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Idaho National Engineering Laboratory

ICPP Tank Farm Closure Study

Volume II

Engineering Design Files

LOCKHEED MARTIN

TANK FARM FACILITY CLOSURE FEASIBILITY STUDY
EDF STATUS AS OF 02/02/98

EDF Number	Title	Author	Status	Date Issued
EDF-TFC-001	CPP Tank Farm Heel Flushing/pH Adjustment	R.A. Gavalya	Issued	5-29-97
EDF-TFC-002	Grouting Experiments for Immobilization of CPP Tank Farm Heel	R.A. Gavalya	Issued	5-29-97
EDF-TFC-003	Savannah River High Level Waste Tank 20 Closure	K.D. McAllister	Issued	6-27-97
EDF-TFC-004	Dave Machovec Interview – CPP Tank Farm Closure Information	K.D. McAllister	Issued	6-27-97
EDF-TFC-005	Jim Bosley Interview – CPP Tank Farm Closure Information	K.D. McAllister	Issued	6-27-97
EDF-TFC-006	D. Machovec Interview - Clean Closure of Tank Farm	M. M. Dahlmeir	Issued	9-16-97
EDF-TFC-007	R. A. Hyde Interview - Remediation Issues	S. P. Swanson	Issued	10-23-97
EDF-TFC-008	Don Kenoyer Interview - Remote Demolition Techniques for Tank Farm	S. P. Swanson	Issued	11-19-97
EDF-TFC-009	L. C. Tuott Decision Concerning EIS for Debris Treatment Facility	M. M. Dahlmeir	Issued	10-9-97
EDF-TFC-010	Interview with R. R. Rodriguez – CERCLA/RCRA Issues	M. M. Dahlmeir	Issued	11-14-97
EDF-TFC-011	Area of Contamination Determination	M. M. Dahlmeir	Issued	10-7-97
EDF-TFC-012	Interview with T. E. Venneman - Debris Treatment Facility (Containment Building)	M. M. Dahlmeir	Issued	10-9-97
EDF-TFC-013	Double Containment Issues	M. M. Dahlmeir	Issued	10-9-97
EDF-TFC-014	Characterization Costs	M. M. Dahlmeir	Issued	10-28-97
EDF-TFC-015	Packaging and Disposal Options for the Waste Resulting from the Total Removal of the ICPP Tank Farm	M. M. Dahlmeir	Issued	10-7-97
EDF-TFC-016	Take-Off Calculations for the Total Removal of Soils and Structures at the Tank Farm Facility	S. P. Swanson	Issued	12-18-97

TANK FARM FACILITY CLOSURE FEASIBILITY STUDY

EDF STATUS AS OF 02/02/98

EDF Number	Title	Author	Status	Date Issued
EDF-TFC-017 Revision 1	D. Machovec Interview - Miscellaneous Topics for Clean Closure of Tank Farm and Vessel Off-gas System	S. P. Swanson	Issued Issued	11-7-97 1-27-98
EDF-TFC-018 Revision 1	M. Swenson Interview - Existing and Temporary Supplemental Vessel Off-gas Systems	S. P. Swanson	Issued Issued	10-24-97 1-21-98
EDF-TFC-019 Revision 1	Jet-Grouted Polymer and Subsurface Walls	M. M. Dahlmeir	Issued Issued	10-22-97 10-30-97
EDF-TFC-020	Exposure Calculations for Total Removal Clean Closure of the Tank Farm	S. P. Swanson	Issued	12-9-97
EDF-TFC-021	Recommended Instrumentation During Retrieval Operations	M. M. Dahlmeir	Issued	10-14-97
EDF-TFC-022	High Level Waste Tank Concrete Encasement Evaluation	Vince Gorman	Issued	10-30-97
EDF-TFC-023	Recommended Heavy Equipment and Sizing Equipment for Total Removal Activities	S. P. Swanson	Issued	11-19-97
EDF-TFC-024	Tank Buoyancy Constraints	K.D. McAllister	Issued	12-18-97
EDF-TFC-025	Grout and Concrete Formulas for Tank Heel Solidification	R.A. Gavalya	Issued	1-28-98
EDF-TFC-026	Tank Heel pH Requirements	R.A. Gavalya	Issued	11-10-97
EDF-TFC-027	Tank cooling water sent to PEW	K. C. DeCoria	Issued	12-15-97
EDF-TFC-028	Evaluation of Conservatism of Vehicle Loading on Vaults	Vince Gorman	Issued	10-30-97
EDF-TFC-029	Typical Vault Dimensions and Approximate Tank and Vault Void Volumes	K.D. McAllister	Issued	1-12-97
EDF-TFC-030	Mac McCoy Interview – Radiological Concerns for Temporary Vessel Off-Gas System	S. P. Swanson	Issued	10-23-97
EDF-TFC-031	Flushing Calculations for "Scenario A"	R.A. Gavalya	Issued	1-30-98
EDF-TFC-032	General Flushing Calculations for Tank Heels	R.A. Gavalya	Issued	11-10-97

TANK FARM FACILITY CLOSURE FEASIBILITY STUDY
EDF STATUS AS OF 02/02/98

EDF Number	Title	Author	Status	Date Issued
EDF-TFC-033	Grout Lift Depth Analysis	K.D. McAllister	Issued	12-22-97
EDF-TFC-034	Decontamination solution for waste transfer piping	K.C. DeCoria	Issued	12-15-97
EDF-TFC-035	Grout Lift Determination For Filling Tank and Vault Voids	K.D. McAllister	Issued	12-19-97
EDF-TFC-036	Sprung Structure Vendor Data	R.A. Gavalya	Issued	1-28-98
EDF-TFC-037	Grout Flow Properties Through a 2 to 4 inch Pipe	K.D. McAllister	Issued	12-22-97
EDF-TFC-038	Tank Farm Load Limitations	K.D. McAllister	Issued	1-5-98
EDF-TFC-039	NRC Low Level Waste Grout	K.D. McAllister	Issued	1-29-98
EDF-TFC-040	Project Data Sheet Calculations	R. A. Gavalya	Cancelled: Information was included in Appendix A of the report.	
EDF-TFC-041	Dose Rates for Tank Farm Closure Tasks	S. P. Swanson	Issued	11-25-97
EDF-TFC-042	Exposure and Shielding Calculations for Grout lines	G. C. Mccoy	Issued	12-17-97
EDF-TFC-043	TFF Radionuclide Release Rates	I. E. Stepan	Issued	1-28-98
EDF-TFC-044	Documentation of the Clean Closure of a System with Listed Waste Discharge	L. C. Tuott	Issued	1-28-98
EDF-TFC-045	Documentation of the ORNL Method of Radionuclide Concentrations in Tanks	L. C. Tuott	Issued	1-28-98

6.0.2

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 73501

EDF Serial Number: EDF-TFC-001

Functional File Number: BC-01

Project/Task: CPP Tank Farm Closure Study

Sub task: Tank Farm Heel Flushing/pH Adjustment

TITLE: CPP Tank Farm Heel Flushing/pH Adjustment

SUMMARY

Met with Dave Machovec, CPP Tank Farm Operations Expert. Discussed CPP Tank Farm Heel flushing with either contaminated water from the CPP basins or raw water from the deep wells. The purpose of flushing is to adjust the pH of the heel solution to an optimum level such that the heels can be grouted in place.

Process flow, routing, sampling, and requirements were main topics of the discussion.

The majority of the discussion took place on May 8, 1997 in CPP-699, Room 102. There was a follow-up discussion on May 20, 1997.

Please refer to the three page attachment for details of the discussion.

Distribution: D.J. Harrell, B.R. Helm, D.C. Machovec, F.S. Ward, LMITCO; WTP EIS Studies Library, Tank Farm Closure Library

Authors	Department	Reviewed	Approved
R.A. Gavalya	MC&IE/4130	Bo Spaulding	Bo Spaulding
Rick A. Gavalya		Date 5/29/97	Date 5/29/97

- INTERVIEW -

Dave Machovec, CPP Tank Farm Operations Expert

May 8, 1997

Met with Dave Machovec, CPP Tank Farm Operations Expert, to discuss flushing and pH adjustment of the HLW Storage Tanks (WM-180 through WM-190).

1. WM-182 and -183 have been flushed and diluted with a sodium bearing solution. The current concentration is approximately three (3) molar nitric acid.

2. The cooling coils may have to be flushed and blown before tank closure to remove chromate.

3. Once the tanks have been flushed and the pH adjusted to the desired level, the tanks will have to be isolated so that they can't be refilled.

4. A Liquid Transfer Sheet (LTS) is used when transferring waste from vessel to vessel. An LTS details valve lineups and routing.

5. The preferred path to introduce basin water into the tanks would be thru WM-100, an 18,000 gallon tank. Liquid Transfer Sheets (LTS) are already in place for most transfers between the 601 and 603 "Deep Tanks" to WM-100 or from WM-100 to other vessels.

   The process to add a new LTS to the system will normally take about one week since personnel from Engineering, Operations, Quality Assurance, Safety Analysis, and Environmental need to review and approve the procedure.

   IF NECESSARY, a new LTS could be approved within 24 hours. However, proper planning should eliminate the need to rush an approval through the system.

6. In general, there are two or three points where water for flushing purposes could be injected into the tanks. However, in some instances, lines have been capped leaving only one injection point.

7. Mixing in the tanks would be mainly passive since there isn't a method in place to agitate or stir the tank contents. If water is introduced, it would probably be best to let it sit for several days for natural mixing to occur.

8. Contaminated water could be obtained from the CPP-603 basin or the FAST basin (FT-134).

9. The transfer rate from WM-100 to the storage tanks is about 35-40 gal/minute.

10. High concentrations of chlorides and fluorides in the flushed heels may determine where the flushings are routed. The tanks of the HLW Evaporator cannot handle too high of a concentration of chlorides and fluorides at elevated temperatures due to chemical attack by the fluorides and chlorides on the stainless steel. If chloride and fluoride concentrations from the first flushing are too high for the HLW Evaporator, the first flushing would be routed to a tank that has a lower concentration of chlorides and fluorides.

    The second flushing would be routed to the HLW Evaporator provided the chloride and fluoride concentrations are at an acceptable level. The HLW Evaporator can handle high activity waste at a rate of 4000-5000 gallons/day.

    Subsequent flushings may be routed to the Process Equipment Waste (PEW) Evaporator if the solution is not highly radioactive. The PEW is designed to process LLW at a rate of 7000 gallons/day (due to RCRA permitting constraints).

It is assumed that flushed waste from the tanks will be treated at the New Waste Calcining Facility (NWCF).

11. There are two steam jets per tank with the exception of WM-189 and WM-190 which have one steam jet and one air jet.

12. To check pH levels, the solution in the tank will be jetted to the NWCF to take a sample. To ensure a representative sample from the tank, approximately 500 - 1000 gallons will have to be jetted to NWCF where a sample will be drawn. The excess solution will be returned to the tank. This volume is necessary in order to purge the lines of any previous liquid that is in the piping.

    Existing procedures are in place for sampling.

13. If it is necessary to introduce water to the tanks at an even faster rate than 35-40 gal/min, it would be possible to connect a firewater hose to the decontamination stubs at each riser. This method might provide better agitation and mixing of the waste solution.

14. There is a dilution factor of 5 - 10% from the steam used to operate the jets during the jetting process.

15. Currently, the levels in WM-182, -183 are low. WM-187 is partially empty. WM-190 is essentially empty (normal situation as this is an "emergency tank"). These levels may vary in the future.

16. Copies of Waste Processing Computer System (WPCS) Summary Sheets were printed which detailed liquid levels in the tanks.

17. Two types of waste mentioned were:

    Type 1 - this is the type of waste in the tanks now and is considered a High Level Waste (HLW) or High Activity Waste (HAW).

    Type 2 - this is the type of waste found in the basins and WM-100 and is considered a Low Level Waste (LLW).

18. There may be an issue with mixing Type 1 waste with Type 2 waste since these are different waste forms.

19. Chemical constituents such as fluorides and chlorides in the waste remain a question - can these be stabilized so that they don't attack the stainless steel tanks in the evaporator?

20. Hydrogen is also a factor that needs to be considered. As the waste decays, hydrogen is formed at the liquid/solid interface. If conditions are right, a hydrogen explosion could occur.

21. If chemicals such as NaOH are used to adjust the pH, the material can be obtained from the CPP-601 or CPP-617 Chemical Makeup Tanks and then transferred to the CPP-604 DeCon Tanks.

    The Chemical Makeup Tanks are WL-157 and WL-160. The Decon Tanks are WM-100, WM-101, and WM-102.

22. In general, levels of radioactivity in the tank liquids are < 120 Rem. Solids at the bottom of the tank are expected to be at much higher radiation levels.

23. Requirements were also discussed for flushing/pH adjustment of the tanks. We came up with the following:

    a. New Liquid Transfer Sheets will have to be developed for routing of those vessel-to-vessel waste transfers that aren't currently in place.

    b. If possible, routing of waste transfers should be done in existing process piping.

    c. Since the transfers will be in existing piping and vessels that are contained, there shouldn't be any radiological issues.

    d. It will be necessary to obtain approvals from Engineering, Operations, Quality, Safety, and Environmental personnel.

    e. For processing purposes, at least two tanks in the New Waste Calcining Facility (NWCF) must be empty when sampling a 300,000 gallon tank.

6.1.A.b

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 73501

EDF Serial Number: EDF-TFC-002

Functional File Number: BC-02

Project/Task: CPP Tank Farm Closure Study

Sub task: Grouting of Tank Farm Heels "In Situ"

TITLE: Grouting Experiments for Immobilization of CPP Tank Farm Heel

SUMMARY

Met with John McCray, Engineer for LLW Immobilization. Discussed recent test results where dry grout had been placed in waste simulant. Grout mixture formulations and waste simulant mixtures for two samples were noted during the discussion. In general, the grout mixture consists of equal parts of Portland cement, fly ash, and blast furnace slag.

Testing with phosphate bonded cement is scheduled to begin in June 1997. Phosphate bonded cement has an acidic base and may set up better in an acidic medium such as the heel.

Requirements regarding compression strength and leachability were also discussed.

Please refer to the two page attachment for details of the discussion.

Distribution: D.J. Harrell, B.R. Helm, A.K. Herbst, J.A. McCray, LMITCO;
WTP EIS Studies Library, Tank Farm Closure Library

Authors	Department	Reviewed	Approved
R.A. Gavalya	MC&IE/4130	[signature]	[signature]
Rick A. Gavalya		Date 5/29/97	Date 5/29/97

- INTERVIEW -

John McCray, Engineer for LLW Immobilization

May 8, 1997

Met with John McCray, Engineer for LLW Immobilization, to discuss the results of recent tests where dry grout has been placed in a waste simulant that is in a glass cake pan. Two samples of dry grout that had solidified in the waste simulant were in plastic bags on John's desk. Following are observations from the interview.

1. At this point in the testing, there is skepticism as to the validity of using grout to capture the heel "in situ" (in place). More testing of different grout formulas needs to take place.

2. John referred me to a report put out by Kaiser Engineering titled "Existing Tank Heel Removal Special Study", RPT-025. This is an in-depth look at removing the tank heels.

3. Currently, tests performed for immobilization of the tank heels with grout have been conducted using a 3-way grout blend consisting of equal amounts of portland cement, blast furnace slag, and fly ash. Testing has consisted of:

   a. Dumping dry grout mix into waste simulant and letting it "set" without agitation.

   b. Pouring fluid grout (mixed with water) into a dish with waste simulant in order to displace the simulant. This would be done to "push" the liquid waste to the discharge line (steam or air jet), allowing a large portion of it to be jetted out of the tank using existing equipment.

      The fluid grout absorbs little or none of the liquid waste. The grout will set up, but the liquid waste (acidic) will continually "attack" the grout formation. If fluid grout is used, the liquid waste would have to be jetted out of the tank as soon as possible to minimize attack of the acid on the grout.

4. Two samples of solidified grout were displayed on John's desk. These were the result of testing described in 3a.

   The first sample is porous and crumbly and didn't appear to set up very well. The constituents were as follows:

   Grout Recipe
   60 grams Portland Cement
   60 grams blast furnace slag
   60 grams fly ash

   Liquid Mixture
   60 ml Waste Simulant
   60 ml water

   Dry grout was sprinkled into the liquid mixture and it was allowed to harden.

The second sample is harder and layered. Solids appeared to precipitate out. The constituents of the second test were as follows:

<u>Grout Recipe</u>
79.3 grams Portland Cement
60 grams blast furnace slag
60 grams fly ash

<u>Liquid Mixture</u>
60 ml Waste Simulant
24 ml water
10.7 ml of 29% NaOH

When sodium hydroxide (NaOH) was added to neutralize the waste simulant, a significant amount of precipitate was formed. Stirring was required to achieve uniform neutralization. Dry grout was then sprinkled into the liquid mixture and allowed to harden.

7. Future testing with phosphate bonded cement is slated to begin in June 1997. The phosphate bonded cement has an acidic base and may set up better in the highly acidic waste simulant. Phosphoric acid and magnesium oxide are constituents of phosphate bonded cement.

8. Several pictures were taken of the grout experiments. The pictures were:

   Grout setting up in solution
   Grout being eaten up by acid
   Grout being poured into cake pan.

9. According to John, compressive strength of the grout (when set up) must be at least 500 psi. Typical grout has a compression strength in the range of 1,000 - 5,000 psi.

10. John estimates that the average density of grout is in the vicinity of 1.2 - 2.0 grams/cm^3. By comparison, the density of water is 1.0 grams/cm^3 at Standard Temperature and Pressure.

    Based on a density of 2.0 grams/cm^3, a 25 foot column of grout would exert a pressure of approximately 22 psi. A grout mixture with a minimum compressive strength of 500 psi should easily support the weight of any overlaying grout that may be added at a later date.

11. The higher the acidity of the waste simulant, the lower the compressive strength.

12. In addition to testing compressive strength, a leach test (TCLP) must also be performed.

13. In closing, John recommended (with the limited data currently available) that as much of the waste solution as possible be taken out of the tank before any grout is added. This could be done by diluting the waste with water, jetting as much as possible out, and then repeating the same steps several times. This will yield a waste solution that ultimately produces a much more acceptable heel grout.

INEL ENGINEERING DESIGN FILE

Form L-0431.2#
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Project File Number: 73501
EDF Serial Number: EDF-TFC-003
Functional File Number: BC-03

Project/Task CPP Tank Farm Closure Study
Sub task Bruce Martin & Tommy Caldwell (SRS Engineers) phone Interview(s).

TITLE: Savannah River High Level Waste Tank 20 Closure

SUMMARY

Discussed recent results and implementation issues pertaining to the closure of the High Level Waste Tank number 20 with Bruce Martin and Tommy Caldwell, Engineer's at the Savannah River Site.

The waste tank number 20 was closed under a waste water permit. This eliminated the need for RCRA and NRC closure. The tank was filled with five (5) subsequent layers of clean grout (could only use clean grout due to the waste water permit);

Layers (tank bottom to tank top):

1. Reducing grout;
2. Dry grout (reducing grout without water);
3. Another layer of reducing grout;
4. A deep layer of Controlled Low Strength Material (CLSM), used to fill the resulting tank void;
5. High strength grout, to prevent future access into the tank.

This document further describes steps and processes taken to close waste tank 20 at the Savannah River Site (SRS).

Please refer to the following attached pages for more discussion details.

Distribution: D. J. Harrell, B. R. Helm, Bryan Spaulding, K. D. McAllister, R. A. Gavalya

Authors	Department	Reviewed	Approved
K. D. McAllister	MC&IE/4130	Date 6/27/97	Date 6/27/97

Phone Interview with Savannah River Engineer Bruce Martin and Tommy Caldwell SRS Engineers 6/12/97 and 6/19/97

The following information was obtained via phone interview with Bruce Martin (803)-208-0498 and Tommy Caldwell (803)-208-0502. The topic was the closure of tank number 20 which held high level radioactive waste at the Savannah River Site (SRS).

Description:

1. Waste tanks are made from high carbon steel with a concrete dome.
2. Tank dimensions were 85 feet in Diameter, 34 feet 4 inches to the beginning of the dome, and ~8 feet from the beginning of the dome to the top of the dome.
3. Sludge heel at Savannah River was not acidic (no pH problems).
4. Waste tanks were closed under the "Industrial Wastewater Closure Plan for F- and H-Area High Level Waste Tank Systems."[1]
5. This Plan has been approved by the South Carolina Department of Health and Environmental Control (SCDHEC) [Ref. 1 pp. 6].
6. This plan has been approved by the Environmental Protection Agency (EPA) Region IV [Ref. 1 pp. 6].
7. DOE/Savannah River has been leading the NRC waste classification negotiation and has made presentations to NRC regarding Savannah River Site's approach to meeting the test criteria for incidental waste [Ref. 1 pp. 6].
8. On April 25, 1997, Savannah River poured grout into Tank 20 [Ref. 1 pp.6].
9. A centrifugal sump pump (off the shelf) was used to pump out most of the tank heel.
10. A rubber type hose inside a clear hose was used to transfer waste. The clear hose allowed detection and containment of leaks from rubber hose.
11. There was about 1000-2000 gallons of sludge left in the tank.
12. A temporary grout plant was used at the site as a grout source.
13. Grout plant was obtained through Throop Incorporated, California.
14. The first layer of grout poured inside the tank was called Reducing Grout:
    a. Grout has the ability to absorb 25-30% liquid and sediment with respect to the grout's volume.
    b. Grout absorbs the silt and material residual in the heel.
    c. Grout pushes water away from itself once it has absorbed liquid.
    d. Grout was developed in cooperation with Savannah River and a testing facility called "Construction Technical Laboratories", in Skokie, Illinois.
15. For the reducing grout layers, pipes were inserted down through the tank risers within 5 feet from the tank bottom to prevent grout splashing.
16. Reducing Grout was poured into the tank, one riser at a time causing "patties" to form on the tank floor (6 outside perimeter risers were poured first. Grout was poured through the middle riser (seventh) last. This resulted in a starfish/soccer ball type shape layer).
17. All seven (7) tank risers, except for the risers that had pumps or other equipment were utilized.

18. Two (2) 9 inch diameter holes access holes had to be core drilled through tank top, next to two risers that contained pump and/or other piping equipment. This allowed grout to pour without obstruction and eliminate pump or equipment removal.
19. Video camera and lights were placed inside the risers out of the way of any present pipes.
20. A manifold was placed over each riser with valves to direct the grout to each individual riser.
21. Approximately 180 cubic yards of grout (12 inches deep) was used for this first layer [Ref. 1 pp. 6].
22. Patties were continuously poured in, right after the other. No wait time between each patty pouring was required.
23. Once the poured patty diameter reached ½ to ¾ of the distance to the other risers the grout pouring was stopped for that riser and pouring was started on the next riser.
24. A second layer of dry grout (powdery) was placed next to absorb any free standing water (it took 24 hours for the powder to settle).
25. Placing the dry grout was done twice to cover and fix all standing sludge-water patches completely.
26. Used approximately 7 cubic yards of dry grout was used (65,000 lb.).
27. The dry grout used, was the dry reducing grout used in the previous first layer but without the water.
28. The sand used to make up the dry reducing grout must have less than 3% water. Higher water content in the sand causes the dry grout to hydrate in the pipes going into the tank. They used kiln dried sand to prevent this from happening.
29. If they had to do it over, they would not use sand in the dry grout solution.
30. A large regular cement truck with 3 hoppers and a pump blew the dry grout material through a hose into the center most tank riser.
31. The dry grout was dispersed using a high volume—Low pressure system (500-1000 cfm)
32. An inverted telescope looking nozzle was used to disperse the grout over the reducing grout layer.
33. The center riser was used for dispersing the dry grout.
34. A simple manual arm mechanism was designed to rotate in a 360 degree arc to provide even disbursement of the dry grout.
35. The manual arm mechanism used a rubber hose, a swivel coupling, clamps and cables running from the end of the hose to the operator. Thus allowing operator control of the mechanism.
36. Reducing grout was then poured in again as the third layer through the center riser.
37. The total layers poured (layers 1-3) resulted in a depth of 24 to 36 inches from the bottom of the tank.
38. Reducing Grout mixture was (1 cubic yard):

    1625 pounds of sand (no more than 3% water for dry grout (Kiln Dried))

    1353 pounds of type 5 cement

    209 pounds of slag

    6 gallons of water for 94 lb. of cement (adjusted for moisture content of the sand) for reducing grout.

39. All grout poured into the tank was clean grout due to the closure under a waste water permit.
40. Controlled Low Strength Material (CLSM) was applied as the fourth layer
41. The CLSM was specially formulated not to produce a bleed water layer that can settle on top after pouring by Chris Langton and Rog Rajendran.
42. The CLSM grout was poured for 8-10 hours a day until the layer reached the top, where the tank dome and tank wall began (700 cu/yards per day (about 90 cement trucks)).
43. The CLSM grout was poured through the center riser without a pipe extension into the tank.
44. Tank waste transfer pumps were grouted in place and filled with high strength grout material.
45. The small centrifugal pump (used to pump out most of the heel) was lifted just above the first three layers and then grouted in place and filled with high strength grout.
46. High Strength concrete was poured as the fifth layer from the beginning of the dome tank connection to the top of the dome (what they are doing presently).
47. Each riser was filled to the top and capped
48. Reducing grout was used to fill all pipe lines etc.
49. No attempt was made to fill in the liquid waste transfer lines except vertical running lines.
50. Vertical running liquid waste transfer lines were filled after tank had been filled completely with grout layers.
51. Naturally runny reducing grout enabled the ability to fill vertical transfer lines with ease.
52. Horizontal running transfer lines were not considered for filling.

VOG System

1. Used Coppus Blowers with a flat fan curve
2. Used pre-filters to eliminate the dust from dispersing the dry grout
3. 110 V power supply
4. 1000-2000 scfm
5. Pre-filters were the blue ¢ 0.60 furnace filters at the local hardware store.
6. Would use Flander's Roughing filter as a pre-filter if they had to do it over again.
7. Had to change the pre-filter every thirty (30) minutes.
8. Could not put two Coppus Blowers in parallel—They would over load the circuits.
9. They were able to draw 1 inch (H_2O) of vacuum
10. The pre-filters were changed once the vacuum dropped to ¼ inches (H_2O).

Other Important Information

1. Jeff Newman (803)-208-8659: Savannah River Tank Farm closure regulation expert.
2. Jerry Morrin (803)-725-7669: DOE representative, determines what documents of the tank 20 closure can be transferred to other DOE vacilities (like us).

3. Chris Langton (803)-725-5806: Grout and cement expert helped in the design and formulations of the Reducing Grout and the CLSM.
4. Rog. Rajendran (803)-952-9115: Independent contractor who helped in the design and formulation of the Reducing Grout and CLSM ("fine tuned the grout").

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[1] Summary of Communication with DOE Tank Sites on Tank Closure Issues, Lih-Jenn Shyr and Larry Bustard, Sandia National Laboratroies, Albuquerque, NM 87185-0748, June 1997, Rev 0: pp. 6

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ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 73501
EDF Serial Number: EDF-TFC-004
Functional File Number: BC-04

Project/Task CPP Tank Farm Closure Study
Sub task Dave Machovec Interview.

TITLE: CPP Tank Farm Closure Information

SUMMARY

Discussed and gathered information about ICPP Tank Farm and determined information gathering resources.

Please refer to the following attached pages for more discussion details.

Distribution: D. J. Harrell, B. R. Helm, Bryan Spaulding, K. D. McAllister, R. A. Gavalya

Authors	Department	Reviewed	Approved
K. D. McAllister	MC&IE/4130	Date 6/27/97	Date 6/27/97

INTERVIEW

With Dave Machovec (4/30/97)

The following is a conversation held by David McAllister, Bryan Spaulding and Machovec concerning the following topics on **Tank Farm Closure**.

1. Mr. Machovec has Tank Farm drawings of pipes, lines and photographs.
2. Mr. Machovec has experience in find drawings where lines have been put down that are not exactly shown in the underground piping drawings.
3. He has experience on how the samples are obtained in the tank farm
4. He has tested radiation level for tank #184 which may have been lost else where during the coarse of time.
5. Wants to use gravel from previous spills to place into the empty tanks
6. Pumps must be < 10.5 diameter to fit through riser access holes.
7. Has video's of tank inspections for tanks 185, 187-189
8. Access to manhole is not hard but paper work to open due to radiation contamination will be tough to get through.
9. Fairly good mixing should be possible inside tanks (it wont be easy but could be done)
10. It is possible to get the heel to only 2-3 inches in depth
11. Tanks were designed for 1000 watt/ m^3. Highest known reaction was approx. 100 watt/ m^3. Presently the reaction in side the Tank Farm tanks is < 20 watt/ m^3
12. There are electrical power outlets at the Tank Farm
13. Access shielding plugs are 1100 lbs. There are some plugs that have not been modified. The unmodified plugs are approximately 2500 lbs.
14. Tanks 182-186 are the panel tanks and must be removed first (by 2009).

INEL ENGINEERING DESIGN FILE

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Project File Number: 73501
EDF Serial Number: EDF-TFC-005
Functional File Number: BC-05

Project/Task CPP Tank Farm Closure Study
Sub task Phone Interview with Jim Bosley.

TITLE: CPP Tank Farm Closure Information

SUMMARY

Discussed and gathered information about Tank Farm closure regulations.

Please refer to the following attached pages for more discussion details.

Distribution: D. J. Harrell, B. R. Helm, Bryan Spaulding, K. D. McAllister, R. A. Gavalya

Authors	Department	Reviewed	Approved
K. D. McAllister	MC&IE/4130	Date 6/27/97	Date 6/27/97

PHONE INTERVIEW WITH JIM BOSLEY
(Rev. 4)

1. Federal Facilities Agreement and Consent Order (FFA/CO) implement the CERCLA program at the INEL.

2. The hazardous waste statutes in Idaho are found in the Hazardous Waste Management Act (HWMA). HWMA incorporates the RCRA 40 CFR regulation by reference.

3. HWMA/RCRA closure of waste tanks could be accomplished with an inside of tank clean concrete cap (6-12 inches) and flushed and grouted pipe lines.

4. All waste, waste residue and contaminated soil must be removed from the tank. If all contaminated soil can not be removed, closing must be accomplished using the landfill standards in 40 CFR 265.310. The state of Idaho has expanded this standard to include DOE, in determining that all waste, residues and contaminated structures and soils cannot be practically removed. As a result, the tank unit can be closed to meet the landfill standards.

5. If it is not practical to remove the heel (solid or liquid that cannot be removed by the siphon jet), then the tank could be closed to meet the landfill closure standard with the heel left in place.

6. What we want to propose to the state and federal agencies is that we will satisfy the landfill closure standard by solidifying the heel and placing a clean layer of grout over the solidified heel. We are trying to find a regulatory mechanism that allows HWMA/RCRA to be satisfied and still leave the remaining void to be filled with LLW. Post-closure care would be performed by the FFA/CO (CERCLA management program) for groundwater monitoring and for the final cover for the ICPP. Each tank and the Tank Farm Facility (TFF) as a whole would be included under the final cover as directed by the FFA/CO. For this to happen HWMA/RCRA needs a defined end point—we want to propose that this end point be the solidification of the heel and the thin layer of grout on top of the heel as a cap.

7. Mixed waste disposal units (such as the Tank Farm) must meet the specification for both the NRC near surface disposal and RCRA subtitle D industrial landfill requirements. The NRC license must address the containment requirements, monitoring requirements, capping requirements, waste form requirements etc.

8. Long term monitoring will be performed under the FFA/CO (CERCLA management program).

9. Capping the heel is a HWMA/RCRA landfill closure requirement. The FFA/CO (CERCLA management program) will perform the post-closure care requirements provided that there are no free liquids in the tank farm tanks.

10. Void filling is a waste disposal operation that would have to meet the NRC and Subtitle D requirements. Note: RCRA landfill closure standards require that (1) the unit be covered with a cap (the cap over the heel), (2) prevent subsidence, (3) prevent water collect and run-off, and (4) monitor for release of hazardous constituents from the waste cell (tank). We are proposing at the tank farm, that Run-off is eliminated by design (since waste will be located exclusively in the stainless steel tanks), subsidence prevention and final cover of the tank be deferred to the future, and groundwater monitoring will be performed under the FFA/CO (CERCLA management program) as soon as the HWMA/RCRA closure is complete. The other void filling activities have to be completed prior to placing of the final ICPP cover, but will be handled by different regulatory authorities than HWMA/RCRA hazardous waste regulations.

11. Covering of the entire Tank Farm is accomplished under the FFA/CO (CERCLA management program).

12. The DOE, and the state of Idaho (HWMA/RCRA program personnel) get together and negotiate what is necessary and required for tank closure. This is done through the Closure Plan Approval Process. Some conversations between the DOE and the State take place before the closure plan is approved, but the state generally will not take a position until they have received a formal document for review and comment.

13. The Tank Farm cover may be placed around 2025 or 2027, however, so far, none of the planning or funding are allocated that far in the future. HWMA/RCRA tank capping will start around 2006 through 2015 or as negotiated with the state.

14. HWMA/RCRA closure standards states that the owner must control, minimize, or eliminate post closure escape of hazardous waste hazardous constituents, leachete, contaminated run-off to the ground, or surface waters or to the atmosphere. By eliminating free liquids from the grouted heel, we can prevent their migration out.

15. The closure plan specifies the performance standards that need to be met. It is important to not put in requirements that cannot be safely or practically measured. Mixing would appear to be one of these non-measurable applications. This is due to the inability to guarantee and measure the combining of the heel and the grout in a highly radioactive tank.

16. Mixing would have to be based on mockup testing and analysis on surrogate materials, and we still could not guarantee that we had achieved homogeneous mixing of the heel and grout. However, we could commit to a solidified heel and no free liquids. We can accomplish this with a minimum of radiation exposure by using a camera at the end of a robotic manipulator to verify no liquids appear on top of the solidified heel. If liquids do appear a drying cycle is required. Once dried a cap is placed over the heel.

17. The design of the grout used in capping the heel should be able to prevent big cracks from forming. The cap could be any type of grout or resin.

18. Karen Keck looked at the permeability of a concrete cap for WCF. We did not specifically look at the permeability of the grout inside of the WCF since the placement of the cap was the primary closure standard not void filling.

19. If the remaining volume of the ICPP tanks are to be filled with Low Activity (LA) grout (for void filling), then void filling will have to wait until 2012-2020 when the separations facility comes on line. Once the separations facility is on line, low level waste could be produced and placed in the grout to fill the tank voids.

20. Once all of the waste treatment facilities (such as NWCF, Separations, etc.) have no more waste to either calcine or separate, the facilities will be Decontaminated and Decommissioned.

21. After the facilities at CPP are decommissioned they are covered with a protective layer of soil as required by the FFA/CO and becomes a controlled area for 100+ years as described in the INEEL land use plan.

INEL ENGINEERING DESIGN FILE

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Project/Task: CPP Tank Farm Closure Study
Sub task: D. Machovec Phone Interview with M. Dahlmeir, July 31, 1997

TITLE: D. Machovec Interview - Clean Closure of Tank Farm

SUMMARY

Interviewed Mr. David Machovec, CPP Tank Farm Operations expert, on July 31, 1997, concerning Clean Closure of the Tank Farm.

Discussed the ICPP Tank Farm Clean Closure (total removal of tanks, vaults, etc.) cost estimates prepared by ICF Kaiser, the accuracy of those cost estimates, and what should be done to make the ICF Kaiser cost estimates more realistic. Mr. Machovec indicated that details supporting the cost estimates are not available, but he thought the estimates for equipment costs were high. He did not know whether the overall estimate was high or low, as he did not know how many tasks ICF Kaiser glossed over or overlooked.

The Tank Farm structural analysis, "Evaluation of Existing Vaults for Vehicle Loads," prepared by Advanced Engineering Consultants, was discussed.

Mr. Machovec provided a list of excavation and construction equipment available for possible use by the High Level Waste Tank Farm Replacement Project (HLWTFR).

Mr. Machovec provided a brief summary of those systems, structures, and equipment that would have to be removed under Clean Closure, and the order in which these systems should be excavated. The expected waste streams were also discussed.

Note: A separate interview with Mr. Machovec, conducted by R. A. Gavalya, is documented in EDF-TFC-001. This interview concerns the high level waste storage tank flushing and pH adjustments. This information will be of use during tank rinsing operations prior to complete removal of the Tank Farm.

Distribution: B. C. Spaulding, MS 3765; B. R. Helm, MS 3765, K. D. McAllister, MS 3765; D. Machovec, MS 5111; Project Files (Original +1)

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M. M. Dahlmeir (signature)	MC&IE/4130	B. Spaulding (signature) Date 9/16/97	B. Spaulding (signature) Date 9/16/97

ICF KAISER COST ESTIMATE

M. Dahlmeir asked D. Machovec about the ICF Kaiser Tank Farm Clean Closure cost estimate. He thought the equipment costs were about 2/3 higher than they should be due to the use of exotic equipment and materials. Kaiser's information was based on the Savannah River tank closure. In their cost estimate for the ICPP Tank Farm, Kaiser assumed that due to the highly acidic solutions found in the high level waste storage tanks, exotic materials would be required during the heel removal activities. D. Machovec indicated that rinsing and draining the tanks sufficiently would reduce the acidity and thus allow the use of less exotic materials.

Life cycle costs are not included in the Kaiser estimates. In order to calculate life cycle cost estimates, the waste volumes of concrete, debris, etc. created during closure will be required.

The Kaiser estimate had very rough order of magnitude numbers throughout. D. Machovec thinks the estimate could be high or low by orders of magnitude, depending on how many items Kaiser glossed over compared to how high their material estimates were.

EVALUATION OF EXISTING VAULTS FOR VEHICLE LOADS

Talked about the Advanced Engineering Consultants (AEC) loading calculations [Evaluation of Existing Vaults for Vehicle Loads.] D. Machovec said there is a lot of conservatism in the calculations, that they were very vague, not good, and should be redone. For example, AEC accounted for concrete deterioration due to exposure. The concrete is buried and thus is not exposed to the environment. The buried concrete would become stronger as it ages, not weaker, as assumed in this analysis.

A procedure (MCP-P7.5-A1) was written based on the above mentioned AEC report. This procedure lists the equipment type and quantity allowed out on the Tank Farm. This procedure is MCP-P7.5-A1. The AEC program provided with the original calculations has never worked, it just doesn't run. Specifications for any new piece of equipment needed on the Tank Farm would be provided to AEC, who ran the calculations. AEC would then send a letter to WINCO stating whether or not the equipment could be used. Using equipment listed in MCP-P7.5-A1 does not require a new analysis. Any equipment not listed in the procedure would require a new analysis or DOE approval to use, as the structural integrity of the tanks would be in question. Any vault top soil removal would also invalidate the analysis, thus a new analysis would be required.

A new trench was dug within the Tank Farm. This trench required the excavation of approximately 20 cubic yards of soil. CPP was required to analyze for side loading of the vaults due to the restrictions imposed by the AEC analysis. The AEC analysis does not allow stockpiling more than one cubic yard of soil within a certain distance from any vault. The soil stockpiling details are given in procedure MCP-P7.5-A1.

Finally, Mr. Machovec mentioned that, in all reality, why do we care? Who cares if the structural integrity of the tank is jeopardized - we are removing them anyway.

He recommended figuring the clean closure cost with and without tank loading considerations. If tank loading is considered, a new analysis is required. If tank loading is not considered, a new analysis is not required. He does not feel tank loading should be considered, because we are removing them anyway.

AVAILABLE EQUIPMENT

D. Machovec does have some equipment available for our use - it is slightly contaminated (fixed contamination). We would probably wear it out removing the whole tank farm and may have to replace what we use. Recommended checking around the INEEL site, as other slightly contaminated equipment may be available and should be used prior to contaminating additional equipment, if practical. None of the available equipment is remotely operated, so we would have to modify. Remotely operated equipment would only be required as we approach the bottom of the tank. We could use CATS and scrapers to remove the top soil. The equipment available for use is: compactors, excavators (ten cubic yard bucket), three dump trucks, back hoes, and cement buckets.

Current loading restrictions will require some equipment to sit about 25 - 30 feet away from the dig site. (Equipment approved for use by MCP-P7.5A1 can be used inside the Tank Farm.) Will not find much contamination until excavate down about 10 feet. He doesn't think the soil would be hot until the excavation reached the tank floor elevation. Reference C9E-132739, Task 30, done by Golder Associates, checked for radioactivity and contamination and didn't find any (D. Machovec has a copy of this report). Used core samples to determine this at a depth up to 75'. Did not look for heavy metals.

Equipment needed to size the Tank Farm components into sections remotely may be commercially available. For sectioning the concrete filled piping up to an 8 inch diameter, D. Machovec recommended developing a remote controlled chop saw by modifying commercially available, manually operated, chop saws. In order to cut something greater than an 8 inch diameter, such as the 50' diameter tank, we would have to develop a means to do this remotely. If the bottom of the tank could be decontaminated enough to allow manned entry, the cutter would not have to be operated remotely.

EXCAVATION - WHATS THERE, HOW MUCH, LEVEL OF CONTAMINATION, ETC.

The soil has not been physically sampled and characterized - have done all estimates, etc. from process knowledge. Will have to characterize prior to shipping waste out.

Steam and cold water supplies - can leave in place

There are approximately 200 pillars, placed every 5 feet, 8 inches in diameter, 32 feet long, and filled with concrete throughout the Tank Farm for structural stability purposes. They are located under the pipe trenches for support. These pillars should be clean. D. Machovec suggested assuming 70% will be disposed of as debris, and 30% as radioactive waste. The encasements around the pillars in the center of the Tank Farm, the encasement being the 8" pipe, will be hot, as they are in the same area as the 200 R soil and would have been contaminated during the same spill. Surveys would have to be done as the excavation progressed to determine exactly how to dispose of these pillars. These are not the same pillars as used in the vaults.

The pillars strapped to vault panels should be left in place until the corresponding tanks are removed. For example, tanks WM-180 and WM-181 both have pillars attached to the vaults and thus must be removed prior to the pillars themselves.

See black/white pictures of trenches around tanks 184 - 186 (photo 55-1317, April 1955). The foreground shows the concrete in the trough and as well as some other piping.

Recommended removal order:

- Piping (process lines, VOG lines, etc.)
- Trenches (concrete lined with stainless steel plate, used as electrical and piping ducts)
- Tanks
- Vaults
- Pillars (structural support pillars, which are separate from vault pillars)

During the excavation of any given tank, first the piping and trenches will be exposed and removed, then the tank and its vault. As the tank and vault are being exposed, the pillars in the immediate area will also be exposed, as the top of these pillars are at an elevation of 10 - 15 feet below grade and continue down to bedrock.

Cathodic protection lines will have to be removed. These will be found and removed as the soil is removed.

Table 1: Summary of Expected Objects during Excavation

Depth Below Grade	Object
6 inches	rubber membrane
6 inches - 4 feet	start exposing top of test wells
4 - 6 feet	concrete electrical duct banks (trenches), utility lines
6 feet	supply and return lines, chromate piping
8 feet	main electrical conduit
10 feet	process lines, instrument tubing
10 feet	top of concrete pillars
10 feet	Vault roof
10 feet - 50 feet	Tank and vault structures, vault panel pillars

Six inches down from the surface, we will hit a rubber membrane made by Dupont. This membrane should be cut and stripped into pieces, packaged in waste storage boxes, and disposed of appropriately. This is a heavy rubber, much like an inner tube, and covers the entire Tank Farm (approximately 2 acres)

Excavate four to six more feet to come to more duct banks (electrical duct banks containing cathodic protection, electrical conduit, sump ejector piping, drain lines on valve boxes, etc.) Runs between tank farm and CPP-635 and CPP-636 on the north end. Remove these.

At four feet to six feet below grade, will also hit utility lines (steam, air). Remember to inactivate lines before excavating. Most can be easily isolated in the valve box. This will be approximately 200' of line. Typically, the total length of process lines corresponding to the Tank Farm is estimated at 52 miles. These utility lines would be in addition to this 52 mile estimate.

At six feet below grade, two carbon steel, chromate supply and return lines will be encountered, each measuring eight inches in diameter. These lines are relatively clean and will be hazardous waste, not mixed, hazardous waste. These are included in the 52 miles of process lines estimate. These are generally on the north end of the Tank Farm and run down to the tanks with cooling coils (tanks WM-180, 182, 183, 184, 187, 188, 189, 190). Tanks WM-181, 185, and 186 do not have cooling coils, and thus do not have these supply and return lines.

Also at six feet below grade, chromate piping from the floor of the tanks to CPP-628, CPP-634, CPP-635, and CPP-636. Approximately 500' of piping, not included in 52 mile estimate.

Once the excavation reaches approximately eight feet below grade, remove the main electrical junction boxes for the tank being excavated, as well as the corresponding conduit. An alternate power source will then have to be found for the tank being excavated, if necessary, as the main electrical junction boxes will no longer be in service.

Note: There are a total of 9 boxes, each measuring 2 feet by 4 feet, located on the surface of the Tank Farm (not buried). These boxes are not contaminated. Sequence the rip outs, starting on the north end of the Tank Farm, removing the boxes and ripping out the corresponding lines. In this way, the tanks still in service would have their power sources intact during the excavation.

Excavate to ten feet below grade. At this point, the process lines will begin to be exposed. Vault roofs, pipes coming through top/side of vault will be exposed. Concrete structure over the 4-plex (Tanks 187-190) will be exposed. The vertical concrete filled pillars (32' long, the top of the pillar being 10 to 15 feet below grade) will be exposed quite a bit at this depth. See drawing 105588 for structural drawing of pillars.

Remove the top of the vault (T-beams removed with crane). The top of the vault is made of concrete and, when broken up, will consist of about 80% rubble (non-hazardous, non-radioactive waste). The other 20% will be radioactive waste. The T-beams are shown in detail (structural pre-cast member, drilled and tapped for an eye bolt) in drawing 105589. Roof panels made of 3,000 psi concrete, located between the T-beams will also be removed here. (When installed, 2 cranes were required to install each roof panel - may not be required now as we would not be worried about the forces on the vault anymore, but we would have to look into this.) Will probably have to install new lifting eyes on the T-beams and the vault roof panels, as the old lifting eyes may be corroded, etc. Once the vault roof has been removed, the top of the tank itself will be exposed. Using the remote cutter mentioned earlier, section the top portion of the tank (approximately four feet long sections) and remove.

Continue sectioning the tank in four foot intervals using a remote, robotic cutter (goes around inside of tank - there are cutters commercially available for 4" pipes at <$5,000, for 8" pipes at <$7,000, but one would have to be developed for the 50' diameter tank). Remove this section of tank (vault remaining at this depth will provide shielding, tank will be mixed waste.) A means of either removing the cooling coils prior to sectioning the tank or as the tank is being sectioned would have to be developed.

Remove vault panel at this depth (each panel is 7'11 ½" high by 8'10" wide by 6" thick and lies horizontally, each of vaults 182 - 186 consists of 64 panels). New lifting eyes may be required on these panels to lift them out. Each concrete panel is bolted to the vault pillar using 4 carbon steel, 3" by 11" by 3/8" thick straps with 2 bolts per strap (see drawing 105588 for details on the straps on tanks 182 - 186). As the excavation progresses, new straps may have to be attached to prevent the vault panels from falling into the tank (may not be an issue, as the structural integrity of the tank would already be compromised at this point.) These panels will provide some shielding during the operation. Remove the panel whole with a crane and size it in a cleaner area. The side panels of the vault will be debris. Reference drawings 105591, 105592, structural = 105593, 105590, 105594. Show pillars, vault, tank, etc.

Cut another section of the tank and remove, followed by corresponding vault - continue until the bottom of the tank is exposed. The vault is 4 panels high, and is 38'9" from the bottom of the concrete pad to the top of the T-beam.

This method can be done for tanks 182-186. Tanks 180 and 181 are single poured concrete vaults - worst case, and Tanks 187-190 are in a 4-plex vault - all of which will have to be treated differently. Probably bust concrete up and remove.

Tanks 180 and 181 are bolted to the floor of the vault. Won't be as hot - pulled coupons from WM-180 vessel - 500 mR.

Bottom of tank consists of 5/16" plate with a 4" curb. These were molded at the factory and formed into the "knuckle region" of the tank - see Drawing 105164. This drawing shows the tank bottom and sides. The tank is 21 feet to the tangent of the dome, 29 feet 6 inches to the top of the dome. The man way is another 1 foot 6 inches above the dome.

The bottom/floor of the concrete vault will be disposed of as either debris or radioactive waste.

Summary of auxiliary equipment to be removed:

- Approximately 52 miles of process piping of various sizes and depths (2 supply and return 8" lines, ¼" Schedule 80 instrument tubing outside of CPP-628 at about 10 feet depth maximum, most 1 ½" to 3" at a maximum depth of ten feet)
- Approximately 200 yards of stainless steel lined concrete trough, buried 10 to 20 feet, 90% contaminated LLW radioactive (1 - 2 mR), one small piece highly contaminated by a leak several years ago near the center of the Tank Farm - soil nearby was removed in the '70s, but probably still have stainless steel at contamination levels at 150 - 200 R
- Approximately 5,000 feet of 1 ½" pipe per tank for cooling coils (8 out of 11 tanks have them)
- 200 pillars @ 8" diameter, concrete filled pillars that go down to bedrock (they are 32' long, with 10 to 15 feet of soil above them - verify quantity and depth with drawings 106133, 106134, and 106141 - placed every 5')
- Approximately 15 cubic yards of 200 R general body field soil in center of tank farm. A clean up effort was started to box the waste. People were allowed to package the waste in lead shielded boxes, but were only able to work a few seconds before they reached their ALARA limits. D. Machovec suggested that soil washing may be an option to bring the contamination levels down to workable levels. He suggested that it may be better to put the highly contaminated soil in the tanks themselves and solidify the heel/soil mixture with grout or concrete.

  Note: approximately 5 cubic yards of 7 R soil by tank 181 have been removed - this information is taken from a report that D. Machovec has a copy of - Tank Farm Leak Incident, 1974. There is another known hot spot near CPP-604. Excavations were stopped when the readings reached 7 R.
- 11 test wells with listers (probes) in them - 2" diameter, up to 50' long - various lengths. Three test wells were cut off during a contamination incident between 181 and 184 when the rubber membrane was installed - drawing shows where they were. Eleven are left.
- VOG system - 5,000 feet of piping
- rubber membrane made by Dupont (10 - 15 mils, 2 acres)
- Utility lines (steam, air, and condensate return) - approximately 300' (1 ½", 4", or 8 inch diameter)
- Approximately 500' of chromate piping from floor of tanks in 628 to 634, 635, and 636 at 6'
- CPP-628, 635, 712, and the valve boxes - these would be disposed of as radioactive waste
- CPP-618, 619, and 634 - these would be disposed of as clean debris
- CPP-738 (underground condenser pit) would be disposed of mainly as debris, the outer walls may be radioactive waste

D. Machovec mentioned that it has been estimated that if the Tank Farm is completely removed, approximately 5 cubic acres of material will have to be disposed of.

EXPECTED WASTE STREAMS

Table 2: Summary of Expected Waste Streams during Excavation, excluding soil

Component	Expected Waste Classification	Comments
Tank roof	Mixed waste	The roofs of the tanks roof have not come in contact with any process solutions (waste) because the tanks have never been filled above the tangent line. However, the tanks have come in contact with acid fumes and airborne contamination, and thus should be assumed to be mixed waste.
Bottom/floor vault panels	Radioactive waste or debris	Can be disposed of as debris if there have been no leaks.
Side panels of vault	Debris	
Sump pumps (steam jets)	Mixed waste	The sump pumps are located in the bottom of the tanks and will be considered mixed waste unless we can convince regulators that due to the numerous rinses in the tank it can be considered debris.
Process piping	Mixed waste	
Stainless steel liner in the concrete troughs	Mixed waste	Due to known leaks in the piping contained in the trenches as well as unknown leaks , it should be assumed that the liners will be mixed waste
Concrete troughs	Debris	
CPP-628, 635, 712, and the valve boxes	Radioactive waste	
CPP-618, 619, and 634	Debris	
CPP-738 (underground condenser pit)	Debris and Radioactive waste	Disposed of mainly as debris, the outer walls may be radioactive waste
Tanks	Mixed waste	The tanks will be mixed, unless can convince regulators that due to the numerous rinses in the tank it can be considered debris.

The soil is under ECA 88 (which means that all soil inside the CPP fence is considered a spill area, hazardous mixed waste), which includes all of Tank Farm soil. If ECA 88 is lifted and we can use sampling to determine if mixed or not, a lot of soil could go as contaminated radioactive waste, not mixed waste. If ECA 88 is not lifted for us, we need closure plans, etc. If some soil can be sampled and determined to be clean, soil could be used as back fill. (Down ten feet below grade, the soil should be clean, but if can't get out of ECA 88, doesn't matter.) There shouldn't be a hazardous constituent in the contaminated soil, only radioactive constituents. This is true for those areas not considered a spill area. In those areas where the process lines have leaked, the soil will have a hazardous constituent and will thus be considered a mixed, hazardous waste.

Contamination resulting from migration is not considered mixed waste, just radioactive.

MISCELLANEOUS TOPICS

D. Machovec recommended putting an auxiliary VOG system in one tank and use that tank to pull a vacuum on the rest of the tanks. Pulls the airflow to the existing VOG system. There is a valve on the berm outside of CPP-604 that isolates the tank farm from the existing VOG system. This way, would have to tie in to the system in only one place.

