LOCKHEED MARTIN

ORNL/ER-392

ENVIRONMENTAL RESTORATION PROGRAM

Comprehensive Work Plan for Building 3001 Storage Canal Media Replacement at the Oak Ridge National Laboratory, Oak Ridge, Tennessee

MASTER

ENERGY SYSTEMS

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MANAGED BY
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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Energy Systems Environmental Restoration Program

Removal Action Work Plan for Building 3001 Storage Canal at the Oak Ridge National Laboratory, Oak Ridge, Tennessee

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managed by
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APPROVALS:

Comprehensive Work Plan
for Building 3001 Storage Canal
Media Replacement
at the Oak Ridge National Laboratory,
Oak Ridge, Tennessee
(ORNL/ER-392)

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PREFACE

This report documents compliance with the requirements of the *Action Memorandum for Building 3001 Canal, Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/02-1533&D2) to replace the shielding protection of the water in the canal with a controlled low strength material (CLSM). This work was performed under Work Breakdown Structure 6.1.14.01.04.50, Activity Data Sheet 3300.

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ABBREVIATIONS

ALARA	As Low As Reasonably Achievable
ARARs	Applicable or Relevant and Appropriate Requirements
Bq/L	bequerel per liter
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLSM	controlled low-strength material - a very low strength (<1000 pounds per square inch) mixture of Portland cement, fly ash, sand, and water.
DOE	Department of Energy
ER	Environmental Restoration
HAZWOPER	Hazardous Waste Operations
HEPA	High Efficiency Particulate Air
LMER	Lockheed Martin Energy Research
LMES	Lockheed Martin Energy Systems
LO/TO	Lock Out / Tag Out
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
OGR	Oak Ridge Graphite Reactor
ORNL	Oak Ridge National Laboratory
P&E	Plant and Equipment
PPE	personal protective equipment
psi	pounds per square inch
PWTS	Process Waste Treatment System
RCRA	Resource Conservation & Recovery Act
RCT	radiological control technicians
RWP	Radiation Work Permit
RPP	Radiological Protection Procedures
SLLW	Solid Low Level Waste
SOP	Standard Operating Procedure
SWP	Safety Work Permit
SSHO	Site Safety and Health Officer
TDEC	Tennessee Department of Environmental Conservation
WM	Waste Management

1. Introduction

1.1 Site Background and Purpose

This Comprehensive Work Plan complies with the requirements of the *Action Memorandum for Building 3001 Canal, Oak Ridge National Laboratory, Oak Ridge, Tennessee* (DOE/OR/02-1533&D2) and describes the method of accomplishment to replace the shielding protection of the water in the canal with a controlled low strength material (CLSM) 4.

The canal was used during the operation of the Oak Ridge Graphite Reactor in the 1940s and 1950s to transport spent fuel slugs and irradiated test materials from the reactor, under water to the hot cell in Building 3019 for further processing, packaging, and handling. After the reactor was shut down, the canal was used until 1990 to store some irradiated materials until they could be transferred to a Solid Waste Storage Area. In 1992 a Resource Conservation & Recovery Act (RCRA) task was conducted. At that time all RCRA materials and sludge were removed from the canal. In addition, all other stored materials were removed from the canal in 1996.

The Building 3001 Canal is an approximately 150 feet long "L" shaped below grade concrete reinforced structure running from the west face of the reactor in the Oak Ridge Graphite Reactor (OGR) Building 3001 to a hot cell in the Building 3019. The canal is located in a below grade concrete vault shown schematically in Figure 1-1. The north-south leg of the canal is seven feet wide inside and the east-west leg is five feet six inches wide. At the north end below and west of the reactor back face the canal contains a 22.25 feet deep ceramic tile lined pit. The remainder of the canal varies in depth from 11.7 feet adjacent to the pit to 11.5 feet at the Building 3019 east wall. At that point the canal depth increases to 13 feet deep until it reaches its end underneath an air dam separating the canal vault from the environment in the hot cell of Building 3019. The top of the canal in the hot cell has been sealed.

The concrete walls of the canal beneath the water are contaminated with radionuclides that have penetrated the surface of the walls. This creates a potential problem of exposure for workers in the area to airborne radionuclide contamination if the water is removed and the exposed walls are allowed to dry. A slight negative pressure is maintained on the canal vault by the ventilation system which pumps the air through High Efficiency Particulate Air (HEPA) filters in Building 3002 before the air is exhausted to the environment through the 3018 stack.

The water in the canal is contaminated with radionuclides as shown in Table 1-1. The concentration of contamination in the water is below the Waste Acceptance Criteria levels for the Oak Ridge National Laboratory (ORNL) Process Waste Treatment System (PWTS). The concentration levels are maintained close to the levels described in Table 1-1 by continuously running the water through a demineralizer and by adding only demineralized make-up water. The canal loses approximately 400 gallons of water daily through evaporation and leaks to the ground under the canal. The canal contains approximately 74,600 gallons of water.

