installed and tested, no personnel will be allowed to step on or climb on any electrical cable regardless or whether power is on or off. Physical barriers, including ropes, signs and walkways, will be placed to identify and cable positions and preclude potential danger to personnel and damage to the cable.

8.1.7 Mechanical Hazards

Operations associated with assembly of the ISV system pose various mechanical hazards. Attention must be paid to these potential hazards to preclude injury to

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personnel. These hazards include pinch points, flying objects, moving equipment parts and heavy tools. Mechanical guards, safety devices and personal protective equipment will be used to minimize risk of personnel injury. Prior to use tools and equipment will be inspected to verify that appropriate guards are in place and functional. To minimize potential hazards, equipment operators shall have received appropriate training (i.e., crane operator training) prior to use of the equipment. Gloves, safety glasses, steel toe shoes, face masks and hard hats should be used as appropriate.

Nonessential personnel are not permitted in the immediate vicinity of operations where mechanical hazards are present. Untrained personnel who must be present in the vicinity of operations where mechanical hazards are present must be briefed on the hazards and accompanied by trained personnel.

Eye protection will be provided and ~~used during~~ operations where eye hazards such as flying particulate matter are present. Personnel will not wear contact lenses in eye-hazardous areas or operations. If personnel require corrective lenses they will be provided with prescription safety glasses or goggles that can be worn over their glasses. A portable eye wash unit will be provided onsite.

8.1.8 Heat Stress

During the summer, ISV personnel working outdoors may be subject to heat stress. Cool drinking water will be available onsite and personnel will be encouraged to increase their use of salt on foods during hot periods. Site personnel will be trained to recognize symptoms of heat stress.

Heat stress monitoring using wet bulb globe temperature (WBGT) measurements should be instituted whenever ambient temperatures exceed 85°F. Work-rest regimens recommended by the American Conference of Governmental Industrial Hygienists must be followed.

8.1.9 Cold Stress

As the temperature drops below 20°F, there is an increasing danger of freezing exposed flesh within 1 min, depending on wind speed. Equivalent chill temperatures will be calculated at ambient temperatures less than 20°F. Workers will be warned to avoid skin contact with cold surfaces below 20°F. Breaks will be taken in heated trailers during cold periods.

3.1.10 Thermal Burns

During ISV operations and cool down, the hood and off-gas lines will be very hot. Warning signs will be displayed at exposed surfaces where thermal burns could occur. Access around the ISV equipment during vitrification will be limited to essential trained personnel.

3.1.11 Fire Hazards

A prefire plan has been prepared for ISV operations at the 300-W site. Vegetation will be cleared from the site during site preparation. The work site will be kept orderly and free of debris, tumbleweeds, etc. The use of combustible materials in the controlled area will be minimized. Approved fire extinguishers will be provided and situated for easy access from within and outside of the controlled area.

3.2 WORK SAFETY PLAN

3.2.1 Personnel Training

Minimum training requirements for ISV operations staff and supervisors are defined in the training plan included as part of the ISV Site Environmental Compliance Plan. The plan addresses the job description, skills, education, and training requirements.

Field team personnel directly participating in onsite operations, including ISV operators, in the controlled area are required to complete 40 h of instruction on health and safety for waste site operations. This training will include recognition of observable symptoms of exposure to toxic chemicals associated with the site. Documentation verifying that training has been completed will be placed in the training file for all personnel. On an annual basis, these persons require 8 h of additional training. Other training required of field team and operations team members includes radiation training and respiratory protection training (including a current respirator fitting record card). All site personnel are required to have a multi-chip dosimeter.

3.2.2 Personnel Protective Equipment

Levels of Protection: A _____ B _____ C ___x___ D ___x___

Protection Level D is the minimum level of protection that will be used within the exclusion zone at the 300-W site. Each situation will be evaluated individually, and hazard conditions will determine the actual level of protection and other safety procedures required to meet health and safety requirements. Street clothing can be worn outside the control zone during ISV operations. SOP 58 describes protective clothing requirements (equivalent Level D) when hazardous materials are not involved.