Mentioned that any rinse/wash process we do, in combination with a pump to remove the rinse/wash agent, will probably remove 90 - 95% of any solids located in the tank.

Mike Cole (Charles M.) was the lead engineer on Clean Closure and the Kaiser interface for the tanks. His number is 6-6123.

Eight out of the eleven tanks have cooling coils (181, 185, 186 do not). Tank 190 was never used for waste. About 15 years ago, had a guy standing in the vault next to the vessel, and nothing has been added to it since, so it should be clean. The man way of Tank 190 was removed one to two years ago and sampling was done. The readings were only 1 mR - 2 mR in the bottom of the tank.

Not sure if permitting was part of the EIS or not - if this fits in the EIS, permitting is taken care of.

Rick Gavalya has pictures of the troughs and the lifting blocks on the vault panels. D. Machovec and Mike Swenson also have pictures of the Tank Farm being built.

There is an area approximately 1,000 feet long available for a control trailer on either the north or the west side of the tank farm - has power available.

Mentioned that daily characterization during excavation activities would not be necessary - characterize once to map hot spots. Want to look for radioactive contaminants and especially heavy metals, as this has not been done before.

Are no flammable gases in the tanks - sparks shouldn't be a problem. Shouldn't be any hydrogen left in tanks.

Note that when referencing older, inactive ICPP drawings, the reference grade, or zero elevation, has changed over the years by as much as 8 inches. This means that if an item is said to be, for example, at 11' below grade, it could be anywhere from 11 feet 8 inches below grade to 10 feet 2 inches below grade. Geophysical characterization is thus critical.

D. Machovec mentioned that if waste can be classified as debris, it can be disposed of in a landfill by Central Facilities Area. The waste would have to be sized (less than 1 ft^3 pieces) and could be transported by means of dump trucks. Radioactive waste would be sent to the RWMC in 4 foot by 4 foot by 8 foot boxes. There is a weight limit on these boxes. D. Machovec said that it would be a wise to assume that the 200 R soil would have to be treated in place before it was moved. Soil washing may be a viable option to bring the contamination levels within acceptable levels,

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Project/Task CPP Tank Farm Closure Study

Sub task R. A. Hyde Interview with S. P. Swanson, September 26, 1997

TITLE: R. A. Hyde Interview – Remediation Issues

SUMMARY

Interviewed R. A. Hyde, Remediation Expert, on September 23, 1997, concerning Clean Closure of the Tank Farm.

Discussed possible retrieval methods for soil and piping at the tank farm. R. A. Hyde discussed the possibilities of using a teleoperated excavator and a teleoperated crane. She indicated that both would be fully capable of deploying soil removal and sizing equipment.

Discussed the feasibility of jet grouting cement walls into the soil to provide structural stability for a gantry crane.

Discussed the types of end-effectors that would be effective on a gantry crane (i.e. digging bucket, vacuum hose with air jet, and hydraulic shears).

Discussed possible throughput rates for the operation of a teleoperated gantry crane during digging operations, along with rough order of magnitude costs for equipment.

Distribution: B. C. Spaulding, MS 3765; B. R. Helm, MS 3765; M. M. Dahlmeir, MS 3765; R. A. Hyde, MS3765; S. P. Swanson, MS 3765; Project File (Original +1)

Authors	Department	Reviewed	Approved
Steven Swanson	MC & TC/4130	Reva Hyde Date 10/9/97	[signature] Date 10/22/97

Discussed using jet-grouted cement subsurface walls to support the weight of the gantry crane. R. A. Hyde indicated that the cement, once injected, will likely be capable of carrying the required loads for a 100 foot span gantry crane. R. A. Hyde also stated the current methods for forming these walls requires the use of a drill rig. Due to tank farm loading restrictions, this should be investigated further.

R. A. Hyde suggested using "z-masts", motorized rigid arms that extend and retract vertically on the crane to deploy end-effectors, on the teleoperated crane instead of hoists to allow the crane to provide the required force for digging at the site. A digging mechanism similar to a bucket planned for Pit 9 has not been used on a gantry crane but can be easily adapted. The hydraulics for the bucket would require engineering time for research and development.

A gantry crane could be fitted with a hydraulically driven shear to quickly size the piping in the tank farm. As with the digging bucket, this end-effector would require the use of hydraulics for manipulation. Some engineering time and effort would be required to adapt the system to a crane.

A separate boom crane will be necessary for the installation and movement of the gantry crane. Due to the tank farm loading restrictions, the ability to do so should be investigated.

A vacuum system can be fitted on the gantry crane to allow soil removal above and around the tank farm piping. R. A. Hyde suggested using an air-jet to break up the soil to facilitate vacuuming because soil at CPP will be moist or compacted. Engineering time and effort will be required to implement this type of end-effector on a gantry crane.

Throughputs for a gantry crane with a digging mechanism have not yet been determined, but would be similar to the rate achieved by an overburden removal tool, such as Sonsub International®'s Soil Skimmer™ (throughput is approximately 20 cu.yd/hr with optimization and experienced operator – see reference 1). R. A. Hyde indicated that vacuum systems can be developed to provide the desired soil removal throughputs.

Rough order of magnitude cost for a teleoperated gantry crane with a 100 foot span is approximately 3 million dollars. Rough order of magnitude cost for the vacuum system is approximately $500,000.

References

1. Rice, Phil and Skaggs, John. Removal of Overburden Soils from Buried Waste Sites, EGG-WTD-10767, October 1993, pg. 56.

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501

EDF Serial Number EDF-TFC-008

Functional File Number BC-08

Project/Task CPP Tank Farm Closure Study

Sub task Clean Closure of Tank Farm by Total Removal

TITLE: Don Kenoyer Interview – Remote Demolition Techniques for Tank Farm

SUMMARY

Interviewed Don Kenoyer, of the Inactive Sites Department, Decontamination and Dismantlement Program Support personnel, on September 26, 1997 concerning remotely operated sizing, decontamination, packaging, and demolition techniques. In the interview, Don discussed the current D&D methods for the before mentioned items. Don also included data on excavators, pile extractors, containers, sizing equipment, and RWMC disposal plans (attached).

Discussed necessary equipment and current methods for removing piping within rebar-reinforced concrete encasements.

Discussed decontamination methods for heavy equipment that has not come in direct contact with the contaminants of concern but has been exposed due to dust generation.

Discussed the sizing of piping, concrete piles, and other large objects to be placed into standard 4x4x8 boxes for disposal.

Discussed removing contaminated layers of concrete with scabbling tools. Kenoyer explained that pile extraction equipment is currently available for the removal of underground piles. Excavators are generally used as the deployment platform for D&D end-effectors.

Don Kenoyer indicated that there is little, if any, information on throughputs and practical experience with remote excavation equipment. He indicated that remote technologies have been looked at, but are not deployed at the INEEL for this type of application. Don also stated that currently, packaging of the debris and piping into the cargo containers is accomplished by manual operations; it is not remotely conducted.

Distribution: B. R. Helm, MS 3765; B. C. Spaulding, MS 3765; M. M. Dahlmeir, MS 3765, D. J. Kenoyer, 3921, S. P. Swanson, MS 3765; Project File (Original +1)

Authors	Department	Reviewed DJ Kenoyer	Approved
S. P. Swanson	MC&IE/4130	Date 21-Oct-97	Date 11/19/97

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

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Authors	Department	Reviewed	Approved
S. P. Swanson	MC&IE/4130	Date	Date

Currently, concrete pulverizers are being used at the INEEL for the demolition of large concrete objects and buildings. Pipe encasements (3 ft x 3 ft) that are reinforced with #5 rebar, and steel piles that are 10" in diameter filled with concrete can be sized with this equipment. Kenoyer stated that the concrete pulverizer will break up the concrete and cut through the 12" piping. LaBounty® Manufacturing produces a line of pulverizers that attach to an excavator (the INEEL currently uses the LaBounty® UP50 processor). This processor attaches to a 50,000 lb. excavator (attached to the 2nd member) or a 90,000 lb. excavator (attached to the 3rd member). The pulverizer has a jaw opening of 36 inches or 910 mm. It should be noted that a number of other manufacturers produce hydraulic demolition equipment.

Radiological waste decontamination of the heavy equipment can be accomplished by wiping, vacuuming, and/or grinding surfaces that have come in direct contact with the contaminants of concern. However, items that have come into contact with "Listed" wastes are regulated by RCRA which constitutes the transfer of the waste code to the equipment itself; decontamination for release maybe very difficult. The end-effectors will thus be dumped into waste containers for disposal at various points within the project. As a result, a number of end-effectors will be necessary during the length of the project. The end-effectors would only be disposed of when the project is completed and/or the waste specific task is completed. We don't want to transfer the waste codes to another part of the ICPP Tank Farm.

Kenoyer indicated that D&D operations are currently looking into the potential utilization of soft sided disposal packages (INEEL demonstration was outside Pit 9 on 16-Oct-97) for the containment of removed materials. He indicated that, if approved, it would be acceptable to package the removed materials into the (10 cu.yd/20 ft) poly-bags and then into a roll-off cargo containers for transport. It would not be necessary to size the materials to be placed into 4x4x8 boxes if the materials are not leaving the INEEL.

Scabbling of the concrete can be accomplished using an end-effector that penetrates needles into the concrete while vacuuming debris away from the area. Currently, this end-effector is deployed manually and would require engineering development to be operated remotely.

Pile extraction equipment is currently available for the removal of piles from underground. Don estimated that it takes approximately 1 day to remove 1 pile. This estimate must be verified with pile extractor manufacturers.

Don discussed the advantages of using an excavator over a teleoperated gantry crane. He mentioned that D&D equipment is already developed for deployment from an excavator and that long-reach booms can be used to reach the desired depths (up to approximately 65 ft.).

Don also indicated that there is little, if any, information on throughputs and practical experience with remote excavation equipment. He indicated that remote technologies have been looked at, but not deployed at the INEEL for this particular application. He provided a contact (Richard Meservey) for information on practical experience. Currently, a company in England is conducting remote retrieval and D&D operations (BNFL).

The packaging of the materials into the waste containers is now being done manually. Shielding could be provided to reduce personnel exposure. However, a remote system will require engineering research and development if the equipment is necessary.

Don Kenoyer also provided some photos and descriptions of equipment discussed previously. See the attached sheets for this information.

CONTAINERS AND POLYBAGS

From: JDW --INELMAIL   Date and time 09/08/97 06:37:05

From: Jon D Wells
To: DNK --INELMAIL Kenoyer, Donald J.
RP8 --INELMAIL Piper, Robert B.
HLT --INELMAIL Thorne, Harold L.
TNT --INELMAIL Thiel, Thomas N.
GRR --INELMAIL Rodman, Glenn R.
MEDRAIDV--INELMAIL Medrain, D L.
-- Nelson, Roderick V.
DL6 --INELMAIL Larsen, Douglas J.
YUB --INELMAIL Labuy, Scott A.
-- Fenn, Stanley T.
BJF --INELMAIL Frazee, Bradley J.
GPP --INELMAIL Pell, George P.

Subject: Re: RWMC Other Acceptable Containers

Just a couple of additional things, added to Don's note. High density liners are available for placement into the bags to prevent damage to the bags from sharp waste items. And the vendor performed some testing at his plant. Results were all positive and we have still photos. We are in almost daily contact with the bag vendor, resolving some technical issues. At this moment all indicators are positive in our favor.

An order for metal boxes should be placed today. They will be 4' W x 8'L x 40"H (external), running about $650 each without delivery costs, which are being negotiated. In parallel, preparations are underway to have this box as the standard waste box available through the warehouse. The original order will be used to meet needs until the warehouse is stocked. Official communications will be issued when all arrangements have been concluded.

From: DNK --INELVM1 Date and time 09/05/97 15:48:33

To: BJF	--INELMAIL	B J Frazee	STF	--INELVM1	S T Fenn
YUB	--INELMAIL	S A Labuy	DL6	--INELMAIL	D J Larsen
RVN	--INELVM1	R V Nelson	GPP	--INELMAIL	G P Pell
DAP1	--INELMAIL	D A Peterson	GRR	--INELMAIL	G R Rodman
TNT	--INELMAIL	T N Thiel	HLT	--INELMAIL	H L Thorne
cc: JDW	--INELMAIL	J D Wells	RP8	--INELMAIL	R B Piper

FROM: D. J. KENOYER
3110 Inactive Sites Dept.
Ph 526-9837 Fax 6-3370 MS 3921

Subject: RWMC Other Acceptable Containers

Hi Guys; had a meeting on 02-Sep-97 with Dale Wells and Bob Piper to discuss specifically some new high density poly type bags for LLW Disposal. These bag are manufactured by Transport Plastic Inc. and are in the process of patent application and demonstration testing of system. The nominal application has been 10 cy soil bag system with the bags being placed inside of a metal rolloff container, loaded, sealed, and lifted out for transport & disposal. There is interest in the development of other bag designs to accomodate D&D type LLW types (long steel/metal shapes, etc.). Below are some other items of discussion (I will make a copy of information and route it around):

- 10 cy soil bag / 20,000 lb capacity
- Material has a Safety Factor of 3x
- Materials have various UV and Flame Spread ratings
- Bag configuration would meet 49 CFR DOT "Non-Accident Resistant Packaging" and/or "Industrial Packaging"
- Rolloff metal containers NOT standard at INEEL ... may have to invest in semi-tractors to load and haul
- Talked about "TAGS" to be attached to bags with Bar Coding to meet labelin requirements.
- Optimum Sizing for bags to be utilized for D&D Projects
- The end of September the manufacturer is going to perform a typical D&D debris demonstration on bag durability.
- The RWMC is to be revised again this month 1) No METAL Restrictions 2) Other types of LLW containers will be acceptable (B-25 type metal containers) Dale is working with Procurement on getting 100 each B-25 type containers that are approx. $600 each (4'x7'x3'h / 84 cf) The DOT 7A Type A 130cf containers from Container Products are approx. $1,400 each. I told Dale that D&D was very interested in the metal containers.

That is all for now ... I will make copies and route information around. thanks

Just Get It Done!

JDW | RJC

02-SEP-97

DALE WELLS / BOB PIPER

DUKEWYER

MOU TO FILL-UP RWMC BY 2003

(MTG 1500 - 1600 MST)

TRANSPORT PLASTICS INC. —— ENVIROCARE LINERS FOR SOILS SHIPMENT LAST YEAR 1996

10 CY BAGS 20,000 lbs (SAFETY FACTOR 3X / RATED MATERIAL)

ROLL OFF CONTAINERS W/ BAGS OF VARIOUS SIZES

UV RATINGS

FLAME SPREAD RATINGS] CLOSED LIDS ROLL OFFS

✓ DOT "NON-ACCIDENT RESISTANT PACKAGING" —— IP (INDUSTRIAL PACKAGING)

49 CFR (EXCEPTED PACKAGING)

ROLL OFF CONTAINERS / TRACTOR TRAILERS / SPREADER BARS —— COSTS ANALYSIS

** OPTIMUM SIZE FOR BAGS

TAG ON STRAPS / BAR CODING

TRY TO IMPLEMENT BY FY98

SEPTEMBER D&D DEBRIS BAG DEMONSTRATIONS

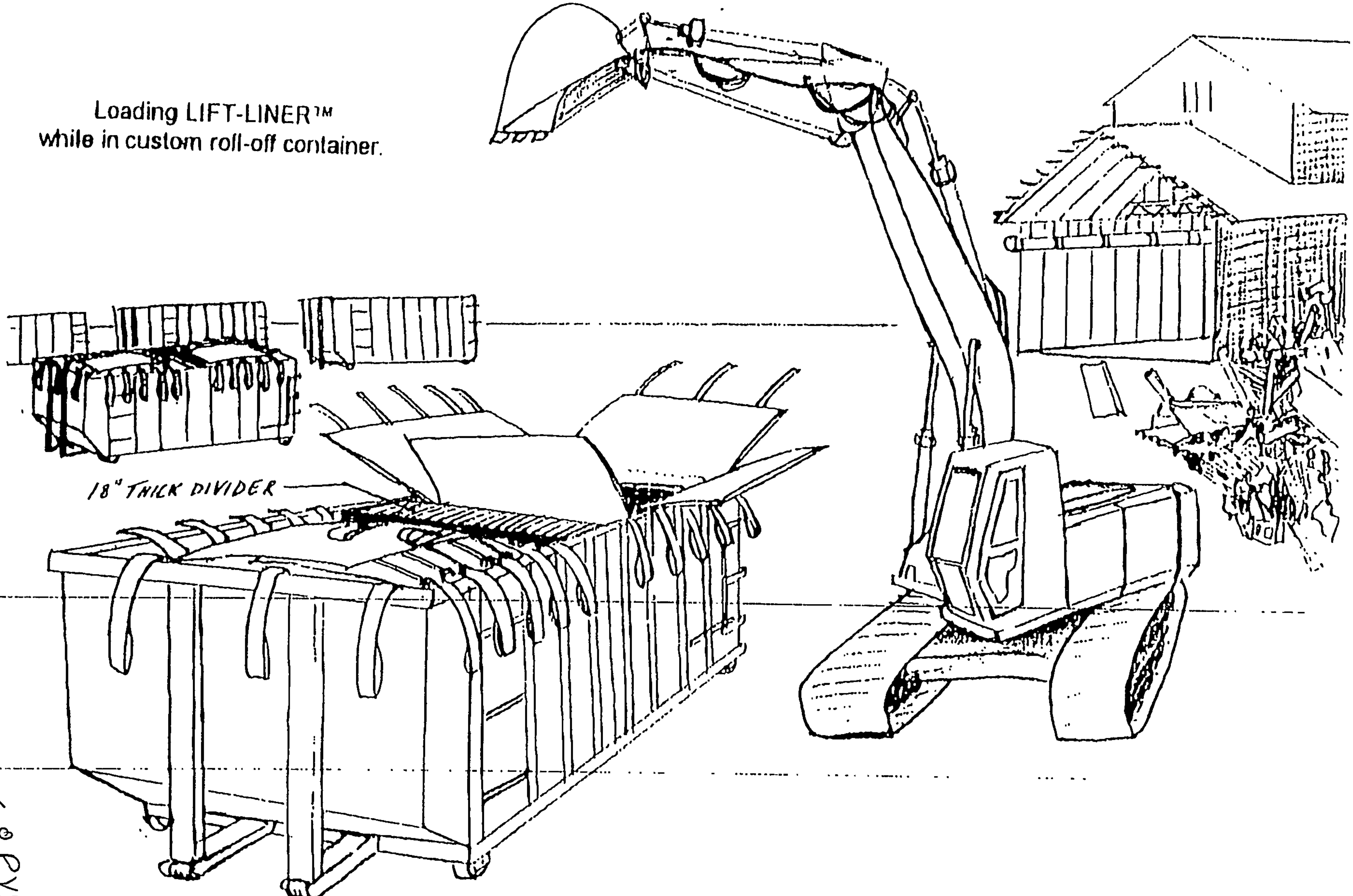
✓ RWMC TO BE REVISED THIS MONTH —— NO METAL RECYCLE RESTRICTIONS

OPTIONS FOR DOT PACKAGING B25s 4×7×3½ $600.00 NEXT ORDER - WOOD TO METAL

DOT [illegible] $1400 —— 130 cf CONTAINER PRODUCTS (1000 ea)

DOT 7A TYPE A

Loading LIFT-LINER™
while in custom roll-off container.



TRANSPORT PLASTICS, INC. • SWEETWATER, TN 37874 • (800) 603-8277

NOVA-THENE

8 oz IBC

Uncoated/Coated

DATA SHEET

COUNT	Nominal 18 x 16 tapes/inch	
WEIGHT - Uncoated - Coated	8.4 oz per square yard (285 gsm) 9.1 oz per square yard (309 gsm)	
TENSILE STRENGTH (Grab Method)	Warp - 475 lbs Weft - 550 lbs	ASTM D5034-90
TEAR STRENGTH (Trap. Method)	Warp - 180 lbs Weft - 185 lbs	ASTM D4533-85
MULLEN BURST	865 psi	ASTM D3786-87
SCRIM TYPE	UV Stabilized PP 1600 denier warp, 2300 denier weft	
ACCELERATED WEATHERING/UV	More than 70% strength retention after 1200 hours	ASTM G53-84

(Q.U.V.[A-340 Lamps] 8 hrs UV @ 60° C/4 hrs condensation @ 50° C)

WIDTHS	36, 42, 48 inches

Physical tests are based on uncoated fabrics.

These values are typical data and are not intended as limiting specifications.
FDA Status - This fabric complies Title CFR Parts 177.1520 and 178.2010

DS 090998
Rev B

Nominal thickness 25 mil.

Disposal Container Comparison

	2' x 4' x 8' Wood Box	4' x 4' x 8' Wood Box	4' x 4' x 6' Metal Container	7'4" x 8'10" x 4' Soft Container
Outside Dimensions:	26.25" x 46.5" x 96"	48.25" x 46.5" x 96"	52" x 48" x 72"	7'4" x 8'10" x 4'
Outer Volume:	67.8 cubic feet	124.6 cubic feet	104 cubic feet	259 cubic feet
Inside Dimensions:	19" x 36" x 85.5"	41" x 36" x 85.5"	47" x 47" x 71"	7'4" x 8'10" x 4'
Inner Volume:	33.8 cubic feet	73.0 cubic feet	90.8 cubic feet	259 cubic feet
Container Efficiency:	50 %	58.6 %	82.4 %	100 %
Loading Efficiency:	90 %	90 %	90 %	95 %
Waste Volume:	30.4 cubic feet	65.7 cubic feet	81.7 cubic feet	246 cubic feet
Container Cost:	$466	$567	$1,327	$340
Generator Cost:	**$15.3 per cubic foot**	**$8.6 per cubic foot**	**$16.2 per cubic foot**	**$1.4 per cubic foot**
Pit Stacking Efficiency:	94 %	94 %	92 %	95 %
Disposal Efficiency:	**42 %**	**50 %**	**72 %**	**90 %**

Notes:

- Wood Box Dimensions were taken from Drawing No. 410206 (RWMC Radioactive Waste Storage Plywood Box Assemblies)
- Metal container dimensions are estimates
- Wood and metal container costs are systems average prices obtained from Fred Tolli (CFA Warehouse)
- Soft container dimensions and cost information was obtained from Al Beale of Transport Plastics, Inc. (423-337-3003)
- All costs are unburdened (i.e., costs before G&A and material handling adders)
- Container efficiency is: (inner volume) / (outer volume)
- Loading efficiencies are estimates from 1996 ICPP/Envirocare Project (soil was emptied from 1,400 wood boxes into railcars)
- Loading efficiencies are for soil
- Waste volume is: (inner volume) x (loading efficiency)
- Generator cost is: (container cost) / (waste volume)
- Wood and metal pit container stacking efficiencies are per EDF RWMC-787, rev 3 (LLW Forecasting Assessment for the INEEL)
- Soft container pit stacking efficiency is an estimate
- Disposal efficiency is: (waste volume) / [(outer volume) / (pit stacking efficiency)]
- Store stock # for the 2' x 4' x 8' wood box is 15-09213
- Store stock # for the 4' x 4' x 8' wood box is 15-09214
- Store stock # for the 4' x 4' x 6' metal container is 15-10159

DOT PACKAGE PROPOSAL CONCEPTS

DOT APPROVED

Non-accident resistant

For SCO and LSA Waste

DOT INFORMATION

- Approved as an Industrial Package (IP) in 49 CFR 173.403
- Authorized for the packaging and transport of Surface Contaminated and Low Specific Activity radioactive material. 49 CFR 173.403

DOT INFORMATION

- Per 49 CFR 173.410
  - Is capable of withstanding effects of any acceleration, or vibration under normal conditions of transport.
  - Tested to to 3X rated capacity.
  - Easily handled and transported
- Available in user required dimensions and capacity

DOT ACTIVITY CAPACITY

- To demonstrate the nuclide activity potential for this package two general material categories are discussed.
  - Surface Contaminated Objects, solid objects which are not themselves radioactive.
  - Low Specific Activity materials, material with limited specific activity, the radioactivity being either distributed throughout or uniformly distributed

SURFACE CONTAMINATED WASTE

- Limits for non-fixed and fixed contamination is 8 X 10^5 Bq/cm^2 average
  - 1 Bq = 1dps
  - The limit then is 8 X 10^5 dps /cm^2
  - or 20 microcuries/cm^2
- Example 4” pipe at 20 lbs and 310 cm^2/ft
  - Which equals 2.48 X E8 Bq or dps or E-4 TBq
  - 1000 ft = 2.4E11 dps or .24 TBq or 6.48 Ci/pkg

LOW SPECIFIC ACTIVITY

- LSA limits are nuclide specific, from 49 CFR 173.403, LSA II solids is $< 10^{-4} A_2/g$
- For a specific nuclide, Cs-137, $A_2 = 0.5$ TBq or 13.5 Ci
- Example, 20,000 lb soil with Cs-137 which is limited to < 5E-5 TBq/g
  - (5E-5 TBq/g) (453.6g/lb) (2000 lb/ton) =
  - 45.36 TBq/ton (10 ton) = 453.6 TBq/ pkg or 12,247 Ci/pkg
  - Actual limit for this example is < 453.6 TBq

Positive and Negative Factors

A discovery activity to determine if the proposed package will satisfy legal and operational requirements.

Positive Factors

- Cost Effective
- Volumetrically efficient
- Rapid closure, without tools
- New containers store collapsed
- Minimum capital outlay to implement
- Waste stack will be stable
- Subsidence nearly eliminated

Positive Factors (cont)

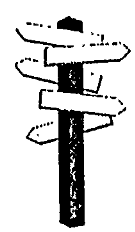
- Reusable transport frames
- Reduced the need to segregate pit space
- Handle significant quantity of radioactivity
- Exempted Packaging with reduced DOT requirements
  - Testing not required
  - Decreased Marking and Labeling
  - No Placarding

Negative Factors

- Not storage containers
- Retrieval may not be feasible
- Pit package locating system may need revision
-

Summary

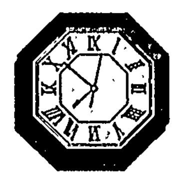
Where do we go from here?



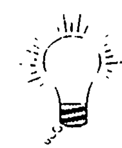
Path Forward

- Pursue answers to technical questions
  - Final development and testing
  - UV exposure effects
  - Cold temperature characteristics
  - Flame spread rating
  - Size options -- unique operations
  - Automated rigging release

Path Forward

- Vendor demonstration at the INEEL
- If Feasible
  - Prepare Implementation Plan
  - Revise the RRWAC
  - Procure necessary equipment
  - Revise operating procedures
  - Train users and handlers
  - Implement and save  and 

PACKAGE PROPOSAL CONCEPTS



DOT APPROVED

Non-accident resistant

For SCO and LSA Waste

RWMC LLW DISPOSAL PIT REMAINING VOLUME

LOCKHEED MARTIN

Lockheed Martin Idaho Technologies Company

INTERDEPARTMENTAL COMMUNICATION

Date: January 30, 1997

To: Distribution

From: K. L. Falconer, Env. Restoration MS 3921 6-1559
M. J. Wolters, Waste Operations MS 3940 6-1677

Subject: RADIOACTIVE WASTE MANAGEMENT INTEGRATION INITIATIVES AT THE IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY (INEEL) - KLF-18-97 AND MJW-10-97

Attached for your information is a Memorandum of Understanding entered into by the Department of Energy Idaho Operations Office (DOE-ID)/ Lockheed Martin Idaho Technologies Company (LMITCO) Waste Operations (WO) and Environmental Restoration (ER) organizations, to implement integrated work plans for radioactive waste management that cross-cut both organizations. The goal is to eliminate stovepipe work approaches and replace them with cost effective integrated solutions, drawing upon the strengths of both organizations.

The plan is to work each initiative through joint WO/ER task teams. Each team's charter will be to develop the strategy along with a project based work plan to implement the strategy. The work plan (technical, cost, schedule) will then be integrated into specific Ten Year Plan projects identified for the INEEL. LMITCO personnel assigned to lead the initiatives include the following individuals:

- INEEL Radionuclide Contaminated Soils Policy - Kathy Davis, Roger Piscitella
- INEEL D&D Waste Policy - Brad Frazee, Roger Piscitella
- RWMC SDA Project Plan - Roger Piscitella, Kathy Davis
- RWMC/WAG 7 Environmental Monitoring - Leah Street, Tom Stoops
- RWMC/WAG 7 Closure - Doug Jorgensen, Raj Bhatt
- RWMC/WAG 7 Performance Assessment & Risk Assessment - Raj Bhatt, Walt Sullivan

Initiation of this effort will begin immediately, with each of the task team leads developing a work plan for management approval. An overall project schedule will be developed to coordinate and status the tasks.

If you have any questions, please call Mike Wolters at 6-1677 or Kathy Falconer at 6-1559.

Memorandum of Understanding
between
Waste Operations and Environmental Restoration
Concerning Radioactive Waste Management Integration
at the INEL

Waste Operations (WO) and Environmental Restoration (ER) are committed to the development of a joint strategy and implementation of a project specific work plan for each of the following:

- Management of INEL radionuclide contaminated soils
- Management of INEL D&D waste
- Optimization of the remaining capacity of the RWMC SDA, based on the following:
  - cost effectiveness
  - compliance with the performance assessment limits
  - maintaining adequate capacity for critical customers
  - fill the remaining capacity by 2003
- RWMC/WAG 7 environmental monitoring
- RWMC/WAG 7 closure
- RWMC/WAG 7 performance assessment and risk assessment

In addition, WO is committed to support ER in the management of ER and D&D waste including LLW, hazardous waste, mixed waste, and TRU waste.

Implementation of the joint strategies will be via project specific integrated work plans developed as an integral component of the Ten Year Plan project baselines for the INEL.

1/28/97
M. J. Wolters, Director, LMITCO Waste Operations

1/28/97
K. L. Falconer, Director, LMITCO Environmental Restoration

29 JAN 97
G. L. Beausoleil, DOE Acting Facility Manager, RWMC

30 JAN 97
J. T. Case, DOE Manager, Waste Management Program

1/30/97
N. R. Jensen, DOE Acting Manager, Environmental Restoration Program

Lockheed Martin Idaho Technologies Company

INTERDEPARTMENTAL COMMUNICATION

Date: August 27, 1997

To: R. R. Piscitella MS 2414 6-1137

From: R. B. Piper *Bob Piper* MS 2414 6-4702

Subject: RWMC LLW DISPOSAL PIT REMAINING VOLUME - RBP-03-97

Reference: Engineering Design File RWMC-963, RWMC Disposal Pit Utilization, July 21, 1997

The purpose of this letter is to document an analysis that determined the remaining contact-handled (CH) LLW disposal volume in RWMC's Disposal Pit.

General information regarding the Disposal Pit's topography:

- Bottom elevation ranges from 4,980 ft to 4,982 ft
- The bottom of the front row of waste containers are at an elevation of approximately 4,982 ft
- Waste containers are stacked an average of 20 ft high to an elevation of approximately 5,002 ft
- Surrounding ground level elevation is approximately 5,010 ft.

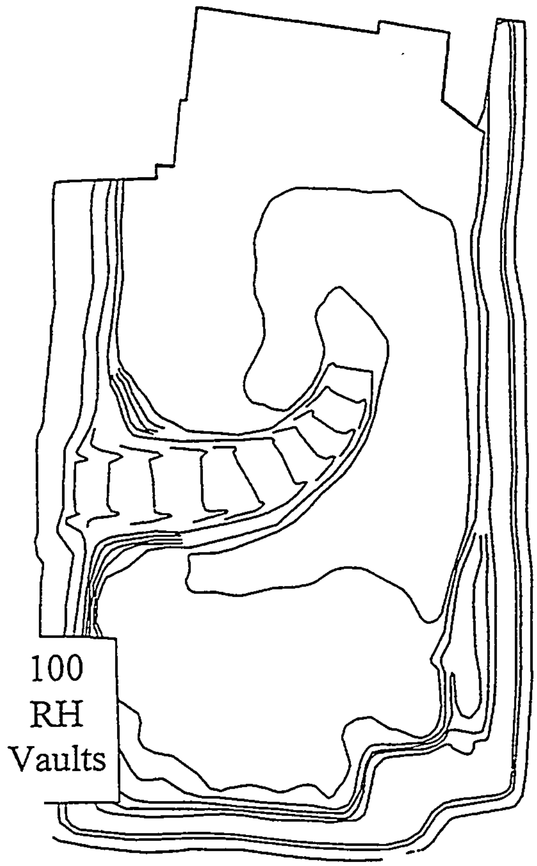
The current Disposal Pit configuration is shown in Figure 1. It is planned to add 200 additional remote-handled (RH) concrete vaults adjacent to the existing 100 RH vaults. It is also planned to add a new bulk disposal area for RH containers unable to fit in the concrete vaults, and/or large bulky CH items.

The addition of the RH vaults and the bulk disposal area (as shown in Figure 2) is the preferred alternative for the reconfiguration of the Disposal Pit per referenced Engineering Design File RWMC-963. The Disposal Pit will be filled with waste to 5,002 ft and covered with clean soil to 5,010 ft. This satisfies the Performance Assessment requirement of 2.4 meters of clean soil for an operational cover. The remaining CH LLW disposal volume estimate for the preferred alternative is **73,160 cubic meters**.

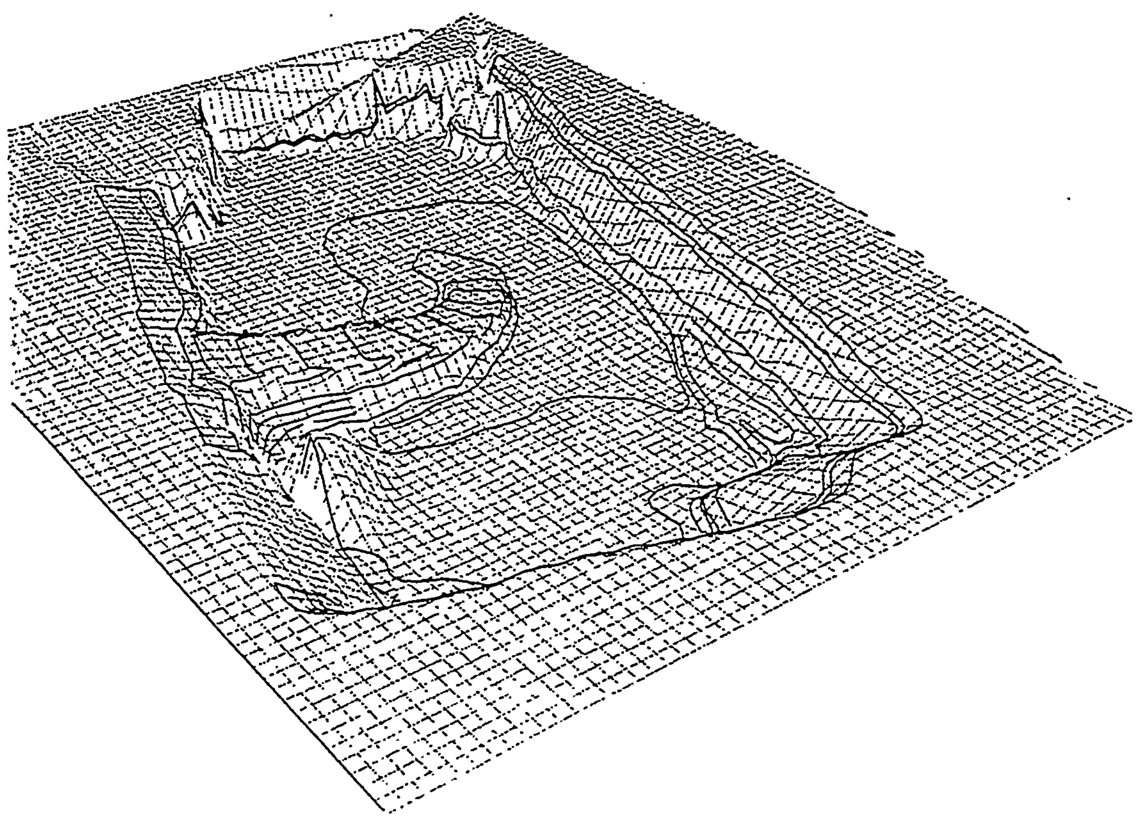
The following are remaining CH LLW disposal volume estimates for several different scenarios:

- Scenario 1: This is the current Disposal Pit Configuration. No new bulk disposal area, 100 RH vaults, pit is filled to an elevation of 5,002 ft. Estimated remaining volume = 100,100 cubic meters.

Figure 1: Current RWMC Disposal Pit Configuration



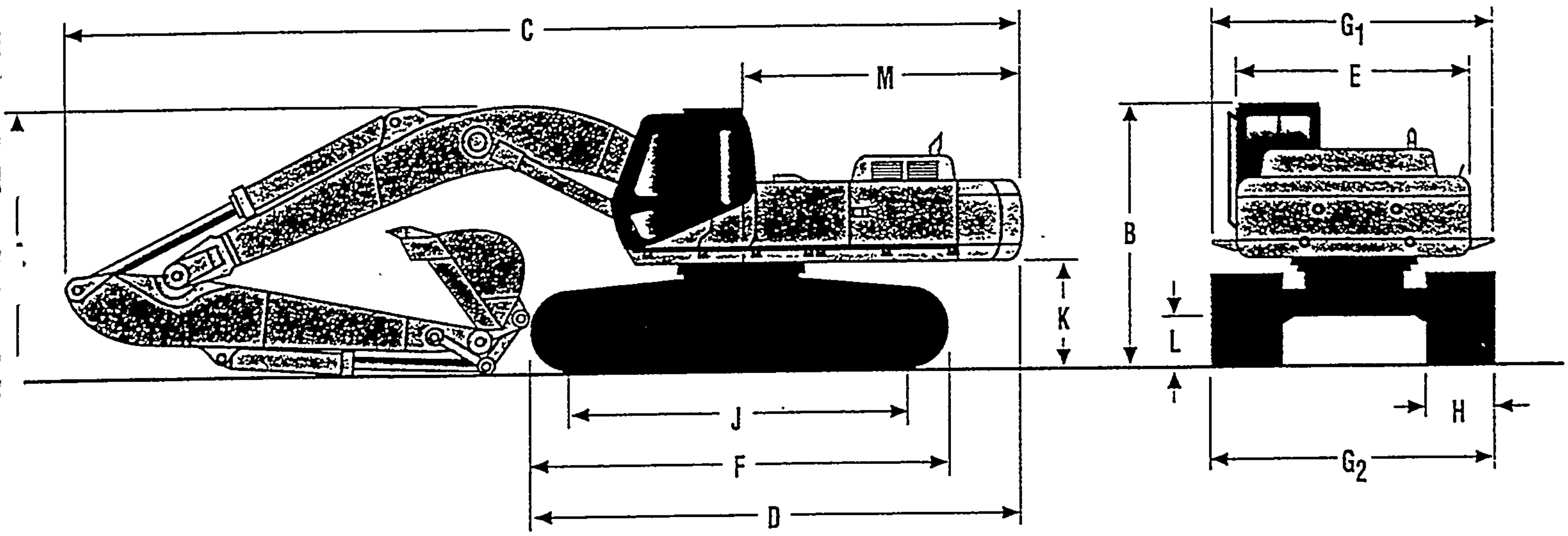
Plan View



3-D View

EXCAVATORS

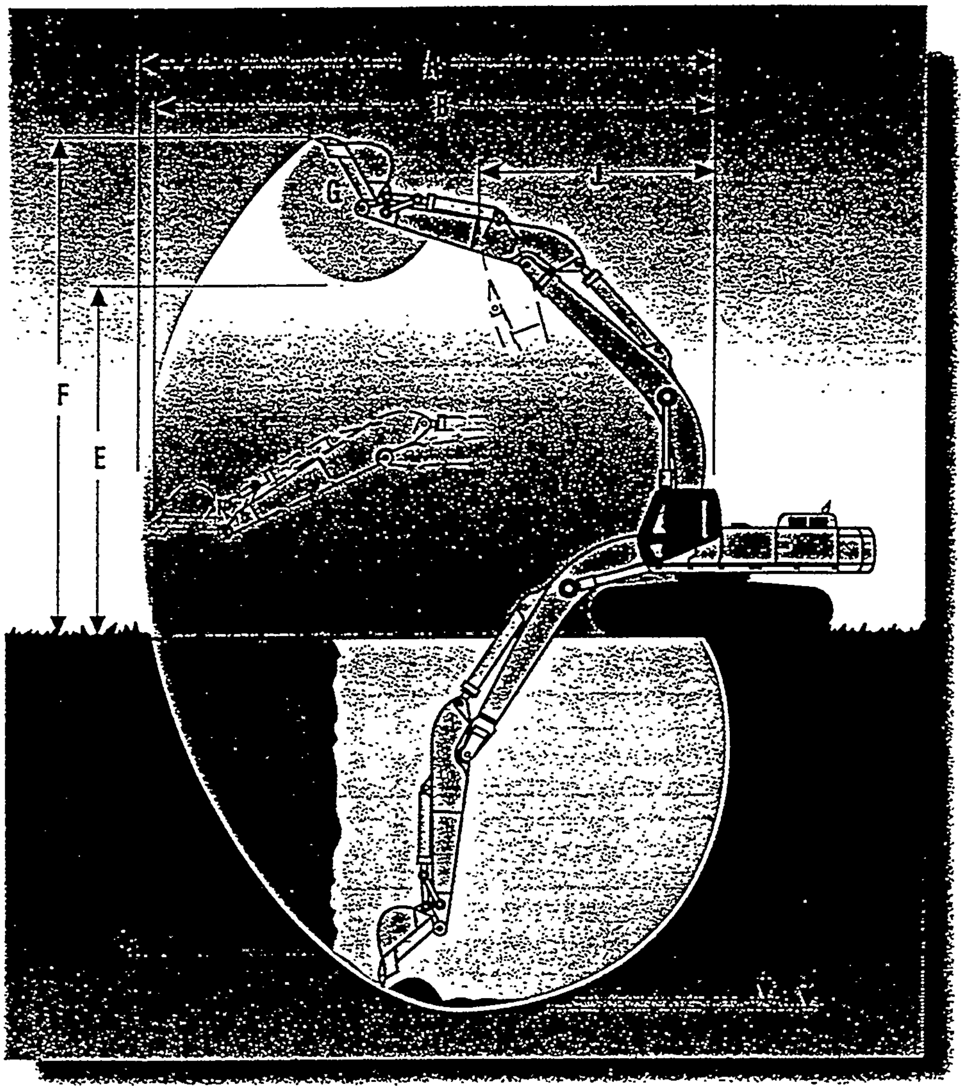
Dimensions



Arm Length	13'1" (4.00 m)	11'0" (3.36 m)	17'8" (5.40 m)	8'3" (2.50 m)
A. Overall transport height w/ attachment	11'4" (3.49 m)	11'5" (3.49 m)	16'2" (4.92 m)	11'8" (3.55 m)
B. Cab height	10'10" (3.31 m)	10'10" (3.31 m)	10'10" (3.31 m)	10'10" (3.31 m)
C. Overall length	39'4" (11.99 m)	39'3" (11.97 m)	38'8" (11.78 m)	39'4" (11.99 m)
D. Overall length (w/o attachment)	20'4" (6.20 m)	20'4" (6.20 m)	20'4" (6.20 m)	20'4" (6.20 m)
E. Width of upper structure (w/o catwalks)	10'2" (3.09 m)	10'2" (3.09 m)	10'2" (3.09 m)	10'2" (3.09 m)
F. Track overall length	17'4" (5.28 m)	17'4" (5.28 m)	17'4" (5.28 m)	17'4" (5.28 m)
G_1. Width of upper structure (with catwalks)	11'11" (3.64 m)	11'11" (3.64 m)	11'11" (3.64 m)	11'11" (3.64 m)
G_2. Track overall width w/35" (900 mm) shoe	11'11" (3.64 m)	11'11" (3.64 m)	11'11" (3.64 m)	11'11" (3.64 m)
H. Track shoe width	35" (900 mm)	35" (900 mm)	35" (900 mm)	35" (900 mm)
J. Center to center (idler to sprocket)	14'0" (4.26 m)	14'0" (4.26 m)	14'0" (4.26 m)	14'0" (4.26 m)
K. Upper structure ground clearance	4'7" (1.39 m)	4'7" (1.39 m)	4'7" (1.39 m)	4'7" (1.39 m)
L. Minimum ground clearance	1'10" (550 mm)	1'10" (550 mm)	1'10" (550 mm)	1'10" (550 mm)
M. Tail swing radius	11'10" (3.60 m)	11'10" (3.60 m)	11'10" (3.60 m)	11'10" (3.60 m)
Working weight*	99,658 lb (45,204 kg)	99,324 lb (45,053 kg)	101,172 lb (45,891 kg)	99,175 lb (44,985 kg)
Ground pressure*	7.7 psi (53 kPa)	7.6 psi (53 kPa)	7.8 psi (54 kPa)	7.6 psi (54 kPa)

*With 35" (900 mm) track shoes, [illegible] capacity standard [illegible], 175 lb (79 kg) operator, full fuel and standard equipment.

Performance Data



Arm Length	13'1" (4.00 m)	11'0" (3.36 m)	17'8" (5.40 m)	8'3" (2.50 m)
A. Maximum dig radius	41'0" (12.50 m)	39'2" (11.94 m)	45'3" (13.78 m)	36'9" (11.20 m)
B. Dig radius at groundline	40'3" (12.28 m)	38'5" (11.71 m)	44'7" (13.58 m)	35'11" (10.95 m)
C. Maximum dig depth	27'6" (8.39 m)	25'5" (7.75 m)	32'1" (9.79 m)	22'7" (6.89 m)
D. Dig depth – 8'0" (2.44 m) Level bottom	27'1" (8.26 m)	24'11" (7.60 m)	31'7" (9.64 m)	22'0" (6.71 m)
E. Dump height	26'1" (7.94 m)	25'6" (7.78 m)	27'7" (8.40 m)	24'8" (7.53 m)
F. Overall reach height	36'10" (11.22 m)	36'3" (11.06 m)	38'4" (11.68 m)	35'6" (10.81 m)
G. Bucket rotation	182°	182°	182°	182°
H. Vertical straight wall				
Dig depth	22'10" (6.96 m)	20'11" (6.37 m)	27'6" (8.39 m)	18'2" (5.54 m)
J. Minimum swing radius	16'5" (5.01 m)	16'6" (5.02 m)	16'9" (5.11 m)	17'2" (5.23 m)
Arm digging force	38,132 lb (17,747 kg)	44,006 lb (19,957 kg)	31,657 lb (14,357 kg)	53,135 lb (24,097 kg)
Bucket digging force	54,085 lb (24,519 kg)	54,085 lb (24,519 kg)	54,085 lb (24,519 kg)	54,085 lb (24,519 kg)

Lift Capacities

[redacted] a 2,910 lb (1320 kg) bucket and [redacted] and in "fine" mode.

LOAD (LIFT POINT) RADIUS

LOAD (LIFT POINT) HEIGHT	10′ (3.05 m) END	10′ (3.05 m) SIDE	15′ (4.57 m) END	15′ (4.57 m) SIDE	20′ (6.10 m) END	20′ (6.10 m) SIDE	25′ (7.62 m) END	25′ (7.62 m) SIDE	30′ (9.14 m) END	30′ (9.14 m) SIDE	35′ (10.67 m) END	35′ (10.67 m) SIDE	MAXIMUM REACH @	MAXIMUM REACH END	MAXIMUM REACH SIDE
25′ *(7.62 m)*													36′4″ *(11.07 m)*	8,289 lb* *(3760 kg)*	8,289 lb* *(3760 kg)*
20′ *(6.10 m)*									17,238 lb* *(7819 kg)*	14,998 lb *(6803 kg)*			38′4″ *(11.68 m)*	8,259 lb* *(3746 kg)*	8,259 lb* *(3746 kg)*
15′ *(4.57 m)*							20,437 lb* *(9270 kg)*	19,866 lb *(9011 kg)*	18,316 lb* *(8308 kg)*	14,577 lb *(6612 kg)*	12,227 lb* *(5546 kg)*	10,928 lb *(4957 kg)*	39′6″ *(12.04 m)*	8,439 lb* *(3828 kg)*	8,439 lb* *(3828 kg)*
10′ *(3.05 m)*	26,905 lb* *(12 204 kg)*	26,905 lb* *(12 204 kg)*	38,532 lb* *(17 523 kg)*	38,634 lb* *(17 524 kg)*	28,215 lb* *(12 798 kg)*	26,815 lb *(12 163 kg)*	22,855 lb* *(10 367 kg)*	18,907 lb *(8576 kg)*	19,656 lb* *(8916 kg)*	14,017 lb *(6358 kg)*	16,166 lb* *(7333 kg)*	10,668 lb *(4839 kg)*	40′0″ *(12.19 m)*	8,830 lb* *(4005 kg)*	8,468 lb *(3841 kg)*
5′ *(1.52 m)*	15,587 lb* *(7070 kg)*	15,587 lb* *(7070 kg)*	45,693 lb* *(20 726 kg)*	38,704 lb *(17 556 kg)*	32,084 lb* *(14 553 kg)*	25,135 lb *(11 401 kg)*	25,075 lb* *(11 374 kg)*	17,937 lb *(8136 kg)*	20,926 lb* *(9492 kg)*	13,448 lb *(6100 kg)*	16,788 lb *(7615 kg)*	10,357 lb *(4698 kg)*	39′8″ *(12.09 m)*	9,458 lb* *(4290 kg)*	8,400 lb *(3810 kg)*
Groundline	22,156 lb* *(10 050 kg)*	22,156 lb* *(10 050 kg)*	48,[illegible] lb* *(21 [illegible] kg)*	36,923 lb *(16 748 kg)*	34,785 lb* *(15 778 kg)*	23,936 lb *(10 857 kg)*	26,696 lb* *(12 109 kg)*	17,176 lb *(7791 kg)*	21,045 lb *(9546 kg)*	12,979 lb *(5887 kg)*	16,517 lb *(7492 kg)*	10,108 lb *(4585 kg)*	38′8″ *(11.79 m)*	10,408 lb* *(4721 kg)*	8,669 lb *(3932 kg)*
-5′ *(-1.52 m)*	29,114 lb* *(13 206 kg)*	29,114 lb* *(13 206 kg)*	48,[illegible] lb* *(22 [illegible] kg)*	36,473 lb *(16 544 kg)*	35,435 lb* *(16 073 kg)*	23,316 lb *(10 576 kg)*	27,386 lb* *(12 422 kg)*	16,707 lb *(7578 kg)*	20,717 lb *(9397 kg)*	12,679 lb *(5751 kg)*	14,958 lb* *(6785 kg)*	9,989 lb *(4531 kg)*	36′10″ *(11.22 m)*	11,839 lb* *(5370 kg)*	9,359 lb *(4245 kg)*
-10′ *(-3.05 m)*	38,433 lb* *(17 433 kg)*	38,433 lb* *(17 433 kg)*	46,3[illegible]2 lb* *(21 00[illegible] kg)*	36,634 lb *(16 617 kg)*	34,434 lb* *(15 619 kg)*	23,197 lb *(10 522 kg)*	26,746 lb* *(12 132 kg)*	16,557 lb *(7510 kg)*	20,637 lb *(9361 kg)*	12,608 lb *(5719 kg)*			34′0″ *(10.36 m)*	14,107 lb* *(6399 kg)*	10,708 lb *(4857 kg)*
-15′ *(-4.57 m)*	52,331 lb* *(23 737 kg)*	52,331 lb* *(23 737 kg)*	41,473 lb* *(18 812 kg)*	37,154 lb *(16 853 kg)*	31,385 lb* *(14 236 kg)*	23,446 lb *(10 635 kg)*	24,266 lb* *(11 007 kg)*	16,726 lb *(7587 kg)*					29′11″ *(9.12 m)*	14,438 lb* *(6549 kg)*	13,358 lb *(6059 kg)*
-20′ *(-6.10 m)*	44,743 lb* *(20 295 kg)*	44,743 lb* *(20 295 kg)*	33,243 lb* *(15 079 kg)*	33,243 lb* *(15 079 kg)*	25,236 lb* *(11 447 kg)*	24,097 lb *(10 930 kg)*	18,126 lb* *(8222 kg)*	17,346 lb *(7868 kg)*							

[redacted] a 3,091 lb (1402 kg) bucket and [redacted] counterweight and in "fine" mode.