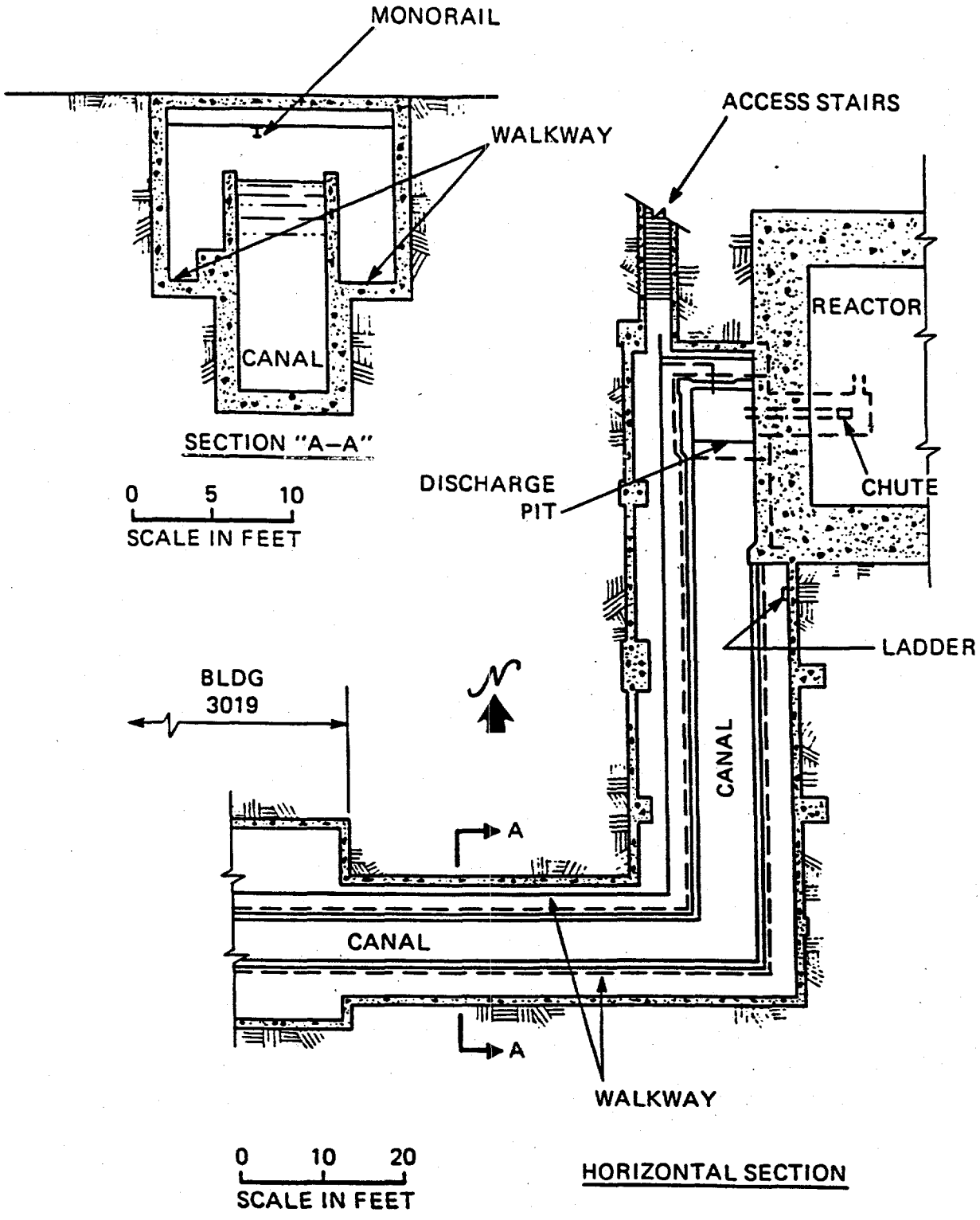


Figure 1-1 Building 3001 Canal Plan View and Typical Section

Isotope Quantity (Bq/L)[1]	^{137}Cs	^{90}Sr	^{60}Co	Gross a	Gross b
Water	54	60	0.78	7.8	205
DCG[2]	111	37	185	N/A	N/A

[1]Bq/L = Bequerel/Liter
[2]DCG = Derived Concentration Guide

Table 1-1 Isotope Concentrations In Building 3001 Storage Canal Water

1.2 Project Scope and Objectives

This task has the following objectives and components: 1. minimize potential future risk to human health and the environment; 2. reduce surveillance and maintenance cost of the canal; 3. perform site preparation activities; 4. replace the water in the canal with a solid CLSM; 5. pump the water to the PWTS for further processing at the same rate that the CLSM is pumped under the water; 6. remove the water using a process that will protect the workers and the public in the visitors area from contamination while the CLSM is being pumped underneath the water; 7. painting a protective coating material over the CLSM after the CLSM has cured.

1.3 Site Access Control

Hazardous Waste Operations (HAZWOPER) requirements shall be applied to this task; however, it has been determined that an As Low As Reasonably Achievable (ALARA) Plan and a Hoisting and Rigging Plan will not be required. The canal work area in the canal vault is located in a radiologically contaminated zone. Radiological Worker II training, RWPs, and Safety Work Permits are required for entry. Stairs at the north end of the canal vault are used for entry and exit with a buffer zone at the top of the stairs. Another stairway and door is located at the Building 3019 end of the canal vault for emergency exit only. A hatchway is located in the ceiling of the vault over the corner of "L" in the canal which will be used to transmit the CLSM to the canal. If needed, for better distribution of the CLSM in the canal, a hatch is also located over the 3019 end of the canal adjacent to the 3019 outside wall between the two buildings. A one ton crane in the hatch room of Building 3001 at ground level may be used to raise and lower heavy objects into the canal. The Site Safety and Health Officer (SSHO) will control access to the HAZWOPER controlled contaminated areas.

2. Project Organization and Responsibilities

All work in the canal area will be performed with Lockheed Martin Energy Research (LMER), Lockheed Martin Energy Systems (LMES), and subcontract personnel. A subcontractor will be used to operate the CLSM pumper. All CLSM will be purchased ready- mixed from a local

concrete batch plant and delivered by the batch plant contractor's trucks and drivers. All subcontractors will be badged for ORNL access.

Figure 2-1 shows the project organization structure.

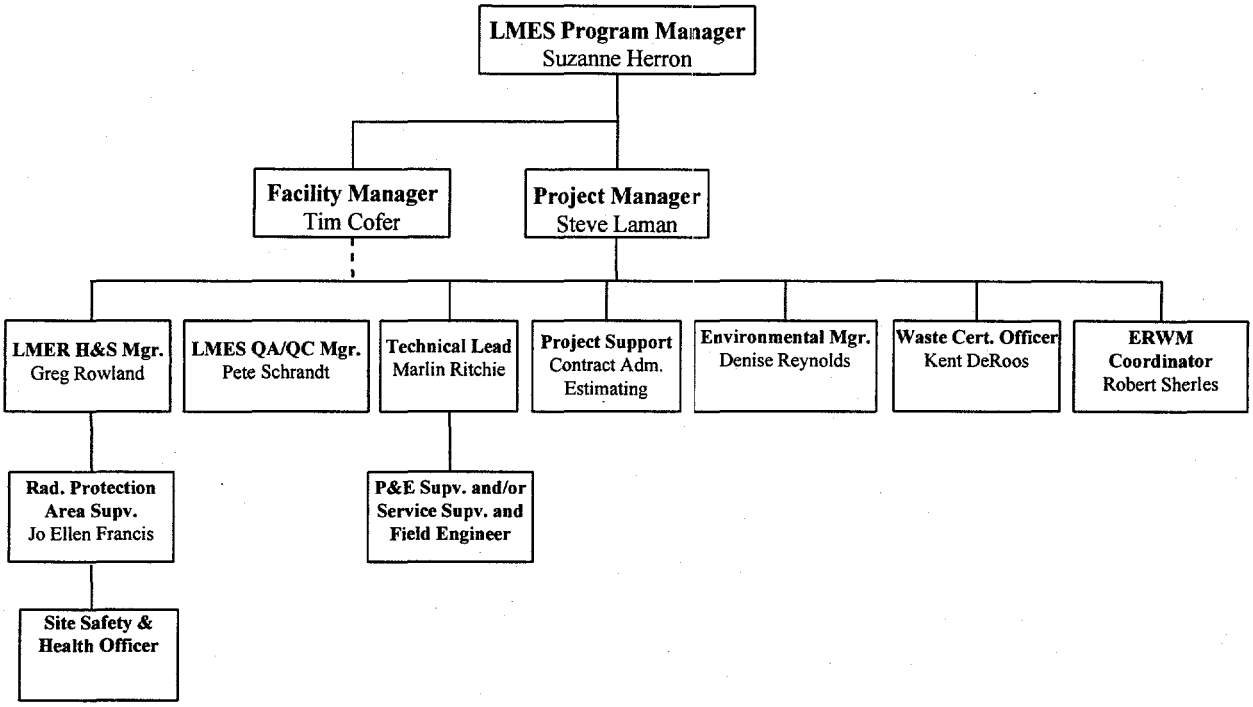


Figure 2-1 Organization for Building 3001 Storage Canal Media Replacement

2.1 Facility Manager for Building 3001

(1) Controls access to the facility and work areas.

(2) Ensures facility is maintained in a safe condition and notifies workers of any known hazards or other safety concerns which could impact the workers.

(3) Reviews and approves RWPs and other safety related documents as needed.

(4) Attends pre-job briefings and provides input as needed.

2.2 Project Manager

(1) Provides customer and LMES/LMER management status of project until completion.

(2) Assures that project schedule, funding, and reporting requirements are met.

(3) Assures that the project is adequately planned and project resources are provided when required throughout the plan.

(4) Assures that all applicable regulations are recognized and the plan complies with them.

(5) Assures that adequate contingency planning has been performed to address the areas of high project risks.

2.3 Site Safety and Health Officer

(1) Serves as the primary on-site contact for safety and health during field activities.

(2) Oversees the on-site execution of all field activities regarding safety and health procedures.

(3) Has the authority to stop all work if conditions are judged to be hazardous to on-site personnel.

(4) Keeps the log book up to date, recording all actions and progress each work shift and initiates completion of Health and Safety Plan field change forms when changes occur in tasks, hazards, SSHO, and/or occurrences are reported.