The highest level of protection required during test preparation and operation is Level C. A control area will be established around the site. Level C protection is required in the control area during ISV operations and when site excavation is involved. Protective equipment and clothing required will be determined by the work activities involved. Personal protective equipment requirements for site preparation and system operation have been provided in this test plan. When there is a potential for contact with radionuclides the protective equipment and clothing requirements are specified in the site-specific Radiation Work Permit (RWP).

8.2.3 Medical Surveillance

All team members must be covered by a medical surveillance program. The medical examinations provided to employees for Hanford contractors satisfies the medical surveillance requirements. OSHA requires that employee medical records be maintained for a minimum of 30 years. Hanford employee medical records are maintained for 75 years. Physical examinations will be provided annually or following any suspected exposure above allowable limits.

8.2.4 Monitoring

Radiation protection technicians (RPT) will monitor site operations on an as-needed basis dependent on the site work activity.

Air monitoring of the exhaust from the off-gas stack will be conducted to ensure that no hazardous levels of radiological or chemical contamination are being released.

8.2.5 Site Control Measures

Public access to secured areas of the Hanford Site is strictly controlled. Visitors require special badges and must be escorted. The 300-W site is located inside a fenced area and is controlled by limited key access. Visitors must be issued a "Visitor" badge by PNL security and be escorted by PNL personnel. Entrance to the ~~exclusion area~~ Safety zone must be authorized by the shift engineer.

JEO 7/11/91

A radio will be located onsite for routine and emergency communications. Phones are located in the process control trailer, the off gas trailers and support trailers. The Hanford Fire Department's 300 Area Fire Station will provide emergency medical treatment for this site and will be notified prior to the start of work. This fire station is approximately 1 mile southeast of the site with an estimated less than 5 minute response time. An emergency medical technician (EMT) is on duty at the 300 Area Fire Station at all times. The nearest first aid station is located in the 3706 bldg of the 300 Area.

No less than two people will be onsite at any one time during test operations. A wind direction indicator will be posted during sampling activities and ISV operations. To the extent feasible, personnel will be positioned upwind of any site activity.

Site preparation work will be conducted only during daylight hours, unless night lighting is provided. ISV operations are run continuously, 24 h/day.

8.2.6 Emergency Response Plan

A site-specific Emergency Plan will be posted at the site. The nearest first-aid station is located in the 3706 bldg. of 300 Area.

8.2.7 Nearest Site Resources

Water Supply	3790 Bldg, 300 Area
Telephone	300-W ISV Site, 300 Area
Flush Toilet Facilities	3790 Bldg, 300 Area

8.2.8 Sanitation

During site preparation activities, the field team is considered to be a mobile team with transportation available to the nearest water and sanitation needs. Once waste processing by ISV is started, the site will be equipped with the following sanitation items:

- Potable water will be provided outside the controlled area in closed containers equipped with a tap and labeled as "Drinking Water." Non-potable water supplies will be labeled, "Unsafe and Not for Drinking, Washing, or Cooking Purposes."
- One chemical toilet will be located outside the controlled area.

9613400.0890

9.0 RESIDUALS MANAGEMENT

While no hazardous materials will be used in this test, solid residuals (wastes) could potentially be generated. These wastes would likely include contaminated protective clothing, scrub tank sediment, sample jars and similar debris. Those wastes determined to be hazardous per EPA and WDOE regulatory requirements will be disposed of in accordance with EPA's land disposal restrictions (40 CFR 268).

The vitrified product will remain in the ground at the test site.

9613400.0891

10.0 CHANGE CONTROL

Changes to or departures from this test plan or SOP 58 may be needed as the test progresses. Any changes to the documentation governing this test shall first be defined as a minor or a major change. Minor changes are changes which have no impact on the environment, personnel or equipment safety. Major changes have a potential impact on the environment or worker safety or possible damage to process equipment. The determination of whether a changer is minor or major shall be made by the shift engineer. After the scope of a change is determined, the following will be performed.