LOAD (LIFT POINT) RADIUS

LOAD (LIFT POINT) HEIGHT	10′ (3.05 m) END	10′ (3.05 m) SIDE	15′ (4.57 m) END	15′ (4.57 m) SIDE	20′ (6.10 m) END	20′ (6.10 m) SIDE	25′ (7.62 m) END	25′ (7.62 m) SIDE	30′ (9.14 m) END	30′ (9.14 m) SIDE	MAXIMUM REACH @	MAXIMUM REACH END	MAXIMUM REACH SIDE
25′ *(7.62 m)*											34′2″ *(10.41 m)*	10,139 lb* *(4599 kg)*	10,139 *(4599 kg*
20′ *(6.10 m)*							20,166 lb* *(9147 kg)*	20,168 lb* *(9148 kg)*	18,556 lb* *(8417 kg)*	14,828 lb *(6726 kg)*	36′5″ *(11.10 m)*	10,088 lb* *(4576 kg)*	10,088 *(4576 k*
15′ *(4.57 m)*					26,286 lb* *(11 923 kg)*	26,286 lb* *(11 923 kg)*	22,126 lb* *(10 036 kg)*	19,667 lb *(8921 kg)*	19,648 lb* *(8912 kg)*	14,478 lb *(6567 kg)*	37′8″ *(11.48 m)*	10,289 lb* *(4667 kg)*	9,738 lb *(4417 k*
10′ *(3.05 m)*			42,554 lb* *(19 302 kg)*	40,874 lb *(18 540 kg)*	30,115 lb* *(13 660 kg)*	26,405 lb *(11 977 kg)*	24,357 lb* *(11 048 kg)*	18,746 lb *(8503 kg)*	20,807 lb* *(9438 kg)*	13,988 lb *(6345 kg)*	38′1″ *(11.61 m)*	10,748 lb* *(4875 kg)*	9,308 lb *(4222 k*
5′ *(1.52 m)*			47,331 lb* *(21 469 kg)*	38,153 lb *(17 306 kg)*	33,914 lb* *(15 383 kg)*	24,945 lb *(11 315 kg)*	26,438 lb* *(11 992 kg)*	17,906 lb *(8122 kg)*	21,585 lb *(9791 kg)*	13,497 lb *(6122 kg)*	37′10″ *(11.53 m)*	11,488 lb* *(5211 kg)*	9,259 lb *(4200 kg)*
Groundline	19,976 lb* *(9061 kg)*	19,976 lb* *(9061 kg)*	45,323 lb* *(20 558 kg)*	36,994 lb *(16 780 kg)*	35,772 lb* *(16 226 kg)*	24,006 lb *(10 889 kg)*	27,525 lb* *(12 485 kg)*	17,286 lb *(7841 kg)*	21,167 lb *(9601 kg)*	13,118 lb *(5950 kg)*	36′10″ *(11.23 m)*	12,628 lb* *(5228 kg)*	9,619 lb *(4363 kg)*
-5′ *(-1.52 m)*	30,384 lb* *(13 782 kg)*	30,384 lb* *(13 782 kg)*	48,272 lb* *(21 896 kg)*	37,135 lb *(16 844 kg)*	35,664 lb* *(16 177 kg)*	23,616 lb *(10 712 kg)*	27,686 lb* *(12 558 kg)*	16,947 lb *(7687 kg)*	20,957 lb *(9506 kg)*	12,928 lb *(5864 kg)*	34′10″ *(10.62 m)*	14,356 lb* *(6512 kg)*	10,487 *(4757 kg)*
-10′ *(-3.05 m)*	42,342 lb* *(19 206 kg)*	42,342 lb* *(19 206 kg)*	44,791 lb* *(20 317 kg)*	37,434 lb *(16 980 kg)*	33,865 lb* *(15 361 kg)*	23,656 lb *(10 730 kg)*	26,376 lb* *(11 964 kg)*	16,916 lb *(7673 kg)*	20,516 lb* *(9306 kg)*	12,979 lb *(5887 kg)*	31′10″ *(9.70 m)*	16,726 lb* *(7587 kg)*	12,218 *(5542*
-15′ *(-4.57 m)*	51,831 lb* *(23 510 kg)*	51,831 lb* *(23 510 kg)*	38,704 lb* *(17 556 kg)*	37,783 lb *(17 138 kg)*	29,725 lb* *(13 483 kg)*	24,035 lb *(10 902 kg)*	22,697 lb* *(10 295 kg)*	17,227 lb *(7814 kg)*			27′4″ *(8.33 m)*	11,879 lb* *(5388 kg)*	11,879 lb* *(5388*
-20′ *(-6.10 m)*	36,654 lb* *(16 626 kg)*	36,654 lb* *(16 626 kg)*	28,565 lb* *(12 957 kg)*	28,565 lb* *(12 957 kg)*	21,447 lb* *(9728 kg)*	21,447 lb* *(9728 kg)*							

All capacities are calculated using a 2,463 lb (1117 kg) bucket and [illegible] counterweight and in "fine" mode.

LOAD (LIFT POINT) RADIUS

LOAD (LIFT POINT) HEIGHT	10′ (3.05 m) END	10′ (3.05 m) SIDE	15′ (4.57 m) END	15′ (4.57 m) SIDE	20′ (6.10 m) END	20′ (6.10 m) SIDE	25′ (7.62 m) END	25′ (7.62 m) SIDE	30′ (9.14 m) END	30′ (9.14 m) SIDE	35′ (10.67 m) END	35′ (10.67 m) SIDE	40′ (12.19 m) END	40′ (12.19 m) SIDE	MAXIMUM REACH @	MAXIMUM REACH END	MAXIMUM REACH SIDE
25′ (7.62 m)															40′11″ (12.47 m)	6,689 lb* (3034 kg)	6,689 lb* (3034 kg)
20′ (6.10 m)											12,264 lb* (5563 kg)	11,638 lb (5279 kg)			42′8″ (13.00 m)	6,669 lb* (3025 kg)	6,669 lb* (3025 kg)
15′ (4.57 m)									15,538 lb* (7048 kg)	15,137 lb (6866 kg)	14,127 lb* (6408 kg)	11,347 lb (5147 kg)			43′10″ (13.36 m)	6,799 lb* (3084 kg)	6,799 lb* (3084 kg)
10′ (3.05 m)							19,498 lb* (8844 kg)	19,246 lb (8730 kg)	17,176 lb* (7791 kg)	14,477 lb (6567 kg)	15,618 lb* (7084 kg)	10,937 lb (4961 kg)	10,038 lb* (4553 kg)	8,378 lb (3800 kg)	44′2″ (13.46 m)	7,088 lb* (3215 kg)	7,020 lb (3184 kg)
5′ (1.52 m)	29,335 lb* (13 306 kg)	29,335 lb* (13 306 kg)	38,673 lb* (17 542 kg)	38,673 lb* (17 542 kg)	27,575 lb* (12 508 kg)	26,235 lb (11 900 kg)	22,276 lb* (10 104 kg)	18,508 lb (8395 kg)	18,867 lb* (8558 kg)	13,748 lb (6236 kg)	16,607 lb* (7533 kg)	10,498 lb (4762 kg)	11,279 lb* (5116 kg)	8,139 lb (3692 kg)	43′11″ (13.39 m)	7,549 lb* (3424 kg)	6,918 lb (3138 kg)
Groundline	24,945 lb* (11 315 kg)	24,945 lb* (11 315 kg)	45,563 lb* (20 667 kg)	37,873 lb (17 179 kg)	31,795 lb* (14 422 kg)	24,476 lb (11 102 kg)	24,507 lb* (11 116 kg)	17,447 lb (7914 kg)	20,316 lb* (9215 kg)	13,078 lb (5932 kg)	16,517 lb (7492 kg)	10,088 lb (4576 kg)	11,208 lb* (5084 kg)	7,919 lb (3592 kg)	43′0″ (13.11 m)	8,239 lb* (3737 kg)	7,059 lb (3202 kg)
-5′ (-1.52 m)	27,256 lb* (12 363 kg)	27,256 lb* (12 363 kg)	47,953 lb* (21 751 kg)	36,165 lb (16 404 kg)	34,244 lb* (15 533 kg)	23,305 lb (10 571 kg)	26,275 lb* (11 918 kg)	16,667 lb (7560 kg)	20,637 lb* (9361 kg)	12,569 lb (5703 kg)	16,186 lb (7342 kg)	9,777 lb (4435 kg)			41′5″ (12.62 m)	9,248 lb* (4195 kg)	7,478 lb (3392 kg)
-10′ (-3.05 m)	33,894 lb* (15 374 kg)	33,894 lb* (15 374 kg)	47,922 lb* (21 737 kg)	35,624 lb (16 159 kg)	34,785 lb* (15 778 kg)	22,725 lb (10 308 kg)	26,855 lb* (12 181 kg)	16,217 lb (7356 kg)	20,296 lb* (9206 kg)	12,269 lb (5565 kg)	16,008 lb (7261 kg)	9,608 lb (4358 kg)			39′0″ (11.89 m)	10,759 lb* (4880 kg)	8,298 lb (3764 kg)
-15′ (-4.57 m)	41,932 lb* (19 020 kg)	41,932 lb* (19 020 kg)	45,642 lb* (20 703 kg)	35,735 lb (16 209 kg)	33,654 lb* (15 265 kg)	22,626 lb (10 263 kg)	26,065 lb* (11 823 kg)	16,098 lb (7302 kg)	20,236 lb* (9179 kg)	12,198 lb (5533 kg)	15,066 lb (6834 kg)	9,689 lb (4395 kg)			35′6″ (10.82 m)	13,197 lb* (5986 kg)	9,769 lb (4431 kg)
-20′ (-6.10 m)	55,140 lb* (25 011 kg)	55,140 lb* (25 011 kg)	40,682 lb* (18 453 kg)	36,323 lb (16 476 kg)	30,415 lb* (13 796 kg)	22,917 lb (10 395 kg)	23,415 lb* (10 621 kg)	16,308 lb (7397 kg)	17,736 lb* (8045 kg)	12,458 lb (5651 kg)					30′8″ (9.35 m)	13,717 lb* (6222 kg)	12,608 lb (5719 kg)
-25 (-7.62 m)	44,613 lb* (20 236 kg)	44,613 lb* (20 236 kg)	31,985 lb* (14 508 kg)	31,985 lb* (14 508 kg)	23,885 lb* (10 834 kg)	23,517 lb (10 667 kg)	17,187 lb* (7796 kg)	16,967 lb (7696 kg)									

[illegible] Lift capacities are calculated using a 3,280 lb (1488 kg) [illegible] 9,095 lb (8662 kg) counterweight and in "fine" mode.

LOAD (LIFT POINT) RADIUS

LOAD (LIFT POINT) HEIGHT	10′ (3.05 m) END	10′ (3.05 m) SIDE	15′ (4.57 m) END	15′ (4.57 m) SIDE	20′ (6.10 m) END	20′ (6.10 m) SIDE	25′ (7.62 m) END	25′ (7.62 m) SIDE	30′ (9.14 m) END	30′ (9.14 m) SIDE	MAXIMUM REAC[illegible] @	MAXIMUM REAC[illegible] END	MAXIMUM REAC[illegible] SIDE
25′ (7.62 m)											31′11″ (9.73 m)	13,448 lb* (6100 kg)	13,4[illegible] lb* (610[illegible] kg)
20′ (6.10 m)					25,496 lb* (11 565 kg)	25,496 lb* (11 565 kg)	22,295 lb* (10 113 kg)	19,967 lb (9057 kg)			34′4″ (10.47 m)	13,338 lb* (6050 kg)	11,9[illegible] lb (543[illegible] kg)
15′ (4.57 m)			38,863 lb* (17 628 kg)	38,883 lb* (17 637 kg)	29,026 lb* (13 166 kg)	27,284 lb (12 376 kg)	24,006 lb* (10 889 kg)	19,238 lb (8726 kg)	21,175 lb* (9605 kg)	14,218 lb (6449 kg)	35′7″ (10.85 m)	13,567 lb* (6154 kg)	10,908 lb (494[illegible] kg)
10′ (3.05 m)			45,812 lb* (20 780 kg)	38,914 lb (17 651 kg)	32,595 lb* (14 785 kg)	25,655 lb (11 637 kg)	25,876 lb* (11 737 kg)	18,398 lb (8345 kg)	21,857 lb* (9914 kg)	13,819 lb (6268 kg)	36′1″ (11.0 m)	14,107 lb* (6399 kg)	10,408 lb (472[illegible] kg)
5′ (1.52 m)			34,233 lb* (15 528 kg)	34,233 lb* (15 528 kg)	35,455 lb* (16 082 kg)	24,436 lb (11 084 kg)	27,304 lb* (12 385 kg)	17,668 lb (8014 kg)	21,486 lb (9746 kg)	13,417 lb (6086 kg)	35′10″ (10.92 m)	15,018 lb* (6812 kg)	10,3[illegible] lb (4712 kg)
Groundline			40,492 lb* (18 367 kg)	36,473 lb (16 544 kg)	35,984 lb* (16 322 kg)	23,797 lb (10 794 kg)	27,915 lb* (12 662 kg)	17,196 lb (7800 kg)	21,197 lb (9615 kg)	13,157 lb (5968 kg)	34′7″ (10.54 m)	16,336 lb* (7410 kg)	10,8[illegible] lb (4939 kg)
-5′ (-1.52 m)	33,795 lb* (15 329 kg)	33,795 lb* (15 329 kg)	45,872 lb* (20 807 kg)	37,834 lb (17 161 kg)	34,963 lb* (15 859 kg)	23,686 lb (10 744 kg)	27,326 lb* (12 395 kg)	17,017 lb (7719 kg)	21,167 lb (9601 kg)	13,129 lb (5955 kg)	32′6″ (9.91 m)	18,177 lb* (8245 kg)	12,0[illegible] lb (548[illegible] kg)
-10′ (-3.05 m)	49,752 lb* (22 567 kg)	49,752 lb* (22 567 kg)	41,013 lb* (18 603 kg)	37,953 lb (17 215 kg)	31,945 lb* (14 490 kg)	23,936 lb (10 857 kg)	24,835 lb* (11 265 kg)	17,176 lb (7791 kg)			29′1″ (8.87 m)	14,778 lb* (6703 kg)	14,5[illegible] lb (661[illegible] kg)
-15′ (-4.57 m)	41,013 lb* (18 603 kg)	41,013 lb* (18 603 kg)	33,204 lb* (15 061 kg)	33,204 lb* (15 061 kg)	25,955 lb* (11 773 kg)	24,546 lb (11 134 kg)							

LaBounty® PPRODUCTS

LaBounty®

Universal Processor - Series II

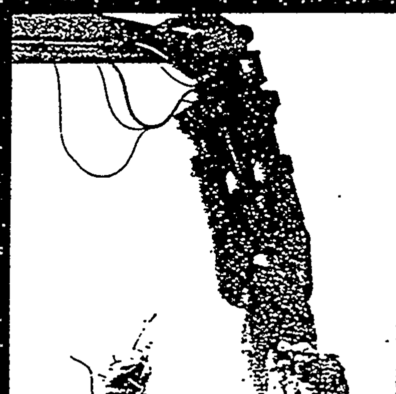
UP-S II FEATURES:

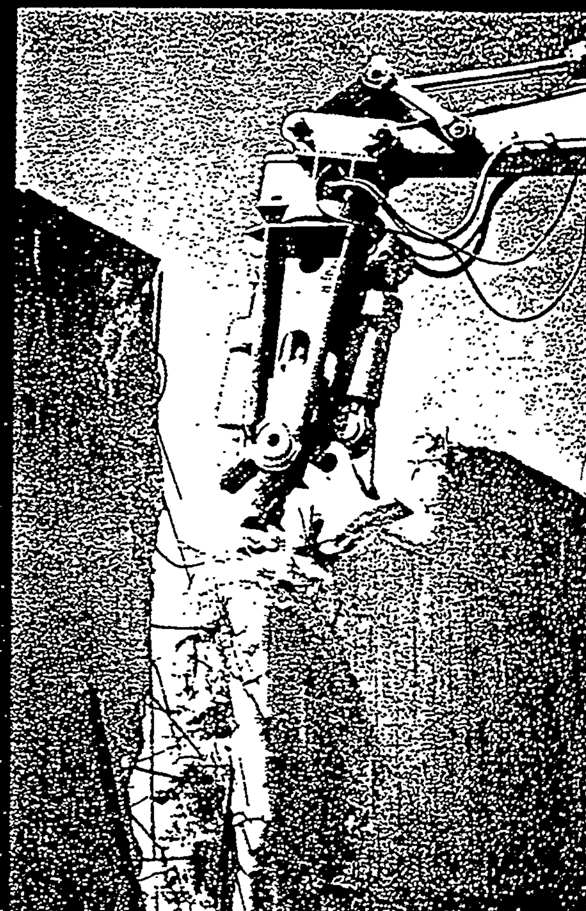
* Universal Processor Series II is available for base machines in the 20,000 lbs. to 150,000 lbs. excavator class. New design technology dramatically increases cutting tonnages, providing users with up to 40% more cutting power than previous models.

* Interchangeable parallelogram cutting blades in UP-S II shear jaws increase machine life by eliminating stress to certain areas of the attachment.

* Cast manganese jaw sections for concrete cracking and concrete pulverizing applications have been incorporated into jaw design to greatly improve wear life while reducing jaw maintenance.

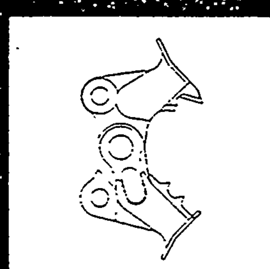
* Large, severe-duty 360° rotating turntable allows for material processing, downsizing and handling at almost any angle.



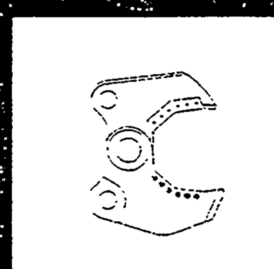


The Power of Interchangeable Jaws

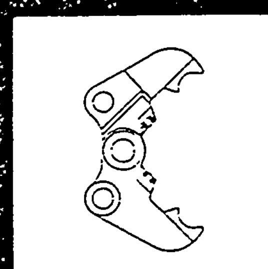
LaBounty Universal Processor line provides unparalleled economy, efficiency and versatility. Three interchangeable jaw options afford optimum results in demolition, steel cutting and concrete processing applications. Special application jaw configurations available upon request.



Concrete Pulverizer Jaws



Shear Jaws



Concrete Cracking Jaws

LaBounty Manufacturing, 100 State Road 2, Two Harbors MN 55616 USA

STANLEY

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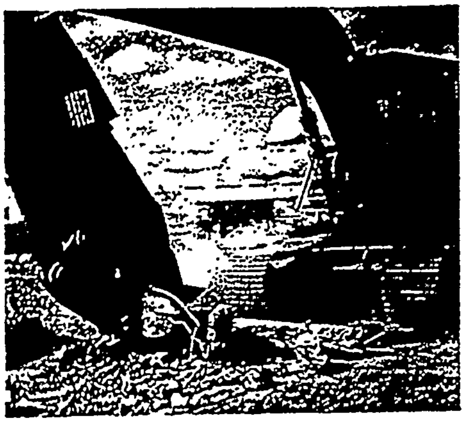
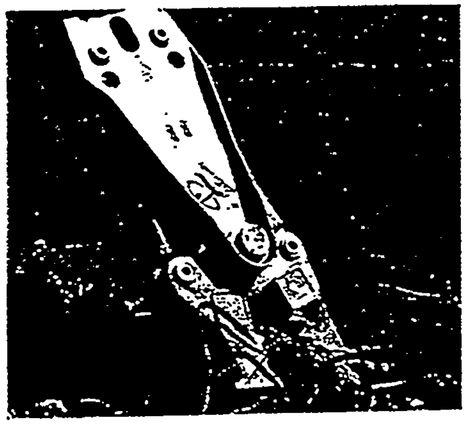
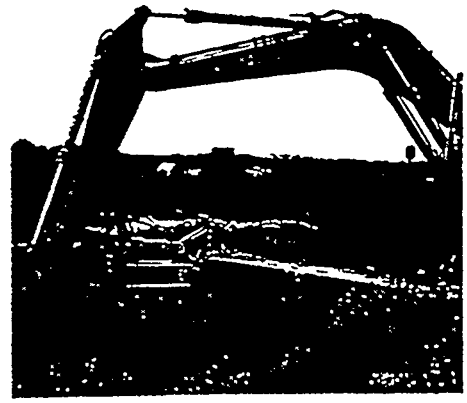
LaBounty Universal Processor - Series II

MODEL	JAW CONFIGURATION	(1) APPROXIMATE EXCAVATOR WEIGHT (2nd Member) (lbs.)	(m. tons)	EXCAVATOR WEIGHT 3RD MEMBER (3rd Member) (lbs.)	(m. tons)	(2) APPROXIMATE ATTACHMENT WEIGHT (lbs.)	(kg.)	JAW OPENING (in.)	(mm.)	JAW DEPTH (in.)	(mm.)	(3) REACH (ft.)	(m.)
UP20 - S II	Shear	20,000	9	42,000	20	4,100	1,860	20	508	18	470	6'-6"	2.0
	Concrete Pulverizer	20,000	9	42,000	20	4,100	1,860	26	670	19	480	6'-5"	2.0
	Concrete Cracking	20,000	9	42,000	20	4,000	1,810	42	1,070	23	600	6'-3"	1.9
UP40 - S II*	Shear	38,000	18	70,000	30	6,500	2,900	24	610	21	540	9'-0"	2.7
	Concrete Pulverizer	38,000	18	70,000	30	6,700	2,950	32	810	21	530	9'-0"	2.7
	Concrete Cracking	38,000	18	70,000	30	6,500	2,900	49	1,260	27	700	9'-0"	2.7
UP50 - S II	Shear	50,000	22	90,000	40	9,200	4,170	27	700	24	620	12'-6"	3.8
	Concrete Pulverizer	50,000	22	90,000	40	9,200	4,170	36	910	23	590	12'-6"	3.8
	Concrete Cracking	50,000	22	90,000	40	9,200	4,170	56	1,430	31	800	12'-6"	3.8
UP70 - S II	Shear	70,000	30	120,000	55	11,500	5,080	36	910	30	760	14'-0"	4.3
	Concrete Pulverizer	70,000	30	120,000	55	11,900	5,216	48	1,220	32	810	14'-0"	4.3
	Concrete Cracking	70,000	30	120,000	55	11,400	5,035	70	1,800	39	1,000	14'-0"	4.3

Universal Processors

UP4	Shear	Mini-Excavator, Skid Steer Loaders and Loader Backhoes		Consult the Factory		400	181	6.7	170	6.7	170	3'-9"	1.1
	Concrete Cracking					400	181	13.5	340	6.6	170	3'-9"	1.1
UP6	Shear					1,500	680	11.5	290	11	300	6'-0"	1.8
	Concrete Cracking					1,200	544	23	600	11	300	5'-10"	1.7
UP70	Shear	62,000	28	100,000	45	10,500	4,880	36	910	26	660	14'-0"	4.3
	Concrete Pulverizer	62,000	28	100,000	45	10,400	4,830	48	1,220	26	660	14'-0"	4.3
	Concrete Cracking	62,000	28	100,000	45	10,400	4,830	70	1,800	39	1,010	14'-0"	4.3
UP90	Shear	90,000	40	150,000	70	16,600	7,530	42	1,070	31	800	13'-0"	4.0
	Concrete Pulverizer	90,000	40	150,000	70	16,600	7,530	62	1,570	35	890	13'-0"	4.0
	Concrete Cracking	90,000	40	150,000	70	16,600	7,530	72	1,800	44	1,110	13'-0"	4.0

(1) Operating weight is based on excavator configurations (boom, stick, bucket), undercarriage and counterweight. Machine sizing is based upon pinning the attachment to the boom.

(2) Universal Processor weight can vary +/- 10% depending on mounting bracket, appropriate cylinders required to maximize base machine operating pressures plus any options installed on the unit.

(3) Typical reach is listed. Reach can vary depending on the bracket needed for the base machine. Total reach may be substantially increased by mounting the UP to the stick and bucket linkage of a larger base machine. LaBounty sales staff are available to assist in reach/base machine sizing.

NOTE: Weights, dimensions and operating specifications listed on this sheet are subject to change without notice. Where specifications are critical to your application, please consult the factory. This product is patented by one or more patents. Worldwide patents pending.

*Preliminary Specifications

A Division of Stanley Hydraulic Tools STANLEY

LaBounty Manufacturing
100 State Rd. 2, Two Harbors, MN 55616 USA
Phone: 218-834-2123
Fax: 218-834-3879

Printed in the USA 1/93.2-UP-S II

Attn Don 208-526-3370

Steve Swanson 6-0425

1.£2

UP Universal Processors

UP Models

SPECIFICATIONS

MODEL	(1) EXCAVATOR WEIGHT APPROX 2nd member (lbs)	(m tons)	(1) EXCAVATOR WEIGHT APPROX 3rd member (lbs)	(m tons)	AVAILABLE JAW SETS	(2) ATTACHMENT WEIGHT APPROX (including jaw set) (lbs)	(kg)	JAW OPENING (in)	(mm)	JAW DEPTH (in)	(mm)	(3) ATTACHMENT REACH (ft-in)	(m)
UP 4	Mini Excavators, Skid Steer Loaders, Loader Backhoes		5,000	2.3	Shear	525	238	6.7	170	6.7	170	3'-9"	1.1
					Concrete Cracking	525	238	13.5	343	6.6	168	3'-9"	1.1
UP 20	24,000	11	40,000	18	Shear	4,100	1,860	20	508	18	457	6'-4"	1.9
					Concrete Pulverizer	4,300	1,950	25	635	20	508		
					Concrete Cracking	4,550	2,064	38	965	28	711		
					Plate Shear	4,100	1,860	9	229	11	279		
					Wood Shear	4,100	1,860	37	940	26	660		
UP 40	42,000	19	68,000	31	Shear	6,500	2,948	24	610	21	533	9'-0"	2.7
					Concrete Pulverizer	7,000	3,175	31	787	23	584		
					Concrete Cracking	7,000	3,175	43	1,092	34	864		
					Plate Shear	6,000	2,721	14	356	16	406		
UP 50	52,000	24	90,000	41	Shear	9,200	4,173	27	686	24	610	12'-6"	3.8
					Concrete Pulverizer	9,700	4,400	36	914	27	686		
					Concrete Cracking	10,000	4,536	51	1,295	42	1,067		
					Plate Shear	9,200	4,173	16	406	20	508		
UP 70	68,000	31	125,000	57	Shear	11,500	5,216	36	914	30	762	14'-0"	4.3
					Concrete Pulverizer	12,500	5,670	48	1,219	35	889		
					Concrete Cracking	12,500	5,670	62	1,575	46	1,168		
					Plate Shear	9,570	4,341	21	533	24	610		
UP 90	100,000	45	190,000	86	Shear	16,600	7,530	42	1,067	31	787	13'-0"	4.0
					Concrete Pulverizer	17,500	7,938	60	1,524	38	965		
					Concrete Cracking	18,000	8,165	72	1,829	44	1,118		

(1) Excavator weight recommendation is based on standard excavator weights and boom and/or arm lengths. All applications must be approved by LaBounty Manufacturing prior to sale.

(2) Weight may vary depending on options and excavator mounting.

(3) Typical reach is listed. Reach can vary depending on the bracket needed for the base machine.

NOTE: Weights, dimensions and operating specifications listed on this sheet are subject to change without notice. Where specifications are critical to your application, consult LaBounty.

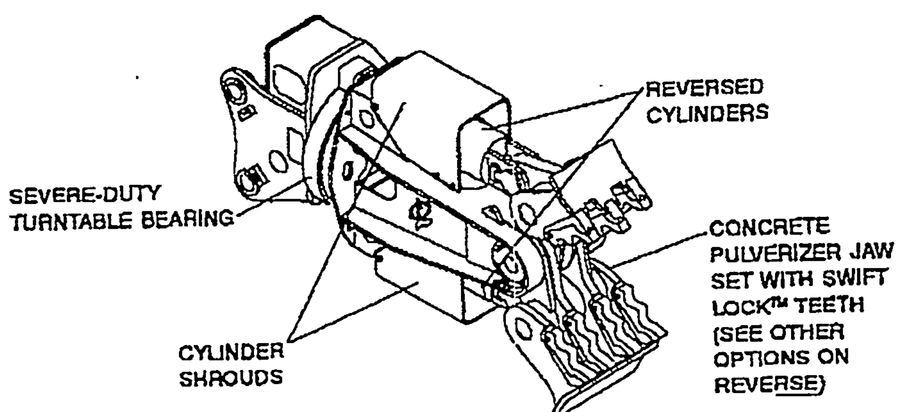
Universal Processors allow various jaw options for maximum equipment utilization. Universal Processors are ideal for demolition, road and bridge reconstruction and concrete recycling operations.

360° Powered Rotation. Standard 360° powered rotation allows for efficient processing at virtually any angle.

Jaw Sets. Additional jaw sets may be available upon request. See the back of this page for jaw options. Jaws can be changed out in as little as 20 minutes.

Swift Lock™ Tooth System. Both the Concrete Pulverizer and Concrete Cracking Jaws feature this LaBounty exclusive pin on replaceable tooth system. This system allows quick and easy change-out of teeth, significantly reducing down time. Cutting blades on the Shear, Plate Shear, and Concrete Cracking Jaws are bolt-on replaceable, making blade rotation and replacement both quick and easy.

UP Universal Processor Components



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LaBounty
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SPECS 10/96

UNIVERSAL PROCESSOR OPTIONS. ACCESSORIES AND WEAR PARTS

The items listed below are available for all UP models (unless otherwise noted)

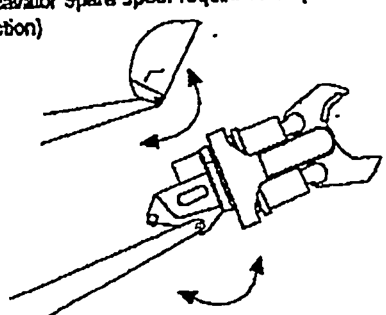
- Concrete Pulverizer Jaws (UP 20, UP 40, UP 50, UP 70 and [illegible] only)
- **Shear Jaws**
- Concrete Cracking Jaws
- **Plate Shear Jaws** (UP 20, UP 40, UP 50, and UP 70 only)
- Wood Shear Jaws (UP 20 only)
- Internal Hydraulic Rotation Kit (factory installed inside rotation head)
- External Hydraulic [illegible] Kit [illegible]
- Hanging Lugs (for hanging from cable crane)
- 3rd Member to 2nd Member Mounting Adaptor Bracket
- Attachment's Bracket/Lugs can be customized to fit other manufacturer's quick attach system (3rd member mount)
- Swift Lock™ Pin-On Replaceable Teeth and Indexable Cutting Blades
- At-Factory Upgrade and Rebuilding Services

Multiple Machine Mounting Capability. The "universal bracket", standard with UP models 20, 40, and 50, manufactured for 3rd member installation, allow mounting to a variety of base machines in the same weight class with similar operating pressures. An additional mounting kit (bushing, spacer and pins) available from LaBounty may be required to complete installation to other compatible machines. **3rd Member to 2nd Member Adaptor Brackets** are also available. Typically, when changing from 3rd to 2nd member, the base machine may drop 2 classes in size. All such conversions must be approved by LaBounty Manufacturing prior to sale. LaBounty UPs are compatible with most other manufacturer's quick couplers

Universal Processor Operation

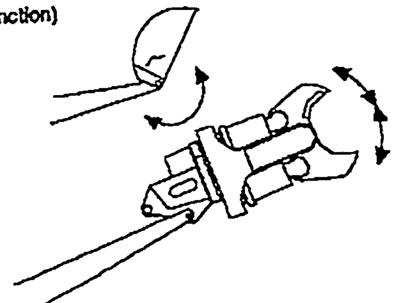
The LaBounty Universal Processor replaces the bucket or stick of an excavator and requires two hydraulic circuits to operate. One (full flow and pressure) for open and close, and one (low flow and pressure) for rotation. Please consult LaBounty Manufacturing for complete installation requirements.

THIRD MEMBER MOUNT
(excavator spare spool required for open-close function)



Bucket DUMP = Articulates UP
Bucket CURL = Articulates DOWN

SECOND MEMBER MOUNT
(bucket circuit can be used for open-close function)



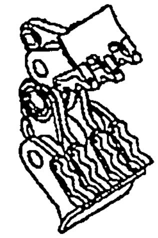
Bucket DUMP = Attachment OPEN
Bucket CURL = Attachment CLOSE

Warranty. The LaBounty Universal Processors carry a limited warranty against defects in material and workmanship for 12 months or 1,500 hours from the date of purchase.*

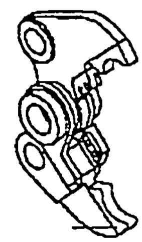
LaBounty reserves the right to repair or replace only those parts which prove to have been defective at the time of purchase.

Ask your dealer to explain this warranty in detail.

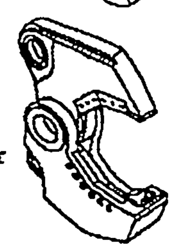
* The UP 4 carries a 6-month, 750-hour warranty.



Concrete Pulverizer Jaws separate concrete and rebar, leaving two recyclable products. Swift Lock™ teeth allow for quick changeover and reduced downtime.



Concrete Cracking Jaws break large, oversized concrete (abutments, beams, etc.) Swift Lock™ teeth allow for quick changeover and reduced downtime.



Shear Jaws cut rebar and structural steel such as H- and I-beams as well as a variety of other ferrous and non-ferrous metals.

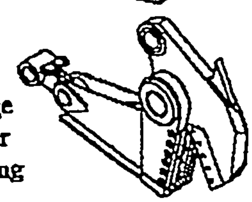
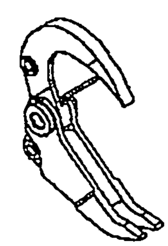


Plate Shear Jaws process above- and below-ground storage tanks as well as other plate materials leaving minimal distortion.



Wood Shear Jaws downsize stumps, logs, railroad ties, pallets and other wood debris.

Call the LaBounty dealer nearest you...

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CASE

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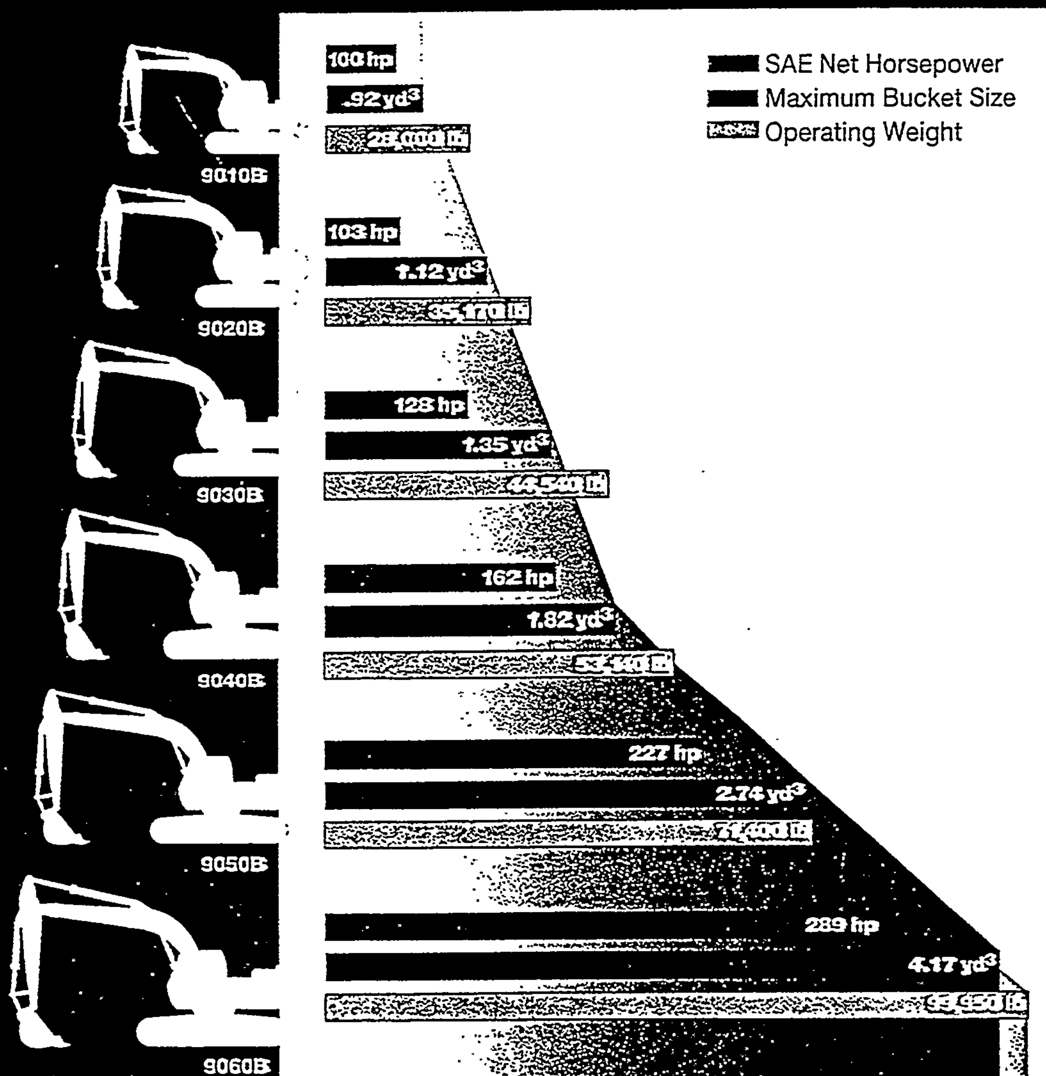

Excavator MODELS				
9010B	✓	✓		
9020B	✓	✓		
9030B	✓	✓	✓	✓
9040B	✓	✓	✓	✓
9050B	✓	✓		✓
9060B	✓	✓		

NOTE: All specifications are stated in accordance with SAE Standards or Recommended Practices, where applicable.

IMPORTANT: Case Corporation reserves the right to change these specifications without notice and without incurring any obligation relating to such change. Units shown may be equipped with non-standard equipment.

CASE CORPORATION
700 STATE STREET
RACINE, WI 53404 USA

CASE CANADA CORPORATION
3350 SOUTH SERVICE ROAD
BURLINGTON, ON L7N 3M6 CANADA

Attachments from other manufacturers are shown for illustration only. Case Corporation does not warrant the safety or reliability of these attachments.

Form No. CE 067-7-95

Printed in USA

INEL ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number	73501
EDF Serial Number	EDF-TFC-009
Functional File Number	BC-09

Project/Task CPP Tank Farm Closure Study
Sub task Clean Closure of Tank Farm by Total Removal

TITLE: L. C. Tuott Decision Concerning EIS for Debris Treatment Facility

SUMMARY

The attached note from L. C. Tuott to M. M. Dahlmeir provides a basis for assuming that a RCRA Land Disposal Restriction (LDR) Debris Treatment Facility would be required prior to initiating the complete removal of the ICPP Tank Farm. It is assumed that a new Environmental Impact Statement (EIS) would be required for the facility, but would be accomplished separate from the High Level Waste Environmental Impact Statement.

In addition, the attached note suggests that an existing Low Level Waste (LLW) Disposal Facility may have to be expanded or a new facility built to be able to handle the volume of waste expected from clean closure of the Tank Farm Facility.

Before reading the attached communication, a clarification in the first paragraph should be noted. The note reads "This facility would provide RCRA LDR-compliant treatment of tank farm waste generated prior to disposal." The waste that it referred to is that waste and debris resulting from the clean closure of the Tank Farm facility. In other words, the tanks, vaults, piping, etc. are removed from the site under RCRA closure and must be treated to LDR treatment standards before being disposed of as low level waste in a RCRA Subtitle D landfill.

Distribution: B. C. Spaulding, MS 3765; B. R. Helm, MS 3765; L. C. Tuott, MS 3428; M. M. Dahlmeir, MS 3765; Project File (Original + 1)

Authors	Department	Reviewed	Approved
[signature]	10-9-97	[signature]	[signature]
M. M. Dahlmeir	MC&IE/4130	Date 10-9-97	Date 10/7/97

Lee C Tuott

09/24/97 07:13:40 AM

To: Michelle M Dahlmeir/MG6/LMITCO/INEEL/US@INEL
cc: Bruce M Angle/BA4/LMITCO/INEEL/US@INEL
Subject: EIS - Future NEPA for Tank Farm Complete Removal of Contaminants/Equipment Option?

Michelle, in terms of the option that you are evaluating and cost estimating, you've asked what level of NEPA evaluation should be identified to construct a new RCRA-permitted Debris Treatment facility. This facility would provide RCRA LDR-compliant treatment of tank farm waste generated prior to disposal. It is my understanding that at the present time, a facility does not exist for treatment of the tank farm wastes (tank shell, piping, equipment, etc.) that would be removed from the facility.

NEPA: I would identify the preparation of an EIS (per 10 CFR 1021 Subpart D) to evaluate the siting and construction of this facility.

ISSUE: You'll need to make an assumption or have an answer as to the viability of your option -should this debris treatment facility analysis be provided in the EIS currently being prepared.

DISPOSAL ISSUE: Also, it is my understanding that after treatment, the treated mixed wastes would be managed as a LLW. They would be disposed at a LLW disposal site that would meet RCRA subtitle D requirements. Are facilities available with adequate capacity to accept this treated waste for disposal or would the complete removal require expansion/construction of a new LLW Disposal facility? Do these facilities have NEPA evaluation to accept this waste (e.g., Envirocare at Utah). This construction/expansion/transportation would also be part of the EIS analysis.

Michelle, I'm ccing Bruce Angle on this note as he is the NEPA Tech Lead and could answer any of your follow-up questions.

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ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501
EDF Serial Number EDF-TFC-010
Functional File Number BC-10

Project/Task CPP Tank Farm Closure Study
Sub task Clean Closure of Tank Farm by Total Removal

TITLE: Interview with R. R. Rodriguez – CERCLA/RCRA Issues

SUMMARY

Interviewed R. R. Rodriguez, WAG 3 Remedial Investigation and Feasibility Study Team Member, on September 24, 1997 concerning the interfaces involved when discussing clean closure through total removal of the Tank Farm under RCRA.

Feasibility studies to support RCRA and CERCLA goals at the ICPP Tank Farm are underway. The scope of the RCRA action at the Tank Farm is limited to the tank and vault systems, while the scope of the CERCLA action encompasses the adjacent contaminated soil. Both actions will be done in concert with each other, and therefore careful integration of both projects is critical during planning stages. As part of the High Level Waste and Facility Disposition EIS, several alternatives are being evaluated for Tank Farm closure, including Clean Closure through total removal. The detailed analysis of this alternative requires a cost estimate. The purpose of this EDF is to document several planning level assumptions that were necessary as the basis of the cost estimate. It should be noted that as of this writing, a preferred remedial and/or closure alternative for the Tank Farm (soil and tanks) has not been selected. Therefore, it is likely that assumptions made now, in regards to the preferred CERCLA remedial alternative, to support a RCRA clean closure of the Tank Farm will conflict with the upcoming selection of the preferred CERCLA Tank Farm remedial alternative.

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Authors	Department	Reviewed	Approved
M. Dahlmeir	11-11-97	René R. Rodriguez	[signature]
M. M. Dahlmeir	MC&IE/4130	Date	Date 11/14/97

R R. Rodriguez recommended that for cost estimating purposes, two closure scenarios for the CERCLA work be evaluated. One scenario would consist of total removal clean closure with the CERCLA action consisting of post closure removal of contaminated soil to the basalt interface and the second scenario costed assuming post closure in-situ stabilization of the contaminated soils around the tanks.

Feasibility studies to support RCRA and CERCLA goals at the ICPP Tank Farm are underway. The scope of the RCRA action at the Tank Farm is limited to the tank and vault systems, while the scope of the CERCLA action encompasses the adjacent contaminated soil. Both actions will be done in concert with each other, and therefore careful integration of both projects is critical during planning stages. As part of the High Level Waste and Facility Disposition EIS, several alternatives are being evaluated for Tank Farm closure, including Clean Closure through total removal. The detailed analysis of this alternative requires a cost estimate. The purpose of this EDF is to document several planning level assumptions that were necessary as the basis of the cost estimate. It should be noted that as of this writing, a preferred remedial and/or closure alternative for the Tank Farm (soil and tanks) has not been selected. Therefore, it is likely that assumptions made now, in regards to the preferred CERCLA remedial alternative, to support a RCRA clean closure of the Tank Farm will conflict with the upcoming selection of the preferred CERCLA Tank Farm remedial alternative.

The following scenario would be assumed in order to cost estimate the total removal of the Tank Farm, the tanks, vaults, piping, and ancillary equipment being removed by the RCRA program, and the soil being removed by the CERCLA program. The RCRA program would remove the heel from the tanks while the CERCLA program removed the Environmentally Controlled Area (ECA) soils in the Tank Farm. This work could be done in parallel if the heels were not removed from all eleven tanks at once, but were removed one at a time as the tanks came under the cease use order. Once a tank had been emptied, CERCLA would remove the surrounding ECA soil. Once all eleven of the heels were removed, the integration of the two groups (RCRA and CERCLA) would be critical, as the soil would have to be removed by CERCLA to expose the tanks, vaults, piping, and ancillary equipment sufficiently for the RCRA program to remove the items from the excavation pit. This interaction would continue until all eleven tanks, vaults, piping, ancillary equipment and the soil down to the bedrock layer had been removed. The excavation pit would then be back filled, CERCLA filling the pit with the clean soil stockpiled throughout the remedial action, and RCRA bringing in sufficient clean soil to return the pit to grade level.

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number	73501
EDF Serial Number	EDF-TFC-011
Functional File Number	BC-11

Project/Task CPP Tank Farm Closure Study
Sub task Area of Contamination Background and Definition

TITLE: Area of Contamination Determination

SUMMARY

The first note attached to this Engineering Design File (EDF) was received from T. W. Jenkins via L. C. Tuott on August 5, 1997.

In this note, the Area of Contamination (AOC) for the ICPP Tank Farm is defined as "the entire area within the ICPP Tank Farm fence (ICPP Tank Farm fence line to fence line)". This allows for excavations to be conducted in the ICPP Tank Farm, with approval of the disturbance, and the excavated soils returned to the excavations without generating waste.

The note serves as the documentation for this decision.

The second note concerns the rationale on why the AOC should be established. This note was originally sent to T. W. Jenkins from T. E. Venneman on Tuesday, July 8, 1997.

NOTE: The attached notes have been modified slightly for inclusion in this Engineering Design File. The notes were sent electronically to a number of people – all of those E-mail addresses have been deleted. In addition, the formatting has been modified, as the margins, fonts, etc. did not convert from E-mail to Microsoft Word well. The wording has not been changed.

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Authors	Department	Reviewed	Approved
M. M. Dahlmeir	MC&IE/4130	Date 10/7/97	Date 10/7/97

Forwarded by Lee C Tuott/TUO/LMITCO/INEEL/US on 08/05/97 02:54 PM

To: MG6 --INELMAIL Dahlmeir, Michelle M.

Subject: Fwd: ICPP Tank Farm AOC issue

Forwarded for your information! This should help resolve issues with the cost estimating for the tank farm soil excavations, LDR requirements, etc. - the only caveat is the section requiring "approval of the disturbance."

A conference call was held on July 10, 1997 with the EPA (Howard Orlean) and IDHW/DEQ (Scott Reno). One of the issues discussed was the area of contamination (AOC) for excavations within the ICPP Tank Farm. The conference call dealt with expanding the definition of the AOC for the individual sites within the ICPP Tank Farm. It was agreed that a new definition of an AOC for the ICPP Tank Farm area would be "the entire area within the ICPP Tank Farm fence (ICPP Tank Farm fence line to fence line)". This allows for the excavations to be conducted in the ICPP Tank Farm, with approval of the disturbance, and the excavated soils returned to the excavations without generating waste.

The above discussion is to formally change the definition of the AOC for the ICPP Tank Farm. As Howard and Scott have agreed to this new definition, this e-mail can be considered as a formal change to the AOC definition for the ICPP Tank Farm. If other projects are determined to need AOC clarification or definition, these clarification and definitions could be discussed and new definitions issued.

If you have questions, let me know by telephone at (208) 526-4978 or an electronic message.

Thanks,

Talley

****

Forwarded by Lee C Tuott/TUO/LMITCO/INEEL/US on 08/05/97 03:05 PM

Subject: Rationale on why the AOC should be established

Background information on the AOC rationale - FYI.

Date: Tue, 08 Jul 1997 14:01:15 -0700
From: Tim Venneman <tev@inel.gov>
To: JENKINTW@INEL.GOV

TALLY, THE FOLLOWING FORWARDED NOTE ADDRESSES OUR OVERALL APPROACH TO AOC IDENTIFICATION. A VERY SHORT OVERVIEW FOR THE TANK FARM IS AS FOLLOWS:

FOR THE TANK FARM, WHAT WE WANT TO DO IS ITITIALLY IDENTIFY THE TANK FARM BOUNDARIES AS THE INITIAL AOC. AS NEW DATA IS REVIEWED, IF THE

DATA INDICATES THAT CONTAMINATION IS EXTENDING FROM THE TANK FARM IN A PARTICUAR DIRECTION, WE MAY WANT TO MODIFY THE BOUNDARIES OF THE INITIAL TANK FARM AOC IN THAT DIRECTION (IF IT HAS WASTE MANAGMENT ADVANTAGES AND IS DEEMED CONTIGUOUS).

THE TANK FARM CAN BE INITIALLY IDENTIFIED AS AN AOC BASED ON RAD CONTAMINATION AS WELL AS OTHER CONSTITUENT CONTAMINTION. THE DEFINTION OFAOC IS INCLUDED IN THE FOLLOWING NOTE AND OUTLINES HOW (AND REASONING BEHIND)THE IDENTIFICATION OF AOCs.

THIS BASIC APPROACH WOULD BE THE SAME INITALLY FOR ANY WASTE MANAGEMENT UNIT THAT IS ALSO SUBJECT TO CERCLA REMEDIATION.

NOTE: IF WE FIND THAT SMALL CONTAMINATED AREAS EXIST WITHIN VERY CLOSE PROXIMITY TO EACH OTHER AND DELINEATING AN AOC TO ENCOMPASS ALL THE CONTAMINED AREAS WOULD PROVIDE WASTE MANAGMENT ADVANTAGES (SUCH AS CONSOLIDATION) WE MAY WANT TO ENCOMPASS THOSE AREAS WITHIN A SINGLE AOC PROVIDING THE "CLEAN AREAS" BETWEEN THE CONTAMINATED AREAS WERE NOT TO GREAT A DISTANCE (E.G, INCUDE A ROADWAY, OFFICE BUILDING).

Forwarded Note:

Date: Tue, 08 Jul 1997 13:26:16 -0700
From: tev@inel.gov (Tim Venneman)

TALLY,
JAY MITCHELL JUST STOPPED BY AND ASKED ME TO SEND YOU A NOTE ON OUR APPROACH TO DELINEATING AN AREA OF CONTAMINATION (AOC).

OUR APPROACH WOULD BASICALLY FOLLOW THE FEDERAL GUIDLINES AS OUTLINED IN THE EPA SUPERFUND LDR GUIDE #5, AN AOC "IS DELINEATED BY THE AREAL EXTENT (OR BOUNDARY) OF CONTIGUOUS CONTAMINATION. SUCH CONTAMINATION MUST BE CONTINUOUS, BUT MAY CONTAIN VARING TYPES AND CONCENTRATION OF HAZARDOUS SUBSTANCES."

IN ADDITION, AOCs MAY HAVE SMALL NON-CONTAMINATED ZONES DISBUSED WITHIN THE DELINEATED AOC (OR ALONG THE BOUNDARY) WHICH MAY BE USED FOR STAGING/STORING WASTE AND/OR EQUIPMENT.

TYPICALLY, WE WOULD START WITH THE BOUNDARIES OF UNITS (E.G., ICPP TANK FARM, PERC POND OR SIMLAR TYPE OF UNIT BOUNDARIES). WHERE UNITS DO NOT EXIST, SAMPLING AND ANALYSIS OF THE SUSPECTED AREA WOULD BEGIN THE DELINEATION PROCESS FOR DRAWING THE BOUNDARIES OF THE AOC.

ONCE BOUNDARIES ARE INITIALLY ESTABLISHED, IF FURTHER SAMPLING AND

ANALYSIS INDICATES THAT THE CONTAMINATION FROM A PARTICULAR SOUCE AREA (I.E, AOC) EXTENDS IN ONE PARTICULAR DIRECTION (SUCH AS A PIPE LINE FROM A TANK SYSTEM) THE AOC COULD BE MODIFIED TO INCLUDE THE CONTAMINATION ZONE THAT FOLLOWS THE PIPE LINE IN QUESTION (UNTIL TRACED TO ANOTHER AOC OR THE CONTAMINATION CEASES). MODIFICATION OF THE INITIAL AOC WOULD ONLY OCCUR IF THERE EXIST WASTE MANAGEMENT ADVANTAGES FOR EXPANSION OF THE ORIGINAL AOC TO INCLUDE THE NEWLY DISCOVERED CONTAMINATION. (NOTE: THE ASSUMPTION HERE IS THAT THE CONTAMINATION IS CONTIGUOUS IN THAT DIRECTION).

ADVANTAGES:

AIDS IN EXPEDITING CLEANUP, BY NOT INVOKING TESTING AND OR COMPLIANCE WITH LDR TREATMENT STANDARDS DURING ROUTINE UTILITY UPGRADES (OR OTHER ACTIVITIES WHICH TEMPORARILY DISTURBES CONTAMINATED SOIL).

REDEPOSITION OF SOILS AFTER EXCAVATION CAN OCCUR WITHOUT TRIGGERING LDR COMPLIANCE.

CONSOLIDATION OF CONTAMINATED SOILS INTO ONE LOCATION WITHIN THE AOC CAN TAKE PLACE WITHOUT TRIGGERING LDRs.