(5) Assures that all personnel have had the appropriate training to perform in the area.

(6) Implements and assures that requirements of the Site Safety and Health Plan are met.

2.4 Plant and Equipment

Responsibilities for Plant and Equipment (P&E) personnel can be found throughout Section 3.0.

2.5 Radiation Protection

A typical radiological survey of the work area is attached in Appendix II. The radiological control technician (RCT) will:

(1) Attend pre-entry and daily Health and Safety briefings and inform all site workers of radiological conditions and requirements.

(2) Perform radiological surveys as needed during task activities and give input on ways to keep exposures and spread of contamination ALARA.

(3) Assure that personnel and equipment are frisked for contamination before leaving radiological areas.

(4) Write and/or approve Radiation Work Permits (RWP) prior to start of task.

(5) Maintain radiological postings in compliance with 10 CFR.835, ORNL Radiological Protection Procedures (RPP), and standard operating procedures (SOP).

(6) In conjunction with SSHO establish appropriate personal protective equipment (PPE) for use during each task.

Note: A cross-trained SSHO/RCT may be used on this project if warranted with support from the responsible organizations.

2.6 Environmental Compliance

Section 4 describes how the work is to be accomplished consistent with the Applicable or Relevant and Appropriate Requirements (ARAR).

2.7 Waste Certification Officer (WCO)

Responsibilities are listed in ORNL/ER-288, Section 4.9.

2.8 Environmental Restoration Waste Management Coordinator

Responsibilities are listed in ORNL/ER-288 Section 4.3.

3. Project Activities

3.1 Controlled Low Strength Material Specification

The specification for the CLSM is in Appendix I.

3.2 Radiological Conditions and Requirements

The 3001 canal vault is a radiation area and contamination area. A radiological survey of the work area in the canal vault is attached in Appendix II. All work in the canal vault will be controlled by RWPs which will contain the up to date radiological conditions and requirements.

3.3 CLSM Supplier Selection and Procurement

At least three ready-mix concrete suppliers have been identified with the capability to meet the CLSM specification attached in Appendix I and are located close enough to ORNL to supply the material. The suppliers identified are:

Harrison Construction Company
250 Union Valley Rd.
Oak Ridge, TN
Attn. Doug Brown
(423) 981-5760

American Limestone Company
2209 Blount Avenue
Knoxville, TN 37920
Attn. Phil Johnson
(423) 573-4501

Ready Mix Concrete Company
1104 Spring Hill Road
Knoxville, TN. 37914
Attn. Al Hancock
(423) 524-3331

In addition, a pumper will be required with approximately 110 feet of hose to pump the CLSM under the water in the canal. The pumper will be required to be parked on top of the canal vault in the alley between Building 3019 and Building 3001. The canal vault top in the alley has a weight loading limitation of 300 pounds per square feet or 9000 pounds per axle. Three concrete pumping service companies were contacted in the Knoxville and Oak Ridge area. These companies are East Tennessee Concrete Pumping Service, Nichols Concrete Equipment Inc., and Con Quip Company. Due to the design of their pumper equipment only East Tennessee Concrete Pumping Service clearly has the equipment that will not exceed the load limit of the canal vault top. This company is located at:

East Tennessee Concrete Pumping Service
1715 New Topside Road
Louisville, TN.
(423) 970-3912

These services supply an operator with the equipment. Both East Tennessee Concrete Pumping Service and Nichols Concrete Equipment Inc. have ORNL badged operators. Con Quip Company does not.

Because the hose is expected to be contaminated by the operations in this task, the hose must be purchased and later disposed of as solid low level waste (SLLW) when the task is completed. Measures will be taken to ensure that the pumper will not become radiologically contaminated. In addition, the areas of the equipment to be in contact with the ground will be surveyed before use and prior to release.

3.4 Site Preparation

3.4.1 Pipe Design and Placement for Water Removal Behind 3019 Air Dam

The Building 3001 Canal extends approximately 4'-3" underneath Hot Cell Number 1 in Building 3019. A five foot thick concrete air dam extends down into the water of the canal from the common wall between the hot cell and the canal vault. The top of the canal in the hot cell has been sealed off with a welded steel plate over the canal. As CLSM is added to the canal under the water when the CLSM reaches the bottom of the air dam it will effectively eliminate any escape of the remaining water on the hot cell side of the dam.

(1) P&E will construct two four inch diameter "U" shaped pipes, or construction of equivalent cross section, such that the top of the open end of one of the pipes will be at the same level as the present top of the water on each side of the dam. The second pipe of similar configuration will be placed parallel with the first pipe (separated by at least two feet) but with the top of the pipe on the hot cell side sticking

approximately 2 inches above the end of the first pipe. This second pipe on the 3001 side of the hot cell wall will be at the same height as the first pipe. This will provide an escape for the water trapped on the hot cell side of the air dam as the CLSM level is raised to the present water level. After all but one or two inches of the water has been removed from the canal, CLSM will be pumped through the first pipe until CLSM starts coming out of the second pipe. The final four inch cap of clean CLSM will fill the pipe and entomb it in place. A sketch of a longitudinal section of the canal in this area is shown in Figure 3-1 with a conceptual sketch of the pipe to be placed in the canal for water equalization.

(2) P&E will plug the canal overflow pipe, after disabling the water delivery systems to the canal, to prevent water and CLSM from overflowing into the floor.

3.4.2 Preparation of CLSM Pumper Site

(1) The CLSM pumper service will park their equipment outside the hatch room of Building 3001 in the alley between Buildings 3019 and 3001. The pumper will be positioned as close to the hatch room double doors as reasonably possible. As a result it is necessary for the pumper to be parked on top of the canal vault ceiling which has a 300 pounds per square inch (psi) load limit. The concrete delivery trucks will not be permitted to back their trucks onto the vault .

(2) P&E will construct a rectangular wood frame from nominally 2" X 6" timbers approximately six feet by eight feet to be laid under the receiving end of the pumper and extending out from the pumper far enough for the concrete truck to back close enough to it to allow the delivery shoot to be over the frame.

(3) P&E will place a heavy gauge plastic over the frame, resting it on the ground, to catch any spillage from the truck shoot or pumper during their operation. This area is free of radiological contamination.

(4) As soon as enough CLSM has spilled on the plastic basin to require its removal to prevent run off, P&E will pick up the CLSM in the plastic basin and place it into a suitable container for disposal as construction waste and a replacement plastic sheet will be installed for a clean collection basin.

3.4.3 Preparation of Slings and Mechanisms for Hose Handling/Manipulating

Since the CLSM will be delivered to the canal bottom using an approximately 2 ½ inch diameter flexible hose approximately 100 feet long, the hose will have substantial weight. The hose full of CLSM is expected to weigh between three and four pounds per linear foot depending on the actual weight of a foot of empty hose.