- All minor changes shall be documented in the record copy of the test plan or SOP 58 and noted, in the LRB. Changes shall be noted in the record copy of the effected document and initialed and dated. GEJ 7/11
- All major changes shall be approved by the ISV equipment custodian and the project manager. ~~It will be at the discretion of the ISV equipment custodian and the project manager as to whether or not the proposed change will be discussed with a Laboratory Safety representative~~
- Changes affecting the objectives of the test as stated in this test plan will be approved by the project manager and ISV equipment custodian.

Laboratory safety personnel will be contacted to discuss changes which can potentially increase personnel safety risks. Changes will be noted in the record copy of the effected document and initialed & dated. GEJ 7/11/91

9615400.0892

11.0 STAFF REQUIREMENTS

Staff support will be identified prior to testing so that the appropriate training can be performed. It is the practice of this section to staff operation shifts with a minimum of one experienced operator or engineer. *In addition to the experienced staff, at least two additional personnel will be on shift at any given time except for non-powered periods following the test. Staff identified for test operations are listed in the attached shift schedule and include the use of Geosafe personnel.*

12.0 SCHEDULE

The attached schedule lists the tentative operating staff and alternates. Table 12.1 provides the tentative large-scale UTV operations schedule. Each crew consists of 4 people with one person off allowing for 3 people on site per shift at all times except as noted above. Staff on shift include a shift engineer and two operators for each of the three shifts. The schedule is structured to allow for each person to work 6 days on followed by 2 days off. During the 2 days off, the 4 th person assigned to the shift rotates in for a 6 day assignment. Each shift includes at least one person with previous large-scale operations experience, either with the PNL system, or alternatively, with the Geosafe Large-Scale system. The Site Equipment Supervisor and the Task Leader will be available during day shift and, as needed, on off-shifts. One of the 3 staff members assigned to each shift will have the primary responsibility of monitoring the MM5 sampler. Changes to this schedule must be coordinated with the Task Manager and the Site Equipment Supervisor.

Large-Scale UTV Shift Schedule

Draft Schedule 6/27/1991 - Blanks will be filled in later with alternates

Leo E Thompson

Start-up scheduled for Tuesday, July 16, 1991

Crews are from: 8:00 am to 4:15 pm (days)
4:00 pm to 12:15 am (swing)
12:00 midnight to 8:15 am (grave)

Crews consist of 4 people with one person rotating in for relief.
At any one time, there will be 3 people per shift on site with the 4 th crew member having a day off.
Alternate shift engineer is in charge of the shift when the primary shift engineer has a day off.
Asterisk denotes dual responsibility for operating the MM5 sampler (primary responsibility).

Crew 1 (Day Shift)

Bergsman	(shift engineer)
Luey *	(alternate shift engineer)
Fichter*	
Timerman	

Crew 2 (Swing)

Kindle	(shift engineer)
Bigelow	(alternate shift engineer)
Siiger *	
Winkelman*	

Crew 3 (grave)

Tixier	(shift engineer)
Powell*	(alternate shift engineer)
Garcia*	
Campbell	(2nd alternate shift engineer)

Alternate Shift Engineers/Operators

Koegler
Thompson
Another off-shift operator from another crew
Woosley, Carter
Jeffs (last resort)