IF TAKEN OUT OF THE AOC, WASTE/CONTAMINATED SOIL WOULD TRIGGER "PLACEMENT" (I.E., BE SUBJECT TO LDRs)

I. PLACEMENT OCCURS WHEN:

CONSOLIDATION OF WASTE/SOIL FROM DIFFERENT AOCs INTO A SINGLE AOC OCCURS.

WASTE/SOIL IS MOVED OUTSIDE OF AN AOC (FOR TREATMENT OR STORAG) AND RETURNED TO THE SAME OR DIFFERENT AOC.

WASTE ARE EXCAVATED FORM AN AOC, PLACED IN A SEPARATE UNIT, SUCH AS AN INCINERATOR OR TANK THAT IS WITHIN THE AOC, AND REDEPOSITED INTO THE SAME AOC.

II. PLACEMENT DOES NOT OCCUR WHEN:

WASTE/SOIL ARE TREATED IN SITU

WASTE/SOIL ARE CAPPED IN PLACE

WASTE/SOIL ARE CONSOLIDATED WITHIN THE AOC OR

WASTE/SOIL ARE PROCESSED WITHIN THE AOC (BUT NOT IN A SEPARATE UNIT, SUCH AS A TANK) TO IMPORVE ITS STRUCTURAL STABILITY (E.G. FOR CAPPING OR TO SUPPORT HEAVY MACHINERY).

BOTTOM LINE: IDENTIFICATION OF AOCs ALLOWS FOR CERTAIN ACTIVITIES TO TAKE PLACE WITHIN THE DELINEATED AREA WITHOUT TRIGGERING LDRs. IT DOES NOT CHANGE THE REGULATED STATUS OF THE WASTE OR SUBSEQUENT CLEANUP APPROACH, IT ONLY ALLOWS FOR LAND DISPOSAL WITHOUT MEETING LDRS FOR CERTAIN CASES.

CURRENTLY, WE ARE UNDERGOING CERTAIN UTILITY UPGRADES THAT REQUIRE SOIL EXCAVATION, HOWEVER, WITHOUT DELINEATED AOCs THE SOIL, IF HAZARDOUS, IS "ACTIVIELY" MANAGED AND CANNOT BE REDEPOSITED AS BACKFILL INTO ORIGINAL HOLE AND/OR OTHERWISE BE LAND DISPOSED WITHOUT TRIGGERING FULL RCRA COMPLIANCE AS APPLICABLE (SUBTITLE C LANDFILL, LDR COMPIANCE).

COMMITTMENT AND/OR AGREEMENT ON HOW THE SOIL WOULD BE MANAGED IN THE INTERIM PRIOR TO REDEPOSITION OR CONSOLIDATION WITHIN THE AOC NEEDS TO BE DISCUSSED WITH THE STATE/EPA. FOR EXAMPLE, IF PLACED IN A WASTE PILE COMPLIANCE WITH CERTAIN WASTE PILE REQUIREMENTS WOULD OCCUR (RUN-ON/RUN-OFF AND A COVER, AND/OR CONTAINERIZED IF VOLUME IS SMALL AND REDEPOSITION WILL OCCUR IN A WEEK OR TWO). SOIL REDEPOSITED WITHIN THE SAME EXCAVATED AREA WITHIN A DAY OR TWO SHOULD NOT BE SUBJECT TO CONTAINERIZATION/ WASTE PILE REQUIREMENTS UNLESS THERE ARE SPECIFIC HEALTH/SAFETY CONCERNS IDENTIFIED WITHIN THE IMMEDIATE AREA.

ONE FINAL NOTE: THE TERM "WASTE" AS USED IN THIS NOTE DOES NOT REFER TO PPE OR NEWLY GENERATED WASTE IT ONLY REFERS TO THE CERCLA WASTE SOURCE ITSELF (I.E., SOIL, SLUDGE WHATEVER THE SOURCE OF CONTAMINATION IS).

HOPE THIS HELPS....TKS..TIM

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ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501
EDF Serial Number EDF-TFC-012
Functional File Number BC-12

Project/Task CPP Tank Farm Closure Study
Sub task Clean Closure of Tank Farm by Total Removal

TITLE: Debris Treatment Facility (Containment Building)

SUMMARY

Held a conference call with T. E. Venneman, L. C. Tuott and M. M. Dahlmeir on September 23, 1997 to discuss the environmental issues involved with the Tank Farm Facility Total Removal Clean Closure option.

RCRA requires proper management of RCRA waste. A debris treatment facility (containment building) is one of the most efficient ways to properly manage the large volumes of mixed debris wastes that may result from the clean closure of the Tank Farm facility per RCRA land disposal restriction standards (LDRs).

Distribution: B. C. Spaulding, MS 3765; B. R. Helm, MS 3765; L. C. Tuott, MS 3428; M. M. Dahlmeir, MS 3765; Project File (Original + 1)

Authors	Department	Reviewed	Approved
Michelle Dahlmeir 10-9-97			
M. M. Dahlmeir	MC&IE/4130	Date 10/9/97	Date 10/9/97

RCRA requires proper management of RCRA waste. A debris treatment facility (containment building) is one of the most efficient ways to properly manage the large volumes of mixed debris wastes that may result from the clean closure of the Tank Farm facility per RCRA land disposal restriction standards (LDRs). This is due to the numerous waste codes and the potential inability to use conventional methods of treatment for LDR compliance. T. E. Venneman stated that a debris cleaning facility does not currently exist for any significant volume of mixed debris wastes such as would result from the clean closure of the Tank Farm facility. For cost estimating purposes, it can either be assumed that a debris treatment facility would be built (assumption) or the cost of a debris treatment facility could be included in the cost analysis. The debris cleaning facility would take approximately eight years to permit. A RCRA permit would be required unless the building was operated as a ninety day storage and treatment unit.

Once the waste had undergone debris cleaning, it could be managed as radioactive waste. The radioactive waste would be sent to a Low Level Waste (LLW) Disposal Site that would also meet RCRA Subtitle D requirements.

There are numerous methods available to debris clean wastes (see 40 CFR 268.45). One method is to scabble off approximately ¼" of the surface. Impervious surfaces, such as stainless steel, are easier to clean.

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ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number	73501
EDF Serial Number	EDF-TFC-013
Functional File Number	BC-13

Project/Task CPP Tank Farm Closure Study
Sub task Clean Closure of Tank Farm by Total Removal

TITLE: Double Containment Issues

SUMMARY

Interviewed K. M. Garcia, a technical researcher into the engineering feasibility of confinement and containment strategies, concerning the level of containment that would be required during the clean closure by total removal of the Tank Farm. The interview took place on August 29, 1997.

K. M. Garcia stated that a conservative assumption is that double containment would be required during the clean closure by total removal of the Tank Farm. The goal would be to keep the size of the containment zone at a minimum, so a weather structure would also be needed to allow year-round operations.

Redundant ventilation systems would be required on both the primary and secondary containment structures.

Continuous monitoring would be required in all containment structures, including the weather enclosure.

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Authors	Department	Reviewed	Approved
[signature] 10-8-97		[signature]	[signature]
M. M. Dahlmeir	MC&IE/4130	Date 10-9-97	Date 10/9/97

K. M. Garcia indicated that double containment is a good assumption for costing and planning purposes during the clean closure of the Tank Farm based on the information that has been gathered during the Pit 9 work and the fact that the Tank Farm will have similar contaminants of concern. She stated that Pit 9 did not use weather shields as part of their double containment, but that we should consider using them as enclosures. There were problems with the other containment structures being too heavy for ground pressure restrictions.

In order to have double containment, a negative pressure must be maintained between the primary and secondary containment and monitored continuously. If the negative pressure is not maintained, a loss of boundary results. This leads to air releases and regulatory compliance issues. Due to the significant safety and cost issues associated with the loss of a containment boundary, the ventilation system on a double containment structure consists of both redundant HEPA filters and activated carbon filters on the primary and secondary containment buildings. The HEPA filters, when loaded, can be incinerated.

The double containment cost estimate for the clean closure of the Tank Farm could be based on the estimates done for Pit 9. This information can be found in the Pit 9 or the WAG 3 cost estimates. Be sure to budget time/money to obtain permission to stabilize the buildings with foot pads or by stabilizing the soil.

In addition to the double containment structures, a weather enclosure should be placed over the entire Tank Farm to allow year-round operations. A standard ventilation system, including heating, is sufficient for this structure. Monitoring will be required in the weather enclosure.

Time and money should be budgeted to determine exactly which requirements would be binding during the Clean Closure of the Tank Farm by Total Removal.

References:

1. Interviews with K. M. Garcia, technical researcher into the engineering feasibility of confinement and containment strategies, 1997.

2. DOE Order 6430.1A, Section 1300-7, *Special Facilities, Confinement Systems.*

3. DOE Order 6430.1A, Section 1320-5, *Irradiated Fissile Material Storage Facilities, Confinement Systems..*

4. DOE Order 6430.1A, Section 1550-99, *Heating, Ventilating and Air-Conditioning Systems, Non-Reactor Nuclear Facilities.*

5. DOE Order 6430.1A, Section 1589-99, *Air Pollution Control, Special Facilities.*

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ENGINEERING DESIGN FILE

Form L-0431.2# (05-96-Rev.#02)	Project File Number 73501 EDF Serial Number EDF-TFC-014 Functional File Number BC-14

Project/Task CPP Tank Farm Closure Study
Sub task Tank Farm Total Removal Clean Closure

TITLE: Characterization Costs

SUMMARY

Interviewed R. A. Hyde concerning the field characterization requirements of the Tank Farm during excavation activities. R. A. Hyde is a technical researcher into the engineering feasibility of excavator or crane mounted characterization systems. The interview took place on August 27, 1997.

R. A. Hyde stated that the digface characterization system (excavator or crane mounted) developed by Technology Development should be used to characterize the Tank Farm prior to and during excavation activities. The scan rate for the system is dependent on the sensor capabilities and can be operated for approximately $3K per day (in 1997 dollars). This is independent of the deployment platform used.

The digface characterization system would have to be modified to include a heavy metal sensor, as it does not currently have heavy metal sensing capabilities. Once the sensor is developed, it can be attached to either a crane or excavator system. A coupler could be used for a crane attachment (male end approximately $8K, female end approximately $2K). A system similar to the Warthog, a terrain following, self-stabilizing developed by INEEL EM-50 could also be used to attach the sensors to either a crane or an excavator. The replacement cost for the Warthog is approximately $300K.

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Authors	Department	Reviewed	Approved
M. M. Dahlmeir (signature) 10-22-97	MC&IE/4130	R. A. Hyde (signature) 10/28/97 Date	(signature) Date 10/28/97

Plan two days initially to set up the characterization equipment. Boreholes are not needed for characterization using the digface characterization system.

Assume that geophysical characterization is done once, just prior to setting up the equipment needed to do clean closure of the Tank Farm. It should take approximately 3 days to finish the geophysical characterization of the Tank Farm.

The digface characterization system scan rate is dependent on the sensor capabilities, the contaminants of concern, background radiation levels, moisture content, and the confidence level desired. Typically, the scan rate is 1 foot/second by a 3 foot swath for a plastic scintillator sensor, with other sensors having faster scan rates. All of the sensors necessary to do radiological, chemical, and heavy metal characterization cannot be deployed at the same time, though. Calculate the time required to do the entire Tank Farm once, and then multiply by three, as chemical, radiological, and heavy metal characterization will be required.

Characterization will cost approximately $3K per day, independent of the deployment platform used. This cost is based on field experience using the digface characterization system.

An additional $100K (not including contingency) will be required initially for adding a heavy metal sensor to the digface characterization system. Once the sensor is developed, it can be attached to either a crane or excavator system. A coupler could be used for a crane attachment (male end approximately $8K, female end approximately $2K). A system similar to the Warthog, a terrain following, self-stabilizing developed by INEEL EM-50 could also be used to attach the sensors to either a crane or an excavator. The replacement cost for the Warthog is approximately $300K.

It should be assumed that the Technology Development digface characterization system (sensors, excluding the heavy metal sensor, and the Warthog) will be available for use during the clean closure of the Tank Farm, thus equipment costs for characterization will not be included in the Clean Closure estimate.

Money should be added to the cost analysis to integrate the digface characterization control system with whatever supervisory control system the Tank Farm Clean Closure system uses on all of its remote equipment. A proposal was done for a similar system to integrate all of their equipment (removal, material handling, characterization, video, lighting, HVAC, ect.) for $850K. The original cost estimate was higher , but included deployment, operations, labor and compliance costs that would be site dependent. The $850K just included labor to integrate the system. It could be assumed that the integration costs (labor only) would be similar for the digface characterization system and the clean closure supervisory control system.

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ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number	73501
EDF Serial Number	EDF-TFC-015
Functional File Number	SPR-01

Project/Task CPP Tank Farm Closure Study
Sub task Clean Closure of Tank Farm by Total Removal

TITLE: Packaging and Disposal Options for the Waste Resulting from the Total Removal of the ICPP Tank Farm

SUMMARY

In this Engineering Design File (EDF), the components to be removed from the Tank Farm during Clean Closure by Total Removal are listed, along with their assumed waste classification. The disposal plan and packaging requirements for the different waste classifications are also presented.

Distribution: B. C. Spaulding, MS 3765; B. R. Helm, MS 3765, M. M. Dahlmeir, MS 3765; D. Machovec, MS 5111; Project Files (Original +1)

Authors	Department	Reviewed	Approved
M. M. Dahlmeir	MC&IE/4130	Date 07 OCT 97	Date 10/17/97

Table 1 summarizes the items expected to be removed under Clean Closure - Total Removal, and the assumed waste classification for each based on information provided by D. Machovec (see EDF-TFC-006) as well as engineering judgement. Also see *Take Off Calculations for Clean Closure, Total Removal* (EDF-TFC-16) for more detailed descriptions and drawing references for the components listed.

Table 1: Component Removed and Assumed Waste Classification

Component	Assumed Waste Classification
Tank roof – stainless steel	Mixed waste – contact handled
Bottom of vault - concrete	Radioactive waste – remote handled
Side panels, columns, and beams of the vault - concrete	Uncontaminated solid waste - (noncompactible, nonconditional industrial waste)
Sump pumps (steam jets) – stainless steel	Mixed waste – remote handled
Process piping – stainless steel	Mixed waste – remote handled – 50%[c] Mixed waste – contact handled – 50%[c]
Stainless steel liner in the concrete encasements	Mixed waste – remote handled – 50%[c] Mixed waste – contact handled – 50%[c]
Concrete encasements	Uncontaminated solid waste (noncompactible, nonconditional industrial waste) – 85% Mixed waste – remote handled - 15%[a]
Pilings – steel encased concrete	Uncontaminated solid waste (noncompactible, nonconditional industrial waste) – 67% Mixed waste – remote handled - 33%[b]
Tank Riser – concrete portion	Radioactive waste – contact handled
Tank Risers – stainless steel liner	Mixed waste – remote handled
CPP-628, 635, 712, and the valve boxes	Radioactive waste – contact handled – 50%[c] Radioactive waste – remote handled – 50%[c]
CPP-618, 619, and 634	Uncontaminated solid waste (noncompactible, nonconditional industrial waste)
CPP-738 (underground condenser pit)	Uncontaminated solid waste (noncompactible, nonconditional industrial waste) – 75%[d] Radioactive waste - remote handled – 25%[d]
Rubber membrane	Radioactive waste – incinerable, contact handled

Table 1: Component Removed and Assumed Waste Classification (continued)

Component	Assumed Waste Classification
Duct bank for Radiation Monitoring Lines – concrete	Uncontaminated solid waste (noncompactible, nonconditional industrial waste) – 83% Mixed waste – remote handled - 17%
Cooling coils in eight out of eleven tanks – stainless steel	Mixed waste – remote handled
Tanks – stainless steel	Mixed waste – remote handled

a. 15% of the encasements are located in or near an Environmentally Controlled Area (ECA) and are thus considered to be mixed waste due to the contamination constituents in the ECA – for calculations see EDF-TFC-016. It is assumed that due to the high dose rates in the ECAs involved, remote handling will be required.
b. 33% of the pilings are located in or near an Environmentally Controlled Area (ECA) and are thus considered to be mixed waste due to the contamination constituents in the ECA – for calculations see EDF-TFC-016. It is assumed that due to the high dose rates in the ECAs involved, remote handling will be required.
c. Assume that approximately half of this material can be decontaminated sufficiently prior to shipping to be contact handled.
d. See EDF-TFC-006. D. Machovec stated that the building would mainly be uncontaminated solid waste, the only portion that would be radioactive waste would be the outside walls.
e. 17% of the duct banks are located in or near an Environmentally Controlled Area (ECA) and are thus considered to be mixed waste due to the contamination constituents in the ECA – for calculations see EDF-TFC-016. It is assumed that due to the high dose rates in the ECAs involved, remote handling will be required.

Once the waste has been classified, a final disposal site must be determined for the waste and the required packaging identified. This information is given in Table 2.

Table 2: Final Disposal Site and Required Packaging

Waste Classification	Disposal Plan	Required Packaging
Mixed waste – remote and contact handled	Waste would be shipped to a Debris Treatment Facility (not currently in existence) for treatment to RCRA land disposal restriction treatment standards. [a]	A large volume, large weight payload capable, "moderately" shielded transport cask will be required. Assuming the Debris Treatment (DTF) is located at the INEEL, an INEEL-on-site-use-only transport cask, that is operated under locally authored and approved safety documentation, will suffice. At present, the INEEL only possesses one cask of this type – the 14-190 (220 cuft internal capacity, 23,000 pound payload, and seven inches of concrete for shielding). Assuming the DTF is located off the INEEL, a DOT authorized transport cask will be required [c].
Radioactive waste – remote or contact handled	After the waste has been debris cleaned, it will be classified as low level radioactive waste (LLW) and will be shipped to a RCRA Subtitle D LLW Disposal Site. [d]	Same candidates as for mixed waste [e].
Uncontaminated solid waste	INEEL Landfill Complex as industrial waste, noncompactible, nonconditional waste[f]	DOT 7A Type A D&D Bin [g]

a. For the purposes of this feasibility study, it is assumed that the Debris Treatment Facility is located on the Idaho National Engineering and Environmental Laboratory site. It is also assumed that the Debris Treatment Facility will remove the hazardous constituent from the mixed waste and that just LLW radioactive waste will be left (see EDF-TFC-012).

b. The safety analysis will have to demonstrate that the presence of the hazardous constituents will not adversely affect the transport cask's containment capability (i.e the presence of VOCs or any other off-gas will not degrade the cask's containment seals). c Assume there will be a commercially available cask that is NRC licensed and meets Type B containment when the waste is shipped.

c. The DOT authorized transport casks will be those that are certified by the NRC to its Type-B requirements (10 CFR 71 requirements). Currently there are four commercially available casks of sufficient volume and weight payload capacity to be considered viable candidates, though none of these four are as big as the 14-190. The number of copies of each is unknown. There are a significant number of like-sized, commercially available casks – the NRC-certified LSA/Type-B casks. However, after April 1999, they will be severely restricted in contents such that they will not be viable candidates. It is reasonable to expect that commercial vendors will upgrade their "fleets" to replace a portion of these LSA/Type-B casks, thus increasing the number of suitable candidates.

d. Due to the high volumes of waste expected from the total removal of the Tank Farm, it should be assumed that a new LLW Disposal site would be built for the Tank Farm waste. It is further assumed that this LLW disposal site will be located on the Idaho National Engineering and Environmental Laboratory site.

e. Assume treatment does not reduce volume. Disposal utilizing these casks will require the use of a disposable liner. A disposable transport package that my be suitable is the INEEL's DOT 7A Type-A Mark III Concrete Box – a four-by-four-by-eight-foot concrete shielded box with a 12,000 pound payload capacity.

f. A size limit is not given for concrete – "must be transported in equipment that is designed and constructed to be readily emptied and is kept clean" - (DOE/ID-10381, Rev. 6, February 14, 1997, Section 4.3.1).

g. A DOT 7A Type A D&D Bin is 78 inches wide by 48 inches high by 114 inches long, weight capacity of 10,000 pounds per bin.

For the purposes of this feasibility study and the low levels of plutonium found in the Tank Farm Inventory of waste types (Reference 5), it will be assumed that each transport package contains less than 20 curies of plutonium. This assumption is made because transport of more than 20 curies of plutonium requires doubly contained transport packages (NRC regulation), and none of the candidate casks listed above are able to meet this requirement.

References:

1. *Idaho National Engineering and Environmental Laboratory Reusable Property, Recyclable Materials, and Waste Acceptance Criteria (RRWAC)*, DOE/ID-10381, February 1997.

2. Conversations with Mr. R. A. Roesener, Subject Matter Expert, October, 1997.

3. D. Machovec Interview - Clean Closure of Tank Farm, EDF-TFC-006, September 16, 1997.

4. *Take Off Calculations for Clean Closure, Total Removal*, EDF-TFC-16, October, 1997.

5. *Waste Inventories/Characterization Study*, INEL/EXT-97-00600, by R. S. Garcia, September, 1997.

INEL ENGINEERING DESIGN FILE

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Project File Number 73501

EDF Serial Number EDF-TFC-016

Functional File Number C-01

Project/Task CPP Tank Farm Closure Study

Sub task Clean Closure of Tank Farm by Total Removal

TITLE: Take-Off Calculations for the Total Removal of Soils and Structures at the Tank Farm Facility

SUMMARY

This Engineering Design File (EDF) identifies the approximate take-off volumes for concrete, piping, etc, to be removed during Total Removal Clean Closure of the Tank Farm Facility.

The numbers that follow in this EDF are considered rough order of magnitude estimates and are preliminary. A more thorough investigation would be warranted during the design phase of the project if this option were chosen. This independent analysis was compared with ICF Kaiser Engineering's take-off calculations. Results indicate the proposed take-off calculations are approximately the same as those proposed by ICF Kaiser Engineering.

The information contained in this EDF is as follows:

Excavation Methodology and Summary
APPENDIX A – Supporting Calculations
APPENDIX B – Sketches
APPENDIX C – ICF Kaiser Engineering Cost Estimate
APPENDIX D – References
APPENDIX E – ICPP, AEC, and ICF Kaiser Engineering Drawings

See Table 1 on page 4 for a summary of the results.

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Authors	Department	Reviewed	Approved
Stan Swanson (signature) S. P. Swanson	MC&IE/4130	Ali S. Siahpush (signature) Date 12-18-97	(signature) Date 12/18/97

Excavation Methodology and Summary

The following paragraphs provide a summary of the take-off values for Total Removal Clean Closure of the Tank Farm Facility (TFF). The volumes to follow are rough order of magnitude estimates. Should Total Removal Clean Closure be chosen as the preferred TFF closure option, a more detailed analysis may be necessary.

Excavation Area

The proposed excavation area for the TFF is 2.83 acres (See Sketch 7-1 in Appendix B for excavation area dimensions). This area was based on the WAG 3 FS Alternatives Cost Estimate (Reference 3) and includes the tanks, vaults, and Environmentally Controlled Areas (ECAs) in the immediate area. The ECAs covered in the proposed excavation area include CPP -16, 24, 26, 28, 30, 31, 32, and 79. Other ECAs are not included in this Total Removal Clean Closure study. See Reference 1 for a description of the environmentally controlled areas within the Tank Farm Facility boundaries.

Excavation Depth

The excavation depth is estimated at 50 feet. Idaho Chemical Processing Plant (ICPP) drawing 105582 (Sections A and B) indicates that the bottom of the vaults could be as much as 45 feet below grade. An additional 5 feet is added to create some padding for some unforeseen event - including removing soil from beneath the vaults.

Tank Vault Waste Volume

The tank vault concrete volumes were based on vaults VES-WM-182 through 186. It was assumed that these are typical vaults. Dimensions for the vaults were derived from both CPP drawings (105587 through 105592) and figures from a Tank Farm loading restrictions analysis (Reference 2). MathCad was used to calculate the concrete volume for one vault. The volume was then multiplied by eleven to approximate the total volume for all eleven vaults. The total calculated volume of waste for all eleven vaults is approximately 301,800 cu.ft.

Tank Waste Volume

Tank 184 (VES-WM-184) was used as the typical tank for the TFF. Dimensions for the tank were derived using CPP drawing 105164. Some approximating was performed while estimating the tank dome volume, as the curvature of the dome was not expressed in a formula. The total calculated volume for all eleven tanks is approximately 2640 cu.ft. of material.

Concrete Encased Pipe Pile Support Waste Volume

Piles (pipes filled with concrete) are used in the TFF to structurally support the piping encasements. According to CPP drawings 105584, 106133,106144, 106325, and 106269, there are approximately 310 piles at an estimated average length of 30 feet. The pile diameter is 10 inches. Dave Machovec (Tank Farm Expert) estimated 200 piles at the TFF (EDF-TFC-006). This number is low. The total pile volume consists of approximately 5070 cu.ft. of material. The pipe wall is made of steel and has a 3/8" thickness. The approximate volume of the piping is 760 cubic feet.

Concrete Encasement Waste Volume

Encasements surround process lines at the TFF. These encasements are made of concrete and are supported by the piles mentioned earlier (See Sketch 7-6 in Appendix B). Scaling off of CPP "Underground Utilities Systems" drawings (055328, 055327, and 057567), approximately 1967 linear feet of encasement were identified. CPP drawings 106262, 106127, 106261, 106269 and 106134 were used to calculate an encasement cross-section of 7.11 square feet. The total volume for the encasements is approximately 18613 cubic feet of waste (including encasement, encasement cap, and pile caps). Steel lining inside of the encasements is 11 gage and has an approximate cross-section of .0375 square feet. The liner waste volume is approximately 74 cubic feet.

Concrete Duct Bank Waste Volume

Concrete duct banks were installed at the TFF to encase wiring. Newer duct banks are located above the Dupont membrane. Approximately 273 linear feet of new duct bank was installed according to ICF Kaiser Engineering (ICF KE) drawing 377999 (only two new "major" duct runs were identified). Using "Underground Utilities Systems" drawings, rough calculations were made by using a scale to measure the duct banks on each relevant drawing. According to these drawings (055330, 059837, 500174, 092094, 092092, 500177, 059836, 055337, 500173, 092095, 092093, 500176) the approximate length of the duct banks is 2475 feet (2846 feet when including a 15% increase for possibly missed items). The cross-sectional area of the duct banks is based on CPP drawings 171825 and 171800 and ICF KE drawings 377999 (E-088), 378000 (E-089), and 378001 (E-100). The approximate cross-sectional area of the duct banks is 2 sq.ft based on a four-conduit encasement for the entire tank farm. The approximate volume of the duct banks is 5692 cu.ft. of material. It is assumed that 75% of the ductwork is below the surface (EDF-TFC-017). After reviewing Underground Utilities drawings along with the ECA report, it is assumed that 17% of the ducting is located in ECA areas and therefore mixed waste.

Building Removal Waste

The square footage of the buildings at the TFF was calculated using CPP drawing numbers 104725, 106190, 106287, 105600, 103211, 137938, and 051372 for buildings CPP–638, 634, 635, 628, 712, 622, 623, 632, and 631 respectively. The total square footage is approximately 2870 sq.ft. with an average area of 319 sq.ft per building. This average will be fed into Don Kenoyer's D&D cost estimation software package to estimate the cost. Exact volumes of the buildings were not calculated.

Tank Riser Waste Volume

Using drawing 105594, the approximate volume of a riser is 487 cubic feet of concrete. The total volume of the 71 risers (risers were counted from Underground Utilities drawings) is approximately 34577 cubic feet. All risers were considered the same - manway, sump, and access risers. The steel lining was neglected.

Divergence Valve Boxes

Using valve box A5 as a typical valve box (105595), the calculated approximate volume per box is 108 cu.ft. of concrete - this neglects the void space within the valve boxes. Using Underground Utilities drawings, a total of 33 boxes were identified. The total volume contribution of waste from the valve boxes is approximately 3573 cubic feet.

Table 1. Summary of calculated volumes.

Summary	Volume (cu.ft)
Electrical Duct Banks:	5,700
Valve Boxes:	3,600
Risers:	34,600
Concrete Encasements:	18,620
Steel Liners:	74
Piles:	5,100
Pile - steel encasement	760
Tanks:	2,700
Vaults:	302,000
Soil:	4,765,865

Comparison of Take-Off Calculations (Independent vs. ICF Kaiser Engineering)

Soil:

According to ICF Kaiser Engineering's report (Reference 4), the amount of soil to be removed from the site is 88,580 CY of contaminated soil, 88,580 CY of soil to be removed by hand/machine, and 118108 CY of soil to be removed by regular excavation means (See Appendix C for a copy of the relevant sections of the cost estimate). Thus the total soil to be removed is 295,268 CY. Independent calculations approximate a volume of 175,000 CY. The difference in the calculation is due to a difference in proposed excavation area. To remove the amount of soil proposed by ICF KE, an excavation site with a 50-foot depth, 557-foot length, and 286-foot width is necessary. This is a larger excavation area than is planned by this project, but justifies the magnitude of the independent soil calculations.

Demolish Concrete Structures:

According to ICF Kaiser Engineering's report, the total volume of concrete to be demolished is 16,460 CY. Independent calculations indicate that the total volume of duct banks, vaults, risers, encasements, and piles is approximately 13,780 CY. The difference between the two calculations is about 16%. However, it is felt that ICF Kaiser Engineering's estimate may have included other structures not included in the independent study (including above ground buildings). The ICF Kaiser Engineering number is also more conservative. Thus, the Kaiser number for concrete demolition will be used.

Piping:

According to the ICF KE report, approximately 11 miles of piping must be removed in order to remediate the tanks and vaults. This number differs greatly from the numbers reported by the Tank Farm Facility Expert (David Machovec) in EDF-TFC-006. According to Michelle Dahlmeir, Systems Engineers use the numbers identified in EDF-TFC-006 frequently. As a result, the numbers from the independent study must be used.

APPENDIX A – SUPPORTING CALCULATIONS

Supporting Calculations for Volumetric Waste Generated and Weight of Buried Objects

Assumptions:

Depth of soil to be excavated is 50 feet from grade - based on Advanced Engineering Consultants information and EDF-TFC-006.

Surface area to be excavated is 2.83 acres - based on WAG 3 Cost Estimate and EDF-TFC-006.

$\text{Density} := 144\cdot\frac{\text{lb}}{\text{ft}^3}$ Density of concrete.

Volume of the tank vaults at the tank farm: AEC figures 2,3,6,7,8, and 11.

$a := (122\cdot\text{ft} + 6\cdot\text{in})\cdot(120\cdot\text{ft} + 6\cdot\text{in})\cdot(35\cdot\text{ft} + 1\cdot\text{in})$ Tanks 187-190 Vault 713 AEC Fig. 2 & 3

$b := ((73\cdot\text{ft})^2 - ((.5\cdot(21\cdot\text{ft} + 4.5\cdot\text{in})^2)\cdot 4))\cdot 37.3\cdot\text{ft}\cdot 2$ Tanks 180 - 181 Vaults 780 and 781 AEC Fig. 6 & 7

$c := ((60\cdot\text{ft})^2 - (.5\cdot(9\cdot\text{ft} + 10.1875\cdot\text{in} + 8\cdot\text{ft} + 4.1875\cdot\text{in})^2))\cdot(2\cdot\text{ft} + 6\cdot\text{in} + 32\cdot\text{ft} + 9\cdot\text{ft} + 3\cdot\text{in})\cdot 5$

Tanks 182-184 Vaults 782 - 786 AEC Fig. 8 & 11

Total vault volume:

$TVV := a + b + c$

$TVV = 1.599\cdot 10^6\cdot\text{ft}^3$

Volume of the soil at the tank farm:

$d := 50\cdot\text{ft}\cdot 2.83\cdot\text{acre}$ Assumed 50 foot excavation - see ECA map for surface area

Total volume of soil to be removed is equal to volume of area minus volume of vaults.

$TotalVol := d - TVV$

$TotalVol = 4.565\cdot 10^6\cdot\text{ft}^3$

Volumes and Weights of vault components: See "Vaults" on tagged drawings

Roof Beams (RB-1, RB-2, RB-5): Drawings 105588 and 105589. Using vaults 182 through 184 as models for all vaults.

$area := (3\cdot\text{ft} + 6\cdot\text{in})\cdot(2\cdot\text{ft} + 6\cdot\text{in}) + (7\cdot\text{in}\cdot(3\cdot\text{ft} + 6\cdot\text{in}))$

See drawing 105589. Cross-sectional area found from Sections A, B, and D
Lengths were found from Beam RB-1, RB-2, and RB-5 Views.
All three beams have the same cross-sectional area.
Lengths were found from the plan view drawings with: RB1=60ft, RB2=40.3ft, RB-5=5ft

$area = 10.792\cdot\text{ft}^2$

$Length := (8.5\cdot\text{ft}\cdot 6) + (60\cdot\text{ft}\cdot 5) + ((43\cdot\text{ft} + 3.62\cdot\text{in})\cdot 2)$

$Length = 437.603 \cdot ft$

$Volume := area \cdot Length$

$Volume = 4.722 \cdot 10^3 \cdot ft^3$

$Weight := Density \cdot 60 \cdot ft \cdot area$ Maximum weight of a beam

$Weight = 9.324 \cdot 10^4 \cdot lb$

$Tonage := \frac{Weight}{2000 \cdot lb}$

$Tonage = 46.62$

Rectangular Columns (Column C1): Drawings 105590,105588 and AEC figure 10.

$VolumeRC := (32 \cdot ft + 7.5 \cdot in) \cdot (3 \cdot ft) \cdot (3 \cdot ft)$ Volume=Area*length

$VolumeRC = 293.625 \cdot ft^3$

$Number := 8$ Total number of columns per vault. See dwg 105588 Plan drawing

$TotalVolume := VolumeRC \cdot Number$

$TotalVolume = 2.349 \cdot 10^3 \cdot ft^3$

$MaxWeight := VolumeRC \cdot Density$ Maximum weight of a beam

$MaxWeight = 4.228 \cdot 10^4 \cdot lb$

Pentegonal Columns (Column C2): Drawing 105588 and AEC figure 9.

$VolumePC := (32 \cdot ft + 7.5 \cdot in) \cdot (22 \cdot ft^2)$ Assumed a square cross-sectional area of 3ft x 3ft - See AEC figure 9

$VolumePC = 717.75 \cdot ft^3$

$NumberPC := 8$ Total number of columns per vault. See dwg 105588 Plan drawing

$TotalVolumePC := VolumePC \cdot NumberPC$

$TotalVolumePC = 5.742 \cdot 10^3 \cdot ft^3$

$MaxWeightPC := VolumePC \cdot Density$

$MaxWeightPC = 1.034 \cdot 10^5 \cdot lb$

Vault Panels: Drawing 105590 - See Typical Panel detail

$VolumeVP := (7 \cdot ft + 11.5 \cdot in) \cdot (8 \cdot ft + 10 \cdot in) \cdot 6 \cdot in$ Volume=height*base*thickness

$VolumeVP = 35.149 \cdot ft^3$

$MaxWeightVP := VolumeVP \cdot Density$

$MaxWeightVP = 5.061 \cdot 10^3 \cdot lb$

$NumberVP := 64$ Number indicated on Typical Panel Detail

$TotalVolumeVP := VolumeVP \cdot NumberVP$

$TotalVolumeVP = 2.25 \cdot 10^3 \cdot ft^3$

Base Slab: Drawing 105587 See Section A and plan drawing

$AreaBS := (64 \cdot ft \cdot 64 \cdot ft) - .5 \cdot (18 \cdot ft + 9 \cdot in)^2 \cdot 4$ Area=60ft*60ft-.5*base*height*4

$AreaBS = 3.393 \cdot 10^3 \cdot ft^2$

$TotalVolumeBS := 2.93 \cdot ft \cdot AreaBS$

$TotalVolumeBS = 9.941 \cdot 10^3 \cdot ft^3$

Perimeter Beams (RB-3 and RB-4): See drawing 105589 Beam RB3 and RB4 detail and Section C detail

$VolumePB := (8 \cdot ft + 10 \cdot in) \cdot (2.5 \cdot ft \cdot 3 \cdot ft)$ Volume=length*width*height

$VolumePB = 66.25 \cdot ft^3$

$NumberPB := 16$

$TotalVolumePB := VolumePB \cdot NumberPB$

$TotalVolumePB = 1.06 \cdot 10^3 \cdot ft^3$

$MaxWeightPB := VolumePB \cdot Density$

$MaxWeightPB = 9.54 \cdot 10^3 \cdot lb$

Roof Slabs: Drawing 105588 and AEC figure 8

$$RSVolume := (6 \cdot in) \cdot \left(5 \cdot ft + 10 \cdot in + \frac{3}{16} \cdot in\right) \cdot (60 \cdot ft) \cdot (4) + (6 \cdot in) \cdot \left(8 \cdot ft + 4 \cdot in + \frac{3}{16} \cdot in\right) \cdot (40.3 \cdot ft) \cdot (4)$$

Volume=thickness*width*length+thickness*width*length

$RSVolume = 1.375 \cdot 10^3 \cdot ft^3$

Thickness is shown on Typical Arrangement for RB5 detail. Lengths are estimated from the plan drawing. Width is the distance between the beams as shown on the plan drawing

Total average volume of concrete per vault:

$$Total := Volume + TotalVolume + TotalVolumePC + TotalVolumeVP + TotalVolumeBS + TotalVolumePB + RSVolume$$

$$Total = 2.744 \cdot 10^4 \cdot ft^3$$

Total for all eleven tanks:

$$GrandTotal := Total \cdot 11$$

$$GrandTotal = 3.018 \cdot 10^5 \cdot ft^3$$

CLEAN CLOSURE
TAKE-OFF CALCULATIONS
(VALUE BOXES)

Value Boxes:

USING Box A-5 as standard for all value boxes
[See "Value Boxes" on flagged drawings in Appendix E]

Drawings 105595 [Detail 5 and Section A]

$N = 33$ Valve Boxes [Number counted from Underground Utilities Drawings]

$V = (6')(4'\text{-}5")(5'\text{-}5") - [(5'\text{-}5") - (2\cdot 8")]\cdot[(4'\text{-}5") - (4"\cdot 2)]\cdot[(6" + 1'\text{-}9")]$

$V = (6')(4.42')(5.42') - [5.42' - 1.33']\cdot[4.42' - .667']\cdot[2.25']$

$V = 108\ ft^3$

Total for Tank Farm:

$V_{TFF} = V \cdot N = (108\ ft^3)(33\ \text{valve boxes}) = 3{,}573\ ft^3$

[Calculating volume and subtracting out void space]

CLEAN CLOSURE
TAKE-OFF CALCULATIONS
(Pipe Encasements)

DRAWINGS: 106269, 10[illegible], [illegible]262 (Flagged as "Encasements" on drawing in Appendix E)

PILE CAPS: (Dwg 106269 [illegible])

[Assuming all encasements have similar dimensions]

[Neglecting circular voids (2) with each pile cap]

[Number of pile caps was calculated by counting the piles on drawings 105584, 106133, 106144, 106269, and 106325]

$A = 4'6" \times [illegible] = 9\ ft^2$

$V = A \cdot h = 9\ ft^2 \times 1'3") = 11.25\ ft^3$

N = 1 pile cap for every two piles

$V_T = V(155\ \text{caps}) = 11.25\ ft^3(155) = \underline{1744\ ft^3}$

ENCASEMENTS: (Dwg 106262)

Assuming Encasement #9 as standard [See Section E-E on drawing 106[illegible]]

$A = (2'8")(2'11") - (6")(8")(2) = 7.11\ ft^2$

Volume = A (Length);
where Length = 1967 ft [Length was calculated by [illegible] Underground Utilities [illegible]]

$\text{Volume} = (1967\ ft)(7.11\ [illegible]) = \underline{14,000\ ft^3}$

ENCASEMENT CAPS: (Dwg 106261) [Assuming Cap in Section k-k is standard for all encasements]

[Using a width of 2'-11" (same as [illegible] for encasements)]

$A = (6")(2'11") = 1.46\ ft^2$

$V = A(\text{Length}) = (1.46\ ft^2)(1967\ ft) = \boxed{2869\ ft^3}$ [Length was calculated by scaling of Underground Utilities drawings]

TOTAL VOLUME:

$V_{TFF} = V_T + \text{Volume} - V = 1744\ ft^3 + 14,000\ ft^3 + 2869\ ft^3 = \boxed{18613\ ft^3}$

% mixed waste = $\frac{\text{Length in ECA areas}}{\text{Total Length}} = \frac{295\ ft}{1967\ ft} = [illegible]\ \%$

[Length in ECA areas was assumed after reviewing the ECA map and Underground [illegible]]

CLEAN CLOSURE
TAKE-OFF CALCULATIONS
(ENCASEMENT PILES)

Drawings: 106133, 106144, 106269, 105584, 106325 [See "Piles" in Appendix E drawings]

Piles:

L = average length of 30 ft [Assumed after looking at drawings - conservative estimate]

D = 10 inches } [See drawing 106144 Detail 2]

t = 3/8"

N = 310 piles [Counted by hand using dwg# 105584, 106133, 106144 & 106269]

$$V = \frac{\pi D^2}{4} \cdot L = \frac{\pi \left(\frac{10\,in}{12\,in} \right)^2}{4} \cdot 30\,ft = 16.35\,ft^3$$

$$V_T = V \cdot N = (16.35\,ft^3)(310) = \boxed{5070\,ft^3}$$

% mixed waste = NUMBER IN ECA AREAS / TOTAL NUMBER OF PILES = [illegible] / [illegible]30 = .33 ⇒ 33%

[Assumed number of piles in ECA areas after reviewing the ECA map and Underground Utilities drawings]

CLEAN CLOSURE
TAKE-OFF CALCULATIONS
(TANKS)

Drawings: 105164 [See "Tanks" in Appendix E drawings]

[Assuming this tank is standard for the Tank Farm]

$R_i = 25'$
$t = 5/16"$ (max thickness)
$h = 29'-6"$

Base Volume:

$V_1 = t \pi r^2$

$V_1 = \frac{5}{16} in \cdot \frac{1 ft}{12 in} \cdot \pi (25 ft)^2 = 51.12 \ ft^3$

SIDE Volume:

converting inches to feet

$V_2 = 2\pi r t h$

$V_2 = 2\pi (25 ft)(\frac{5}{16} in \cdot \frac{1 ft}{12 in})(29.5 ft) = 121 \ ft^3$

Dome Volume:

Assuming (R = 25' and 1/3 of sphere)

$V_3 = \frac{4\pi r^2}{3} t$

$V_3 = \frac{4\pi (25 ft)^2}{3} \cdot \frac{5}{16} in \cdot \frac{1 ft}{12 in} = 68.14 \ ft^3$

Total Volume per Tank:

$V_T = V_1 + V_2 + V_3$

$V_T = 51.12 \ ft^3 + 121 \ ft^3 + 68.14 \ ft^3 = 240 \ ft^3 \Rightarrow \sim 9 \ yd^3$

Tank Farm Total:

[Eleven tanks at the Tank Farm]

$V_{TFF} = V_T \cdot 11$

$V_{TFF} = 240 \ ft^3 \cdot 11 = 2640 \ ft^3 \Rightarrow \sim 98 \ yd^3$

Drawings: 105594 [See "Risers" in Appendix E drawings]

RISER: Area = (6')(6') - (2')(2') = 32 ft² [See detail 5 and Section A]

Volume = Area (height)

Volume = (32 ft²)(8'-4" + 2'-6" + 1') = 379 ft³

71 risers [Counted from Underground Utilities Drawings]

CAP: V_c = (3')(6')(6') = 108 ft³ [Neglecting slope on cap - assuming a square top]

Riser Volume Total:

V_T = Volume + V_c = 379 ft³ + 108 ft³ = 487 ft³

Total for Tank Farm

V_{TFF} = V_T (Risers) = 487 ft³ (71 risers) = 34,577 ft³

CLEAN CLOSURE
TAKE-OFF CALCULATIONS
(Buildings)

Bld. 638
Dwg: 104725
(12' + 7-8")(11'-4") + (3'-6")(13'-8 3/4")
⇒ (222.88')² + (48.05')² = 271 ft²

Bld 634
Dwg: 106190
(10'-8")(20'-8") = 221 ft²

Bld 635
Dwg: 106287
(13'-4")(30') = 400 ft²

Bld 628
Dwg: 105600
(26')(58') = 1508 ft²

Bld 712
(16')(13'-6") = 216 ft² → Dwg: 103211

Blds 622, 623, + 632
(8')(3'-6') = 28 ft² each
84 for all 3 buildings
Dwg: 137902

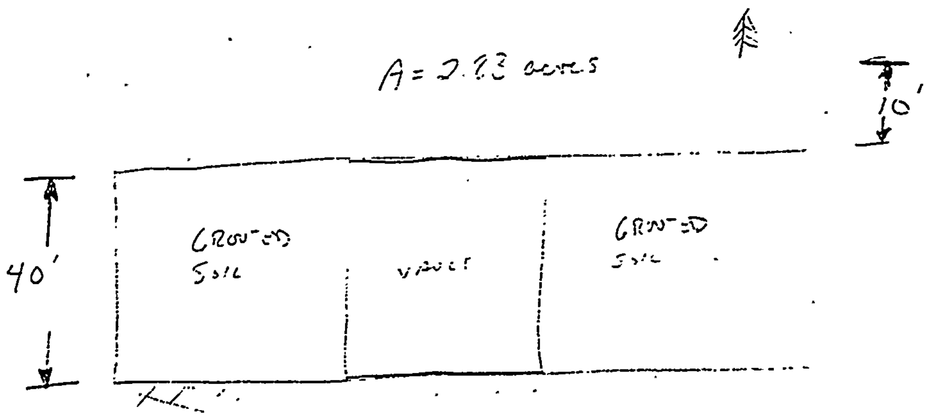
Bld 631
Dwg: 051372
(11'-4")(13'-4") + (4')(4'-10")
→ 151 + 19 3 = 170 ft²

total sq. ft = 271 + 221 + 400 + 1508 + 216 + 28 + 170 = 2870 ft²

average sq ft. = $\frac{2870}{9}$ = 319 ft²

CLEAN CLOSURE
TAKE-OFF CALCULATIONS
(Paraffin-based grout)

Area of EXCAVATION = 2.83 acres = 123275 ft^2 [See ECA map]
Depth of paraffin-based grout = 40 ft [Assumes to reach top of vault]
Volume of Vaults = 1,440,000 ft^3 [concrete vault calculations]
(assuming vault height of 40 ft)



VOLUME OF PARAFFIN BASED GROUT

V_P = (Area X Depth) − (Vault volumes)

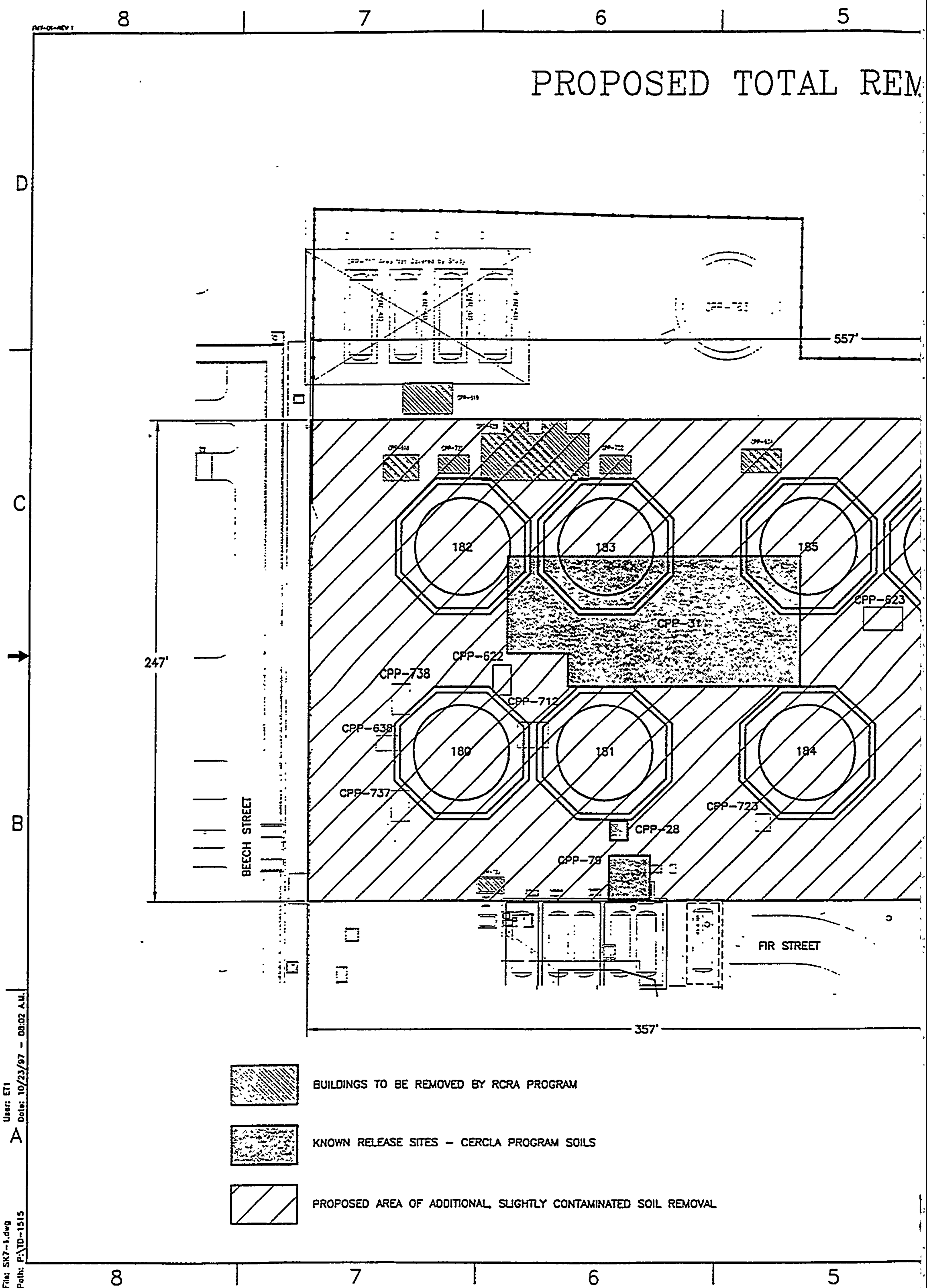
$V_P = (123275\ ft^2)(40\ ft) - 1{,}440{,}000\ ft^3$

$V_P = 3{,}491{,}000\ ft^3$

$= 129{,}300\ yd^3$

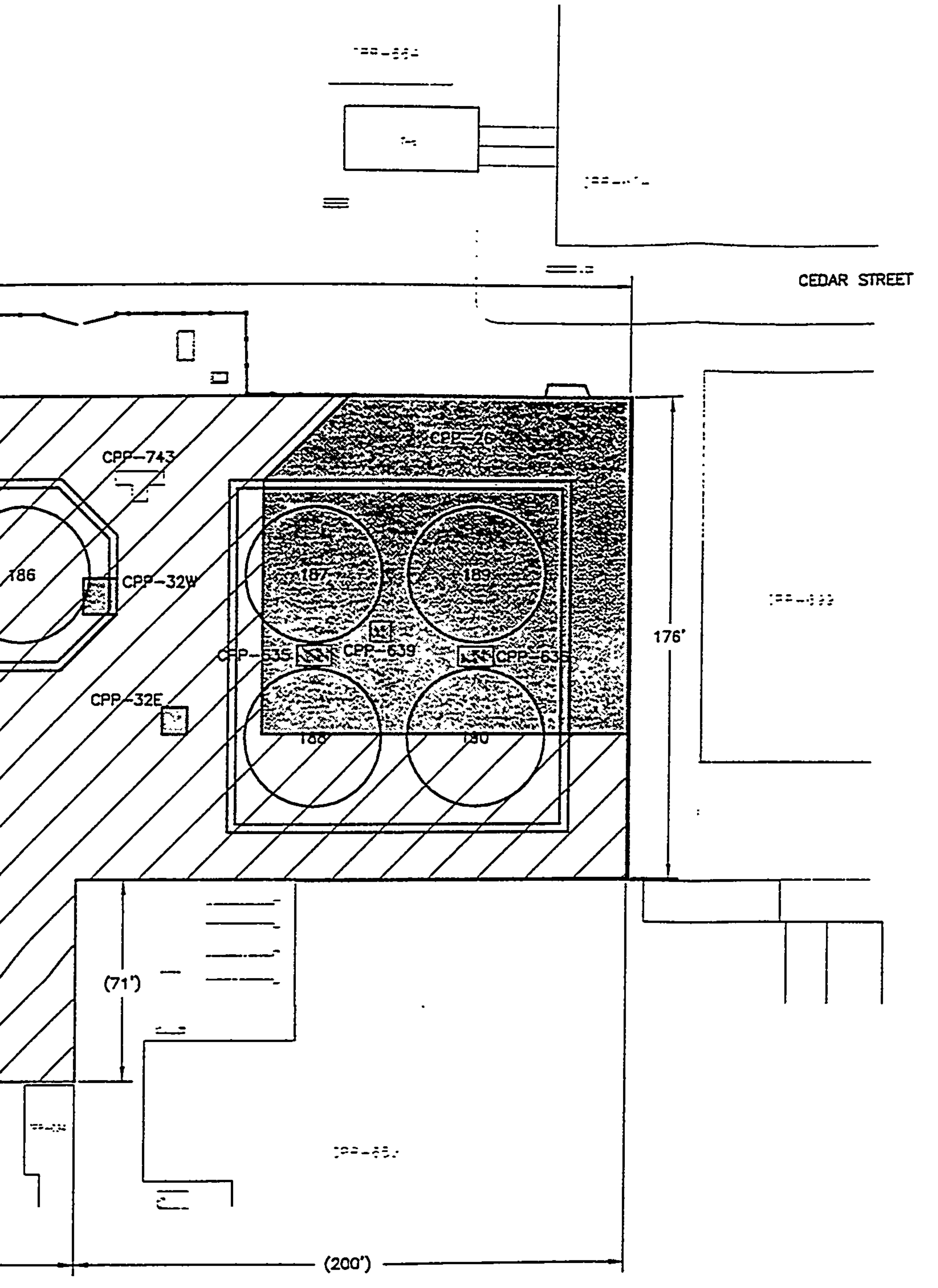
APPENDIX B – SKETCHES

PROPOSED TOTAL REM



EDF-TFC-016 Pg 19 of 4[illegible]