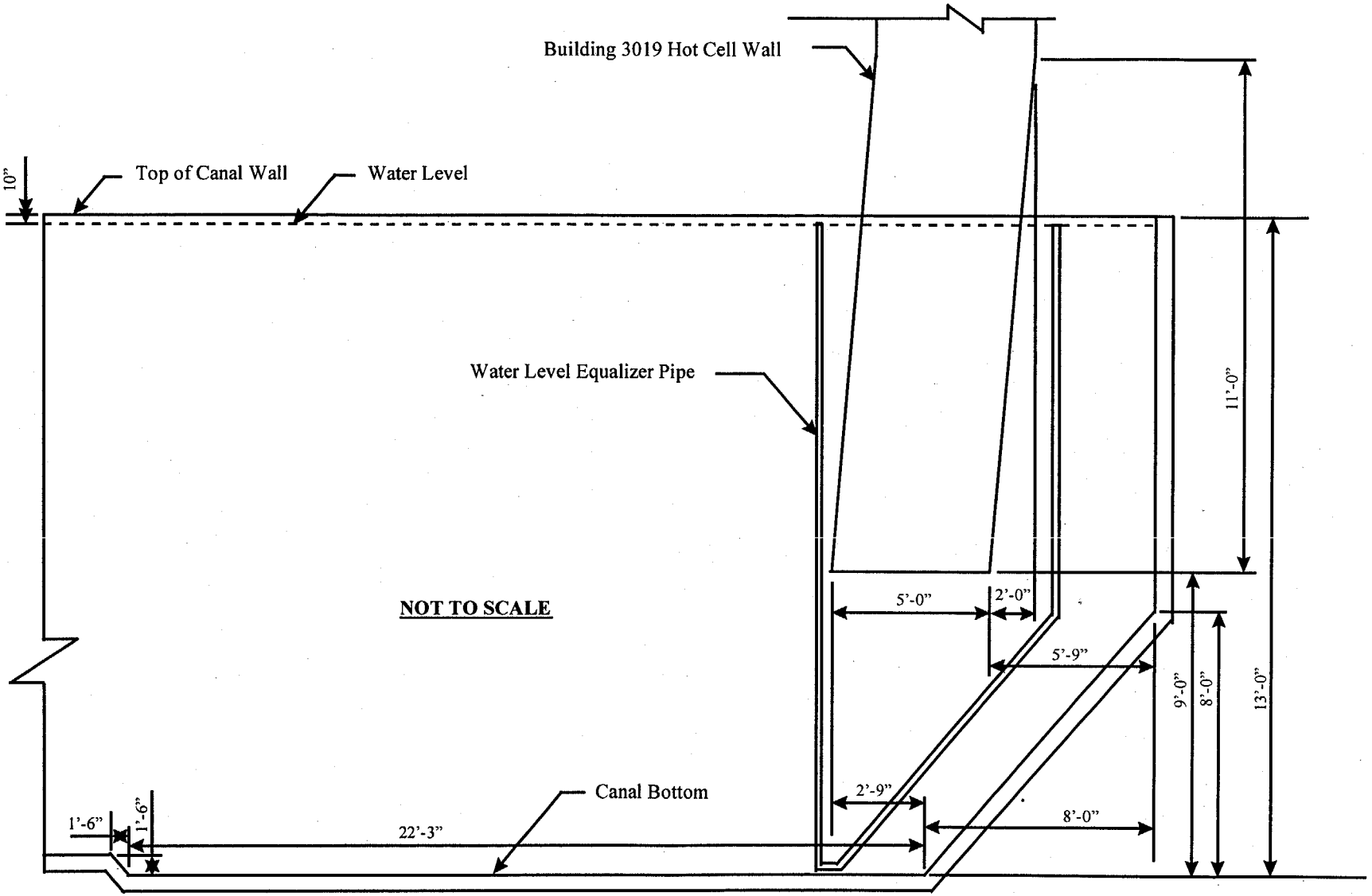


Figure 3-1 Longitudinal Section of Building 3001 Storage Canal at Building 3019 Air Dam

(1) P&E will keep the majority of the hose length out of the canal with the exception of the exit end which must be kept under the surface of the newly pumped CLSM. The crane in the hatch room may be used with a sling to support the weight of the hose suspended directly below the hatch room. The bulk of the hose not being actively controlled and manipulated by the CLSM placement personnel may be allowed to be supported on the walkway along the east and north side of the canal. When large lengths of the hose must be moved to reposition where the CLSM will be placed, it may be necessary to use the monorail crane in the canal or a simple trolley supported on the crane rails with a sling to support some of the weight of the hose.

(2) At least two crew members will be required at all times in the canal vault to control the placement location of the hose and to keep as much of it out of the water as possible.

(3) P&E will inspect all cranes and slings to verify certifications are in compliance with applicable safety standards.

(4) P&E will provide a plastic sleeve to cover the last 25 to 30 feet of hose that will be in the canal water at various times. The sleeve will provide protection for the P&E personnel to prevent them from having to handle a wet hose and to prevent the wet portion of the hose from lying on the floor or canal wall. The sleeve will be kept out of the water at all times but be available to slide over wet portions of the hose as it is removed from the canal.

3.4.4 Disabling Water Delivery Systems in Canal

(1) After the canal has been filled with CLSM, all of the water has been removed, and painting and demobilization has been completed, P&E will cap the demineralized make-up water supply line for the canal from Building 3004 at the most accessible location.

(2) The Facility Manager will close and place valves for all other water lines in the canal vault under administrative control.

3.4.5 Preparation of Hatch Room

(1) All radiological contamination on the floor of the hatch room has been fixed. P&E will cover the hatch room floor with Herculon to prevent contamination of the floor.

(2) The fall protection provisions around the hatch will remain in place.

(3) P&E will prepare a sling to support the CLSM pumper hose to distribute some of its weight. The sling will be arranged so that no part of the contaminated portion of the hose can be raised into the hatch room. The crane can then be used to raise the hose, thus shortening it, when needed for hose maneuverability in the canal area.

3.4.6 Preparation of Supplemental Drain and Filter System

(1) The PWTS drain in the floor gutter on the inside corner of the canal vault will be checked to assure that it drains freely. If not, clear the drain by any method necessary to get it flowing freely.

(2) The drain opening will be prepared to permit a PVC pipe to be connected to it from one or both of the recirculating pumps hanging from the side of the canal.

(3) Both of the recirculating pumps hanging on the side of the pool close to the floor drain will be moved and plumbed in parallel to exhaust through a bag filter to the floor drain. The largest pipe possible will be used to achieve the maximum flow rate through the pumps to the drain. The pumps will be arranged so that the height of the suction side of the pumps will be 10 inches below the top of the canal and so that the pumps and their supports will be at least three inches higher than the suction end of the pipe. The plumbing to the drain will be prepared so that it can be easily disconnected and a bag filter can be installed between the pumps and the drain. It will be configured to be able to remove the last of the water from the canal with these pumps using the filter to prevent any mud from going to the drain.

(4) A properly sized bag filter will be installed, when needed, to handle the full rated flow rate of both pumps with minimal flow reduction using a 10 micron filter. Twenty-four extra filters will be procured. The filter should be designed to easily change the contaminated filters during the process of pumping the water from the canal.

3.5 CLSM Pumper Preparation and Operation

The CLSM truck drivers and the pumper operator will not be permitted to enter the hatch room or any other contaminated areas.

(1) The pumper operator will assure that the pumper is positioned over the catch basin to catch any spillage and that the delivery truck is positioned over the basin properly to collect any spillage also.

(2) The pumper operator will notify the P&E operators in the canal when the first CLSM from a truck is about to be delivered to the canal and get confirmation that they are ready before starting to pump the CLSM. The P&E operators must have all pumps running at maximum capacity to remove the water being replaced by the CLSM. The rate of water removal will govern the rate at which the CLSM can be delivered to the canal. Therefore, there will have to be continual communication between the P&E operators and the CLSM pumper operator to assure that the water level in the canal stays essentially constant at approximately 10 inches below the top of the canal wall.

(3) The pumper operator will notify the P&E operators in the canal when one truck has finished unloading and the next one is ready to start unloading.

(4) At the end of the shift, when it is time to shut the pumper off until the beginning of the next shift, the pumper operator will notify the P&E operators in the canal vault that the last truck has been emptied for the shift.

(5) After the last CLSM has left the pumper, the last truck will run enough water into the pumper to flush a soft sponge through the hose with the water, thus pushing the remaining CLSM out of the hose. A new sponge will be required each time this operation is performed. The used sponge will be treated as SLLW.