Revision 2, July 7

DATE	SHIFT	SHIFT ENGINEER	OPERATORS	
Tuesday, 7/16/1991	Day	Bergsman	Timmerman	Luey*
	Swing	Kindle	Bigelow	Sliger*
17-Jul	Grave	Tixier	Powell *	Campbell
	Day	Bergsman	Timmerman	Luey *
	Swing	Kindle	Bigelow	Sliger*
18-Jul	Grave	Tixier	Powell *	Campbell
	Day	Bergsman	Timmerman	Fichter*
	Swing	Kindle	Bigelow	Winkelman*
19-Jul	Grave	Tixier	Powell	Garcia*
	Day	Bergsman	Timmerman	Fichter*
	Swing	Kindle	Bigelow	Winkelman*
20-Jul	Grave	Tixier	Powell	Garcia*
	Day	Luey	Timmerman	Fichter*
	Swing	Bigelow	Winkelman	Sliger *
21-Jul	Grave	Tixier	Campbell	Garcia*
	Day	Luey*	Timmerman	Woosley
	Swing	Bigelow	Winkelman	Sliger *
22-Jul	Grave	Tixier	Campbell	Garcia*
	Day	Bergsman	Luey	Fichter
	Swing	Kindle	Winkelman	Sliger *
23-Jul	Grave	Powell	Campbell	Garcia*
	Day	Bergsman	Luey	Fichter*
	Swing	Kindle	Winkelman	Sliger *
24-Jul	Grave	Powell	Campbell	Garcia*
	Day	Bergsman	Timmerman	Luey*
	Swing	Kindle	Bigelow	Sliger*
25-Jul	Grave	Powell	Campbell*	Woosley
	Day	Bergsman	Timmerman	Luey *
	Swing	Kindle	Bigelow	Sliger*
26-Jul	Grave	Powell	Campbell*	Woosley
	Day	Bergsman	Timmerman	Thompson
	Swing	Kindle	Bigelow	Winkelman*
27-Jul	Grave	Powell	Woosley	Garcia*
	Day	Koegler	Timmerman	Thompson
	Swing	Kindle	Bigelow	Winkelman*
28-Jul	Grave	Powell	Woosley	Garcia*
	Day	Luey	Timmerman	Thompson*
	Swing	Bigelow	Winkelman	Sliger*
29-Jul	Grave	Campbell	Woosley	Garcia*
	Day	Luey	Timmerman	Fichter *
	Swing	Bigelow	Winkelman	Sliger *
30-Jul	Grave	Campbell	Woosley	Garcia*
	Day	Luey	Koegler	Fichter*
	Swing	Kindle	Winkelman	Sliger *
31-Jul	Grave	Powell	Campbell	Garcia*
	Day	Luey	Woosley	Fichter*
	Swing	Kindle	Winkelman	Sliger *
Thursday 8/1/1991	Grave	Powell	Campbell	Garcia*
	Day	Luey*	Timmerman	Woosley
	Swing	Kindle	Bigelow	Sliger*

Friday	8/2/91	Grave	Tixier	Powell*	Campbell
		Day	Luey*	Timmerman	Woosley
		Swing	Kindle	Bigelow	Sliger*
	3-Aug	Grave	Tixier	Powell*	Campbell
		Day	Thomoson	Timmerman	Fichter*
		Swing	Kindle	Bigelow	Winkelman*
	4-Aug	Grave	Tixier	Powell	Garcia*
		Day	Koegler	Timmerman	Fichter *
		Swing	Kindle	Bigelow	Winkelman*
	5-Aug	Grave	Tixier	Powell	Garcia*
		Day	Bergsman	Timmerman	Fichter*
		Swing	Bigelow	Winkelman	Sliger *
	6-Aug	Grave	Tixier	Campbell	Garcia*
		Day	Bergsman	Timmerman	Fichter*
		Swing	Bigelow	Winkelman	Sliger*
	7-Aug	Grave	Tixier	Campbell	Garcia*
		Day	Bergsman	Woosley	Fichter*
		Swing	Kindle	Winkelman	Sliger *
	8-Aug	Grave	Powell	Campbell	Garcia*
		Day	Bergsman	Woosley	Thomoson
		Swing	Kindle	Winkelman	Sliger *
	9-Aug	Grave	Powell	Campbell	Garcia*
		Day	Bergsman	Timmerman	Woosley
		Swing	Kindle	Bigelow	Sliger *
	10-Aug	Grave	Tixier	Powell*	Campbell
		Day	Bergsman	Timmerman	Woosley
		Swing	Kindle	Bigelow	Sliger*

Asterisk (*) denotes MM5 operator. The operation of the MM5 system is the primary responsibility of this staff memeber unless superseeded by personnel or equipment safety issues.

Crew schedule changes must be preapproved by Thompson (Jeff's or Koegler alternate).

If the start-up date slips, the schedule will not slip. In other words the schedule is fixed. Extenced delays may necessitate a revision of the schedule to accommodate commitments.