OVAL BOUNDARIES

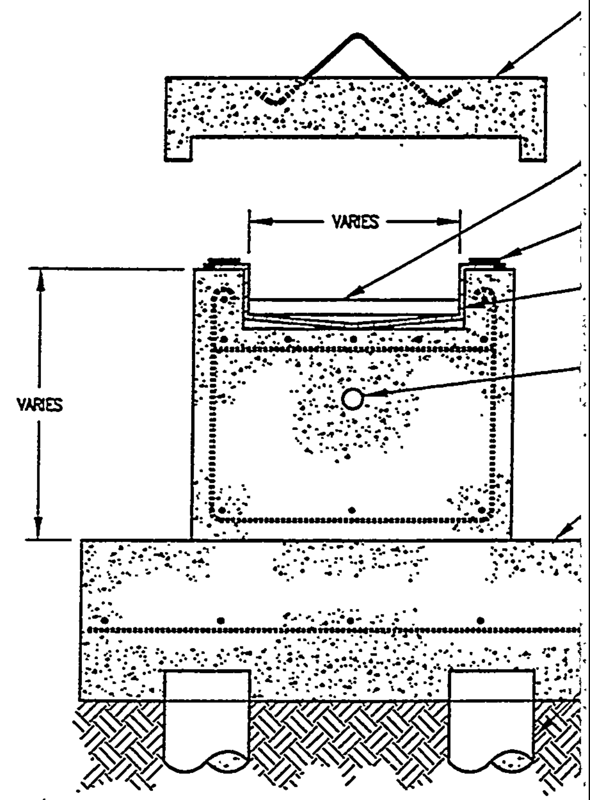


REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

SUBCONTRACT NO.	LOCKHEED MARTIN
REQUESTER:	
DESIGN: STEVE SWANSON	TANK FARM CLOSURE STUDY
DRAWN: ERIC E THOMAS	TOTAL REMOVAL CLEAN CLOSURE
PROJECT NO.	PROPOSED TOTAL REMOVAL BOUNDARIES
SPEC CODE	
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE D · CAGE CODE 01MF3 · INDEX CODE NUMBER: AREA, TYPE, CL, ORG 530 · DWG-SK7-1 · REV
EFFECTIVE DATE:	SCALE: NONE · SHEET 1 OF 1

8 7 6 5

STAINLESS STEEL LINED CON



SECTION OF TYPICAL ENCASEME

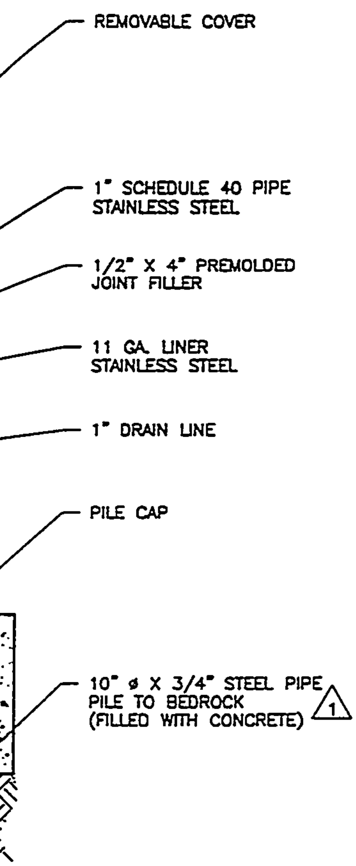
User: ETI
Date: 10/23/97 - 08:39 A.M.
File: SK7-6.dwg
Path: PATD-1515

8 7 6 5

4 | 3 | 2 | 1

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

CRETE ENCASEMENTS AND PILES



NT PIPE

NOTE:

1. PILES RUN FROM THE BOTTOM OF THE PILECAP TO THE BEDROCK LAYER. (APPROXIMATELY 30 FEET)

SUBCONTRACT NO.	LOCKHEED MARTIN
REQUESTER:	
DESIGN: STEVE SWANSON	TANK FARM CLOSURE STUDY
DRAWN: ERIC E THOMAS	TOTAL REMOVAL CLEAR CLOSURE
PROJECT NO.	STAINLESS STEEL LINED CONCRETE ENCASEMENT
SPEC CODE	AND PILES
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE D; CAGE CODE 01MF3; INDEX CODE NUMBER: AREA, TYPE, I, Q, ORIG 530; DWG- SK7-6; REV
EFFECTIVE DATE:	SCALE: NONE; SHEET 1 OF 1

D C B A

APPENDIX C – ICF KAISER ENGINEERING COST ESTIMATE

ICF KAISER ENGINEERS, INC.
INEL IDAHO FALLS, IDAHO
JOB NO. 91203-220-01

ICF KAISER ENGINEERS INTERACTIVE ESTIMATING
HIGH LEVEL WASTE TANK FARM REPLACEMENT PROJECT
RCRA CLOSURE STUDY - MAGNITUDE ESTIMATE
REPORT D1 - ESTIMATE DETAIL BY FACILITY

DATE: 02/10/94 09:24
BY I. KORNYEY

--WORK BREAKDOWN--- WBS	.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	SCOHP& ODC	TOTAL DOLLARS
2		Phase 2									
2A		Option A - Demolition and Removal									
2A1		Option A - Demolition and Removal									
2A1	.0100000.	MOBILIZATION/DEMOBILIZATION	1 LS	0	0	0	0	1050000	0	0	1050000
2A1	.0214341.	DEMOLISH CONCRETE STRUCTURE	16460 CY	21810	585784	128594	0	0	0	247173	961551
2A1	.0214342.	DEMOLISH TEMP. CONCRETE PADS	280 CY	224	6016	1321	2279	0	0	2766	12382
2A1	.0234321.	CHIP OFF CONTAM. CONCRETE SURFACE	1320 CF	1584	39244	6833	0	0	0	16381	62458
2A1	.0234420.	DISPOSAL- 4 MI ROUNDTRIP 20 CY TRUCK (UNITS INCLUDE 1.25 SWELL FACTOR)	21400 CY	892	23076	38327	0	0	0	13063	74466
2A1	.0242100.	BACKFILL STRUCTURAL @ VAULT	337630 CY	27010	696498	527716	0	0	0	331371	1555585
2A1	.0268001.	EXCAVATION STRUCTURAL	118108 CY	17716	445805	106888	0	0	0	189011	741704
2A1	.0268117.	EXCAVATION CONTAMINATED SOIL	88580 CY	404937	10685275	709614	0	0	0	4345071	15739960
2A1	.0268119.	EXCAVATION - MACHINE/HAND/ HIGH INTERFERENCE AREAS	88580 CY	265740	7012214	465665	0	0	0	2851452	10329331
2A1	.0268301.	HAUL EXCAV MAT'L TO STOCKPILE	206700 CY	18603	481260	506002	0	0	0	243104	1230366
2A1	.0268302.	HAUL BACKFILL MAT'L ON SITE FROM STOCKPILE	337630 CY	43892	1151507	1258685	0	0	0	586471	2996663
2A1	.0277240.	SOLDIER BEAMS & LAGGING TIE BACK SYST., 40' EXCAV INCL. REMOVAL	80500 SF	92575	2478630	557463	2852719	0	0	1332470	7221282
2A1	.0280001.	MONITOR/SEAL CONTAM SOIL BOXES (4X4X8) APPROX 4CY/Ea	18685 BOX	18685	455104	65248	0	0	0	188566	708918
2A1	.0280002.	MONITOR/SEAL/CONTAMIN MAT'L	161 BOX	483	11764	1686	0	0	0	4874	18324
2A1	.0280100.	HAUL DISPOSAL BOXES TO HOLDING AREA LARGE QTY	30 BOX	14	361	124	0	0	0	157	642
2A1	.0280110.	ON SITE DISPOSAL OF RADIOACTIVE WASTE	30 BOX	0	0	206	0	90000	0	21	90227
2A1	.0280111.	DISPOSAL OF PKGD MIXED WASTE INCL. COST OF CONTAINERS	3131000 CF	0	0	0	0	**	0	0	939300000
2A1	.0281001.	SOIL TESTING DURING EXCAVAT'N 1 MEN FULL TIME + 150 LAB SAMPLES	1 LS	3950	237000	0	0	48000	0	94800	379800
2A1	.0282100.	CUT UP & DISPOSE OF REMOTE CONTROL EQUIPMENT, SUPPORTS AND ENCLOSURE - ALLOW	1 LS	5000	119940	6930	0	700000	0	48669	875539
2A1	.0330000.	CONCRETE PADS TEMP. SUPTS FOR TRUSSES, DECONTAMINAT'N PAD 3000 PSI	280 CY	792	19642	4673	20291	0	0	10353	54959
2A1	.0510131.	STEEL TRUSSES & RAILS SUPPORT & RUNWAY FOR MOVING REMOTE CONTROL EQUIPMENT	50 TON	0	0	0	105000	0	0	10500	115500
2A1	.0510132.	STEEL TRUSSES & RAILS INSTALL/MOVE/DISMANTLE	11 TNK	4400	127722	25452	0	0	0	53634	206808

ICF KAISER ENGINEERS INTERACTIVE ESTIMATING
HIGH LEVEL WASTE TANK FARM REPLACEMENT PROJECT
RCRA CLOSURE STUDY - MAGNITUDE ESTIMATE
REPORT D1 - ESTIMATE DETAIL BY FACILITY

--WORK BREAKDOWN--- WBS	.STANDRD.WKPKG	DESCRIPTION	QUANTITY	MANHOURS	LABOR	EQUIP USAGE	MATERIAL	SUB-CONTRACT	EQUIP-MENT	SCOHP& ODC	TOTAL DOLLARS
2A1	.0536200.	ENCLOSURE FLOOR PLATE 1/4"SS (EQUIVALENT APPLIED TO TOTAL AREA)	8000 SF	8800	251211	75432	185640	0	0	126592	638875
2A1	.1311011.	REMOTE CONTR.EQUIPMT (GANTRY) TANK DEMOLITION, CHIP OFF CONTAM.CONCR.SURF,PACKAGING	1 EA	0	0	0	0	0	5250000	262500	5512500
2A1	.1311012.	INSTALL/MOVE/DISMANTLE REMOTE CONTRLLED EQUIPMENT	11 TNK	15400	396653	115928	0	0	0	170254	682835
2A1	.1350111.	ENCLOSURE FOR REMOTE CONTROL WORK AREA - AIR STRUCTURE	8000 SF	0	0	0	126000	0	0	12600	138600
2A1	.1350112.	INSTALL/MOVE/DISMANTLE ENCLOSURE FOR WORK AREA	11 TNK	1100	26387	1525	0	0	0	10707	38619
2A1	.1350151.	VENTILATION SYSTEM FOR REMOTE CONTROL WORK AREA ENCLOSURE INCL. HEPA FILTERS	8000 SF	0	0	0	168000	0	0	16800	184800
2A1	.1350152.	INSTALL/MOVE/DISMANTLE VENTILATION SYS.FOR REMOTE CONTROL WORK AREA ENCLOSURE	11 TNK	2200	68344	11579	0	0	0	28496	108419
2A1	.1350160.	ALLOWANCE FOR INSTALL, MOVE, DISMANTLE TEMP. UTILITIES TO REMOTE CONTROL WORK AREA	11 TNK	6600	182437	28006	346500	0	0	110425	667368
2A1	.1596455.	CUT EXCAV. PIPE TO 3'PIECES, REMOVE AND PACKAGE FOR DISPOSAL - ASSUME 3" AVG	20000 PCS	144000	4473429	757920	0	0	0	1865164	7096513
2A1	.2013010.	SECURITY/SITE ORIENTATION/ OSHA/ETC - ALLOWANCE	48600 MH	48600	1150848	0	0	0	0	0	1150848
2A1	.2013016.C1	HEALTH AND SAFETY - ALLOW 3 MEN FOR DURATION OF WORK	13830 DY	331920	0	0	0	19915200	0	0	19915200
	TOTAL	Option A - Demolition and Removal		1,486,927	31,126,151	5,401,817	3,806,429	961,103,200	5,250,000	13,173,445	1,019,861,042
2A2		Option A-Operat'n of Remote Equipmt									
2A2	.2350010.	OPERATION & MAINTENANCE REMOTE EQUIPMENT-3 OPERATOR 2 SVC/REPAIR,1 SUPV. 7MO/TK	11 TNK	80300	0	0	0	4840000	0	0	4840000
	TOTAL	Option A-Operat'n of Remote Equipmt		80,300	0	0	0	4,840,000	0	0	4,840,000
2A3		Option A - Verification of Cleanup									
2A3	.2311004.	LABORATORY SOIL SAMPLES	22 EA	0	0	0	0	7040	0	0	7040
2A3	.2311901.	SAMPLING TIME AND REVIEW OF LABORATORY RESULTS	40 MH	0	0	0	0	2400	0	0	2400
	TOTAL	Option A - Verification of Cleanup		0	0	0	0	9,440	0	0	9,440
2A4		Option A - Risk Assessment									
2A4	.2311902.	IN-HOUSE CERTIFICATION	160 MH	0	0	0	0	19200	0	0	19200

piping

APPENDIX D – REFERENCES

1. WINCO Environmental Restoration - ICPP Environmentally Controlled Areas Reference Guide. 2/28/92.
2. Advanced Engineering Consultants. Evaluation of Existing Vaults for Vehicle Loads, HLWTFR Project. AEC Job No. 1002-08. Performed under WINCO BOA 219989, Task Order No. 8. August 26, 1993.
3. WAG 3, FS Alternatives Cost Estimate. Estimate File #2951. April 18, 1997. Estimator: DNS/TES
4. ICF Kaiser Engineering. High Level Waste Tank Farm Replacement Project – RCRA Closure Study Magnitude Estimate. Job No. 91203-220. 10-Feb-94

APPENDIX E - DRAWING LIST

DRAWING	*REV*	*TITLE*
377999	1	ELECTRICAL VALVE BOX UPGRADES UNDERGROUND DUCTBANK L/O SH-3
378000	1	ELECTRICAL VALVE BOX UPGRADES UNDERGROUND DUCTBANK L/O SH-4
378001	1	ELECTRICAL VALVE BOX UPGRADES UNDERGROUND DUCTBANK DETAILS SHEET – 1
104725		ICPP WASTE STATION – WM 180, IDAHO PARTICIPATION CONCRETE PAD & CONTROL HOUSE
106190	3	PIPE MANIFOLD BUILDING
106287		PIPE MANIFOLD BUILDING #2 CPP 635, PIPE MANIFOLD BUILDING #3 CPP 636
105600	7	CONTROL HOUSE FOUNDATION PLAN
103211		FLOOR PLANS FOR BUILDINGS CPP 701, CPP 702, CPP 710, CPP 711, AND CPP 712
103210		BUILDINGS CPP 701, CPP 702, CPP 710, CPP 711, CPP 712
137938	3	INSTRUMENTATION BUILDINGS CPP-622/623/632 & PULL BOXES – PLANS, SECTIONS, & DETAILS
051372		CPP – RALA OFF GAS STORAGE BLOWER ROOM CPP- 631 PLANS AND ELEVATIONS
105582	5	CPP YARD WASTE STORAGE AREA 11 CIVIL EXCAVATION PLAN & SECTIONS
105164		CPP YARD WASTE STORAGE AREA 11 TANK WM –184
105587	2	CPP YARD WASTE STORAGE AREA 11 WASTE STORAGE TANK BASE SLABS PLANS, SECTIONS & DETAILS
105588	3	CPP YARD WM-182, 183 & 184 TANKS AREA 11 STRUCTURAL WASTE STORAGE TANK ENCLOSURE ERECTION DIAGRAM OF PRECASE MEMBERS
105589	3	CPP YARD WM-182, 183 & 184 TANKS AREA 11 STRUCTURAL PRECAST MEMBERS DETAIL SH. #1
105590	3	CPP YARD WM-182, 183 & 184 TANKS AREA 11 STRUCTURAL PRECAST MEMBERS DETAIL SH. #2
105591	4	CPP YARD WM-182, 183 & 184 TANKS AREA 11 STRUCTURAL WASTE STORAGE TANK ENCLOSURE OPENINGS
105592	3	CPP YARD WM-182, 183 & 184 TANKS AREA 11 STRUCTURAL WASTE STORAGE TANK BASE SLABS REINFORCING DETAILS
105595		CPP YARD WASTE STORAGE AREA 11 STRUCTURAL SUPPORTS
105594	2	CPP YARD WM-182, 183 & 184 TANKS AREA 11 STRUCTURAL WASTE STORAGE TANK ENCLOSURE ACCESS RISER DETAILS
105584	8	CPP YARD WASTE STORAGE AREA 11 STRUCTURAL SUPPORTS AND ENCASEMENTS FOR WM TANK YARD PIPING PLAN
106133	4	CPP YARD STRUCTURAL PILE LOCATION PLAN & DETAILS SHEET NO. 1

106144	4	CPP YARD STRUCTURAL PILE LOCATION PLAN & DETAILS SHEET NO. 2
106269	3	CPP YARD PILE LOCATION PLAN SECTION & DETAILS
106325	2	CPP AREA PILE LOCATION PLAN & DETAILS
106127	7	CPP YARD PIPING KIQUID WASTE STORAGE AREA PLAN & SECTION "D"
106134	4	CPP YARD STRUCTURAL YARD PIPING SUPPORTS & ENCASEMENTS GENERAL ARRANGEMENT PLAN & DETAILS SHEET NO. 1
106261	4	CPP YARD YARD PIPING SUPPORTS & ENCASEMENTS ENCASEMENT COVERING PLANS, SECTIONS & DETAILS
106262	4	CPP YARD YARD PIPING SUPPORTS & ENCASEMENTS SECTIONS AND DETAILS
106269		CPP YARD PILE LOCATION PLAN SECTION AND DETAILS

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Pg 27 of 40

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August 26, 1993

Mr. Sal Mascarenas
Westinghouse Idaho Nuclear Co., Inc.
HLWTFR Project
Box 4000, M/S 5306
Idaho Falls, ID 83415-2304

Subject: Evaluation of Existing Vaults for Vehicle Loads, HLWTFR Project

Dear Mr. Mascarenas:

Advanced Engineering Consultants, Inc. (AEC) is pleased to submit two (2) copies of the final report entitled, "Evaluation of Existing Vaults for Vehicle Loads, HLWTFR Project." This report documents the work performed by AEC to implement the scope of work under WINCO BOA 219989, Task Order No. 8.

This has been a very interesting and challenging project. AEC looks forward to being of further service to WINCO.

Please call me if you have any questions.

Very truly yours,

Lincoln E. Malik

Lincoln E. Malik
President

LEM:rm

Enclosures

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Pg 28 of 40

AEC Job No. 1002-08

Evaluation of Existing Vaults for Vehicle Loads, HLWTFR Project

Project Manager
Dr. Lincoln E. Malik

Task Manager
Dr. Said Bolourchi

Prepared for
Westinghouse Idaho Nuclear Co., Inc.
Idaho Falls, Idaho

Prepared by
Advanced Engineering Consultants, Inc.
180 Montgomery Street, Ste 850
San Francisco, CA 94104

August, 1993

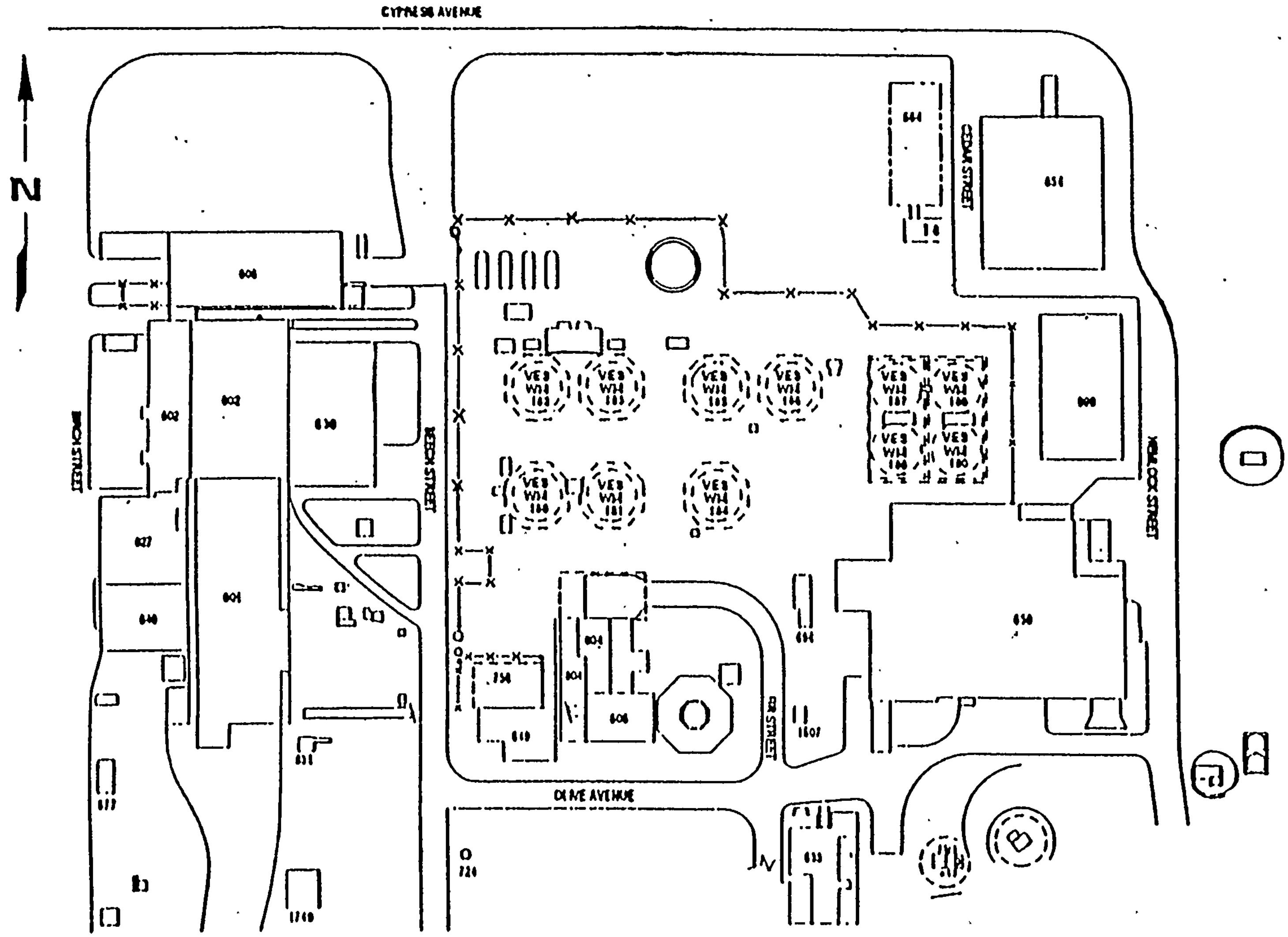


FIGURE 1 PLAN VIEW OF HIGH LEVEL WASTE (HLW) TANK FARM

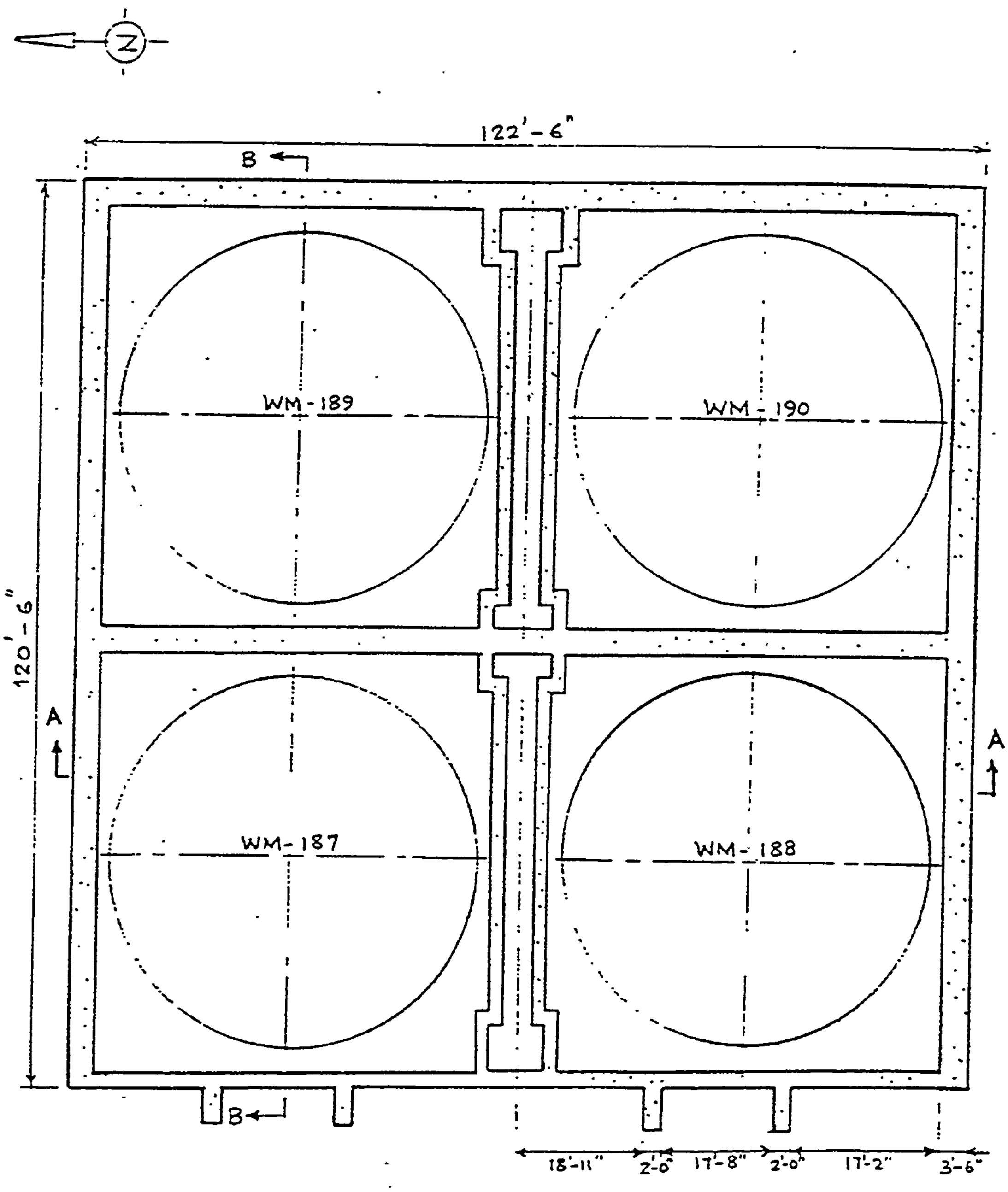


FIGURE 2 PLAN VIEW OF VAULT CPP-713

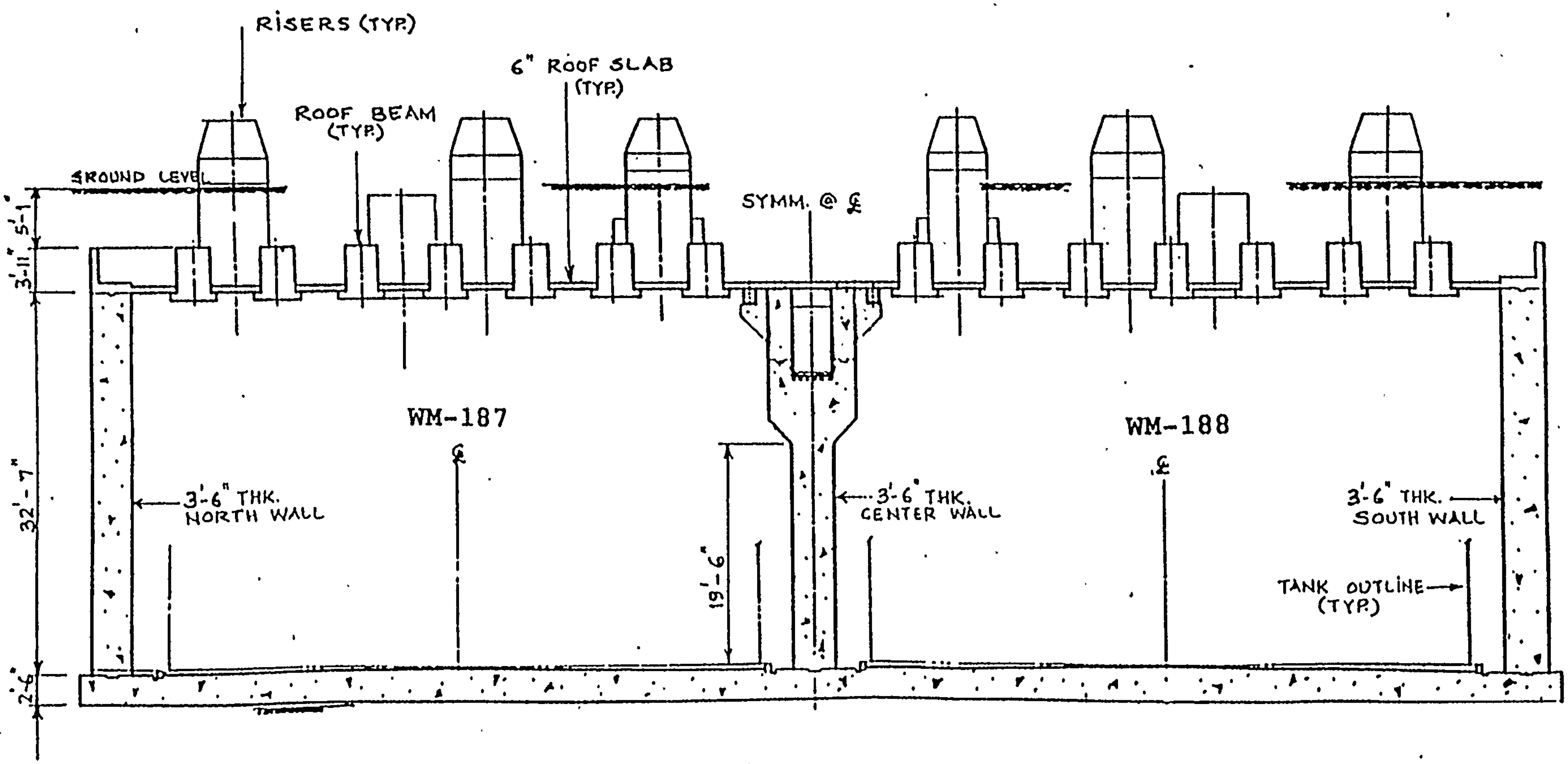


FIGURE 3 N/S SECTION (A-A) THRU VAULT WM-713

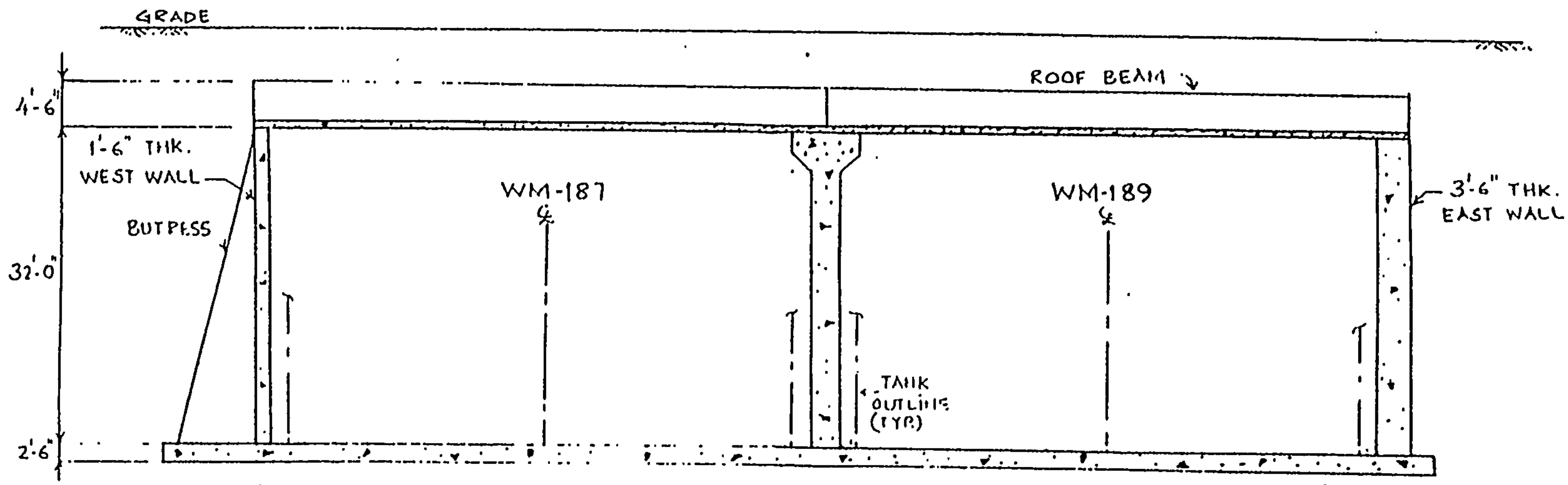


FIGURE 4 EAST-WEST SECTION (B-B) THRU VAULT CPP-713

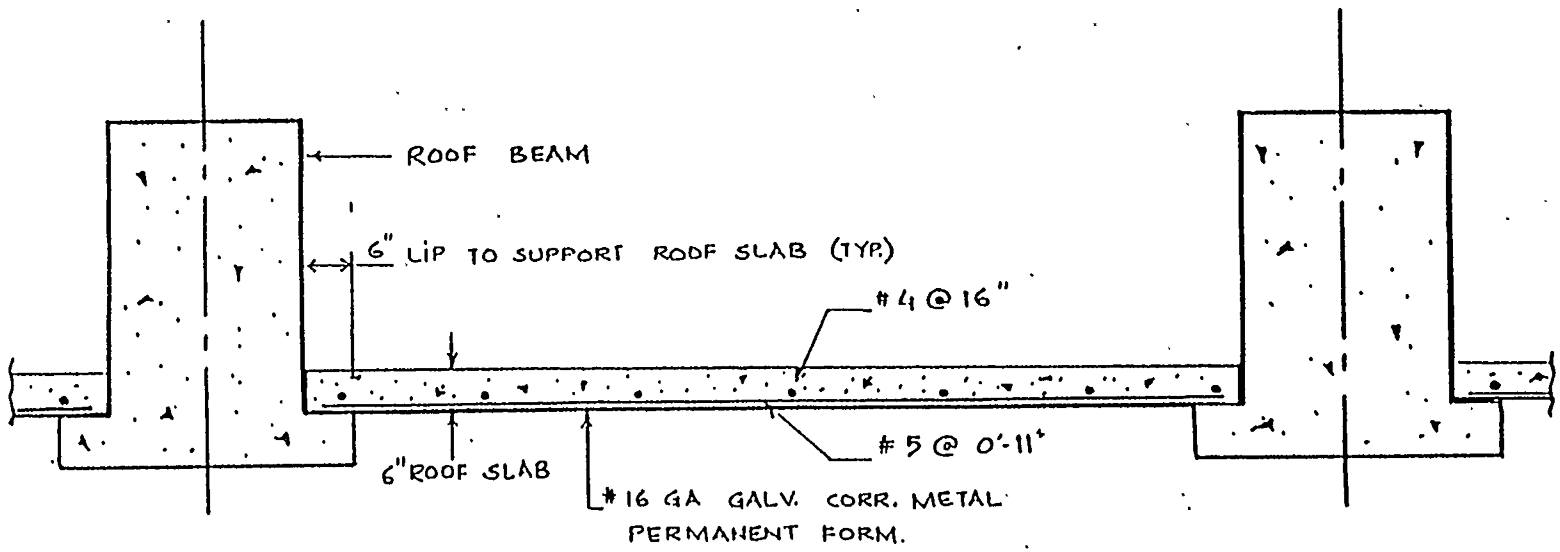


FIGURE 5 ROOF SLAB OF VAULT CPP-713

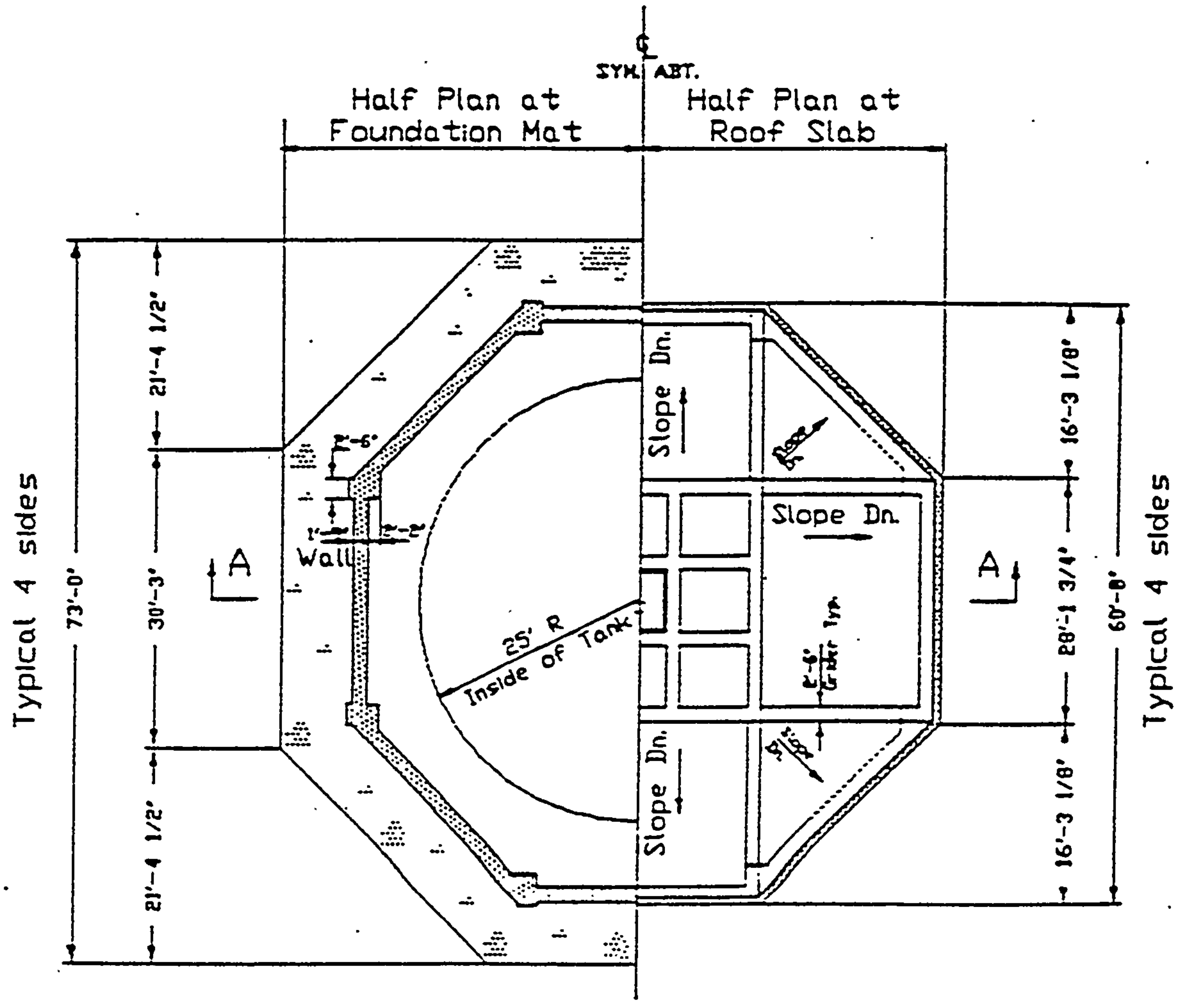
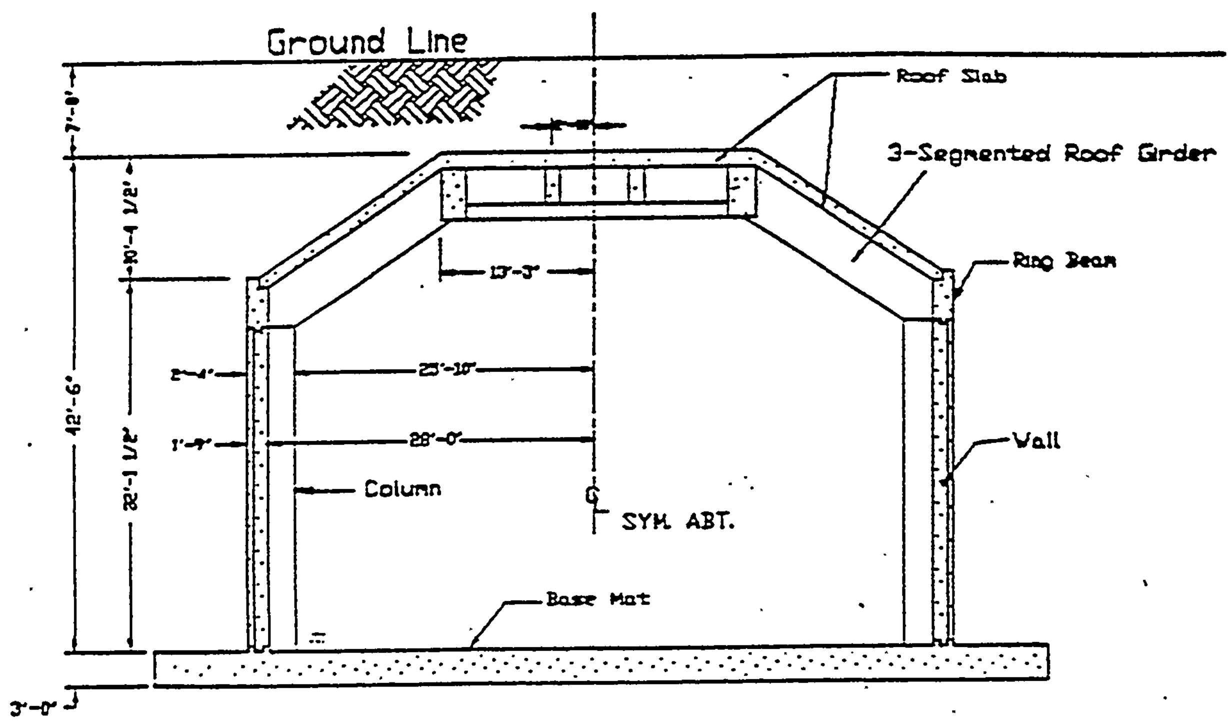


FIGURE 6 VAULTS CPP-780 & CPP-781



SECTION A-A

FIGURE 7 VAULTS CPP-780 & CPP-781

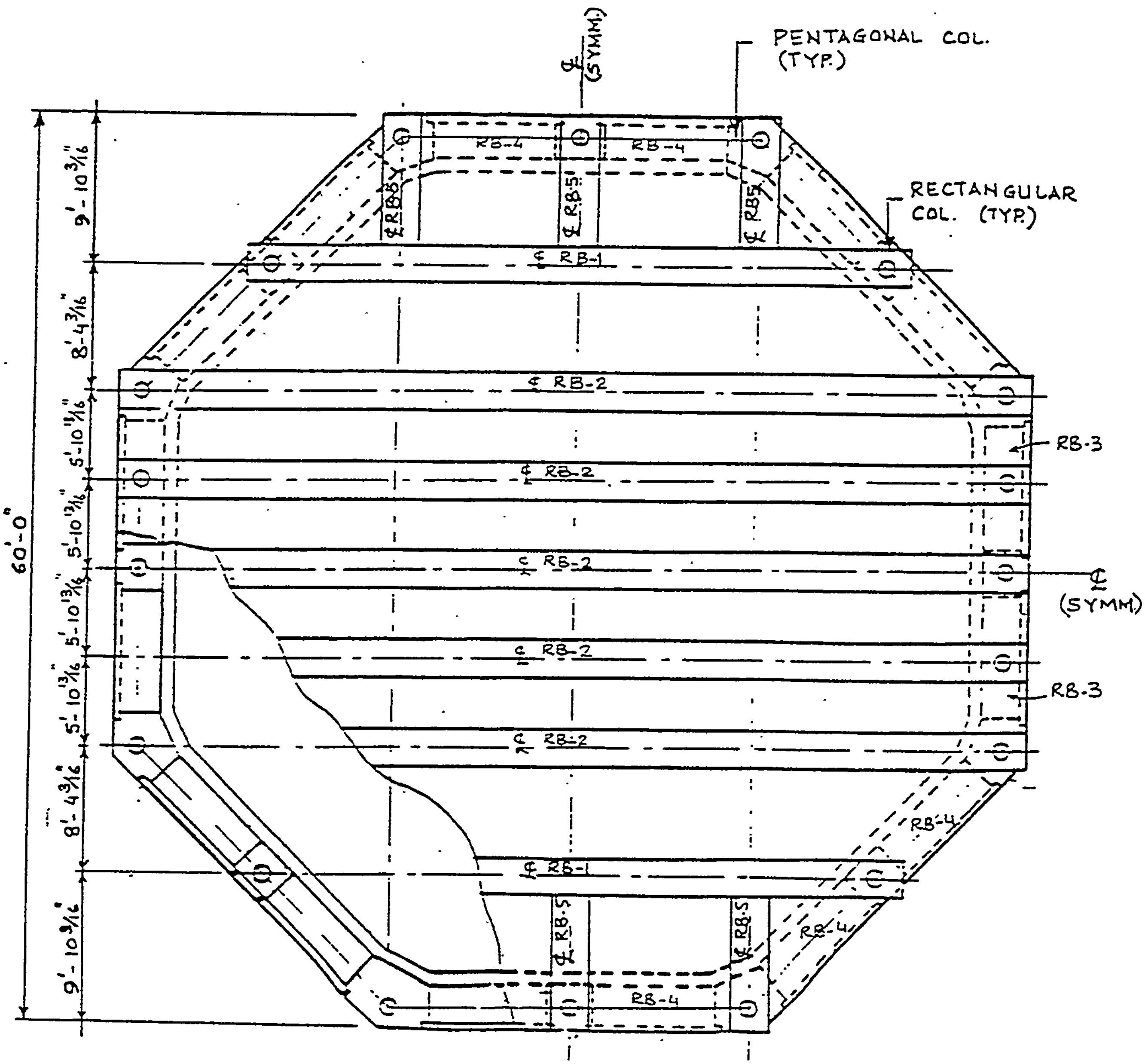


FIGURE 8 ROOF PLAN OF VAULT CPP-782 THRU CPP-784
(VAULTS CPP-785 & 786 ARE SIMILAR IN PLAN)

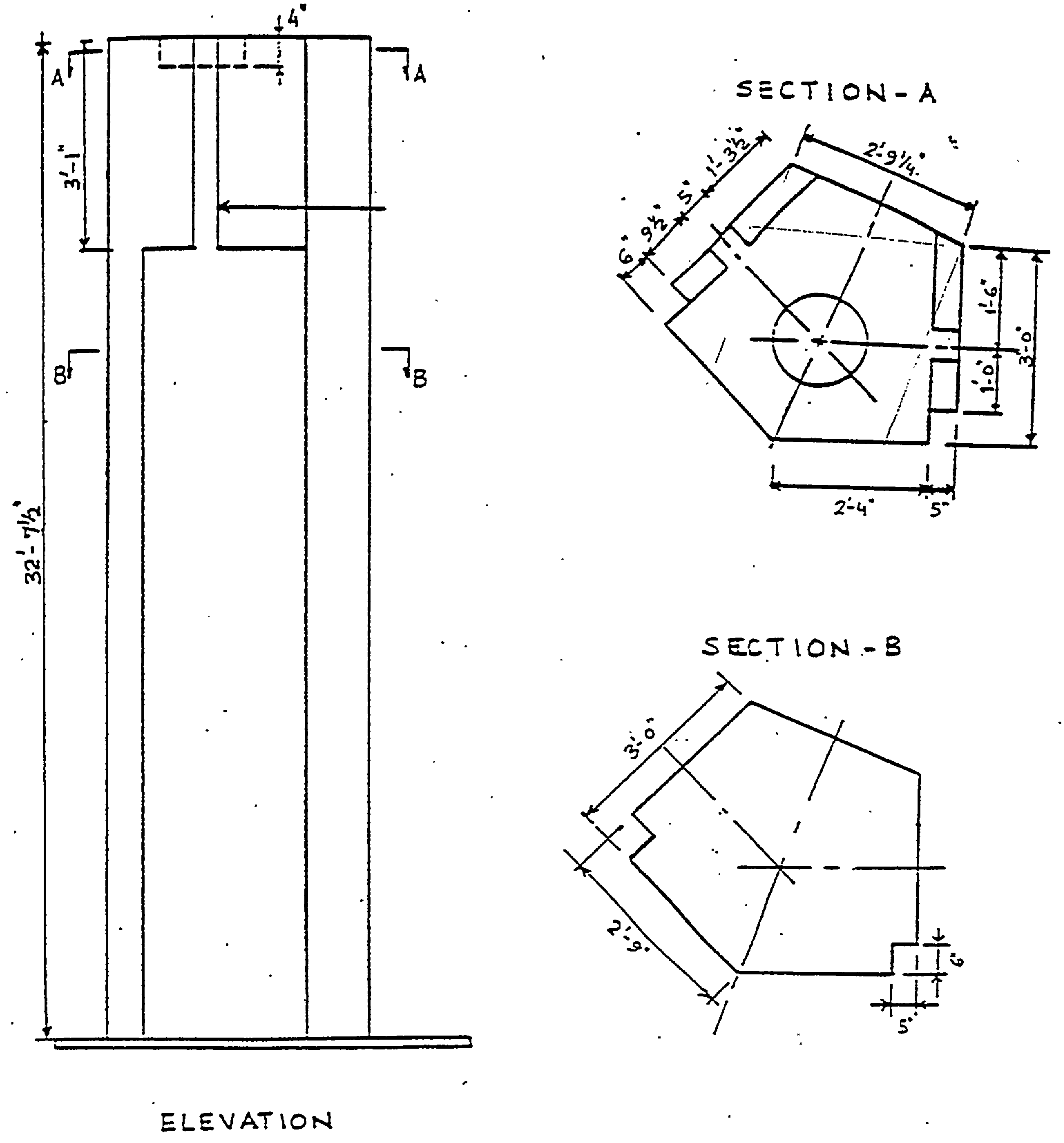


FIGURE 9 PENTAGONAL COLUMNS OF VAULTS CPP-782 THRU CPP-784 (VAULTS CPP-785 & 786 HAVE SIMILAR COLUMN DETAILS)