3.6 CLSM Preparation and Quality Control

(1) The batch plant preparing the CLSM in the trucks will be required to check the flow consistency of the first batch prepared each day to assure that the material meets the Class requirements for flow specified in the specification in Appendix I. If flow requirements are not met, the material constituent proportions will be adjusted to meet the requirements and all quality control formulations adjusted for the correction before the mixing of the next batch.

(2) The Field Engineer will sample the first truck load of CLSM for each day prior to delivery to the site in accordance with the Class I requirements for flow specified in the specification in Appendix I. If flow requirements are not met, the material will be rejected and subsequent batch mixtures corrected by the batch plant until a satisfactory test result is received before any CLSM is delivered.

3.7 Water Removal and Coordination With Pumping

Water will be removed from the canal using the demineralizer pump and a electric pump (or pumps) hanging on the side of the canal. The demineralizer pump will draw water from the top of the pool at its present suction location. Another portable pump (now being used for water recirculation that hangs on the side of the canal) will be relocated near the PWTS drain in the floor at the intersection of the east - west leg and the north - south leg of the canal and also used for pumping the water from the canal. The end of the suction pipes for both pumps will be placed no more than six inches below the top of the present water level.

(1) P&E will plumb the suction side of the two pumps as described above.

(2) P&E will plumb the exhaust side of the portable pumps in the canal directly to the PWTS floor drain. The plumbing will be arranged so that a section of pipe can be easily removed and a bag filter canister can be quickly and easily inserted into the exhaust line when it is needed. This pump can be activated and de-activated by an electrical plug on the side of the canal wall near the pump.

(3) The Facility Manager will adjust the valving in the demineralizer system to by pass the demineralizer resin columns and pump the water from the demineralizer pump directly to the PWTS.

(4) When the water approaches one foot deep or closer to the top, it may be necessary to use an in-line filter to reduce the amount of cementicious wash out being pumped out with the remaining water to PWTS. At this time P&E will add a ten micron filter bag to the exhaust line of the portable pump and the rest of the water will be pumped through the filter. A pressure gauge will be placed in the exhaust line between the pump and the filter to determine when the filter needs to be changed to keep the water moving efficiently. At this point the demineralizer pump will be isolated and valved out.

(5) The CLSM pumper service will control the pumping rate of the CLSM to not exceed the water removal rate from the canal as directed by the P&E operators in the canal vault. The water removal rate is limited by the capacity of the demineralizer pump and the temporary pumps plumed into the PWTS; the water can probably be removed at the rate of approximately 40 gallons per minute (gpm). The CLSM pumper service can pump CLSM at about 60 gpm; but with delivery truck change out time considered, it is estimated that the average CLSM pump rate will be 40 to 45 gpm.

(6) P&E will provide a radio to the personnel in the canal vault and to the CLSM pumper service for communication to control the CLSM pump rate.

3.8 CLSM Placement

During the CLSM pumping and placement some precautions must be observed. First, the pumping rate of the CLSM must be regulated to keep the water level in the canal as close to 10 inches below the top of the canal walls as possible. This will minimize further contamination of existing walls now exposed above the present water level. The overflow will be plugged so there should be no concern for the water overflowing into the floor as long as the water is not allowed to run over the top of the canal.

Second, the water level should not be allowed to fall below 10 inches below the top of the canal for extended periods of time that would allow the walls to dry and permit airborne contamination from the more highly contaminated walls below the existing water line. (This is why the CLSM will be filled to 10 inches below the top of the canal walls before all of the water is completely removed.)

Third, P&E must control the water level at all times by controlling the CLSM pumping rate and the water removal pumps. The demineralizer pump is controlled by an on/off switch located on the east side of the demineralizer room on the ground floor.

Fourth, the demineralizer pump should be the primary pump for water removal until the CLSM level gets close enough to the suction pipes that there is too much washout of the CLSM suspended in the water. At that point the demineralizer pump should be shut off and the remainder of the water removed by the hanging pumps with a bag filter connected to them. The on/off control for the hanging pumps is plugging and unplugging them in electrical outlets on the side of the canal.

Fifth, care must be exercised to prevent air entrainment in the CLSM hose at all times when the end of the hose is under water to prevent air bubbles in the water from creating air-borne contamination when the bubbles exit the surface of the water.

(1) P&E will start the CLSM placement in the north end of the canal in the pit. To minimize washout of the cementicious constituents in the CLSM and mixing of the canal water with the CLSM, once a puddle of CLSM is formed in the bottom of the canal and/or pit, the end of the hose will be held underneath the surface of the previously pumped CLSM during the continued pumping. To prevent the end of the hose from whipping and to control where the end of the hose is placed at all times, it may be necessary to attach a stiffener to the hose end. This shall be done with a piece of PVC pipe or other non-electrically conductive light construction material and can be attached to the hose with hose clamps or tape.

(2) P&E will control the water level during the pumping as described previously.

(3) After the pit is filled and the canal is filled to the bottom of the concrete structure designed to hold the removable dam, P&E will move the hose to the other side of the dam to continue delivery of the CLSM in the bottom of the rest of the canal. CLSM will continue to be added to the canal on the south side of the dam until the level rises to the same level on that side of the dam. The hose can then be moved farther south in the canal to try to keep the CLSM at approximately the same depth from one end of the canal to the other. It requires approximately 2.6 cubic yards of CLSM to raise the level in the canal one inch.

(4) P&E must exercise care to keep the hose full of CLSM to minimize entrainment of air in the backfill and to keep the end of the hose under the surface of the freshly pumped CLSM to minimize wash out.

(5) When it becomes necessary to flush the hose for cleaning, during any other operations where air is apt to be entrained in the hose, P&E will raise the end of the hose slightly above the surface of the water to prevent air bubbles from being introduced under the water which could lead to air borne contamination above the canal. Air coming from the hose should be clean but air coming up through the canal water could be contaminated by the water.

(6) When the P&E operators are notified by the pumper operator that the last truck has been unloaded for the shift and cleaning operations are about to start, the P&E operators will pull the end of the hose above the CLSM surface and let the remainder of the CLSM be pumped through to prevent introducing air into the freshly poured CLSM.

(7) The P&E operators will be notified when the sponge is to be pushed through so they can catch it with a fish net as it comes out the other end. The sponge and net will be raised out of the water and allowed to drain over the canal over night. At the beginning of the next shift the sponge can be placed in a plastic bag with some adsorbal until it is ready to be removed from the canal vault as contaminated waste.

(8) After the sponge has been pushed through the hose, the end can be draped over the canal wall and secured so that it will not fall out and drain the remaining water in the hose onto the canal vault floor.

(9) Once the CLSM solidifies against the air dam, no additional CLSM can be placed on the hot cell side of the air dam except through one of the pipes. After all but one or two inches of the water has been removed from the canal, CLSM will be pumped through the shorter

pipe until CLSM starts coming out of the longer pipe. When CLSM starts coming out of the longer pipe, all of the water will have been removed from the other side of the air dam and the remainder of the water will be displaced from the 3001 side.

(10) P&E will continue to add CLSM until it reaches the same level as the existing water level (i.e., approximately 10 inches below the top of the canal walls). At this point all of the water should have been pumped off of the top.

(11) After all of the remaining water has been removed and the CLSM is at the present water level, less vertical shrinkage of one to three inches, P&E will add clean CLSM to cap off the canal. After pouring the last CLSM, P&E will use a long handled float before it dries to smooth the surface satisfactory for painting.

(12) The CLSM backfill will then be completed and P&E can begin demobilization of the CLSM set up and the generated waste removed.

3.9 Isolation of Demineralizer

(1) After all water has been removed from the canal, and before the final cap of clean CLSM is added, P&E will cap the demineralizer suction line at the lowest point in the line near the pump to assure no water is left in the suction line to prevent any contaminated water from flowing back to the canal from the demineralizer.

(2) The suction and return valves will be closed and the Facility Manager will place them under administrative control.

(3) The Facility Manager will lock out and tag out the pump electrical circuit in the off position.

3.10 Cleanup and Demobilization

(1) The pumper operator, at the end of each working shift, will pick up any CLSM spillage in the catch basin at the pumping station in the plastic ground cover and place it in the container provided by the field supervisor for clean construction waste.

(2) P&E will pick up any CLSM spillage around the canal and place it in a plastic lined drum or garbage can for subsequent removal as SLLW.

(3) After all CLSM has been poured and all water has been removed, P&E will remove the portable pump(s) and piping hanging on the sides of the canal, bag them, prepare them for removal, and lift them to the hatch room where they should be placed on blotter paper for further preparation to place them in appropriate waste containers.

(4) Prior to removing all waste from the canal vault P&E will bag it, prepare it for lifting with the hatch crane into the hatch room, lift it, and place it on the hatch room floor on blotter paper for surveying and preparation for waste disposal.

(5) The RCT will survey and tag all waste for disposal and provide the information to the Reactor Operator.

(6) After all surveying, tagging, data collection and paper work is completed, The Reactor Operators will place the waste into appropriate waste containers for waste disposal.

(7) The WCO will complete waste forms and submit them to Waste Management (WM) pick up.

(8) Waste Management will review the forms and schedule the pickup of the waste items by the waste operations personnel.

(9) After all CLSM has been poured and before it dries, P&E will wipe down all remaining exposed walls inside the canal and on top of the canal walls, using 409 cleaner and rags or sanitary napkins, to leave them suitable for subsequent painting. All contaminated materials used for wipe down will be placed into plastic bags for removal and disposal as SLLW.

(10) In addition, after all CLSM has been poured, P&E will cut the CLSM delivery hose sections in small enough pieces to assure that all water has been removed from them and bag them for survey and removal. All other work aids and tools used in the canal vault will be placed into plastic bags for removal and disposal as SLLW.

(11) After painting the CLSM surface, remaining inside canal walls, and top of canal walls, P&E will place all waste generated by the operation into plastic bags and remove as described above for all other waste in the canal vault.

(12) After all work is completed in the canal vault, P&E will replace the Herculon on the walk way of the canal vault floor with new Herculon for shielding purposes, place the removed material in bags, lift it to the hatch room and place on blotter paper for subsequent preparation as contaminated waste as described above.

(13) P&E will remove the barrier around the storm drain and the catch basin and place it in the container provided for construction waste.

(14) The Reactor Operators will remove the Herculon in the hatch room, bag it, have it surveyed, and prepare it for disposal as SLLW.

3.11 Curing

Forty eight hours after all standing water on the surface of the CLSM has been removed either by pumping or evaporation, the CLSM should be firm enough to walk on it. However, the CLSM does not achieve its peak strength for at least 28 days after all the surface water has been removed. The CLSM will be allowed to cure for at least two months to allow as much moisture as possible to evaporate before the surface is painted.

3.12 Painting

P&E will paint the surface of the cured CLSM with two coats of paint for sealing the surface and preventing surface dusting that could contribute to air borne contamination. The first coat will be a water resistant Epoxy based magenta color and the second coat will be a exterior Latex paint with a water-colored blue tint. Painting will be performed by rolling to prevent potential air-borne contamination.

3.13 Removal Action Completion Report

A Removal Action Completion Report will be prepared that describes the results of this task as defined in the Comprehensive Work Plan. Any required/approved deviations from this plan will be delineated with an explanation of the effect of the deviations on the final product. Photographs of the final condition of the canal and work area will be included.

4. Environmental Compliance Activities

4.1 Waste Disposal

Liquid and solid wastes generated during site activities will be segregated, packaged, and handled in a manner commensurate with the physical, chemical, and radiological hazards associated with the waste. Waste generated during this task will be managed according to the WM Plan. Pollution prevention waste minimization will be performed to the extent possible as identified in the WM Plan to reduce the amount of waste generated. As a general rule the following guidelines will be followed:

Non-radiological, non-hazardous solid waste (sanitary waste) generated at the site, such as materials used in clean areas, office wastes, etc., will be segregated from contaminated waste, collected and disposed at the local sanitary landfill. (TDEC 1200-1-7-.01 et seq, 40 CFR 258) (FFCA of 1992 Section 105; TDEC Commissioner's Order for the ORR STP).

Radiologically contaminated wastes will be identified, segregated, packaged, and appropriately managed for pick up by LMES WM for final disposition. It has been determined, based upon process knowledge and the available analytical results, that the canal water is non-hazardous. (TDEC 1200-1-11-.03(1)(b); 40 CFR 262.11(c)and (d)). However, any waste generated that is determined to be hazardous will be managed in accordance with RCRA.

The CLSM will be delivered, to the extent possible, below the water. Contaminated water displaced from the canal will be pumped to the PWTS via process waste lines in the demineralizer room and the floor of the canal vault. The walls, below 10 inches from the top of the canal, will at all times be in contact with water or grout thus eliminating the potential for creating airborne radiological contamination. This method of CLSM delivery will also provide radiological shielding. Area air monitoring data will be collected during stabilization activities to calculate radiological emission measurements. (TDEC 1220-3-11-.08, 40 CFR 61.92, Department of Energy (DOE) Order 5400.5,II.1a, DOE Order 5400.5,I.4) Once cured, two coats of paint will be applied to the surface of the CLSM and exposed wall areas to seal the surface thus decreasing the potential for transferable and airborne contamination due to dusting. The canal area will remain designated as a contamination area and will continue to be periodically surveyed for contamination. (DOE Order 5400.5,IV.6) The activities proposed in

this plan should not have an adverse effect on the historical integrity of the graphite reactor, a national historic landmark. (National Historic Preservation Act Sections 106 and 110, EO 11593, 36 CFR 800)

4.2 Control of Contaminated Equipment

Contamination control plans for CLSM introduction and water removal operations, described in section 3, should preclude any of the equipment located outside the canal from becoming radiologically contaminated. The hatch room will be covered with Herculon to protect the floor from radiological contamination. At the completion of activities each day, the hoses will be bagged and labeled as radiologically contaminated. The hatch will remain open with appropriate radiation zoning and safety barriers in place. Prior to leaving the site, the CLSM pumper will be surveyed by the RCT for free release. In the unlikely event of equipment outside the hatch room becoming contaminated, work will be halted and the equipment decontaminated. Waste generated during decontamination activities will be appropriately containerized and labeled for final disposition.

Upon completion of grouting activities, all hoses, pumps, rags, PPE, and other miscellaneous waste generated in the canal vault during the task will be appropriately bagged, lifted to the hatch room, placed on blotter paper, surveyed, and tagged for disposal. The hatch area will be surveyed by the RCT prior to dezoning the area.

4.3 Spill Prevention Plan

P&E will construct the following three dike areas outside the hatch room: a) The CLSM will be transferred from the concrete mixer truck to a hopper to a hose that will deliver the grout to the canal. A catch basin will be constructed to contain any CLSM that might spill during transfer from the truck to the hopper on the pumper. b) Another basin will be constructed on the southeast corner of building 3001 to conduct the flowability test prior to CLSM delivery to the canal. CLSM contained in these basins will be placed into 55 gallon drums, allowed to solidify, drum lids will be secured, and the drums disposed in a waste landfill, either sanitary or industrial. c) Hay bales and pigs will be placed around storm drains in the immediate area. During actual grouting activities, in addition to hay bales and pigs, plastic sheeting will be placed over the drains.