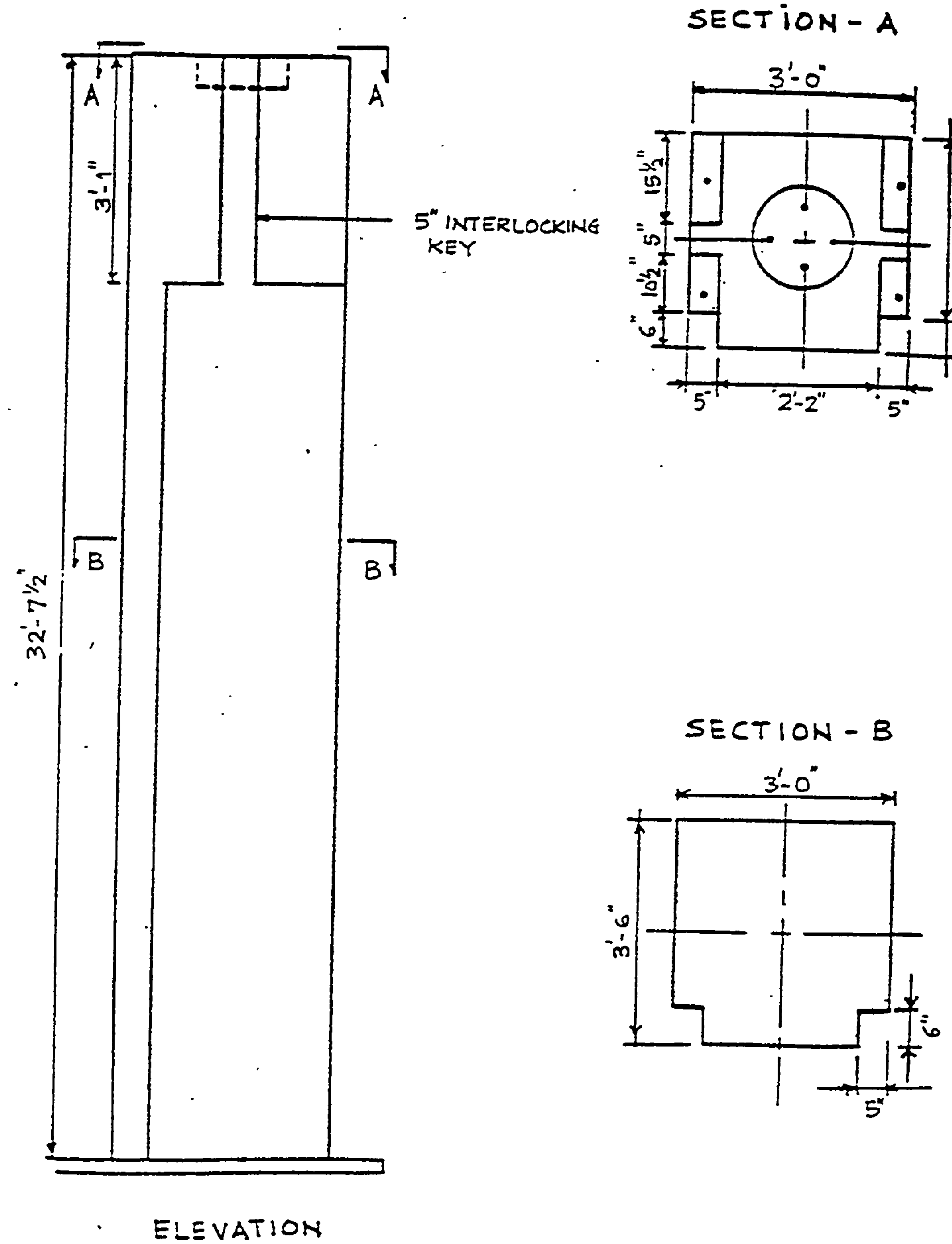


FIGURE 10 RECTANGULAR COLUMNS OF VAULTS CPP-782 THRU CPP-784
(VAULTS CPP-785 & 786 HAVE SIMILAR COLUMN DETAILS)

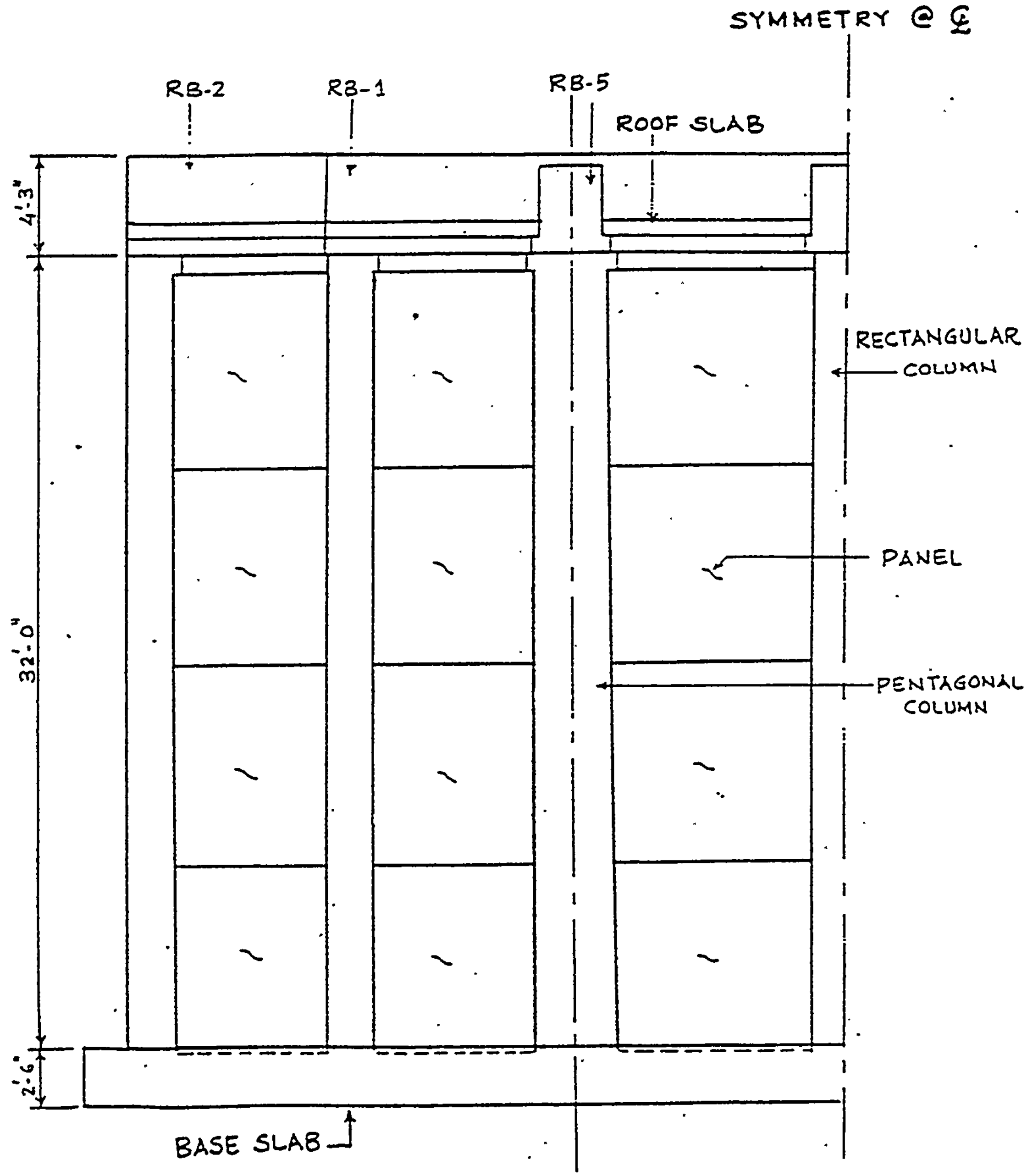


FIGURE 11 ELEVATION OF VAULT CPP-782 THRU CPP-784 (VAULTS CPP-785 & 786 ARE SIMILAR IN ELEVATION)

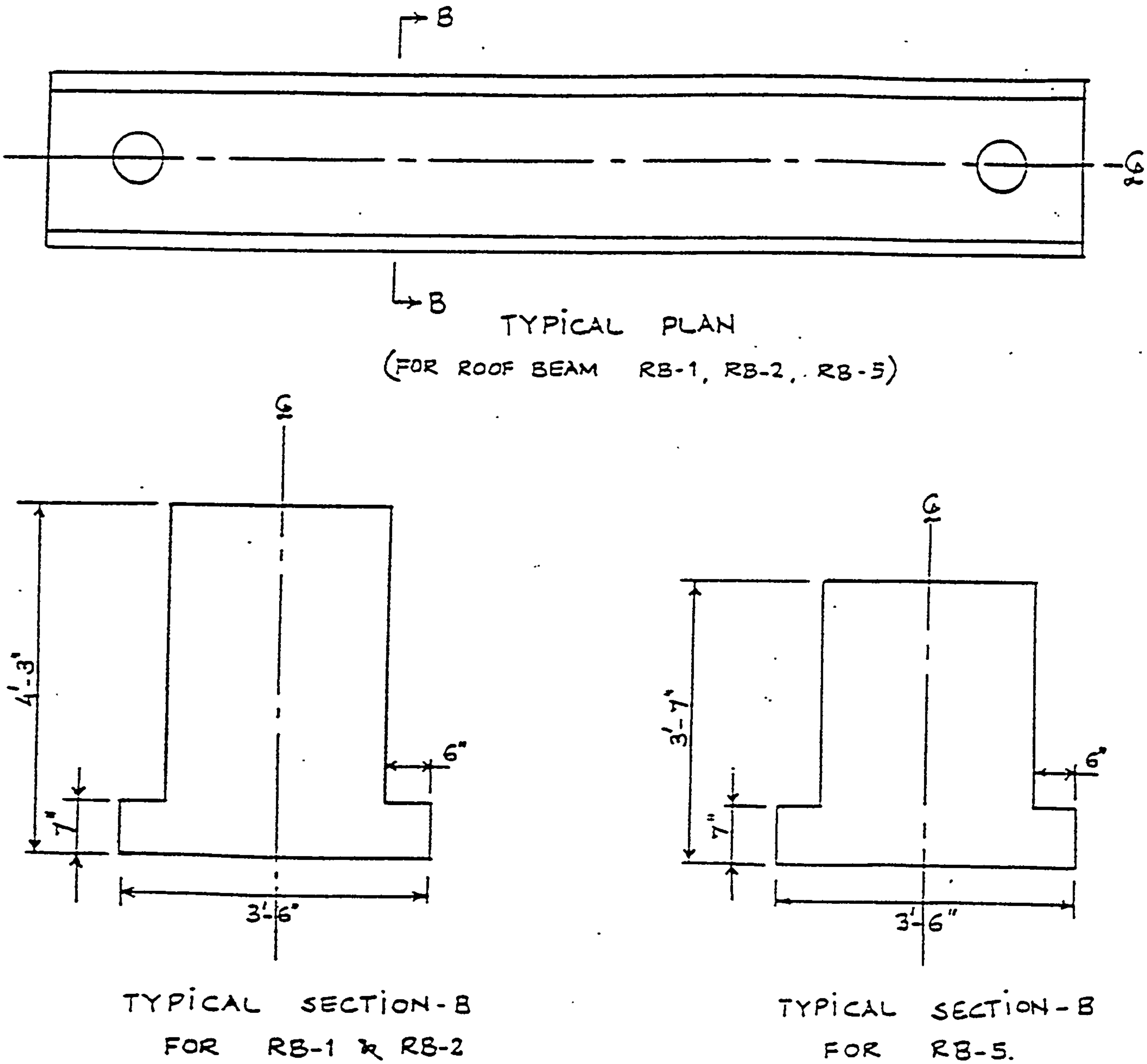


FIGURE 12 TYPICAL ROOF BEAM OF VAULTS CPP-782 THRU CPP-784
(VAULTS CPP-785 & 786 HAVE SIMILAR ROOF BEAM DETAILS)

INEL **ENGINEERING DESIGN FILE**

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501

EDF Serial Number EDF-TFC-017, Rev. 1

Functional File Number BC-15

Project/Task CPP Tank Farm Closure Study

Sub task Clean Closure of Tank Farm by Total Removal.

TITLE: D. Machovec Interview – Miscellaneous Topics for Clean Closure of Tank Farm and Vessel Offgas System

SUMMARY:

Interviewed David Machovec, Tank Farm Tank and Piping Expert, on September 30, 1997, concerning miscellaneous topics for clean closure and a temporary supplemental vessel offgas system.

Clean Closure –

In the interview, the piping encasements buried at the TFF were discussed. Specifics on how the piles, pile caps, encasements, and encasement liners were attached to each other were discussed and confirmed.

Demolition of the buildings on the surface of the TFF were identified and discussed. Also, verification was given on the percentage of duct banks located above the TFF membrane.

VOG System –

A number of items for the vessel offgas system were confirmed including: implementation of and recommendation on shielding, required double contained piping, HEPA filter change-out procedures, disposal of HEPA filters, piping materials to be used, movement and decontamination of VOG piping.

Distribution: B. R. Helm, MS 3765; B. C. Spaulding, MS 3765; M. M. Dahlmeir, MS 3765; D. C. Machovec, MS 5111; S. P. Swanson, MS 3765; Project File (Original +1)

Authors	Department	Reviewed	Approved
S. P. Swanson	MCSTE/4130	D Machovec Date 1/26/98	Date 1/27/98

Clean Closure –

In the interview, D. Machovec discussed the connections or methods of attachment for the large concrete piping encasements at the Tank Farm Facility. After reviewing a few drawings, a consensus was made on how the items are interrelated.

The piles are not physically attached to the pile caps by rebar as D. Machovec had previously thought. The pile caps are set on top of the piles, with the piles fitting into pre-fabricated holes in the caps. The piles only penetrate half way through the pile caps.

The pile caps are themselves attached to the pipe encasements with rebar, according to D. Machovec. When the encasements are attached to the pile caps in this fashion, it is difficult to simply lift the encasements from the pile caps. As a result, the gantry crane must remove both the pile cap and encasement at the same time for separation at another location.

The steel liner within the encasements is welded to the encasements by "lugs" that were set into the concrete. This is a process that is still used today. Removal of the liner would require these welds to be broken or sheared.

The piping located within the encasements is not "encased" in concrete. When the encasement caps are lifted off of the encasements, the piping is accessible. However, some junction boxes have short sections of tile encased piping that are currently abandoned (old style of encasements). The approximate length of these encasements is .5 miles. One line from CPP 641 to the Tank Farm has this type of encasement. Most of the original encasement has been removed.

The numbers that were acquired for M. Dahlmeir's EDF – TFC – 006 were applicable to the immediate area of concern. Pipe lengths did not include runs to the CPP stack or building including CPP 604.

The buildings that remain on the surface of the TFF (buildings 618, 619, 622, 623, 632, 712, 628, 631, 634, and 638 are primarily made of cinderblock walls. CPP-638 has been abandoned and is simply a wall structure – nothing remains inside of the building. CPP-635 and –636 are framed with steel and have Transcite siding.

The concrete duct banks at the TFF were also discussed. According to Machovec, approximately 75% of the duct banks are located below the soil membrane. All new duct banks are being constructed above the membrane.

VOG System –

A number of confirmations were made concerning the vessel offgas system requirements.

The temporary supplemental VOG will require shielding only on the ducting that precedes the HEPA filters. Ducting downstream of the HEPA filtration will most likely not require any shielding because 99.99% of the particulates will be captured in the filters.

Double contained piping will be required for the ducting that runs from the tanks to the filter skid units and the ducting that runs from the filter skid units to the PEW system. D. Machovec explained that this ducting could be single contained if a formal inspection is made to check for leaks every 24 hours. Documentation must be made to show that the inspections were made.

D. Machovec suggested using lead blankets to shield the portion of the piping that is upstream of the HEPA filters. These lead blankets weigh approximately 25 pounds each and can be placed directly overtop of the ducting by personnel.

To move the VOG lines to facilitate heel removal, the ducting can be disconnected, bagged at the ends, and taped. D. Machovec explained that it would most likely not be necessary to decontaminate the temporary ducting until the project has been completed.

D. Machovec also discussed plans to upgrade the valve boxes within the TFF. These upgrades will bring the valve boxes into compliance and will allow their continued usage past the year 2009. The drain lines from the valve boxes will not drain into the vaults, but will be jetted directly to the process system. Machovec also suggested that it is acceptable to tie into the PEW system by using the decontamination stubs on the process lines.

Machovec confirmed that the 125-fpm requirement for flow into the tanks is not an absolute. The tank must have flow into the tanks and this can be confirmed by smoke generators. There are no requirements for flow in the piping.

D. Machovec suggested using a glovebox attachment for the HEPA filter change-outs on the filter skid units. These glovebox attachments can be purchased from Flanders. After the HEPAs are removed, Machovec suggested sending them to the CPP-659 Calciner decon cell for disposal. At the cell, the center of the HEPA is punched out, and the center is dissolved – filter leach.

D. Machovec also discussed the current vacuum capacity of the tank farm. He indicated that the tank farm can now have a .5" negative pressure applied to the tanks. However, when a riser is opened on a tank that is towards the end of the VOG line, it is difficult to keep this vacuum on the tank, due to upstream vacuum relief valves opening (they open at .8" of w.c.). For example, if a riser is opened in a tank downstream of VES-WM-180, -181, or 184, the vacuum/pressure relief valves begin to "chatter" on the lines running to these tanks.

Stainless steel ducting should be used for the temporary supplemental offgas system at the TFF.

See the Plant Safety Document and General Plant Document for a list of how equipment is numbered and labeled.

INEL ENGINEERING DESIGN FILE

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(05-96-Rev.#02)

Project File Number 73501

EDF Serial Number EDF-TFC-018,Rev.1

Functional File Number BC-16

Project/Task CPP Tank Farm Closure Study

Sub task Clean Closure of Tank Farm by Total Removal

TITLE: M. Swenson Interview – Existing and Temporary Supplemental Vessel Offgas Systems

SUMMARY

Interviewed Mike Swenson, Tank Farm Systems Engineer, on September 29, 1997.

The main topics that were discussed concerned: the existing VOG system's vacuum capabilities, flow requirements into the tank and through ducting, decontamination methods, and the use of high efficiency metal filters (HEMF) at CPP.

Distribution: B. R. Helm, MS 3765; B. C. Spaulding, MS 3765; M. M. Dahlmeir, MS 3765; M. C. Swenson, MS 5104; S. P. Swanson, MS 3765; Project File (Original +1)

Authors	Department	Reviewed	Approved
[signature] S. P. Swanson	MC&IE/4130	M C Swenson Date 1-21-98	M C Swenson Date 1-21-98

By [signature] 2/2/98

According to Mike Swenson, there is no numerical requirement for the flow into the tanks when a riser is opened. The only requirement for containment is that the flow of air be into the tanks. This can and has been verified by using smoke generators at an open riser.

Currently, the existing VOG system at the TFF has the capacity for producing a negative flow into a tank when a 12" or 18" riser is opened. This operation is done for removing corrosion coupons or for video inspections. Opening the risers is not a "routine" operation and is conducted on a less than annual basis. Total time duration for tank risers is less than 20 hours (2 shifts).

M. Swenson indicated that the vessel pressure/vacuum relief system is currently unable of providing a .5" negative pressure on the tanks at the extreme end of the header.

To decontaminate the existing VOG lines, water can be used as the decontamination liquid. According to M. Swenson, there is not enough contamination within the lines to require a nitric solution for decontamination. The decontamination of the lines would require a tremendous amount of water because the lines can not be isolated and are large (up to 12" diameter). It would require more equipment than is presently available at the CPP facility.

In order to decontaminate the PEW lines, the sump areas of the vaults can be filled and the sump jets activated.

High Efficiency Metal Filters (HEMF) have been discussed in the past for applications at CPP. However, for one reason or another, HEMFs have not been used. M. Swenson suggested using a HEPA filter as the pre-filter to the required HEPA filters. Swenson indicated that this was a standard procedure and is cost effective.

For the existing VOG system, gases are being fed through two HEPA filters before release into the environment. M. Swenson suggested that if the heel removal activities did not produce a lot of air borne contamination, two HEPA filters in series would be adequate. However, if there is going to be a lot of sparging and steam jetting, three HEPA filters in series are recommended. Demisters are also required upstream of the HEPA filters to remove airborne liquid from the offgas.

Swenson indicated that there are no particular requirements for the filter skids except that loading, shielding, heating and ventilation must be addressed. The gases should be superheated before entering the main ducting to prevent any condensation. Condensation prevention can also be achieved by insulation or heat trace.

M. Swenson also indicated that there is no need for double contained VOG piping because the waste is not under pressure and is therefore not under RCRA regulations. However, if there is liquid condensate, double contained drain lines are necessary.

INEL ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501
EDF Serial Number EDF-TFC-019, Rev. 1
Functional File Number CB-01

Project/Task CPP Tank Farm Closure Study
Sub task Total Removal Clean Closure of the Tank Farm

TITLE: Jet-Grouted Polymer and Subsurface Walls

SUMMARY

The attached information and basic sizing calculations provide a basis for the costs associated with jet-grouting a subsurface cement wall to support the two gantry cranes proposed for use during retrieval activities. The costs for jet-grouting a paraffin-based product to encapsulate the contaminated soil in the Tank Farm for contamination control purposes are also presented.

A total of 2,220 holes would be required for the subsurface cement walls at an estimated cost of $1.72M. This cost includes mobilization, demobilization, decontamination, operating, and training costs.

The total cost for encapsulating the soil in a paraffin based grout is estimated at $106.9M, which includes mobilization, demobilization, decontamination, operating, and training costs.

Twelve holes can be jet-grouted per day, assuming a double shift.

Please note that this EDF only discusses the supports needed for the proposed gantry cranes. The weather enclosure, primary and secondary containment structures mentioned in EDF-TFC-013 would require separate footings. These footings are not discussed in this EDF, as it is not known exactly what type of enclosure and containment structures will be used, or the type of footings required for each structure. It is assumed that the required footings for the structures would be determined during the design phase of Total Removal Clean Closure.

Revision 1: Subsurface walls were brought up to grade level rather than stopping 10 feet below grade. This increased the estimated cost for the subsurface walls from $1.6M to $1.72M.

Distribution: B. C. Spaulding, MS 3765; B. R. Helm, MS 3765, M. M. Dahlmeir, MS 3765; F. P. Hanson, MS 3655; S. P. Swanson, MS 3765; K. D. McAllister, MS 3765; Project Files (Original +1)

Authors	Department	Reviewed	Approved
M. M. Dahlmeir (signed) 10/29/97	MC&IE/4130	(signed) 10/30/97	(signed) 10/30/97

Subsurface cement walls would be jet-grouted into the Tank Farm in order to increase the allowable loading throughout the Tank Farm area sufficiently to support two gantry cranes (see Sketch 1). These walls would serve as the structural support for the cranes proposed for use during retrieval activities. [A similar subsurface wall was shown to support a 98,000 pound excavator in the excavation position (excavator located on the edge of a vertical excavation wall with the boom extended) during full-scale demonstrations – see Reference 4]. Each wall would be approximately 50 feet in height, extending from grade level to 50 feet below grade. Four walls of varying lengths (560 feet, 200 feet, and 2 @ 360 feet) would be needed to support the crane and associated rail system (see Sketch 1). Assuming a wall three holes wide on a triangular pitch with a spacing of two feet diametrically between holes (see Sketch 2 for an example of the hole spacing), the following number of holes would be required:

For the 560 foot wall:

560 ft/2 ft diameter hole * 3 holes wide = 840 holes

For the 200 foot wall:

200 ft/2 ft diameter hole * 3 holes wide = 300 holes

For the 360 foot walls:

360 ft/2 ft diameter hole * 3 holes wide * 2 walls = 1,080 holes

Total Number of Holes Required for Walls:

840 + 300 + 1,080 = 2,220

The cost to grout each hole is estimated at $500 (Reference 1). This cost includes mobilization, demobilization, decontamination, and operating costs. The cement used to create the walls is an additional $0.49 per gallon ($99.00 per cubic yard). Each hole requires 100 gallons (0.5 cubic yards) of cement per 9 foot length (Reference 2).

Estimated cost to grout each hole:

Cost per hole = (100 gallons * (50 feet/9 feet) * $0.49) + $500 = $773

Total Estimated Wall Cost:

Total Estimated Cost = $718 per hole * 2,220 holes = $1.72M

The volume of soil that would be encapsulated in a paraffin based stabilization media is 131,000 cubic yards (Reference 3). It costs an estimated $816 per cubic yard to grout using a paraffin-based stabilization media (Reference 4).

Estimated Paraffin-Based Media Encapsulation Costs:

Total Estimated Cost = 131,000 cubic yards * $816 per cubic yard = $106.9M.

Total Estimated Cost for Jet-grouting (Walls and Paraffin Based Media Encapsulation):

Estimated Grand Total = $1.72M + $106.9M = $108.62M

The drilling time required to jet-grout either cement or a paraffin-based grout is estimated to be 10 minutes per 8 feet (Reference 1). Assuming grouting is done on double shifts and approximately 3.5 hours are required for set-up, take-down, shift changes, etc., approximately12.5 hours are available for drilling.

Estimated Number of holes grouted per day:

Holes/day = 12.5 hours/[(10 minutes/8 feet) * 50 feet/hole*(1 hour/60 minutes)] = 12 holes/day

References:

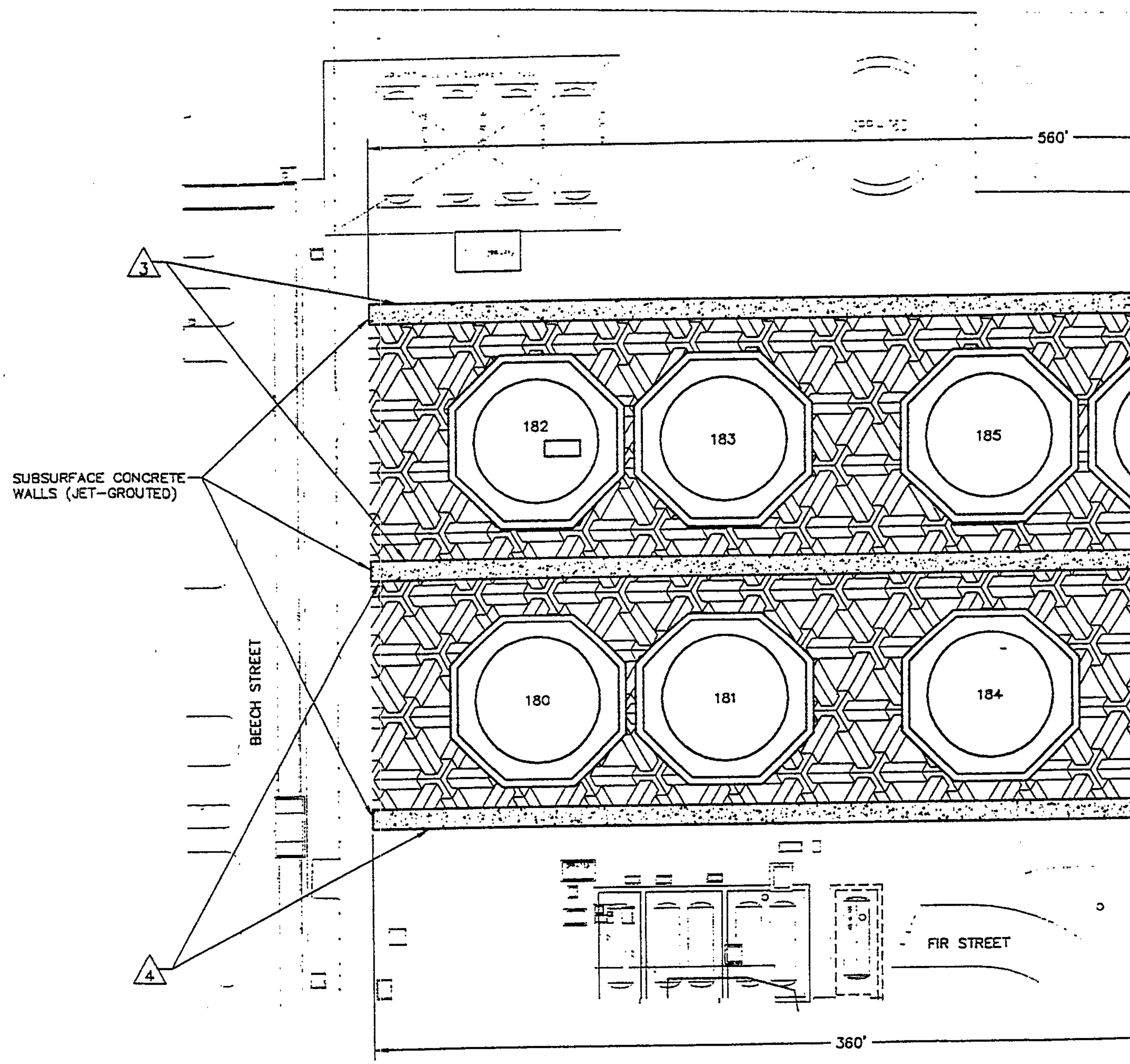
1. Conversations with G. G. Loomis, subject matter expert, October 7, 1997.

2. *Innovative Subsurface Stabilization of Transuranic Pits and Trenches*, Guy G. Loomis, David N. Thompson, and John H. Heiser, December, 1995, INEL-95-0632.

3. *Take-off Calculations for the Total Removal of Soils and Structures at the Tank Farm Facility*, EDF-TFC-016.

4. *Hot Spot Removal System: System Description*, September, 1997, INEEL/EXT-97-00666.

GRADE PREPARATION



NOTES:

1. BUILDINGS MUST BE REMOVED FOR SITE PREPARATION.
2. TWO GANTRY CRANES OF DIFFERENT SIZE ARE REQUIRED FOR EXCAVATION.

(3) NORTH TRACK FOR GANTRY CRANE #1.

(4) SOUTH TRACK FOR GANTRY CRANE #1.

(5) TRACK FOR GANTRY CRANE #2.

User: ETI Date: 10/22/97 - 3:12 P.M.

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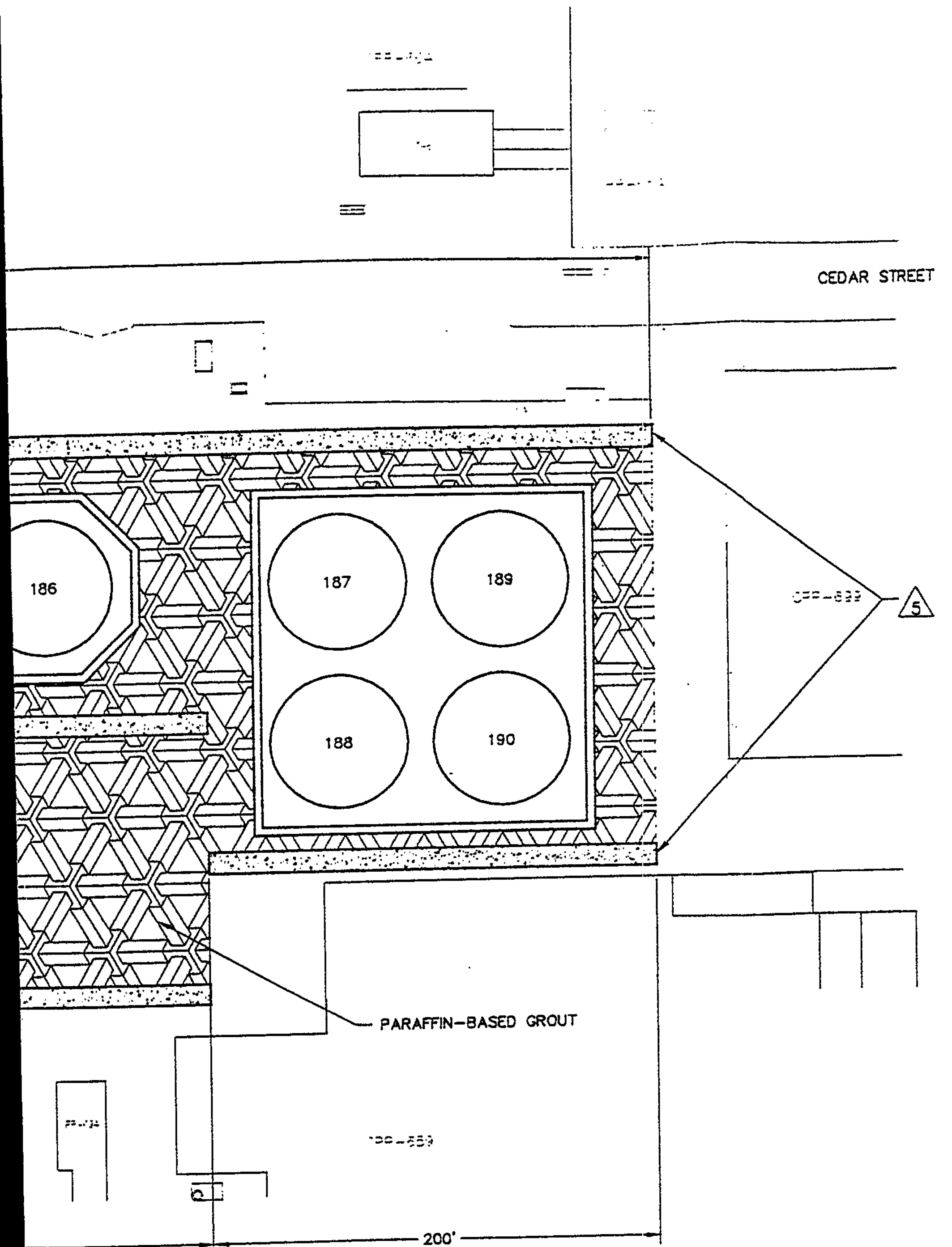
AND JET-GROUTING

4	3	2	1

REVISIONS

REV	DESCRIPTION	EFFECTIVE DATE



D

C

B

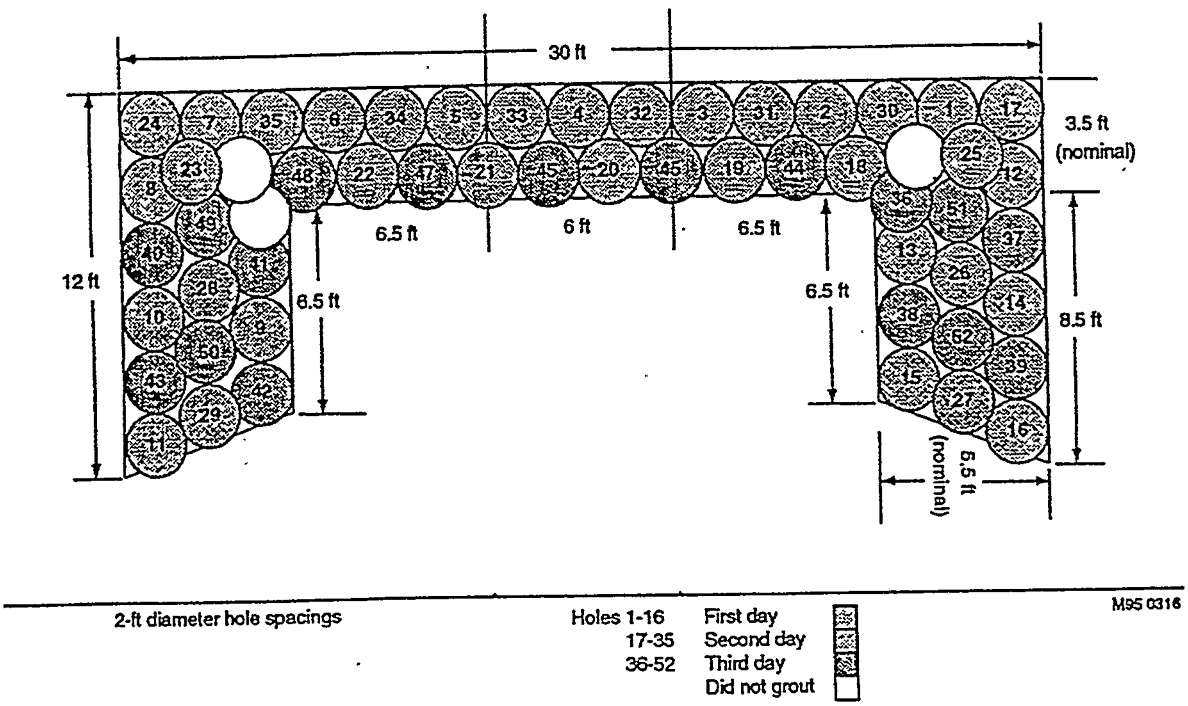
A

20' 40' 60' 80' 100'

(DO NOT SCALE OFF OF THIS DRAWING)

SUBCONTRACT NO.	LOCKHEED MARTIN
REQUESTER:	TANK FARM CLOSURE STUDY TOTAL REMOVAL CLEAN CLOSURE GRADE PREPARATION AND JET GROUTING
DESIGN: STEVEN SWANSON	
DRAWN: ERIC E THOMAS	
PROJECT NO.	
SPEC CODE	
FOR REVIEW/APPROVAL SIGNATURES	SIZE: D · CAGE CODE: 01MF3 · INDEX CODE NUMBER (AREA, TYPE, ..., DISC): 530 · DWG-SK7-3 · REV
SEE DAR NO.	SHEET 1 OF 1

Sketch 2: Drill/grout holes for wall (Graphic M95 0316) taken from Reference 2



It should be noted that some parts of the original drawing were cropped for clarity on this sketch, as they did not apply to this EDF. The entire subsurface wall for the Tank Farm application would be 3 holes wide on a triangular pitch, as shown on the left and right portions of this sketch.

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501

EDF Serial Number EDF-TFC-020

Functional File Number C-2

Project/Task CPP Tank Farm Closure Study

Sub task Total Removal Clean Closure

TITLE: Exposure Calculations for Total Removal Clean Closure of the Tank Farm

SUMMARY

The following Engineering Design File presents the estimated radiological exposure to personnel during Total Removal Clean Closure (TRCC) of the Tank Farm Facility (TFF). These estimates are based on ICF Kaiser Engineering's (ICF KE) methodology for estimating exposure. Due to the unknowns associated with subsurface work, and the inherent possibility of encountering higher radiation fields than expected, these estimates should be considered preliminary. A more thorough investigation would be warranted during the design phase of the project.

For this Total Removal Clean Closure study, manhours, time in contaminated areas, and dose rates were taken from ICF KE's analysis, unless specific tasks were not applicable, deemed incorrect, or were left out. In such a case, the manhours, the time spent in contaminated areas, and the dose rate were assumed using engineering judgment and related Engineering Design Files. Table 1 shows the expected personnel exposure during total removal activities.

These exposures are intended as rough order of magnitude numbers only. The estimated exposure calculation portion of Reference 1, prepared by ICF Kaiser Engineering, is attached to this EDF. The manhours indicated in the calculations are based on the cost estimates done by ICF Kaiser Engineering and manhours estimated during this Total Removal Clean Closure study. The dose rates were determined by engineering judgment. See Reference 1 for ICF Kaiser Engineering's results.

The total personnel exposure during Total Removal Clean Closure of the Tank Farm Facility is estimated at 9,433 R.

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Authors	Department	Reviewed	Approved
Steven Swanson	MC&IE/4130	Date 12-9-97	Date 12/9/97

ICF Kaiser Engineering (ICF KE) provided Westinghouse Idaho Nuclear Company (WINCO) a rough order of magnitude estimate for the radiation exposure personnel could be introduced to during tank heel removal; ancillary piping and valve box decontamination; demolition of piping, equipment, tanks, vaults, and buildings; and soil removal. See Reference 1.

In their approach, ICF KE assumed that personnel would receive 50 mR/hr during valve box extractions, 25 mR/hr around condenser pits and contaminated soils, and 200 mrem/hr during remote excavation activities. The manhours required to perform each task were taken from the cost estimate performed by ICF KE. The amount of time spent by personnel in contaminated areas was assumed for each major task by using engineering judgment. To calculate the estimated personnel exposure for a task, the following equation was used:

(Manhours) * (%Contaminated) * (Dose Rate) = R

The manhours for a task were multiplied by the percent of the time spent in contaminated areas, and multiplied by the estimated dose rate.

For the purpose of this rough order of magnitude estimate, the ICF Kaiser estimates are assumed to be adequate, with the following exceptions: (1) modifications were made to ICF KE's manhours for both "Install/Remove Enclosure" and "Size Excavation Piping", in order to match the current proposal activities; (2) additional manhours were included for the teleoperated cranes "Relocation of Teleoperated Cranes"; (3) "Soldier Beams/Lagging" was replaced with "Sub-Surface Walls and Stabilization"; (4) "Site Characterization Set-up/Takedown", and "On-going Characterization" were added; and (5) "Chip Contaminated Surface" was removed. See Table 1 for the results of the exposure calculations.

For tasks that have been added or modified (References 1* and 3), see the attached calculation sheets for a description on assumptions, references, and calculations.

Table 1. Results of the personnel exposure calculations.

TASK	MANHOURS	%CONTAMINATED	DOSE RATE	EXPOSURE	REFERENCE
CLEAN UP AND ISOLATE TANKS	21,525	30	50mR/hr	323 R	1
HEEL REMOVAL				22 R	1
MASS EXCAVATION	688,400	30	25mR/hr	5200 R	1
DEMOLISH TANKS (operate remote equipment)	80,300	100	25mR/hr	2008 R	1
INSTALL/ REMOVE REMOTE EQUIPMENT	19,800	100	25mR/hr	500 R	1

INSTALL/MOVE ENCLOSURE	3,300	50	25mR/hr	41 R	1* (ICF KE originally based numbers on one enclosure, we are using 2 enclosures that are installed, moved, and disassembled 3 times)
INSTALL/MOVE VENTILATION	2,200	100	25mR/hr	55 R	1
CUT UP/DISPOSE OF REMOTE EQUIPMENT, SUPPORTS, AND ENCLOSURE	5,000	100	25mR/hr	125 R	1
SIZE EXCAVATED PIPING	15,900	100	25mR/hr	398 R	1* (ICF KE based numbers on an 11 mile estimate – we are assuming 52 miles of piping)
SUB-SURFACE WALLS AND STABILIZATION	3,700	100	25mR/hr	93 R	Based on information from EDF-TFC-019
MONITOR/SEAL BOXES AND CONTAMINATED MATERIALS	19,200	100	25mR/hr	480 R	1
SITE CHARACTER-IZATION	672	30	25mR/hr	5 R	3
ONGOING CHARACTER-IZATION	9,216	30	25mR/hr	69 R	3
RELOCATION OF TELEOPERATED CRANES	560	100%	25mR/hr	14 R	3
SOIL TESTING	3,950	100	25mR/hr	100 R	1
TOTAL	873,723			9,433 R	

Table 1 indicates that the approximate exposure to personnel during Total Removal Clean Closure of the Tank Farm Facility is approximately 9,433 R. It would require approximately 873,723 manhours to complete the tasks.

The original ICF KE calculations for the personnel exposure estimates are attached to this EDF.

References

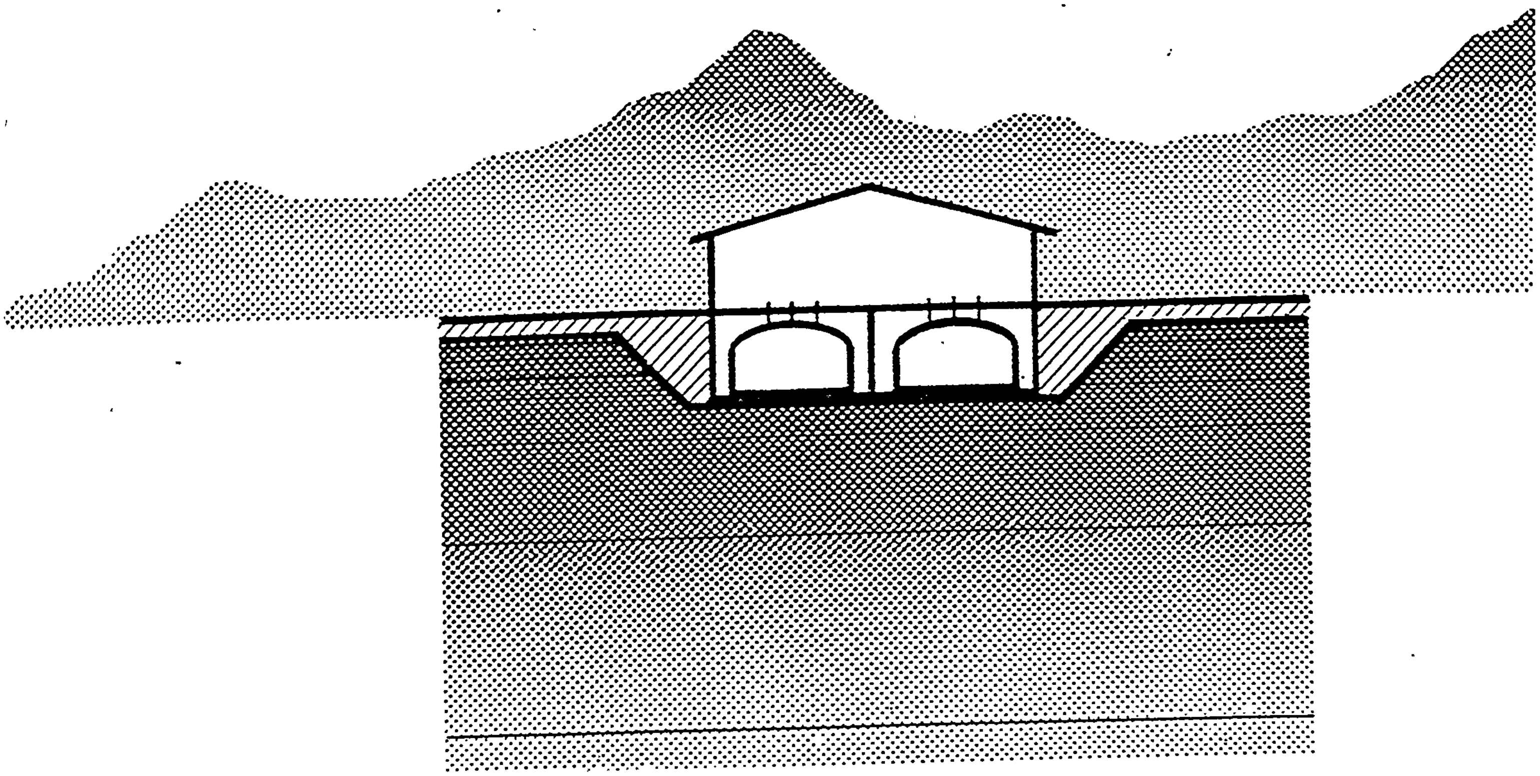
1. ICF Kaiser Engineering, RCRA Closure Study for the ICPP High Level Waste Tank Farm, RPT-032, April 1994.

2. Addendum 16 to the ICF KE Scope of Work Statement, Modification No. 13 to WINCO Subcontract No. 218014, transmitted by letter WI KE 93-0482, dated 8/4/93, Engineering Study for ICPP heel Removal and Handling.

3. Tank Farm Closure Study Cost Estimate. Estimate File #2407. Performed by F. P. Hanson.

2.8

HIGH LEVEL WASTE
TANK FARM
REPLACEMENT PROJECT



RCRA Closure Study for the ICPP High Level Waste Tank Farm

Westinghouse Idaho Nuclear Company, Inc.

ICF KAISER ENGINEERS

Appendix C

EXPOSURE ESTIMATES FOR RCRA CLOSURE ALTERNATIVES

This Appendix addresses how ICF KE estimated the radiological exposure to personnel in implementing the different phases of the RCRA Closure of the ICPP tank farm. The different phases of RCRA Closure alternatives are described in Section 6 of this report. In looking at the different phases of the RCRA Closure alternative, ICF KE made manhour estimates for the tasks involved, which are reflected in our cost estimates in Appendix B. ICF KE made a judgment of the percentage of the manhours of each task that would be in radiologically contaminated areas. Those hours judged to be performed in radiologically contaminated areas would then be done in radiation fields averaging 50 mR/hr in valve boxes and 25 mR/hr in condenser pits and around contaminated soil. These radiation fields are based on the experience at ICPP during construction of valve box upgrades work currently being performed. To illustrate, say a task took 200,000 hours to perform and ICF KE judges that 20% of the task is performed in a radiologically contaminated area. This means 40,000 hours will be the exposure time for workers. Multiplying 40,000 manhours by 25 mR/hr would give a total exposure for that task of 1000 R.

Phase 1, which is common to all the RCRA Closure alternatives ICF KE is looking at, is the decontamination and flushing of all the piping, secondary containment piping, trenches, tank vaults, and valve boxes, removal of the heel from the tank, and isolation of the tank to prevent future contamination. The total manhours estimated for decontamination and isolation of the piping, boxes and trenches is 21,525 manhours. ICF KE assumed 30% of this work is in contaminated areas. Total estimated exposure for decontamination, flushing and isolation is 320 R. The total exposure for removal of the heel from each task is being determined by the Engineering Study for ICPP Heel Removal and Handling (Reference 4), which is being performed by ICF KE. The preliminary results for this study show that the total exposure for heel removal activities is 22 R. The total estimated dose for Phase 1 activities is 342 R. A summary of the tasks and estimated exposures is provided below.

Phase 1 - Decontamination and Isolation

TASK	MANHOURS	% CONTAMINATED	EST. EXPOSURE
cleanup and isolation	21,525	30	320 R
heel removal			22 R
TOTAL			342 R

Phase 2A is the complete dismantlement and removal of ICPP tank farm. Phase 2A would occur after Phase 1. For the tanks and vaults, Phase 2A would require excavation to the vault roof, removal of the vault roof, remote cutting of the tank into small pieces, remote removal of the contaminated sand bed under the tank, remote chipping of the contaminated vault internal surfaces to a depth of 1/4 inch, the demolition and removal of the clean concrete vault, and backfilling the hole. In excavating to the tank, all the valve boxes, trenches and piping above the tanks must be demolished and removed.

ICF KE estimated the dose rate in the tank vault after heel removal to be on the order of 200 mrem/hour. This dose rate is based on an initial dose rate of 1000 R/hr to 500 R/hr dose rate from the tank heel. The heel removal and flushing might get a reduction of 1000. Aggressive decontamination, i.e., the example of G-cell in Section A.8.2 in Appendix A of this report with about 30 flushes, might get the levels down to 100 to 50 mrem, but not likely because of the contamination traps in the tanks, like cooling coils and mounting brackets and the fact that this would create excessive waste. To send workers into the vault or tanks would not be feasible because they would be limited by the dose rate to an unreasonably short time or by the difficultly in trying to shield them. Therefore, ICF KE concluded that any work in the vaults or tanks had to be done remotely. A summary of the tasks and estimated exposure for dismantlement and removal is provided below.

Phase 2A - Dismantlement and Disposal

TASK	MANHOURS	% CONTAMINATED	EST. EXPOSURE
mass excavation	688,400	30	5200 R
demolish tank (operate remote equipment)	80,300	100	2000 R
install/move remote equipment and trusses	19,800	100	500 R
chip contaminated surface	1,584	100	40 R
install/move enclosure	1,100	50	10 R
install/move ventilation	2,200	100	60 R
cut up/dispose of remote control equipment, encl.	5,000	100	130 R
cut up excav. pipe	3,300	100	80 R
soldier beams/lagging	92,575	100	2300 R
monitor/seal - boxes, contaminated mat'l	19,200	100	480R
soil testing	3,950	100	100 R
TOTAL	909,109		10900 R

If the work in Phase 2A for dismantling the contaminated tank and vaults were not done remotely, ICF KE estimated what the total exposure might be, assuming that exposure time is not a problem. The total manhours to dismantle the tanks and chip away the internal surfaces of the vault is 81,884 manhours, and the dose rate is 200 mrem/hour, then the total potential exposure to the workers is 16,377 R. We wish to note that for these same tasks, using remote equipment, the total estimated exposure is 2040 R. ALARA principals would more than justify the expenditure of $5M to $10M for remote equipment and extra time to save on the order of 14,000 R exposure.

Phase 2B provides a RCRA cap over the ICPP tank farm. ICF KE assumes that a bypass needs to be built from valve box DVB-C40 to DVB-B11, because the existing line from DVB-C40 to DBV-B11 would not be allowed to operate under the RCRA cap. The existing facilities at or above grade would have to be demolished so that the RCRA cap can be installed. ICF KE assumed that the tanks and vaults had to be filled with lean concrete in order to support the weight of heavy equipment and RCRA cap above the ICPP tank farm. The demolition of structures is estimated to take 12,825 manhours, of which 20 % is assumed in contaminated areas. Demolition results in 60 R exposure. Filling the vaults and tanks with lean concrete is estimate to take 27,000 manhours, of which 20 % of the time is in contaminated areas. Filling the tanks and vaults results in 140 R exposure. The installation of the bypass line is estimated to take 3000 manhours, of which 30% is assumed in contaminated areas. The bypass line results in 20 R exposure. A summary of the exposure estimates is provided below.

Phase 2B - RCRA cap

TASK	MANHOURS	% CONTAMINATED	EXT. EXPOSURE
demolishing structures	12,825	20	60 R
filling tanks/vaults	27,000	20	140 R
installing bypass line	3,000	30	20 R
TOTAL	42,800		220 R

Phase 2C provides a risk assessment after Phase 1 is completed. There are no tasks in Phase 2C which are performed in a radiologically contaminated areas. Therefore, estimated exposure for Phase 2C is zero.

Install/Move Enclosure

ICF KE used one enclosure and moved it around. The current proposal calls for 2 enclosures [one enclosure is relocated and remobilized and demobilized]. As a result, the manhours were tripled for this category, when compared to ICF KE's estimate.

Size Excavated Piping

ICF KE assumed 11 miles of trenching "encasements" and piping. For this proposal, based on EDF-TFC-006, 52 miles of encasement and piping will be used for calculations.

$$\frac{3{,}300 \text{ manhours}}{10.8 \text{ miles}} = \frac{X}{52 \text{ miles}} \Rightarrow X = 15{,}900 \text{ manhours}$$

$$15{,}900 \text{ manhours} \left(25 \frac{mR}{hr}\right) = \boxed{398 R}$$

Sub-Surface Walls and Stabilization

The manhours for the sub-surface walls and stabilization are based on EDF-TFC-019.

2,220 holes are required for grouting
12 holes can be jet-grouted in 20 hours

$$\text{Manhours} = (2{,}220 \text{ holes})\left(\frac{20 \text{ hours}}{12 \text{ holes}}\right) = 3{,}700 \text{ manhours}$$

Assuming 100% of the time is spent in a contaminated area with a dose rate of 25 mR/hr.