The following spill equipment will be available on-site for spill control and cleanup:

- 55 gallon waste containers
- plastic sheeting
- clay absorbent
- shovel
- pigs

Spill prevention is the responsibility of each team member. Personnel are to conduct activities such that spills of hazardous materials (i.e., fuels, oils) and CLSM is prevented. Each team member is to report spills of materials to the Project Manager as soon as possible, and take action to minimize the spread of the spill immediately following discovery of the spill. Field personnel should be trained in spill control and cleanup, and should assist as necessary to control and cleanup spills.

The Field Engineer will:

(1) Ensure that spill control materials are on-site and available for use for those hazardous materials that are brought on-site.

(2) Ensure equipment is properly staged and stored to minimize the potential for spread of radiological contamination during storage and use.

(3) Ensure wastes are properly segregated, collected, containerized, and stored as described in this section to minimize the potential for spills from any stored wastes.

(4) Ensure full waste containers are removed from the site by LMES WM as soon as possible minimizing the potential for spill from the waste.

(5) Ensure timely and proper action is taken to contain and cleanup spills.

5. References

Action Memorandum for Building 3001 Canal, Oak Ridge National Laboratory, Oak Ridge, Tennessee; DOE/OR/02-1533&D2; November, 1996.

Waste Management/Waste Certification Plan for the Oak Ridge National Laboratory Environmental Restoration Program, ORNL/ER-288.

6. Quality Assurance

6.1 Required Records

The final issue of the following documents and all other LMES internally required plans for this task will be submitted to Environmental Restoration Document Control to become project file records.

6.1.1 Log Book

A project specific narrative logbook will be established and maintained by the SSHO for the duration of the project and will become a project record.

6.1.2 Removal Action Completion Report

A Removal Action Completion Report will be prepared after completion of the field work. It and all formal comments received on the report leading to the D2 submittal to DOE will be project records.

6.1.3 Comprehensive Work Plan

LMES reserves the right to red line this Comprehensive Work Plan for minor changes in the plan that are found needed to assure smooth continuity of work after the work has started as long as the changes do not adversely affect the safety and health of

personnel or the environment. Any red lined changes require the immediate initialing and dating of the changes by the field supervisor and the initialing and dating of the changes by the Technical Leader and Facility Manager within the same work shift. Any changes will be recorded in the SSHO log book. The revised field copy will become the Records File Copy.

6.1.4 As Built Configuration

A photograph of the canal in its final configuration with a description of the final configuration changes will be reported in the Removal Action Completion Report. A short video tape of back filling set up and operation as well as the final condition of the canal will also be recorded and identified as a project record.

6.1.5 Training Records

All training records of personnel will be maintained by the workers' parent organization. All training requirements will be specified by the Site Safety and Health Plan.

6.1.6 Material Certifications

The field engineer will collect all certifications of CLSM composition prepared by the CLSM manufacturer and provide them as a project record.

6.2 Occurrence Reporting

The Facility Manager will be responsible for all occurrence reporting if reports are required.

6.3 Gasoline Storage

The Facility Manager will provide a flammable storage area to store any gasoline in portable containers for the gasoline powered CLSM pumper. Gasoline and containers will be provided by the CLSM pumper company for their equipment. All gasoline will be stored in approved containers.

Appendix I

SPECIFICATION FOR CONTROLLED LOW STRENGTH MATERIAL
December 31, 1996
BUILDING 3001 CANAL BACKFILL

1.0 Description

Controlled low strength material is a material consisting of (a) Portland Cement, (b) fly ash, (c) sand, and (d) water and is used principally as a self compacting backfill material. The proportions are defined to control flowability, density, unrestrained compressive strength, and permeability although all of these properties are not specified as requirements. All materials shall satisfy the specifications listed for them or as stated or as described herein. The material after drying and hydrating shall be excavatable with conventional excavating tools.

Three Classes of material are specified. Class I contains no admixtures. Class II and Class III materials contain admixtures to control anti-washout while producing the desired flowability. The proportions of admixtures are designed to minimize washout of cementitious constituents while pumping the CLSM under or through a water reservoir, thus minimizing the contamination of the CLSM with the water in the reservoir. Class II and Class III materials provide practically equivalent anti-washout behavior but the admixtures from one supplier shall not be mixed with those from another supplier. If washout is not a concern, Class I material should be used to provide equivalent dry/cured properties.

2.0 Material Requirements

Constituent	Specification
Portland Cement (Type I, or II)	ASTM C 150
Fly Ash (Class F)	ASTM C 618
Sand (Manufactured or River Run)	ASTM C 33
Water	ASTM C 94
Anti-Washout Admixture	Rheomac UW 450 or Sikament 100 SC[1] (ASTM C 494, Type A or Type F)
High-range Water Reducing Admixture	Rheobuild 2000B or Sikament 10 ESL[2] (ASTM C 494, Type A or Type F)

3.0 Mixture Requirements

All classes of materials listed shall contain the following proportions of materials specified in paragraph 2.0 in accordance with the requirements and tolerances specified in ASTM C 94 for the solid constituents. All quantities are per cubic yard. The Portland Cement, sand, and fly ash quantities are based on oven dried proportions and their weights shall be adjusted by the supplier of the ready mixed material for water content. The water quantity listed is that required to meet the Modified Flow Consistency Test diameter with all other constituents oven dried and shall be adjusted

[1] Rheomac UW 450 is a product produced by Master Builders, Inc., Admixture Division, 23700 Chagrin Boulevard, Cleveland, OH. 44122-5554 (800-628-9990). Sikament 100 SC is a product produced by Sika Corporation, Admixture Division, 201 Polito Avenue, Lyndhurst, New Jersey 07071, (201-933-8800).

[2] Rheobuild 200B is a product produced by Master Builders, Inc., Admixture Division, 23700 Chagrin Boulevard, Cleveland, OH. 44122-5554 (800-628-9990). Sikament 10 ESL is a product produced by Sika Corporation, Admixture Division, 201 Polito Avenue, Lyndhurst, New Jersey 07071, (201-933-8800).

by the supplier to compensate for the moisture in the other solid constituents. The water quantity to be added shall be adjusted to satisfy the Modified Flow Consistency Test diameter requirement specified for each respective class.

Class I:

Constituent	Quantity/Cubic Yard
Portland Cement	55 pounds mass (lbm)
Fly Ash	650 lbm
Sand	2400 lbm
Water	approximately 50 gallons (gal)

Modified Flow Consistency Test diameter: 8" - 10"

Class II:

Constituent	Quantity/Cubic Yard
Portland Cement	55 lbm
Fly Ash	650 lbm
Sand	2400 lbm
Water	approximately 75 gal
Rheomac UW 450	1.1 gal
Rheobuild 2000B	1.4 gal

Modified Flow Consistency Test diameter: 10" - 12"

Class III:

Constituent	Quantity/Cubic Yard
Portland Cement	55 lbm
Fly Ash	650 lbm
Sand	2400 lbm
Water	approximately 92 gal
Sikament 100 SC	1 gal
Sikament 10 ESL	0.6 gal

Modified Flow Consistency Test diameter: 12" - 14"

4.0 Quality Requirements

4.1 Modified Flow Consistency Test Method:

Place a three inch inside diameter by six inch long open ended cylinder vertically on a smooth level surface. Fill the cylinder flush with its top with well mixed CLSM. Lift the cylinder vertically allowing the CLSM to flow on the level surface. Visually inspect the surface of the spread CLSM to assure that there is no noticeable segregation. Measure the diameter of the spread CLSM to assure that the diameter satisfies the requirement of the specified class in paragraph 3.0. Class II and Class III materials shall be tested only after the admixtures have been added and allowed to mix in a revolving drum mixer or agitator for approximately 100 revolutions of the drum or six to eight minutes of agitation.