The exposure is equal to

$$\Rightarrow (3{,}700 \text{ manhours})\left(.025 \frac{R}{hr}\right) = \boxed{93 R}$$

Relocate teleoperated Cranes

Assume: 8 person crew — 8 hours per work day
3 days to move
3 moves with 100% time in 25 mR/hr field

$$\text{Manhours} = (8 \text{ people})\left(8 \frac{\text{hours}}{\text{day}}\right)\left(3 \frac{\text{days}}{\text{move}}\right)(3 \text{ moves}) = 576$$

$$\text{Exposure} = (576 \text{ hrs})\left(.025 \frac{R}{hr}\right) = \boxed{14 R}$$

SITE CHARACTERIZATION

Assuming 3 days to set up and take down equipment.
Initial characterization takes 11 days. Assuming a crew of six
=> 14 days @ 8 hrs @ 6 people
= 14 (8 hrs)(6) = 672 manhours

Assuming 30% of the time is spent in contaminated areas and the dose rate is 25 mR/hr

=> Exposure = (672 manhours)(.3)(.025 R/hr) **5 R**

On-Going Characterization

Assuming the task requires 192 days @ 8 hours per day with 6 people. Assuming 30% time in contaminated areas at 25 mR/hr

The manhours are => (192)(8 hours)(6) = 9,216 manhours

The exposure is equal to manhours(% time)(dose)
= (9,216 hrs)(.3)(.025 R/hr) **69 R**

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501
EDF Serial Number EDF-TFC-021
Functional File Number CB-02

Project/Task CPP Tank Farm Closure Study
Sub task Clean Closure of Tank Farm by Total Removal

TITLE: Recommended Instrumentation During Retrieval Operations

SUMMARY

Discussed the instrumentation that would be required during retrieval of the Tank Farm with Byron Christiansen, High Level Waste Senior Health Physicist, October 8, 1997.

Mr. Christiansen recommended placing a total of 16 Constant Air Monitors (CAMs) and 10 area Radiation Monitors (ARMs) throughout the primary containment, annulus area and weather enclosure. In addition to the CAMs and ARMs, 2 Automated Personnel Monitors (APMs) should be placed in the weather enclosure. The recommended locations for all of the monitors are discussed in the body of this EDF.

Project specific portable health physics instrumentation should be budgeted at $100K - $150K per year.

Distribution: B. C. Spaulding, MS 3765; B. R. Helm, MS 3765; B. H. Christiansen, MS 5209; M. M. Dahlmeir, MS 3765; Project File (Original + 1)

Authors	Department	Reviewed	Approved
Michelle Dahlmeir 10-14-97 M. M. Dahlmeir	MC&IE/4130	Byron H. Christiansen Date 10-13-97	B. Spaulding Date 10-14-97

Total person-rem calculations (performed by ICF Kaiser Engineering) and the assumptions used to derive them were discussed while briefing Mr. Christiansen on the plan for Clean Closure by Total Removal of the Tank Farm. Mr. Christiansen commented on the assumption that DOE would approve an annual administrative control level for personnel supporting the project equal to an annual limit of 5 rem/year. He noted that a 5 rem/year annual control level would not meet the requirements of the INEEL Radiological Control Manual (IRCM) and is, therefore, unlikely. Also, past experience has shown DOE unwilling to approve more than 2 rem/year as an annual control level. Based on this, he suggested using the current annual administrative control level as stated in the IRCM, Chapter 2, of 1.5 rem/year to determine the number of people that would be needed to support this activity to completion.

Mr. Christiansen's recommendations are based the following assumptions.

1. A double containment system will be necessary over the tank being removed.
2. A weather enclosure (covering the entire High Level Waste Tank Farm) will be necessary.
3. The weather enclosure will only have two entry points (one for personnel, and one high bay for equipment) to aid in access control.

Mr. Christiansen suggested the following locations for redundant alpha/beta Constant Air Monitors (CAMs):

1. Annulus between primary and secondary containment: 1 on each side, for a total of 4
2. Weather enclosure, near the exhaust system intake for the double containment: 2
3. Effluent monitors (stack CAMs): 2

Therefore, a total of 8 primary CAMs will be necessary. A backup CAM would be needed for each primary monitor, thus the total number of CAMs recommended would be 16. Each alpha/beta CAM costs approximately $10,000 and is capable of being operated remotely.

Mr. Christiansen suggested the following locations for redundant alpha/beta Area Radiation Monitors (ARMs):

1. Weather enclosure, near the personnel exit: 2
2. Each side of the double containment: 4

Backup ARM will be required. Thus a total of 12 monitors will be required at a cost of $10,000 each.

Mr. Christiansen suggested the following locations for alpha/beta Automated Personnel Monitors (APMs):

1. Weather enclosure, near the personnel exit: 1
2. Weather enclosure, backup locations near high traffic areas: 1

Backups are not required for APMs, as a portable frisker may be used when the APM is not functioning. Thus a total of 2 APM will be required. Due to the possibility of high background levels at location 2 (Weather enclosure, backup locations near high traffic areas), shielding may be required on one of the

APM. Automated Personnel Monitors cost anywhere from $50K to $100K each. The shielded APM will cost approximately $150K.

In addition to the above instrumentation, project specific portable health physics instrumentation will be required during operations. These items would include custom instruments, extendable probes, portable shielded detectors, remote reading dosimeters, etc. This type of instrumentation can be expensive to purchase and maintain. Mr. Christiansen suggested using $100K per year for budgeting purposes.

ENGINEERING DESIGN FILE

Project File Number 73501

Project/Task CPP Tank Farm Closure

Subtask

Title: High Level Waste Tank Concrete Encasement Evaluation

Abstract:

The objective of this task was determine the allowable depths of concrete pours used to encase the subject vessel without causing failure of the vessel due to external pressure exerted by the concrete mix before it hardens. The ALGOR finite element package was used to model the vessel and evaluate it for buckling under external pressure. Separate models were used for the cylindrical and dome portions of the vessel.

Hydrostatic loads were applied to portions of the vessel based on a 150 pcf density of concrete. Results are in the form of a safety factor based on the theoretical buckling value. A result of (F.S. = 4) means that the theoretical buckling load is four times the load applied.

Results for the cylinder portion give a factor of safety of 4.0 for an eight foot deep pour at the base. A four foot pour in the center portion of the vessel height where the wall is thinner and lateral support is more distant resulted in a factor of safety of 4.2.

Dome results also vary with elevation. A four foot deep pour starting at the base of the dome results in a factor of safety of 12.1. Some additional pours were analyzed assuming a vertical overlap to allow for failure of the thin portion of the concrete cantilever produced by the previous pour. A summary sheet follows this page showing the upper and lower elevations of the various pours analyzed and the corresponding safety factor. For the cylinder, the base of the dome is elevation zero and for the dome the base of the dome is elevation zero.

Subsequent to this technical evaluation, it was learned that the dome does not attach directly to the cylindrical portion of the structure but rather is connected to the cylinder by a roof plate, which is a ring with its outer diameter welded to the cylinder. The dome is welded to the roof plate approximately eight inches in from the outer diameter. Thirty gusset plates equally distributed around the circumference stiffen the connection. A new model and reanalysis would be expected to yield nearly identical results. The current analysis is judged to be conservative because it uses a larger (more conservative) dome diameter and the plate connection should stiffen the dome-to-cylinder connection from the "as analyzed" case, also resulting in conservatism in the current model. Therefore, results herein are based on a direct connection of cylinder to dome.

Models and other details are also attached.

Distribution (complete package): B. R. Helm, MS 3765; D. J. Harrell, MS 3211; B. C. Spaulding, MS 3765; R. Gavalya, MS 3765; WTP EIS Library; V. W. Gorman, R. G. Rahl, M. E. Nitzel, AMG 4 File, MS 3760

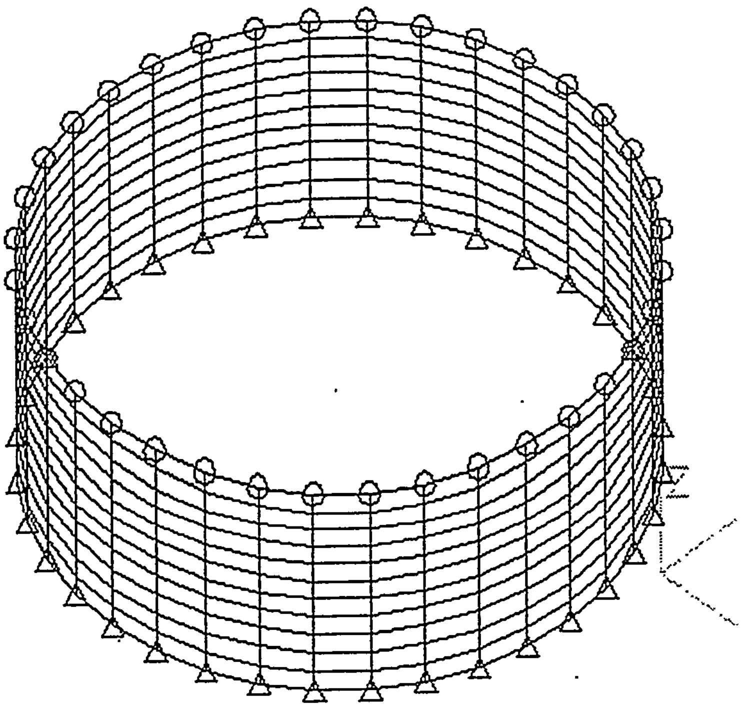
Distribution (summary page only): A. G. Ware, MS 3760

Author: R. G. Rahl	Dept. 41A0	Reviewed V. W. Gorman	Date	Approved A. G. Ware	Date
R. G. Rahl (signature)		(signature)	10/22/97	(signature)	10/30/97
		LMITCO Review	Date	LMITCO Approval	Date

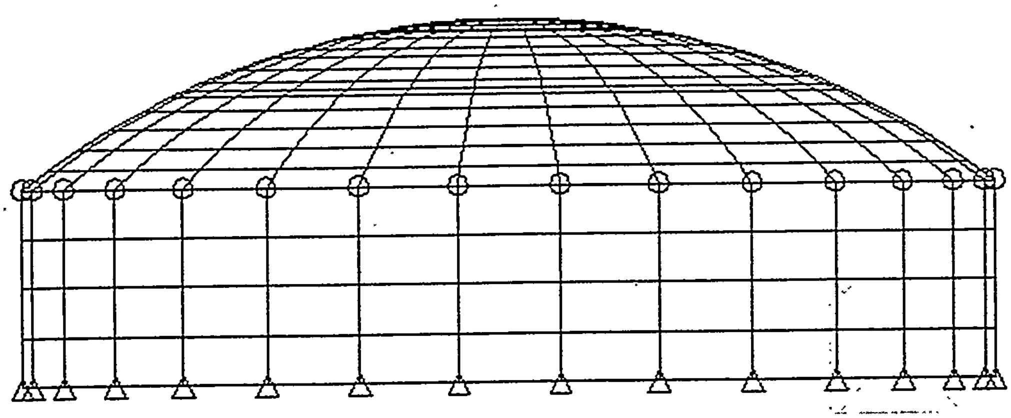
SUMMARY OF RESULTS

CYLINDER	POURS		DOME	POURS	
ELEVATION	ELEVATION	S. F.	ELEVATION	ELEVATION	S. F.
ft	ft		ft	ft	
0	8	4.0	0	4	12.1
8	12	4.2	3	5	16
12	16	4.2	4	6	10.8
16	20	4.2	6	7	14.5
			7	8	6.7
			7	7.6	10
			7.6	8.2	10
			8.2	8.8	10
			8	9	7.0

DISCUSSION OF ANALYSIS: Plots of the models can be found on the following pages. The cylindrical portion was modeled using two foot high plate elements and pressures applied to the elements were mid height pressures based on the calculated hydrostatic pressure for the particular pour. The dome model was modeled such that element boundaries existed at twelve inch vertical increments. Additional boundaries were modeled but loading was incremented at twelve inch intervals. From elevation zero, the base of the dome, up to elevation seven feet, the pressure applied was based on 60% of the delta hydrostatic pressure to account for area change due to radius. From seven to eight that factor was increased to 70% and for the very top area it was increased to 80%. The percentage numbers were based on engineering judgement since this was a preliminary analysis.



CYLINDER MODEL: Base fixed in all DOF, top fixed in horizontal translation.



DOME MODEL WITH PORTION OF CYLINDER FOR BOUNDARY CONDITION EFFECTS:
Junction is restrained in horizontal direction. This was found not to affect stability numbers significantly but does significantly affect elastic stresses. Other than one look at general effects, elastic stresses were not addressed and need to be considered in a final analysis.

INEL Idaho National Engineering Laboratory

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501

EDF Serial Number EDF-TFC-023

Functional File Number ED-02

Project/Task CPP Tank Farm Closure Study

Sub task Total Removal Clean Closure of the Tank Farm

TITLE: Recommended Heavy Equipment and Sizing Equipment for Total Removal Activities

SUMMARY

This Engineering Design File (EDF) discusses recommended equipment for use during Total Removal Clean Closure of the Tank Farm Facility (TFF). This information is based on conversations with Don Kenoyer (Decontamination and Decommission Engineer) and Reva Hyde (Remediation/Excavation Expert). See EDF-TFC-007 and EDF-TFC-008 for the original interview information.

The recommended equipment for Total Removal Clean Closure includes:

2 - Gantry cranes
1 - Boom crane
1 - LaBounty® Concrete Pulverizer
1 - LaBounty® Plate Shear
1 - Vibratory Pile Extractor.

Vendor data is attached to this EDF to provide more specific information on some of the techniques and equipment discussed. This information is meant to show the basic capabilities of the equipment and does not indicate how the equipment must be modified to meet the needs of the TFF task. Additional sizing equipment would have to be designed to remove the steel liners from the concrete encasements.

Distribution: D. J. Harrell, MS 3211; B. R. Helm, MS 3765; B. C. Spaulding, MS 3765; M. M. Dahlmeir, MS 3765; S. P. Swanson, MS 3765; Project File (Original +1)

Authors	Department	Reviewed	Approved
S. P. Swanson	MC&IE/4130	Date 11-19-97	Date 11/19/97

Cranes and Excavators

After briefing Don Kenoyer (D&D Expert) and Reva Hyde (Remediation/Excavation Expert) on the proposed removal of the Tank Farm Facility (EDF-TFC-007 & -008), both agree that a teleoperated excavator would be applicable (See Appendix D for information on excavators). An excavator is capable of digging, grabbing, shearing, and moving large volumes of debris and soil. Excavators are capable of digging to depths of 60+ feet with long reach booms.

The load limitations on excavators are highly restrictive, however. Depending on the track shoes, counterweights, arm lengths, etc., Tank Farm Total Removal operations could require a large excavator (i.e. 100-ton excavator) to lift a 12-ton object at a depth of 60-ft below grade. At these depths and weights, the excavator is limited to a certain operation envelope to prevent tipping. The operator must not over-extend the boom and must keep the load as close to the excavator as possible. The piles, vault panels, and other large ackward objects to be removed during Total Removal would prove difficult for the excavator.

As with the excavators, a teleoperated gantry crane (Appendix A) is also capable of digging, grabbing, shearing, and moving large volumes of debris and soil. The crane has several advantages over the excavator, though. First, a gantry crane is more automated than an excavator is once the debris has been captured. The crane could be set to return to a pre-designated position for unloading the debris. Secondly, the gantry crane operates very efficiently with vertical motions. This feature would be of great benefit during the removal of the approximately 310 piles buried at the Tank Farm Facility (TFF). It should be noted that the crane may require modifications to enable the "z-masts" (EDF-TFC-007) to operate at a depth of 50 feet. Finally, the gantry crane is capable of using multiple end-effectors at the same time. For example, the gantry could be fitted with a vacuum hose, digging bucket and grapple using two "z-masts" and a hoist. A teleoperated excavator would require multiple change-outs to switch tooling between tasks, thus increasing the potential for exposure, operations time, and cost.

Preliminary sizing based on the dimensions of the vault beams indicates that two 15-ton cranes would be required to remove the vault beams and pillars (the largest vault beams weigh approximately 47 tons, see EDF-TFC-016 for the calculations). These beams would be sized into three separate pieces. The spans of the cranes should be approximately 125 feet and 175 feet (See Sketches 7-2, 7-3, and 7-4 in Appendix F for a visual description of the crane layouts). The 175-foot crane would be used to remove the vault components over vault 713, while the 125-foot crane would remove vault components from the other vaults. The gantry cranes would be similar to the Cooperative Telerobotic Retrieval System (CTRS) developed by INEEL engineers (See Appendix A).

A teleoperated excavator would be required to remove soil and debris from the TFF site to prepare the area for the jet-grouting of the subsurface cement walls. The depth of the soil and size of buried objects can be easily handled with a larger excavator. Until the gantry cranes are mobilized, the excavator would also be required for the initial demolition and characterization of the Tank Farm.

A boom crane would be necessary for the installation and movement of the gantry cranes and containment structures. The size of the boom crane would have to be determined at a later date.

Independent of the equipment used, rails, supported by jet-grouted cement (EDF-TFC-019) would be required to operate the equipment due to load restrictions on the Tank Farm.

In Situ Sizing Equipment

According to Reva Hyde and Don Kenoyer (EDF-TFC-007 & -008), LaBounty® Concrete Pulverizer Jaws would be fully capable of sizing the piles, pipe encasements, concrete duct banks, and various other TFF objects. They are fast and efficient, resulting in high throughputs, and do not generate secondary waste (i.e. water, cutting fluids, or abrasives). Furthermore, these pulverizers reduce the potential for fire or explosion as they do not introduce high levels of heat or electrical sparking. LaBounty® equipment is fully adaptable to equipment using hydraulics. A model similar to the UP70-SII model would work effectively (See Appendix E). This size was chosen due to its jaw opening capabilities. The exact size of the processor must be determined at a later date. Engineering time and effort would be required to implement the hydraulics on the crane.

Ex Situ Sizing Techniques

Sizing techniques to remove the steel liner (mixed waste) from the concrete encasement (uncontaminated solid waste) must be looked at further. See Sketch 7-6 in Appendix E for a visual description of the pipe encasements. The method chosen must prevent the spread of contamination, limit secondary waste generation, and size the materials quickly and efficiently. This should be stationary, as it would receive debris to be sized from the gantry cranes. Sizing operations could be done manually; however, fully remote operation is highly desirable.

Pile Extraction

A pile extractor tool is recommended for extracting the piles (See Appendix C). This tool would be deployed from the hoist (See Appendix B) of a crane and attaches directly to the pile. Once attached, the extractor vibrates the pile, while it is still buried in the soil. Due to the vibratory actions created by the extractor, friction between the piles and soil is significantly reduced. Thus, as the extractor vibrates, a crane is able to remove the pile vertically. A vibratory pile removal tool similar to the H&M Model 1700 Vibratory Driver Extractor (manufactured by Hercules Machinery Corporation) is proposed for pile extraction. Field tests would be necessary to determine how much of the pile would have to be excavated due to the forces created by the paraffin grout on the pile.

Tank Sizing Equipment

According to Don Kenoyer (EDF-TFC-008), the LaBounty® Plate Shear would be capable of remotely sizing the 50-foot diameter tanks at the Tank Farm Facility. This end-effector is hydraulically driven and mounts to the same universal processor as the LaBounty® Concrete Pulverizer. See Appendix E for information on the plate shear. The two 15-ton cranes mentioned earlier in this EDF would deploy this end-effector.

Waste Conveyance Equipment

Methods to convey debris and soils from the gantry cranes to the sizing and packaging areas must be developed. Equipment used for waste transfer should be easily decontaminated, reliable, and durable. While debris and soil packaging will most likely be performed manually, it is desirable to implement equipment capable of conveying the waste from the digface and packaging the materials remotely. By relieving personnel of the debris and soil packaging duties, personnel exposure is reduced.

APPENDIX A - CRANES

In a field-deployable setting, the unit is capable of fixing 500 ft^2/15 min with a total encapsulation (3M Foamer), or applying 1,000 ft^2/15 min of dust suppressant (Flambinder) while simultaneously providing 2 gpm mist from six misting nozzles. The vacuum system can be operated continuously during the spray operation. In an emergency response situation, the system is capable of spraying dust suppressant at a rate of 1,000 ft^2/3 min. The system has been used at Hanford for a retrieval treatability study and by INEEL Environmental Restoration during a capping action at EBR-I. At EBR-I, Wendon dust suppressant was used on 1.5 acres.

3.3 Cooperative Telerobotic Retrieval System

Engineers at the INEEL have developed an 80-ft remotely operated gantry crane for the remediation of hazardous/radioactive waste (see Figure 3-1). The Cooperative Telerobotic Retrieval System (CTRS) provides universal access to the waste area. The remote gantry crane system consists of an 80-ft wide girder, two trolley assemblies with vertically telescoping masts (z-masts) each having 22 ft of vertical travel, two six-degree-of-freedom manipulators mounted to the base of each z-mast, and a trolley and 5-ton hoist assembly mounted on a separate truck. The manipulators mounted on the z-masts provide for dexterous teleoperation, telerobotic operations, or full robotics operations of equipment.

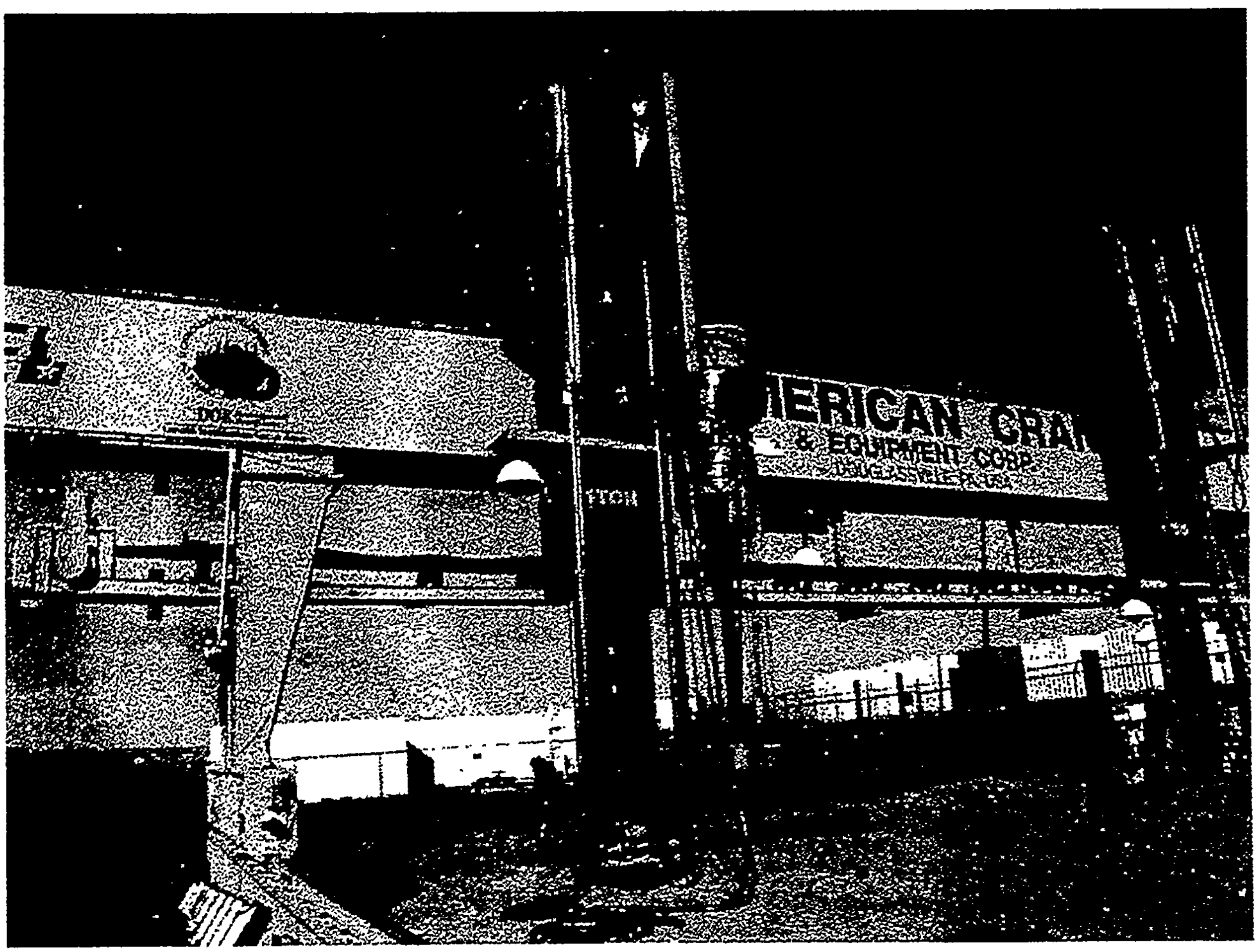


Figure 3-1. Cooperative Telerobotic Retrieval System.

Because the manipulators are mounted to the base of the z-masts, they can be used in cooperation with each other or can be operated separately. The manipulators are mounted so that they can be used in cooperation with the hoist hook for remotely attaching or removing a load from the hook. The system contains 12 closed-circuit television cameras and pan/tilt units for visualization of the workspace during operations. Three of the pan/tilt units have been modified to automatically track objects within the workspace, allowing operations personnel to concentrate on crane and manipulator operations. Three-dimensional cameras are mounted to each manipulator and to the trolley that holds the hoist. The entire system consists of 37 degrees-of-freedom and has closed-loop control using a modified commercial robotics control system. The rails for the system are spaced 60 ft apart and have a length of 60 ft, but the crane could be used on longer rails with minor modifications. The crane also incorporates a 20-ft cantilever overhang for loading equipment into trucks or other vehicles. Maximum loading values for the crane are 2,000 lb in the vertical (z-masts) and 10,000 lb vertical with the hoist. The system has a vacuum hose system for the retrieval of soil. Other end-effectors include a drum handler, grappler, various characterization sensors, and other removal tools.

3.4 Rapid Transuranic Monitoring Laboratory

A field test of the Rapid Transuranic Monitoring Laboratory (RTML) was conducted at the INEEL during the summer of 1993. The RTML is a mobile laboratory developed at the INEEL for use in characterizing low-level radiological source terms at buried radioactive waste remediation sites (see Figure 3-2). Analytical instruments installed in the RTML include a thin window, germanium photon spectrometer equipped with an automatic sample changer, two large-area ionization chamber alpha spectrometers, and four alpha continuous air monitors. The RTML was tested for the Buried Waste Integration Demonstration Program and the Test Reactor Area and Cold Test Pit.

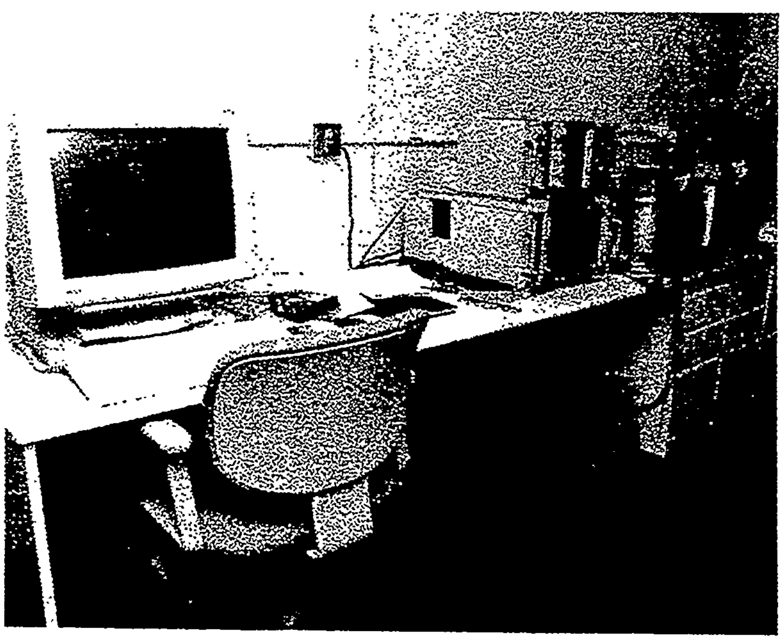
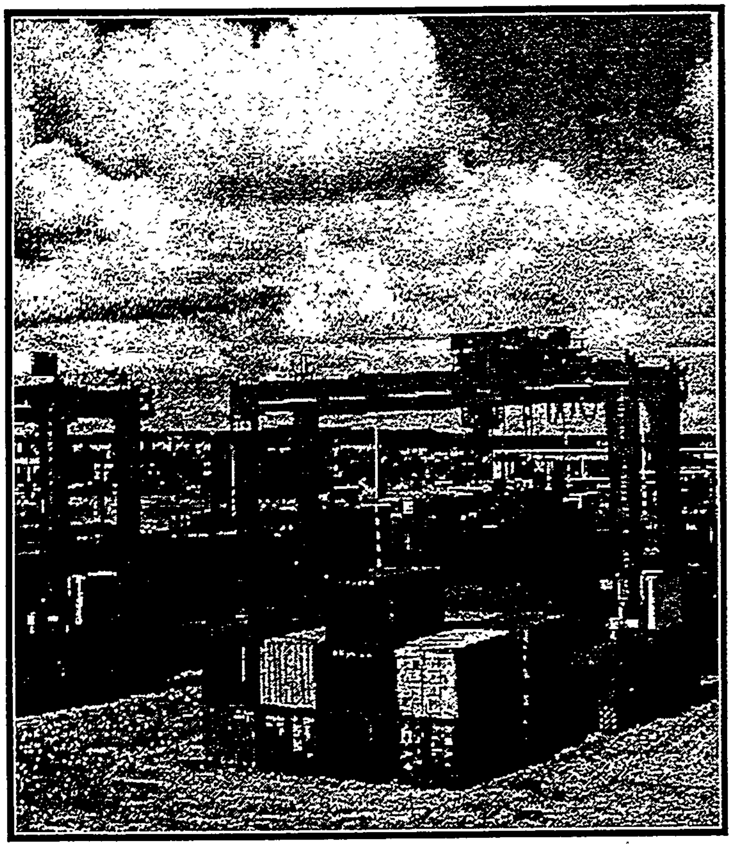


Figure 3-2. Interior of RTML (93-444-1-0).

Welcome to a very unique equipment company. . .

HEAVY MACHINES INC.

SISU RUBBER TIRED GANTRY CRANES

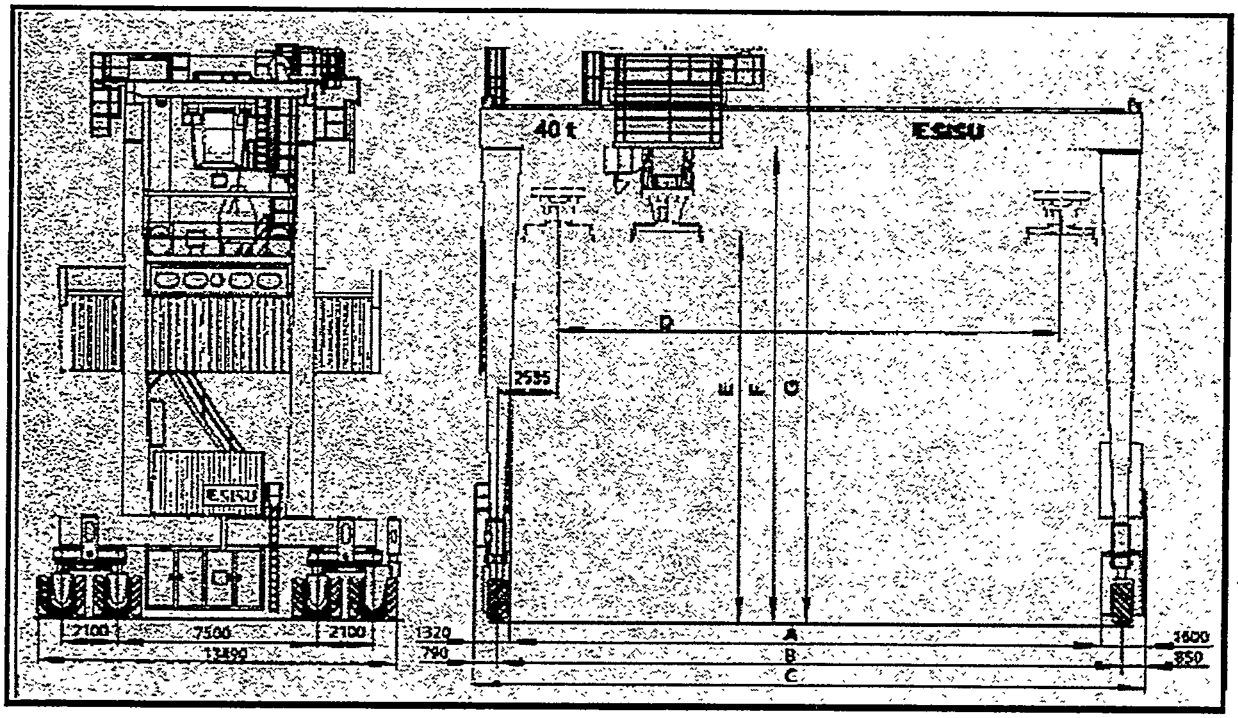


SISU Terminal Systems

Features and Benefits:

- State of the art design
- 8 wheels with excellent stability
- One hoist drum
- Advanced Steering System
- Non-slip trolley drive
- Headblock with anti-sway
- Superior vision from cabin
- Insulated EE-house
- PLC-control with diagnostics
- Fully digital drives
- Fast working cycles
- Classified structures and mechanisms
- Easy and quick maintenance
- After-sales support by global SISU network

Technical Details



Dimensions in mm

Span	5 + vehicle lane	6 + vehicle lane	7 + vehicle lane
A	19420	22190	24820
B	20700	23470	26100
C	22340	25110	27740
D	15630	18400	21030
Height	1 over 3	1 over 4	1 over 5
E	12240	15240	18200
F	15000	18000	20960
G	18490	21490	24450

Operating Data

Capacity under spreader	40	ton
Hoist speed		
empty	40	m/min
with 35 ton load under spreader	20	m/min
Trolley Speed	70	m/min
Gantry Speed	130	m/min
Spreader with ISO twistlocks		
Positions	20,40	ft
Spreader skew	+/-200	mm
	or +/-5	degrees
Dual pressure anti sway		
Number of wheels	8	
Tire size	18.00-25	
Power unit	Cummins/Stamford	

Classifications

According to F.E.M. 1.001 3rd edition

Crane group A7

Mechanisms

-Hoist	M8
-Trolley	M8
-Gantry	M7

For more information concerning standard/optional equipment, weights & performance data, and dimensions, contact Fred Boone at our e-mail address: general@heavymachinesinc.com or give Fred a call at (901) 260-2211 or (800) 238-5591. You may also fax Fred (901) 260-2205.

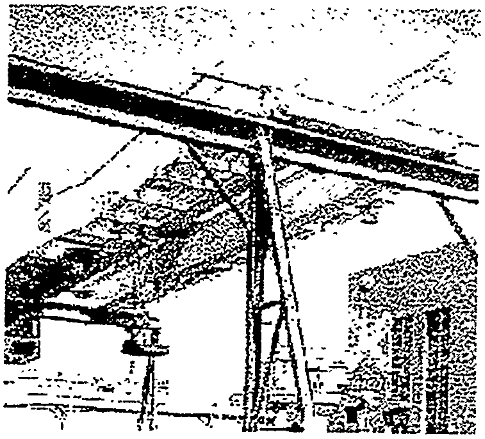
Click Logo to return to Home Page. .

APPENDIX B - HOISTS

ENERGY
INTERNATIONAL

ENERGY INTERNATIONAL CORPORATION
22226 GARRISON • DEARBORN, MI • 48124-2208 • U.S.A.

Cranes and Hoists



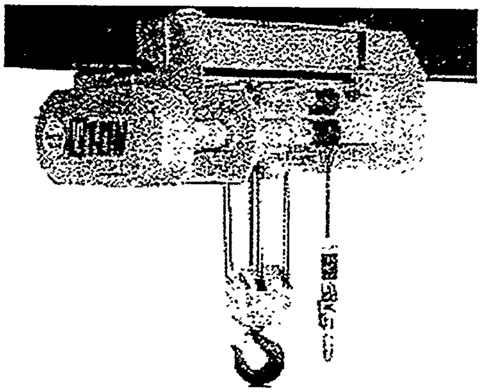
- Different sizes of industrial overhead cranes from small single girder cranes, to large double girder cranes of welded box girder of capacities up to 50 tons and 120 ft span

- Dual speed or variable speed control through frequency inverters are available on all bridge or trolley drives

- Cranes can be driven with air motors or may be hand geared

- Electric operated cranes can be offered for cabin or radio remote control

- Electric wire rope hoists available in capacities from 1/2 ton to 35 ton rated in accordance with HMI-H3/H4 service



- The entire range of hoists is available in explosion-proof versions with spark resistant components or equipped with air-motors throughout

| **Home** | **About** | **Products** | **Services**| **Offices** | **Contacts** |

APPENDIX C - PILE EXTRACTORS

copyrighted material removed.

APE "ON LINE" Text only page.

Welcome to American Piledriving Equipment Online.

7032 South 196th - Kent, WA. 98032 - (800)-248-8498
Send e-mail comments and suggestions to: ape@apevibro.com

The following areas are available:
-Description of a Vibratory Hammer.
-Consider the differences (a comparison of APE vibro's to other vibro's).
-Product information (specifications and features).
-APE Interactive Manuals (programs for the "Windows" environment).

Consider these patented vibro features

1. Multi-Stage Suppressor System.
2. One Piece Eccentric/Gear.
3. Heavy Metal Enhanced Eccentrics.
4. APE Vibros incorporate Spherical Bearings and Helical Gears.

Return to Selections.

Description of a Vibratory Hammer:
Click here for picture!

The vibratory pile driver/extractor generates a vertical oscillating movement created by rotating eccentrics together in a gearbox to create only up and down motion at high speed. Mounted on top of the gear box is a rubber suppressor that eliminates all vibration to the crane boom. Mounted on the bottom of the gearbox is the clamp attachment which grips the pile. As shown above, clamp attachments can be made to fit any type of pile including sheet piles, wood piles, concrete piles, H-Beams, Wide Flange Beams, flat steel plates and plastic sheet piles.

To drive a pile the vibro is hoisted into the air and placed on the pile. The clamp attachment incorporates a hydraulic cylinder that operates a jaw that grips the pile. Once the jaw has closed onto the pile the vibro is activated. The vibro and pile vibrate up and down so fast that it is difficult to see with the naked eye. The pile is lowered into the soil and the soil all around the vibrating pile is suspended and displaced thus allowing the pile to penetrate the earth. To extract the pile from the earth the crane pulls upward while the vibro is vibrating the pile. The pile quickly withdraws from the earth because the vibration has broken all friction between the pile and soil. Piles that refuse to be extracted using a static pull can be removed quickly and safely with a vibro.

APE has developed the most advanced Vibros in the World through innovation and commitment to quality and simplicity.

Return to Selections

---

1. Multi-Stage Suppressor System:

All other vibros on the market use rubber springs to absorb the vibration created by the vibro. Rubbers springs only work well when the vibro is at full speed or frequency. This is why all vibros shake the crane when they operate too slowly such as when they start or stop. APE engineers have solved this problem by developing a suppressor system that automatically adjusts to all conditions.

The APE vibro has a patented suppressor housing with two sets of rubber elastomers. The first stage of rubber elastomers are soft and allow the vibro to work at all speeds without transmitting any vibration to the crane line. This system is so smooth that a person can sit on top of the vibro while it is working and not feel any vibration - so smooth that APE vibros are the prefered vibros for operation on squirt boom type cranes. The second stage rubber suppressor is made up of smaller, high capacity rubbers that only engage during extremely hard pile extraction.
Click here for picture!

APE'S REVOLUTION IN VIBRO SUSPENSION TECHNOLOGY:

One of the most important advancements in Vibro Technology is APE's development of the Multi-Stage suppressor (illustrated above). By splitting up the rubber elastomers into two groups, the weight of the vibro is reduced and the maximum pulling force is greatly increased. To better understand this, one must understand how springs work. The spring rate problem can be illustrated by observing the suspension system on a truck. Trucks can be equipped with heavy springs that make the ride very rough and bumpy but capable of hauling heavy loads. When weight is added the springs compress and the ride improves. the springs only work when the truck is fully loaded. To achieve a soft ride when there is no cargo the truck must be fitted with softer springs. Soft springs improve the ride but limit the trucks ability to carry a heavy load.

Pile weight is continually increasing. Vibros need larger extraction ability. To increase the line pulling ability of a vibro the design engineer must add more rubber springs. The weight of the vibro increases in size and weight as more springs are added. Additional bias weight must be added as well to keep the rubber springs from becoming so stiff that they cannot fully isolate the crane line from vibration. More weight takes away line pull capacity needed during pile extraction and makes the vibro top heavy. Too much weight on the top of the vibro will cause the sheets to bend during initial installation.

The APE multi-stage suppressor adjusts automatically to both conditions. The first stage rubbers are very soft and smooth. The second, high capacity stage is not attached to the vibrator during normal driving and light pulling, so added weight is not necessary. During extraction, the crane operator pulls the suppressor into the second stage, engaging the high capacity rubbers. The crane can pull harder because the vibro weighs less. More of the crane's line pull capacity is used to extract the pile. APE's second stage has more than twice the capacity of any other machine built today. Piles that once were too difficult to extract are easy work for the APE vibro because the crane can pull harder. This patented design protects the investment of all APE owners and gives the pile contractor the needed edge on the job site.

Return to "Consider the Options"

---

2. One Piece Eccentric/Gear:
Click here for Picture!
All vibros have matched pairs of rotating eccentrics. The weights are timed using gears. Timing each pair of eccentrics is very important to control the direction of vibration. Gears eliminate sideways movement by forcing the eccentrics to oppose or join each other when they are in the horizontal position and join each other when facing up or down. This is the basic cycle of a vibro.

Vibros blow up and destroy themselves when gears break or get out of time:
Click here for Picture!
Most vibros fail when the gear becomes separated from the rotating counterweight (eccentric) and all timing is lost. Vibro engineers have been struggling with a way to keep the gear timed to the weight. Many methods are used including bolts, splines, key ways and dowel pins. They all fail eventually.
Click here for Picture!
APE engineers have designed an eccentric that is also a gear-all in one piece. The APE gear does not require bolts to hold it to the counterweight (eccentric). All bolts, pins, dowels and splines have been eliminated. By developing the one piece eccentric/gear, APE engineers have eliminated all fasteners in the gearbox, eliminating the possibility of the gears becoming out of time, thus eliminating the

major cause of vibro gearbox failure. The end result is the most advanced, most reliable vibro in the world.

Return to "Consider the Options"

---

3. Heavy Metal Enhanced Eccentrics:
Click here for Picture!
The APE eccentric is larger and heavier than eccentrics found on other vibros. APE engineers wanted to eliminate parts so they designed larger eccentrics with more mass. The APE eccentric is on average, twice as large as eccentrics found on most other vibros. This means fewer parts including fewer bearings, gears and shafts. In addition, because all other vibros use some sort of fastener to hold the gear to the weight, the amount of parts in other machines is far greater. Heavy metal also increases the vibros vertical motion or amplitude.

Return to "Consider the Options"

4.APE Vibros incorporated spherical bearings and helical gears:
Click here for Picture!
Most vibros use roller bearings and straight cut spur type gears. Spur gears and roller bearings are not designed to handle side loads. APE engineers understand that piles do not always go in the ground straight. Often, piles are required to be driven in battered or at an angle.
Click here for Picture!
APE engineers selected spherical bearings to allow the APE vibro to drive piles in any direction without concern for possible bearing damage. Spherical bearings are designed for side loads. To further add to this technology, a helical gear was selected to increase strength and reduce noise levels. The end result is a gearbox that runs as smooth as a Swiss watch at any angle.

Return to "Consider the Options"

APE Product Information

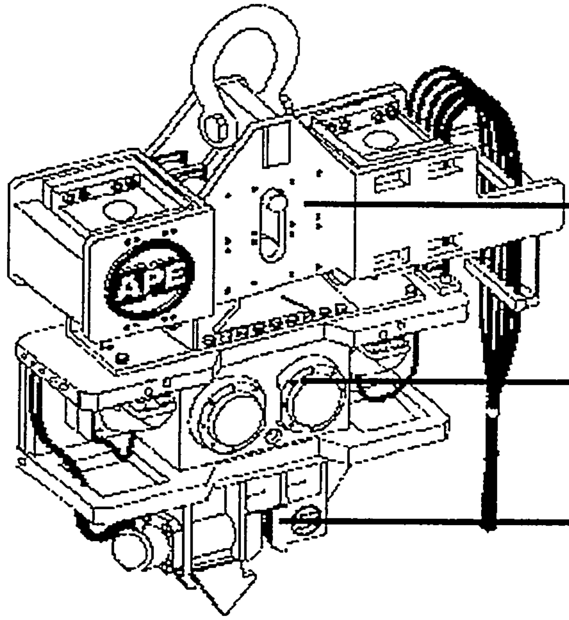
Select one of the following:
- *Model 3 Vibratory Driver/Extractor w/Model 14 Power Unit.*
- *Model 50 Vibratory Driver/Extractor w/Model 230 Power Unit.*
- *Model 150 Vibratory Driver/Extractor.*
- *Model 200 Vibratory Driver/Extractor.*
- *Model 400 (King Kong) Vibratory Driver/Extractor.*
- *Model 4400 Zero Headroom Vibratory Driver/Extractor (Tandem 50's)*
- *Model 50 Auger.*
- *Model 75 Auger.*
- *Model 325 Power Unit.*
- *Model 500 Power Unit.*
- *Model 800 Power Unit.*
- *APE Attachments.*

Return to Selections.

APE Interactive Software

The Following Interactive Manuals are Currently Available:
- *Model 150T Interactive Parts Identification Manual (v1.2 - Windows 3.1 or above).*
- *Pkunzip.exe (Unzip utility - DOS version).*

Description of a Vibratory Hammer:



The vibratory pile driver/extractor generates a vertical oscillating movement created by rotating eccentrics together in a gearbox to create only up and down motion at high speed. Mounted on top of the gear box is a rubber suppressor that eliminates all vibration to the crane boom. Mounted on the bottom of the gearbox is the clamp attachment which grips the pile. As shown above, clamp attachments can be made to fit any type of pile including sheet piles, wood piles, concrete piles, H-Beams, Wide Flange Beams, flat steel plates and plastic sheet piles.

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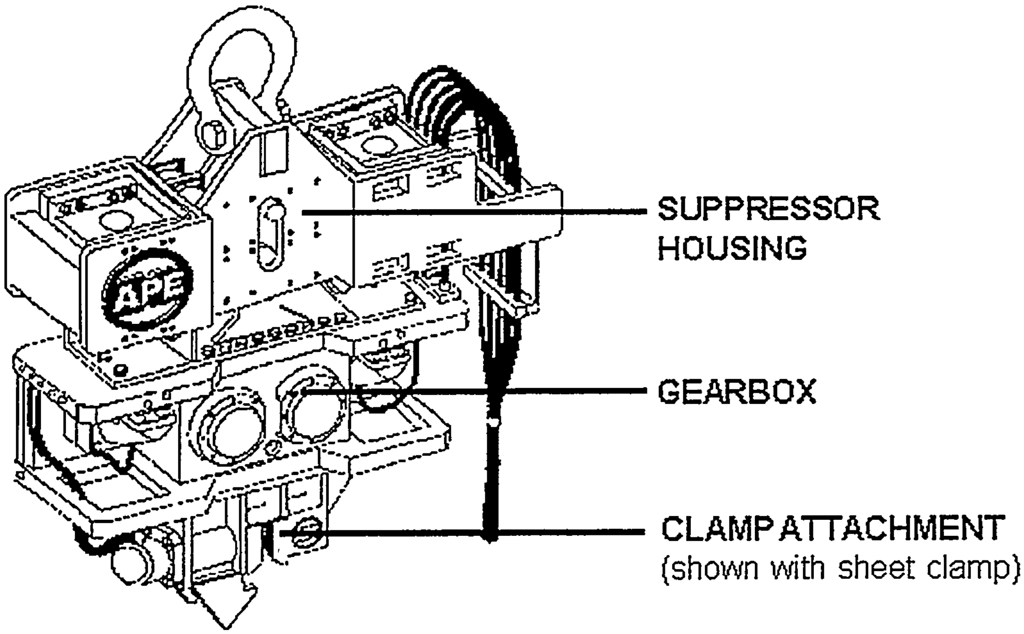
APE has developed the most advanced Vibros in the World through innovation and commitment to quality and simplicity.

Return to Main Page.


APE
SUPPRESSOR
HOUSING
GEARBOX
CLAMP ATTACHMENT
(shown with sheet clamp)

APPENDIX D - EXCAVATORS

copyrighted material removed

APPENDIX E - PULVERIZERS AND SHEARS

LaBounty®

Universal Processor - Series II

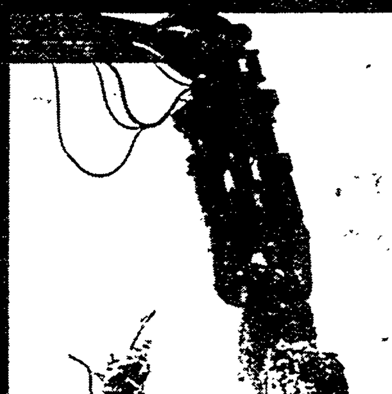
UP-S II FEATURES:

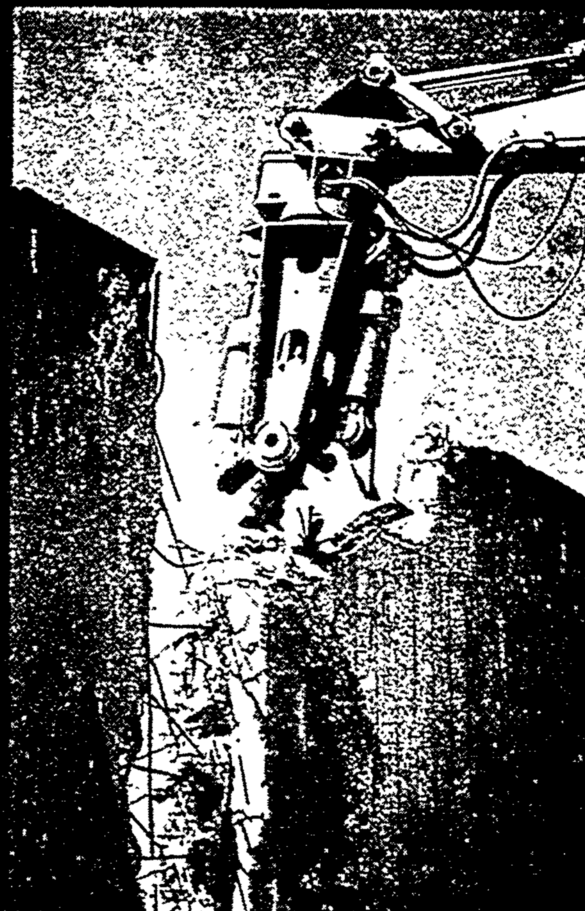
* Universal Processor Series II is available for base machines in the 20,000 lbs. to 150,000 lbs. excavator class. New design technology dramatically increases cutting tonnages, providing users with up to 40% more cutting power than previous models.

* Interchangeable parallelogram cutting blades in UP-S II shear jaws increase machine life by eliminating stress to certain areas of the attachment.

* Cast manganese jaw sections for concrete cracking and concrete pulverizing applications have been incorporated into jaw design to greatly improve wear life while reducing jaw maintenance.

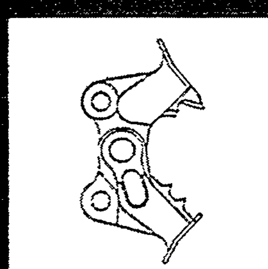
* Large, severe-duty 360° rotating turntable allows for material processing, downsizing and handling at almost any angle.



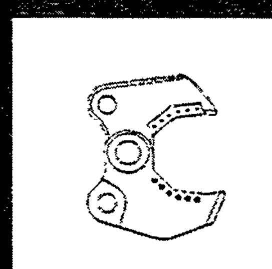


The Power of Interchangeable Jaws

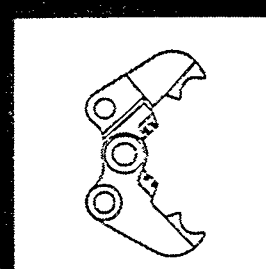
LaBounty Universal Processor line provides unparalleled economy, efficiency and versatility. Three interchangeable jaw options afford optimum results in demolition, steel cutting and concrete processing applications. Special application jaw configurations available upon request.