4.2 Mixtures shall be transported to the point of placement in a revolving drum mixer.

4.3 All mixing, transporting, and pouring of CLSM shall be performed at a minimum of 34 degrees Fahrenheit.

4.4 The batch plant preparing the CLSM in the trucks shall be required to check the flow consistency of the first batch prepared each day to assure that the material meets the flow requirements for the Class specified. If flow requirements are not met, the material constituent proportions shall be adjusted to meet the requirements and all quality control formulations adjusted for the correction before the mixing of the next batch. After batch proportions have been adjusted, flow consistency test will be conducted on the individual batches following the changes until two consecutive batches meet the flow consistency diameter requirements.

4.5 The customer retains the right to sample each truck load of CLSM for each day in accordance with the Class specified. If flow requirements are not met, the material can be rejected and returned to the batch plant for correction at no additional cost to the customer.

4.6 The Batch Plant will provide certifications that mix proportions of CLSM shipped meets the flow consistency test requirements of this specification.

Appendix II

ORNL Radiological Survey Data

ORNL Radiological Survey Data

Survey Number: DDRX-97-0017 **DDRX Field Office** **Date:** 1/15/97 **Time:** 21:58

Surveyor Badge Number: 617044 ☐ Routine Survey **RWP Number:**

Building: 3001 **Specific Location:** CANAL

Description:

RADIATION/CONTAMINATION SURVEY

Instruments Used and Calibration Due Date:

3001-05I	2/19/97	CTA-012	5/31/97	CTB-004	5/31/97

General Description of Radiological Conditions:

GENERAL AREA 0.5mR/HR TO 1mR/HR.HIGHEST DOSE RATE 100mR/HR LEAD BRICK.HIGHEST SMEAR WAS 5,548DPM/100CM2 BETA AND 92DPM/100CM2 ALPHA.

Division or Group Needing the Survey: E.R. **Person-hours spent on the survey:** 3

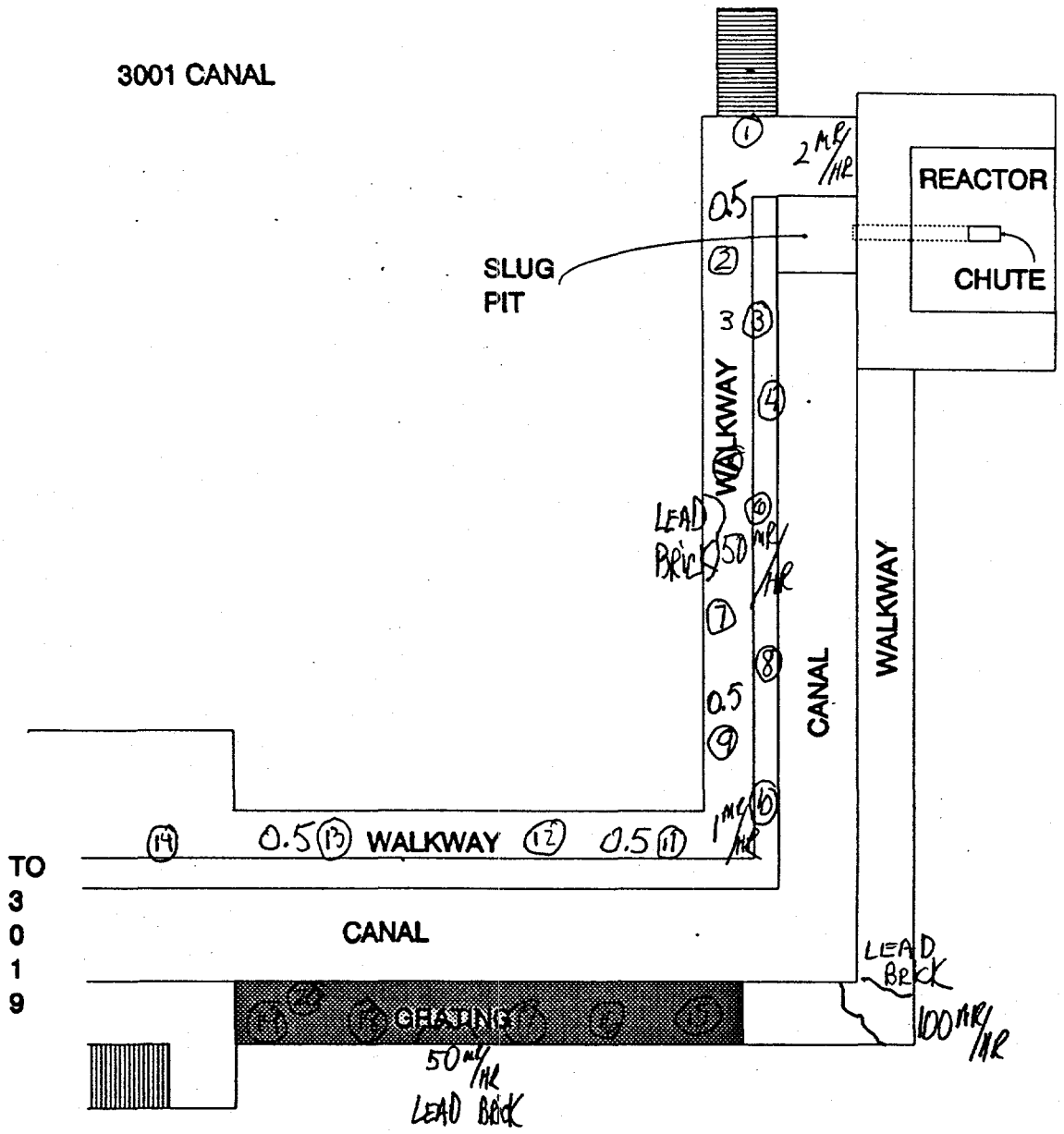
# of Pages: _____ **Completed By:** Bryan K Bolden **Reviewed by:** _____ **Date:** _____

ORNL Radiological Survey Data

Survey Number: DDRX Field Office Date: Time:

Give only D/M on smears over MDA:
dpm/100 cm 2 α
dpm/100 cm 2 β

SMEAR NO.	D/M ALPHA	D/M BETA
1	10	9652
2	<MDA	304
3	20	684
4	<MDA	<MDA
5	<MDA	228
6	27	1824
7	<MDA	266
8	<MDA	<MDA
9	60	3648
10	7	342
11	22	798
12	18	228
13	<MDA	380
14	<MDA	152
15	12	456
16	<MDA	380
17	15	350
18	27	2508
19	92	4332
20	85	5548



#	- Smear Location	Boundary Designations	
#—#	- Large Area Smear	RA - Radiation Area	BA - Radiological Buffer Area
#	- Contact Dose Rate	HR - High Radiation Area	CA - Contamination Area
#	- 30 cm Dose Rate	VR - Very High Radiation Area	HC - High Contamination Area
#	- General Area Dose Rate	AR - Airborne Radioactivity Area	FC - Fixed Contamination Area
SOP	- Step-off Pad	RM - Radioactive Materials Area	SC - Soil Contamination Area
AS	- Air Sample Location	UM - Underground Radioactive Materials Area	

Default units are in mR/hr and are for open window beta/gamma readings. Letter suffixes with the number indicate specific radiations: B - Beta (mRad/hr), G - Gamma (mR/hr), N - Neutron (mRem/hr). Boundary designations are looking from the designations into the zoned area.

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