Concrete Pulverizer Jaws



Shear Jaws



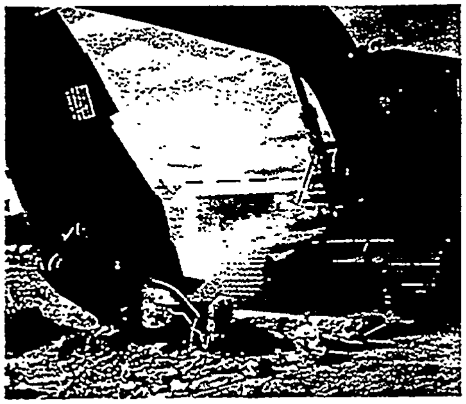
Concrete Cracking Jaws

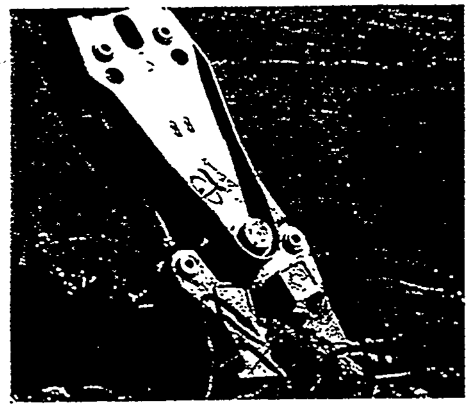
LaBounty Manufacturing, 100 State Road 2, Two Harbors MN 55616 USA

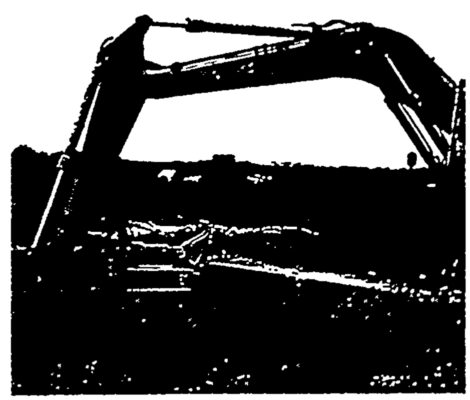
STANLEY

A Division of Stanley Hydraulic Tools

LaBounty Universal Processor - Series II







MODEL	JAW CONFIGURATION	(1) APPROXIMATE EXCAVATOR WEIGHT (2nd Member) (lbs.)	(m. tons)	EXCAVATOR WEIGHT 3RD MEMBER (3rd Member) (lbs.)	(m. tons)	(2) APPROXIMATE ATTACHMENT WEIGHT (lbs.)	(kg.)	JAW OPENING (in.)	(mm.)	JAW DEPTH (in.)	(mm.)	(3) REACH (ft.)	(m.)
UP20 - S II	Shear	20,000	9	42,000	20	4,100	1,860	20	508	18	470	6'-6"	2.0
	Concrete Pulverizer	20,000	9	42,000	20	4,100	1,860	26	670	19	480	6'-5"	2.0
	Concrete Cracking	20,000	9	42,000	20	4,000	1,810	42	1,070	23	600	6'-3"	1.9
UP40 - S II*	Shear	38,000	18	70,000	30	6,500	2,900	24	610	21	540	9'-0"	2.7
	Concrete Pulverizer	38,000	18	70,000	30	6,700	2,950	32	810	21	530	9'-0"	2.7
	Concrete Cracking	38,000	18	70,000	30	6,500	2,900	49	1,260	27	700	9'-0"	2.7
UP50 - S II	Shear	50,000	22	90,000	40	9,200	4,170	27	700	24	620	12'-6"	3.8
	Concrete Pulverizer	50,000	22	90,000	40	9,200	4,170	36	910	23	590	12'-6"	3.8
	Concrete Cracking	50,000	22	90,000	40	9,200	4,170	56	1,430	31	800	12'-6"	3.8
UP70 - S II	Shear	70,000	30	120,000	55	11,500	5,080	36	910	30	760	14'-0"	4.3
	Concrete Pulverizer	70,000	30	120,000	55	11,900	5,216	48	1,220	32	810	14'-0"	4.3
	Concrete Cracking	70,000	30	120,000	55	11,400	5,035	70	1,800	39	1,000	14'-0"	4.3

Universal Processors

UP4	Shear	Mini-Excavator, Skid Steer Loaders and Loader Backhoes		Consult the Factory		400	181	6.7	170	6.7	170	3'-9"	1.1
	Concrete Cracking					400	181	13.5	340	6.6	170	3'-9"	1.1
UP6	Shear					1,500	680	11.5	290	11	300	6'-0"	1.8
	Concrete Cracking					1,200	544	23	600	11	300	5'-10"	1.7
UP70	Shear	62,000	28	100,000	45	10,500	4,880	36	910	26	660	14'-0"	4.3
	Concrete Pulverizer	62,000	28	100,000	45	10,400	4,830	48	1,220	26	660	14'-0"	4.3
	Concrete Cracking	62,000	28	100,000	45	10,400	4,830	70	1,800	39	1,010	14'-0"	4.3
UP90	Shear	90,000	40	150,000	70	16,600	7,530	42	1,070	31	800	13'-0"	4.0
	Concrete Pulverizer	90,000	40	150,000	70	16,600	7,530	62	1,570	35	890	13'-0"	4.0
	Concrete Cracking	90,000	40	150,000	70	16,600	7,530	72	1,800	44	1,110	13'-0"	4.0

(1) Operating weight is based on excavator configurations (boom, stick, bucket), undercarriage and counterweight. Machine sizing is based upon pinning the attachment to the boom.

(2) Universal Processor weight can vary +/- 10% depending on mounting bracket, appropriate cylinders required to maximize base machine operating pressures plus any options installed on the unit.

(3) Typical reach is listed. Reach can vary depending on the bracket needed for the base machine. Total reach may be substantially increased by mounting the UP to the stick and bucket linkage of a larger base machine. LaBounty sales staff are available to assist in reach/base machine sizing.

NOTE: Weights, dimensions and operating specifications listed on this sheet are subject to change without notice. Where specifications are critical to your application, please consult the factory. This product is patented by one or more patents. Worldwide patents pending.

*Preliminary Specifications

LaBounty®

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LaBounty Manufacturing
100 State Rd. 2, Two Harbors, MN 55616 USA
Phone: 218-834-2123
Fax: 218-834-3879

Printed in the USA 1/93.2-UP-S II

…tthew Dow 208-526-3370

Steve Swanson 6-0425

1.E2

UP Universal Processors

UP Models

SPECIFICATIONS

MODEL	(1) EXCAVATOR WEIGHT APPROX 2nd member (lbs)	(m tons)	(1) EXCAVATOR WEIGHT APPROX 3rd member (lbs)	(m tons)	AVAILABLE JAW SETS	(2) ATTACHMENT WEIGHT APPROX (including jaw set) (lbs)	(kg)	JAW OPENING (in)	(mm)	JAW DEPTH (in)	(mm)	(3) ATTACHMENT REACH (ft-in)	(m)
UP 4	Mini Excavators, Skid Steer Loaders, Loader Backhoes		5,000	2.3	Shear	525	238	6.7	170	6.7	170	3'-9"	1.1
					Concrete Cracking	525	238	13.5	343	6.6	168	3'-9"	1.1
UP 20	24,000	11	40,000	18	Shear	4,100	1,860	20	508	18	457	6'-4"	1.9
					Concrete Pulverizer	4,300	1,950	25	635	20	508		
					Concrete Cracking	4,550	2,064	38	965	28	711		
					Plate Shear	4,100	1,860	9	229	11	279		
					Wood Shear	4,100	1,860	37	940	26	660		
UP 40	42,000	19	68,000	31	Shear	6,500	2,948	24	610	21	533	9'-0"	2.7
					Concrete Pulverizer	7,000	3,175	31	787	23	584		
					Concrete Cracking	7,000	3,175	43	1,092	34	864		
					Plate Shear	6,000	2,721	14	356	16	406		
UP 50	52,000	24	90,000	41	Shear	9,200	4,173	27	686	24	610	12'-6"	3.8
					Concrete Pulverizer	9,700	4,400	36	914	27	686		
					Concrete Cracking	10,000	4,536	51	1,295	42	1,067		
					Plate Shear	9,200	4,173	16	406	20	508		
UP 70	68,000	31	125,000	57	Shear	11,500	5,216	36	914	30	762	14'-0"	4.3
					Concrete Pulverizer	12,500	5,670	48	1,219	35	889		
					Concrete Cracking	12,500	5,670	62	1,575	46	1,168		
					Plate Shear	9,570	4,341	21	533	24	610		
UP 90	100,000	45	190,000	86	Shear	16,600	7,530	42	1,067	31	787	13'-0"	4.0
					Concrete Pulverizer	17,500	7,938	60	1,524	38	965		
					Concrete Cracking	18,000	8,165	72	1,829	44	1,118		

(1) Excavator weight recommendation is based on standard excavator weights and boom and/or arm lengths. All applications must be approved by LaBounty Manufacturing prior to sale.
(2) Weights may vary depending on options and excavator mounting.
(3) Typical reach is listed. Reach can vary depending on the bracket needed for the base machine.
NOTE: Weights, dimensions and operating specifications listed on this sheet are subject to change without notice. Where specifications are critical to your application, consult LaBounty.

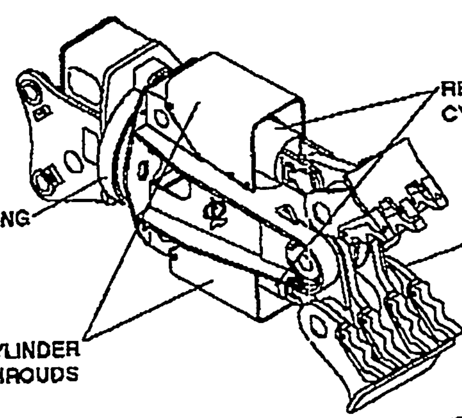
Universal Processors allow various jaw options for maximum equipment utilization. Universal Processors are ideal for demolition, road and bridge reconstruction and concrete recycling operations.

360° Powered Rotation. Standard 360° powered rotation allows for efficient processing at virtually any angle.

Jaw Sets. Additional jaw sets may be available upon request. See the back of this page for jaw options. Jaws can be changed out in as little as 20 minutes.

Swift Lock™ Tooth System. Both the Concrete Pulverizer and Concrete Cracking Jaws feature this LaBounty exclusive pin on replaceable tooth system. This system allows quick and easy change-out of teeth, significantly reducing down time. Cutting blades on the Shear, Plate Shear, and Concrete Cracking Jaws are bolt-on replaceable, making blade rotation and replacement both quick and easy.

UP Universal Processor Components



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SPECS 10/96

UNIVERSAL PROCESSOR OPTIONS, ACCESSORIES AND WEAR PARTS

The items listed below are available for all UP models (unless otherwise noted)

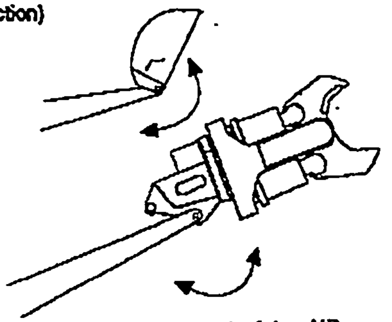
- Concrete Pulverizer Jaws (UP 20, UP 40, UP 50, UP 70 and [illegible] only)
- **Shear Jaws**
- Concrete Cracking Jaws
- **Plate Shear Jaws** (UP 20, UP 40, UP 50, and UP 70 only)
- Wood Shear Jaws (UP [illegible] only)
- Internal Hydraulic Rotation Kit (factory installed inside rotation head)
- External Hydraulic Rotation Kit (dealer or end user installed on base machine)
- Hanging Lugs (for hanging from cable crane)
- 3rd Member to 2nd Member Mounting Adaptor Brackets
- Attachment's Bracket/Lugs can be customized to fit other manufacturer's quick attach system (3rd member mount)
- Swift Lock™ Pin-On Replaceable Teeth and Indexable Cutting Blades
- At-Factory Upgrade and Rebuilding Services

Multiple Machine Mounting Capability. The "universal bracket", standard with UP models 20, 40, and 50, manufactured for 3rd member installation, allow mounting to a variety of base machines in the same weight class with similar operating pressures. An additional mounting kit (bushing, spacer and pins) available from LaBounty may be required to complete installation to other compatible machines. **3rd Member to 2nd Member Adaptor Brackets** are also available. Typically, when changing from 3rd to 2nd member, the base machine may drop 2 classes in size. All such conversions must be approved by LaBounty Manufacturing prior to sale. LaBounty UPs are compatible with most other manufacturer's quick couplers

Universal Processor Operation

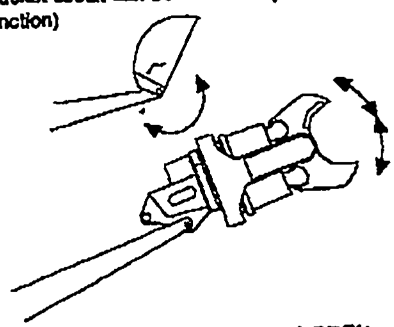
The LaBounty Universal Processor replaces the bucket or stick of an excavator and requires two hydraulic circuits to operate. One (full flow and pressure) for open and close, and one (low flow and pressure) for rotation. Please consult LaBounty Manufacturing for complete installation requirements.

THIRD MEMBER MOUNT
(excavator spare spool required for open-close function)



Bucket DUMP = Articulates UP
Bucket CURL = Articulates DOWN

SECOND MEMBER MOUNT
(bucket circuit can be used for open-close function)



Bucket DUMP = Attachment OPEN
Bucket CURL = Attachment CLOSE

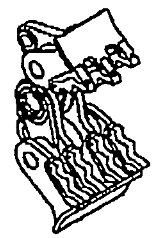
Call the LaBounty dealer nearest you...

Warranty. The LaBounty Universal Processors carry a limited warranty against defects in material and workmanship for 12 months or 1,500 hours from the date of purchase.*

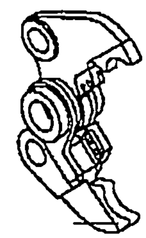
LaBounty reserves the right to repair or replace only those parts which prove to have been defective at the time of purchase.

Ask your dealer to explain this warranty in detail.

* The UP 4 carries a 6-month, 750-hour warranty.



Concrete Pulverizer Jaws separate concrete and rebar, leaving two recyclable products. Swift Lock™ teeth allow for quick changeover and reduced downtime.



Concrete Cracking Jaws break large, oversized concrete (abutments, beams, etc.) Swift Lock™ teeth allow for quick changeover and reduced downtime.

Shear Jaws cut rebar and structural steel such as H- and I-beams as well as a variety of other ferrous and non-ferrous metals.

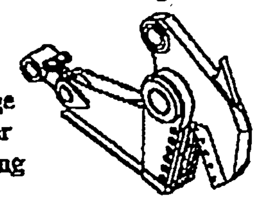
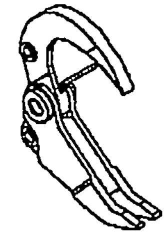


Plate Shear Jaws process above- and below-ground storage tanks as well as other plate materials leaving minimal distortion.



Wood Shear Jaws downsize stumps, logs, railroad ties, pallets and other wood debris.

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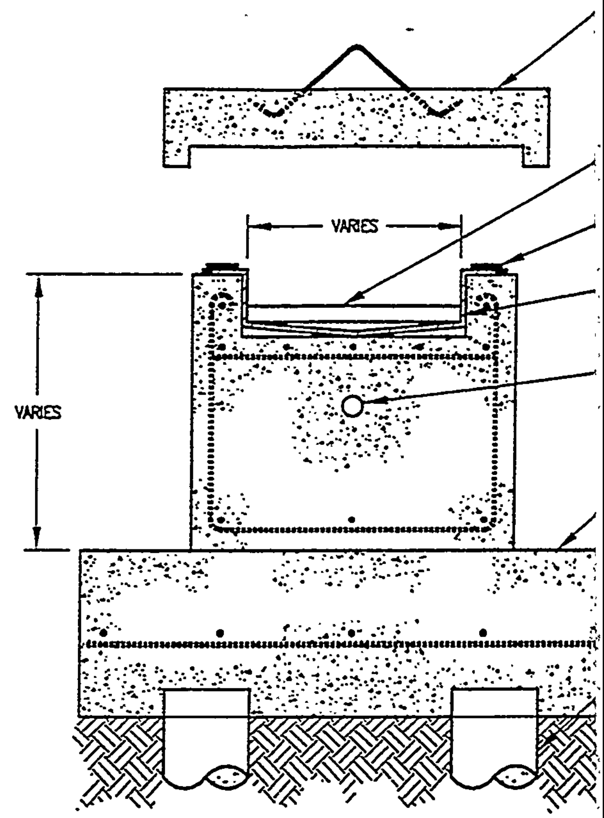
APPENDIX F - SKETCHES

STAINLESS STEEL LINED CON



SECTION OF TYPICAL ENCASEME

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Date: 10/23/97 - 08:39 AM

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

CRETE ENCASEMENTS AND PILES

REMOVABLE COVER

1" SCHEDULE 40 PIPE
STAINLESS STEEL

1/2" X 4" PREMOLDED
JOINT FILLER

11 GA. LINER
STAINLESS STEEL

1" DRAIN LINE

PILE CAP

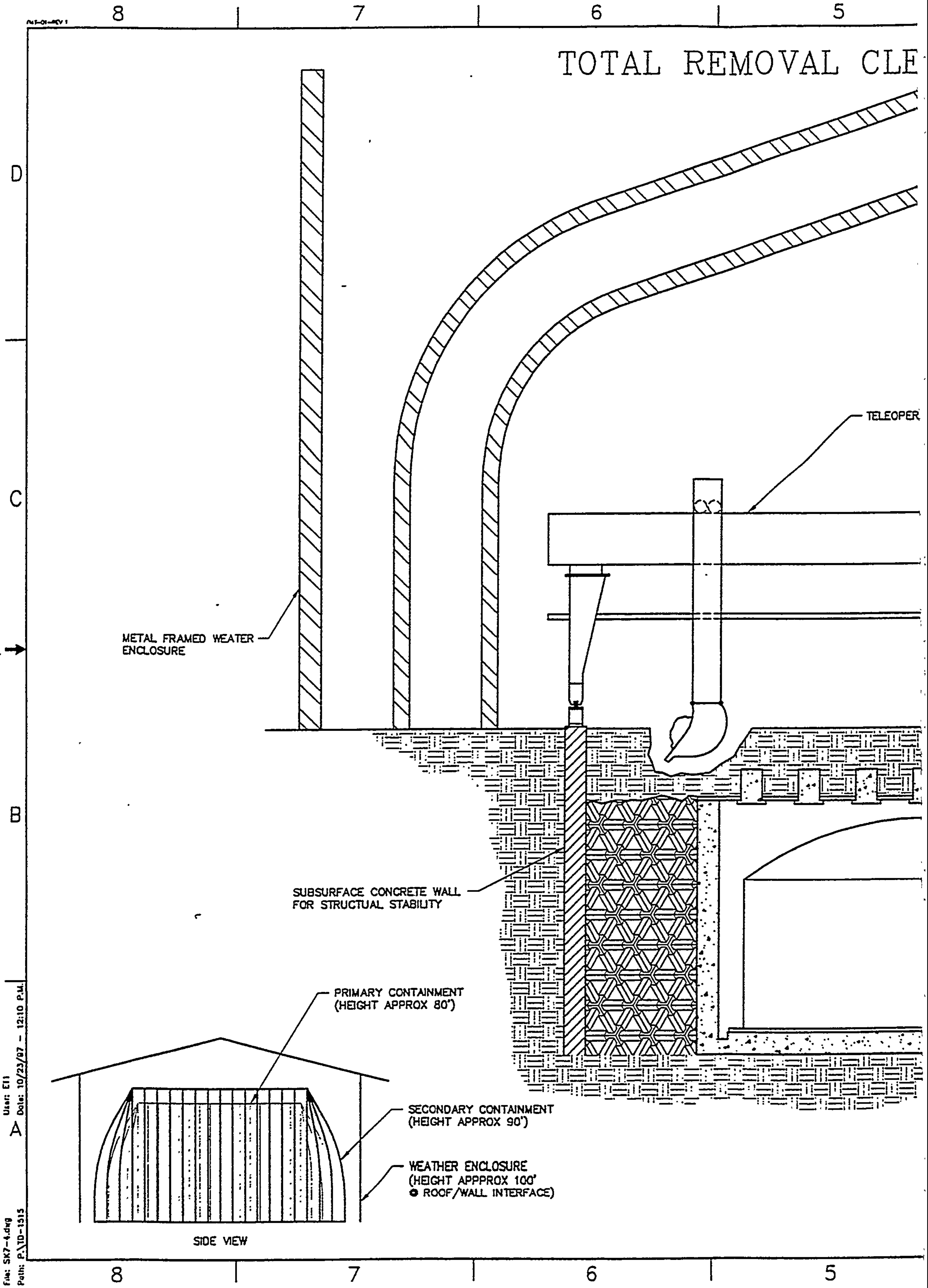
10" ø X 3/4" STEEL PIPE
PILE TO BEDROCK
(FILLED WITH CONCRETE) △1

T PIPE

NOTE:

△1. PILES RUN FROM THE BOTTOM OF THE PILECAP TO THE BEDROCK LAYER. (APPROXIMATELY 30 FEET)

SUBCONTRACT NO.	LOCKHEED MARTIN
REQUESTER:	
DESIGN: STEVE SWANSON	TANK FARM CLOSURE STUDY TOTAL REMOVAL CLEAR CLOSURE STAINLESS STEEL LINED CONCRETE ENCASEMENT AND PILES
DRAWN: ERIC E THOMAS	
PROJECT NO.	
SPEC CODE	
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE D · CAGE CODE 01MF3 · INDEX CODE NUMBER: AREA, TYPE, CL, DISC 530 · DWG-SK7-6 · REV
EFFECTIVE DATE:	SCALE: NONE · SHEET 1 OF 1



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AN CLOSURE EXCAVATION

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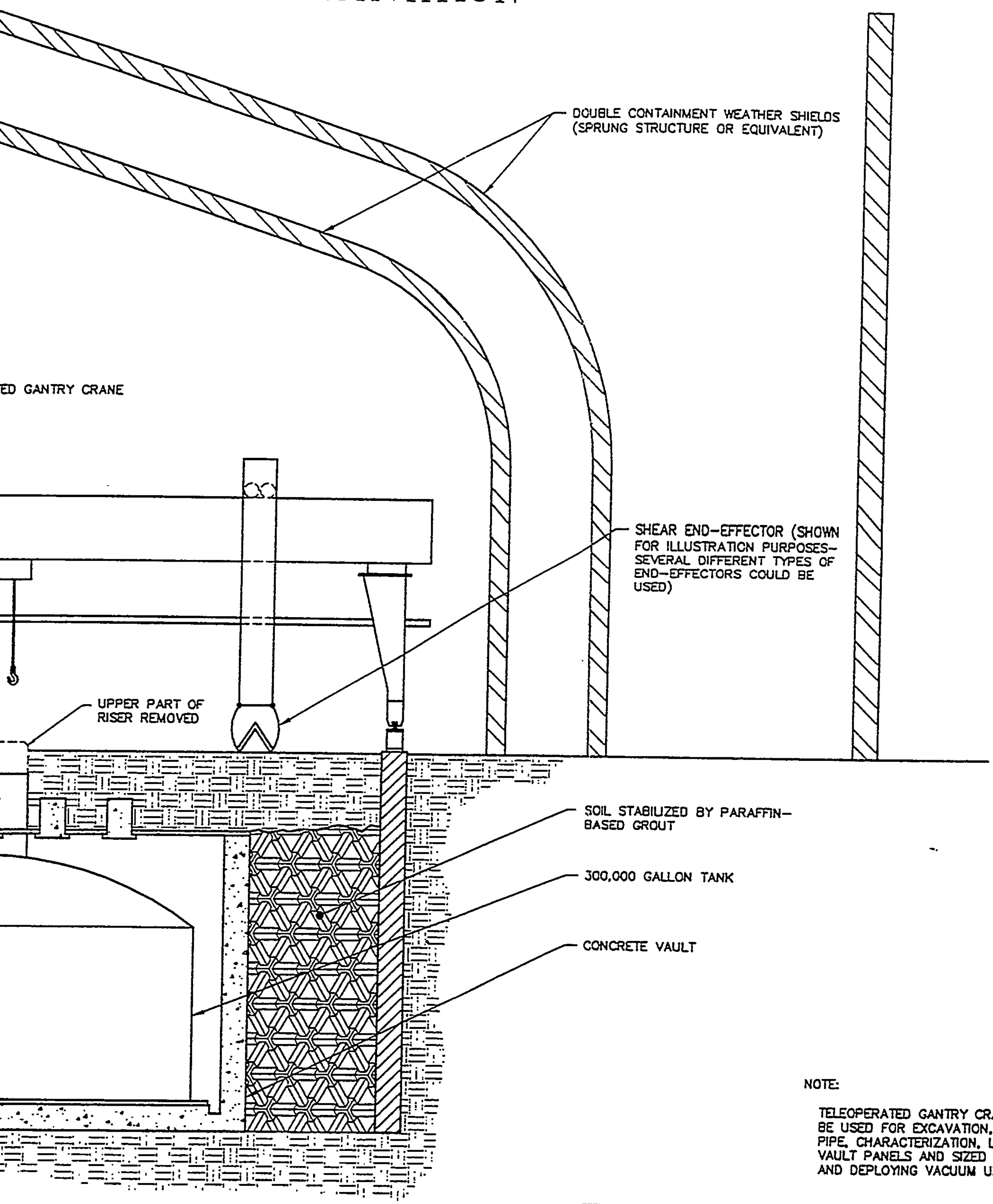


NOTE:

TELEOPERATED GANTRY CRANES WILL BE USED FOR EXCAVATION, REMOVING PIPE, CHARACTERIZATION, LIFTING OUT VAULT PANELS AND SIZED OBJECTS, AND DEPLOYING VACUUM UNITS

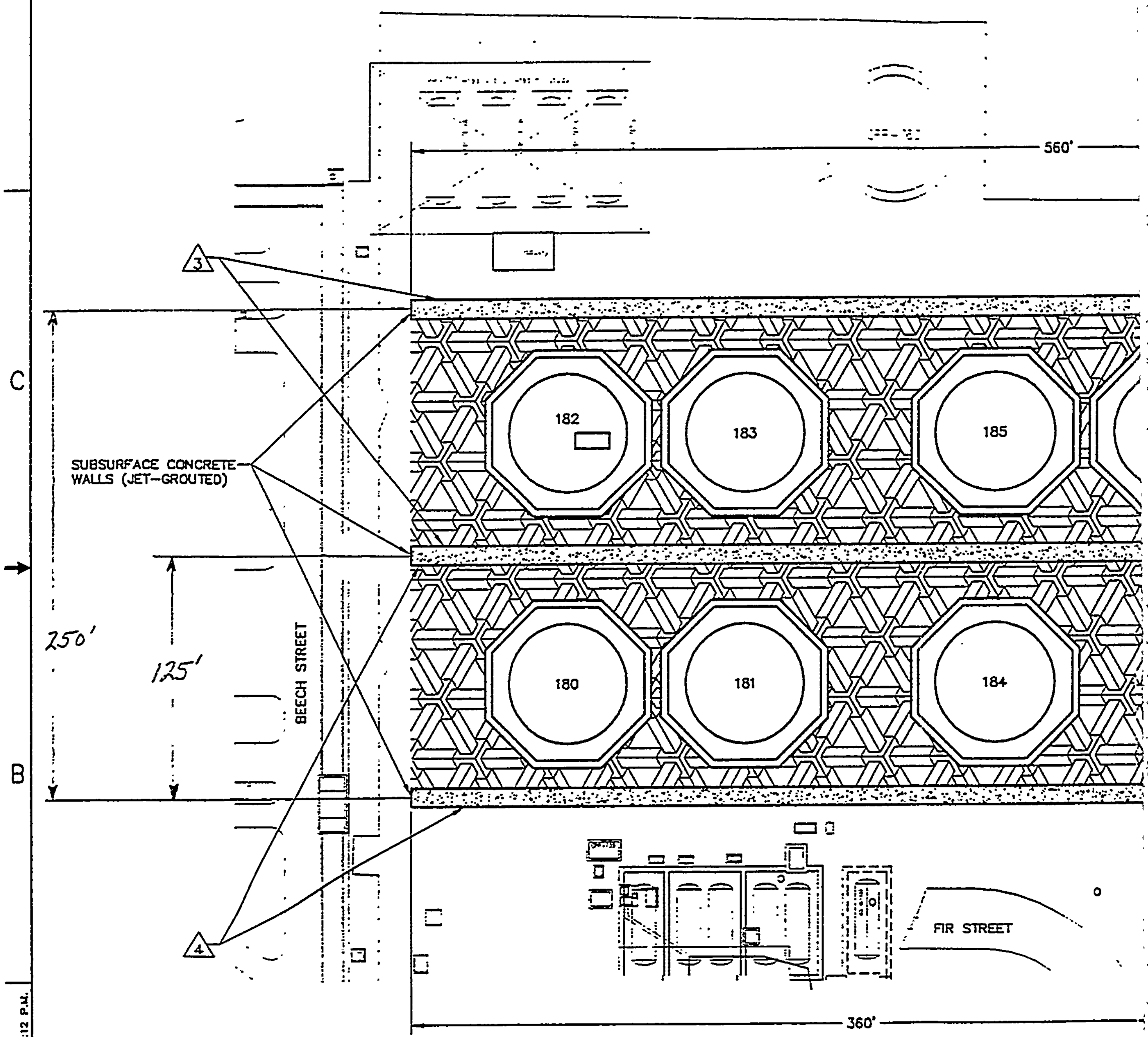
LOCKHEED MARTIN

TANK FARM CLOSURE STUDY
TOTAL REMOVAL CLEAN CLOSURE
EXCAVATION

SUBCONTRACT NO.
REQUESTER:
DESIGN: STEVE SWANSON
DRAWN: ERIC E THOMAS
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES
SITE DAR NO.
EFFECTIVE DATE:

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER AREA TYPE CL DISC 530 | DWG- SK7-4 | REV
SCALE: NONE | SHEET 1 OF 1

GRADE PREPARATION A



NOTES:

1. BUILDINGS MUST BE REMOVED FOR SITE PREPARATION.
2. TWO GANTRY CRANES OF DIFFERENT SIZE ARE REQUIRED FOR EXCAVATION.
3. NORTH TRACK FOR GANTRY CRANE #1.
4. SOUTH TRACK FOR GANTRY CRANE #1.
5. TRACK FOR GANTRY CRANE #2.

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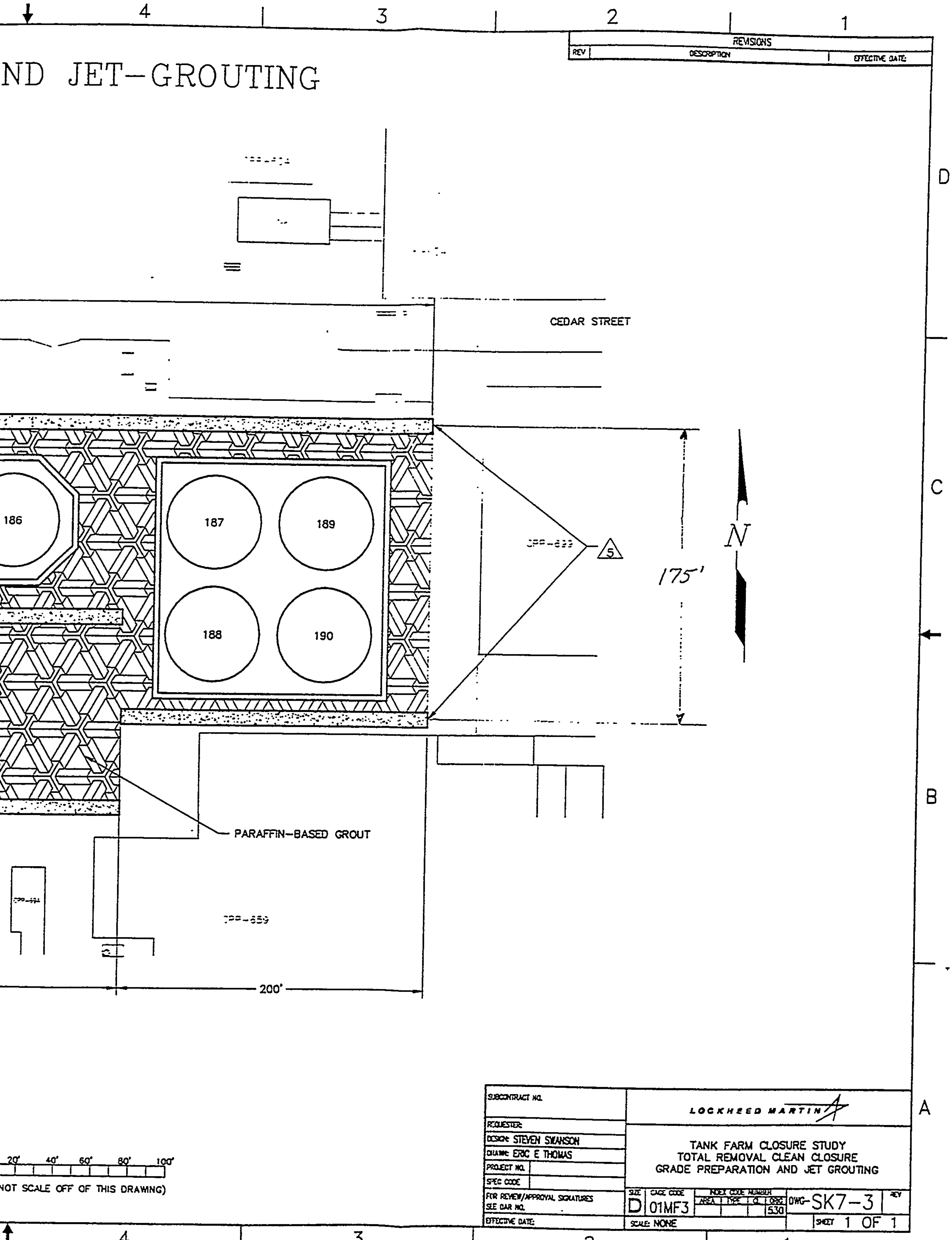
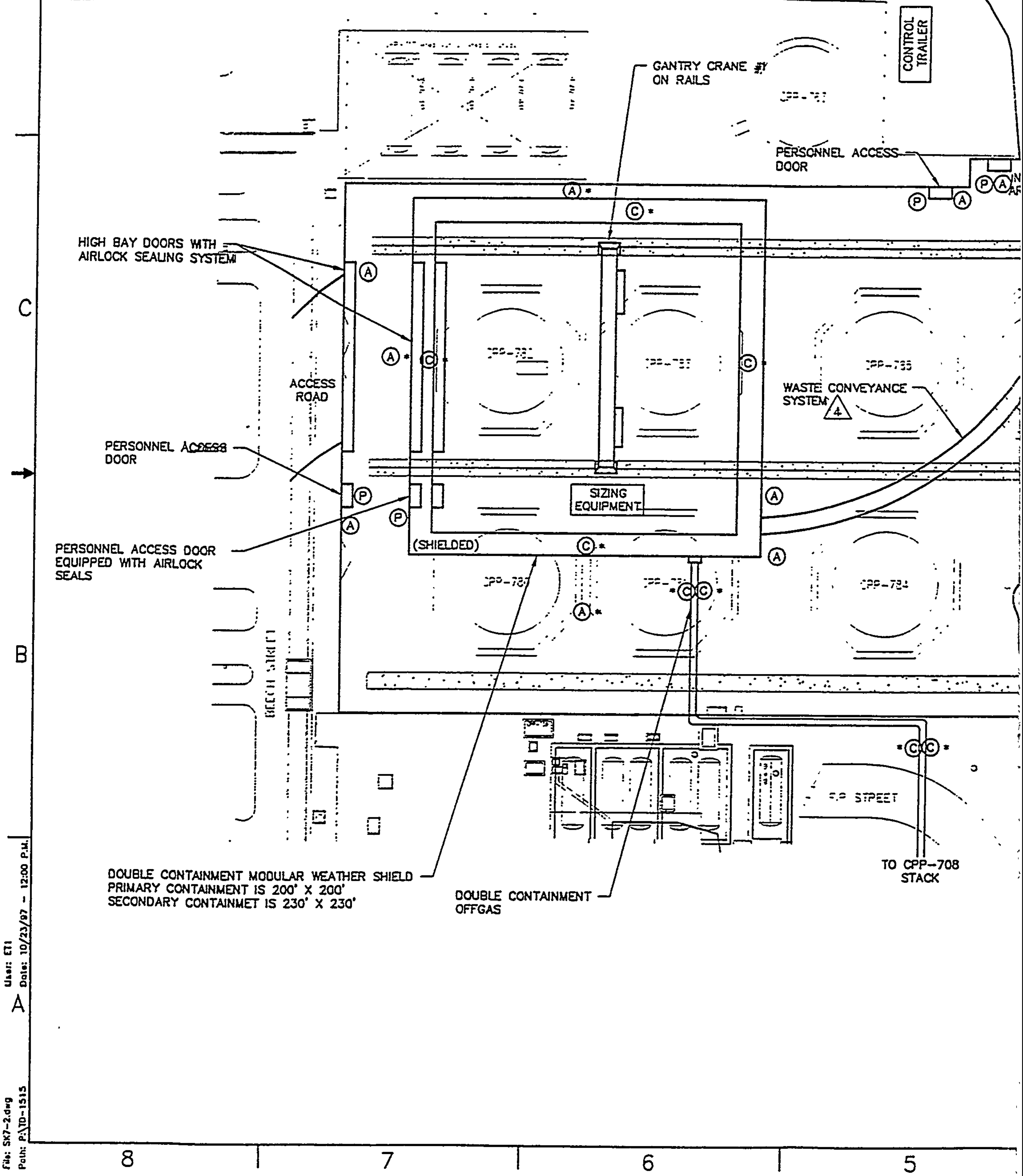


ND JET-GROUTING
REVISIONS
REV
DESCRIPTION
EFFECTIVE DATE
CEDAR STREET
186
187
189
188
190
5
175'
N
PARAFFIN-BASED GROUT
200'
20' 40' 60' 80' 100'
NOT SCALE OFF OF THIS DRAWING)
SUBCONTRACT NO.
REQUESTER
DESIGN STEVEN SWANSON
DRAWN ERIC E THOMAS
PROJECT NO.
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.
EFFECTIVE DATE
LOCKHEED MARTIN
TANK FARM CLOSURE STUDY
TOTAL REMOVAL CLEAN CLOSURE
GRADE PREPARATION AND JET GROUTING
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER AREA TYPE CL ORG 530
DWG-SK7-3
REV
SCALE NONE
SHEET 1 OF 1

PROCESS EQUIPM

NOTES:

1. BUILDINGS MUST BE REMOVED FOR SITE PREPARATION.
2. TWO GANTRY CRANES OF DIFFERENT SIZES ARE REQUIRED FOR EXCAVATION.
3. (Δ3) THE CERCLA PROGRAM WILL DECIDE HAW AND WHERE TO STOCKPILE EXCAVATION SOIL TAKEN FROM THE PIT. THIS AREA IS SET ASIDE FOR THIS USE IF THE CERCLA PROGRAM SO CHOOSES.
4. (Δ4) WASTE CONVEYANCE SYSTEM DETAILS WILL BE DETERMINED LATER.



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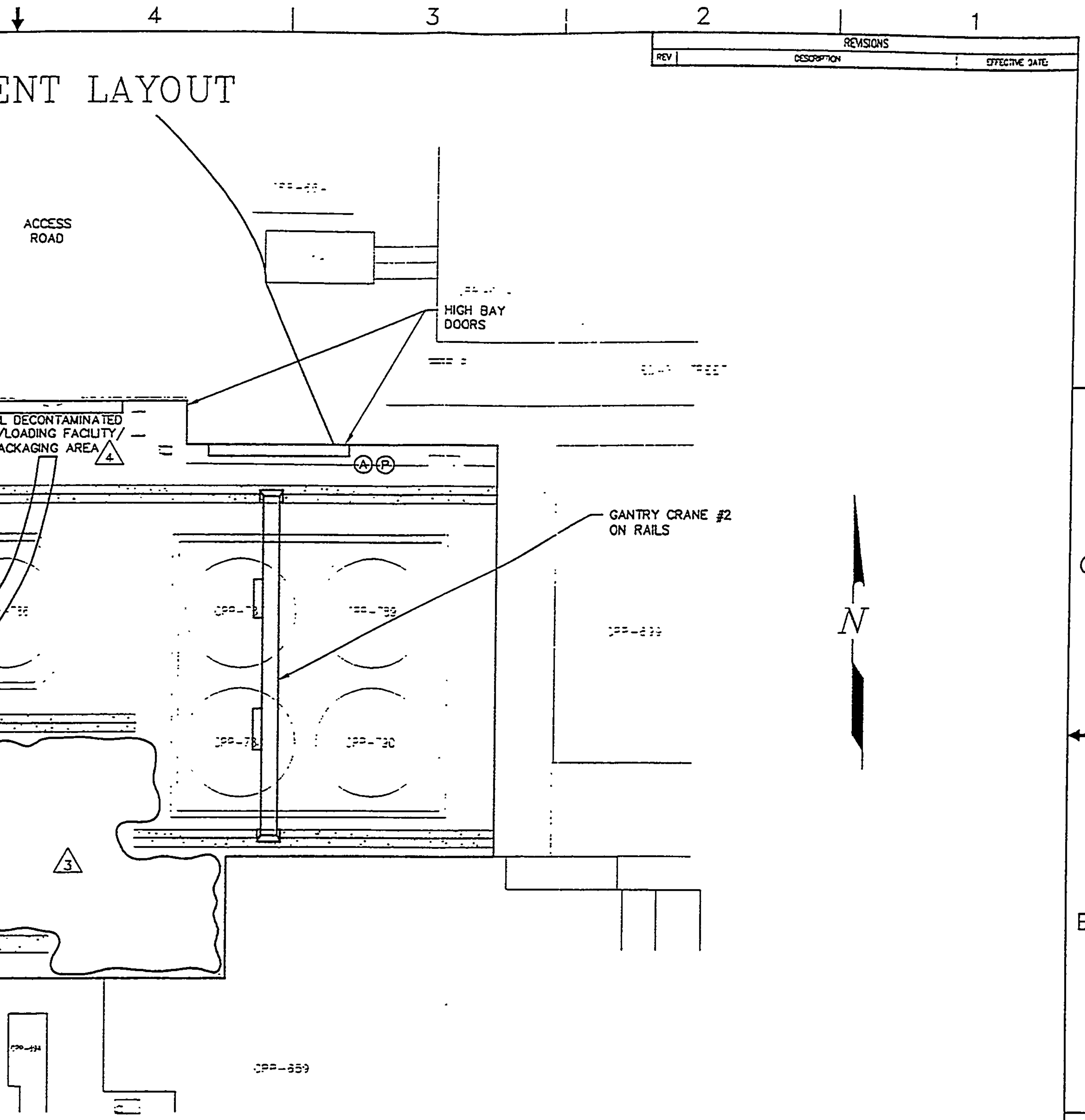

SYMBOLS: + VOC w/Backup

Ⓐ AREA RADIATION MONITOR
Ⓒ CONSTANT AIR MONITOR
Ⓟ PORTAL MONITOR
• BACKUP MONITOR (SAME AS PRIMARY)

0 20' 40' 60' 80' 100'

(DO NOT SCALE OFF OF THIS DRAWING)

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE

SUBCONTRACT NO.	LOCKHEED MARTIN
REQUESTER:	TANK FARM CLOSURE STUDY TOTAL REMOVAL CLEAN CLOSURE PROCESS EQUIPMENT LAYOUT
DESIGN: STEVE SWANSON	
DRAWN: ERIC E. THOMAS	
PROJECT NO.	
SPEC CODE	
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO.	SIZE D · CAGE CODE 01MF3 · INDEX CODE NUMBER: AREA, TYPE, CL, DISC 530 · DWG-SK7-2 · REV
EFFECTIVE DATE:	SCALE: NONE · SHEET 1 OF 1

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 73501
EDF Serial Number: EDF-TFC-024
Functional File Number: C-03

Project/Task: CPP Tank Farm Closure
Sub task: Vault Void Grout Emplacement

Title: TANK BUOYANCY CONSTRAINTS

SUMMARY

Located at the ICPP, eleven 300,000 to 318,000 gallon stainless steel tanks have been placed in concrete vaults. The total tank void volume (the total space inside the tank), based on WM 182-186, is approximately 1,849 cubic yards per tank. The vault void volume (the space between the tank and vault walls) is approximately 1,380 cubic yards (see EDF-TFC-029).

The CPP Tank Farm Closure Feasibility Study—Options 2 through 4 require that the vault void be filled with grout, encasing the tank, while leaving the tank void empty. If the grout, in its initial liquid phase, penetrated underneath the tank during vault void filling, a buoyancy force will be created.

Preliminary calculations show that grout levels of approximately 2.3 feet in the vault void could float the tank if the weight of the tank fails to exceed the buoyancy force caused by the liquid grout (grout in liquid phase). This assumes that 2 feet of grout from the heel stabilization process is already present inside the tank void. The sand bed under the tank was also considered dry and non-sealable from liquid.

A situation is presented where the vault void annulus is filled from 0 to 3.3 feet of liquid grout instantaneously (time = 0). After 3.3 feet of liquid grout is poured, a portion of that liquid grout begins to flow from the vault annulus to the area underneath the tank bottom. If this occurs the tank will float 3.4 inches above the vault floor.

It is recommended that an 18-inch grout lift be poured into the vault void and allowed to harden. This will prevent other grout lifts from penetrating to the tank bottom. As a precaution, a mechanism such as a rubberized membrane, epoxy layer or expandable grout could be placed above this grout lift to prevent liquid from flowing to the tank bottom. Normal vault void filling operations may then resume. Further study and more analysis is however necessary.

Distribution: B.R. Helm, D.J. Harrell, B.C. Spaulding, R.A. Gavalya and WTP EIS Studies Library on distribution.

Authors / Department	Reviewed	Approved
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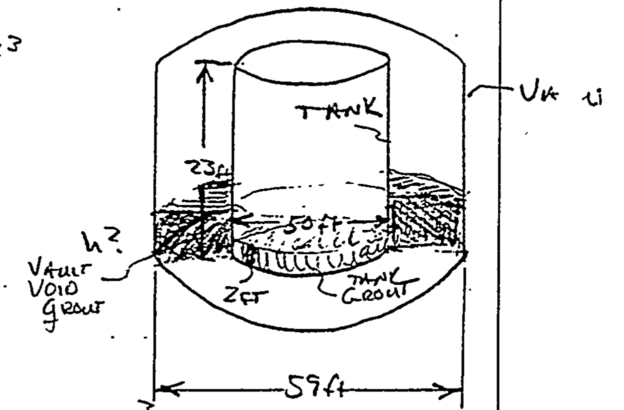
Date 12-18-97	Date 12·18·97	Date 12/18/97

1.) Assume tank is an ideal cylinder
2.) First 8' of the tank from the bottom is 5/16" thick
3.) Total tank height is 21 ft
4.) Assume vault is an ideal cylinder
5.) Assume stainless 347 steel has density of cold drawn steel 489 lb/ft³
6.) Tank lid & bottom thickness is 1/4"
7.) Specific weight of grout is 150 lb/ft³



Find weight of stainless steel tank

$Vol_{5/16}$ = Circumf. × width × Height (conv to ft)

$= 2\pi R_{TANK} \times 5/16 \times 8'$

$= 2\pi(25) \times 26.04E\text{-}3' \times 8' = 32.7 ft^3$

$Vol_{1/4} = 2\pi(25) \times 20.8E\text{-}3' \times 13' = 42.54 ft^3$

$Vol_{LID} = \pi R^2 \times 20.8E\text{-}3' = 40.9 ft^3 \times 2$ ← Both lid & bottom

157.1 ft³ ← Total stainless steel vol

Tank weight = Density · Volume

$= 489 \, lb/ft^3 \, (157.1 \, ft^3)$

= 76.8E3 lbs wt ← Tank weight

Add 2' of grout from solidified heel

Volume of 2' of grout $= \pi R^2 (2') = \pi (25^2)(2)$

$= 3927 ft^3$

grout weight $= 150 \, lb/ft^3 \, (3927 \, ft^3)$

= 589.E3 lb wt

Total weight of tank and grout = 76.8E3 + 589E3

= 665.8E3 lb wt

Bouyancy Force

specific wt of grout placed in vault void

$$W_{tank} + W_{grout} = V_{tank\,in\,grout}\,\gamma_g$$

? What is the max height of grout that can be poured into the vault void befor tank will float?

height of grout

$$W_t + W_g = (\pi r^2)\, h_g\, \gamma_g$$

$$\frac{W_t + W_g}{\pi r^2 \gamma_g} = h_g \Rightarrow \frac{665.8E3}{\pi (25')^2 (150\ lb/ft^3)} \Rightarrow h_g = 2.3\ ft$$

Check answer with Hydrostatic Forces & Pressures

0 surface; grout hydrostatic pressure of grout

$$\frac{P_1}{\gamma} + Z_1 = \frac{P_2}{\gamma} + Z_2 \Rightarrow Z_2 = \frac{P_2}{\gamma}$$

(Z_1: Depth; γ: specific wt of grout; Z_2: Depth of grout)

Finding pressure tank exerts on vault floor with 2' of grout in tank

tank weight

$$P_{tank} = F/A_2 = \frac{665.8E3}{\pi R^2} \Rightarrow 339.1\ lb/ft^2 \Rightarrow 2.35\ psig$$

If P_2 (hydrostatic pressure of grout) must not exceeds the pressure of the tank the tank w/ float

∴ Let $P_2 = P_T$

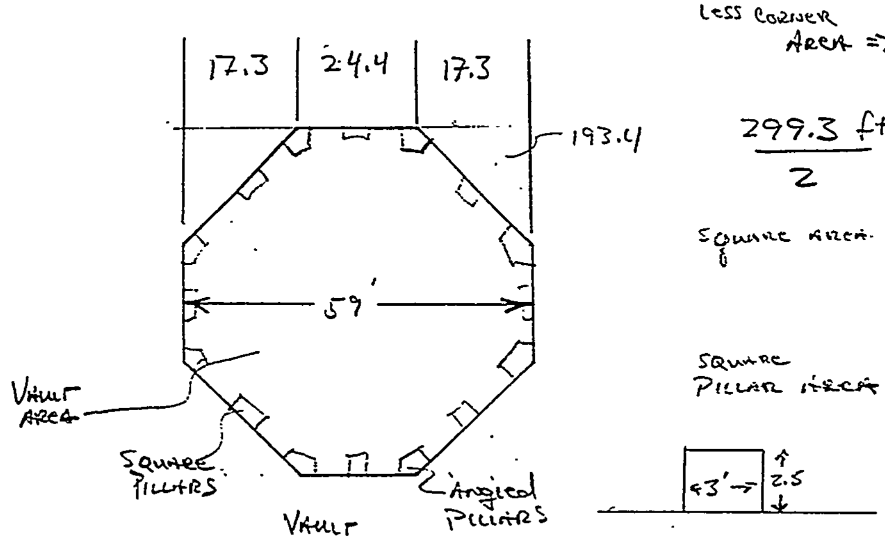
$$Z_2 = \frac{P_T}{\gamma} \Rightarrow Z_2 = \frac{339.1\ lb/ft^2}{150\ lb/ft^3} \Rightarrow Z_2 = 2.3\ feet$$

Finding How high tank w/ float if 3.3 feet of grout is Pumped into vault void.

1.) Find Area of Vault w/o Tank
2.) Find Area of Tank
3.) Find Vault void Area
4.) Find Fraction of tank in grout & depth in grout
5.) Calculate How High tank w/ float w/ 3.3 ft of grout

- Assume 3.3 feet of Liquid grout appears instantly in the vault void
- Assume grout is able to get under tank

Finding Area of Vault w/o Tank



Corners =>

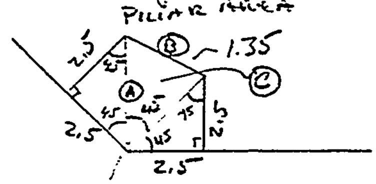
Less Corner Area => $(17.3)^2$ => $299.3\ ft^2$

$\frac{299.3\ ft}{2} = 149.6$ ← Area for each corner

Square area => $(59')^2$ => $3481\ ft^2$

Square Pillar Area => $3' \times 2.5 \times 8$ => $60\ ft^2$ (8 square pillars)

Angled Pillar Area => Length (A) Length (B) Length (C)



Finding Length (A)

$A \Rightarrow \sqrt{A^2 + B^2} = C$

$A = \sqrt{(2.5)^2 + (2.5)^2} = \boxed{3.53 = (A)}$

Finding Length (B)

$\frac{\sin 45^\circ}{(B)} = \frac{\sin 67.5^\circ}{3.53}$

$\frac{\sin 45^\circ (3.53)}{\sin 67.5} = (B) \Rightarrow \boxed{2.7 = (B)}$

ANGLED PILLAR AREA CONTINUED

Finding length (c)

$$a^2 + b^2 = c^2$$

$$\sqrt{-(1.35)^2 + (3.53)^2} = +b$$

$$\boxed{(c) = b = 3.26}$$

FIND AREA of CORNER PILLAR

$2.5 \times 2.5 \Rightarrow 6.25$

$1.35 \times 3.26 \Rightarrow 4.4$

$\boxed{10.65\ ft^2}$ ← AREA of 1 CORNER PILLAR

$10.65\ ft^2 \times 8 \Rightarrow \boxed{85.2\ ft^2}$ AREA of 8 CORNER PILLARS

TOTAL PILLAR AREA

$60\ ft^2 + 85.2\ ft^2 \Rightarrow \boxed{145.2\ ft^2}$

VAULT AREA w/o PILLARS

$3481\ ft^2 - (149.6)4 \Rightarrow \boxed{2882\ ft^2}$

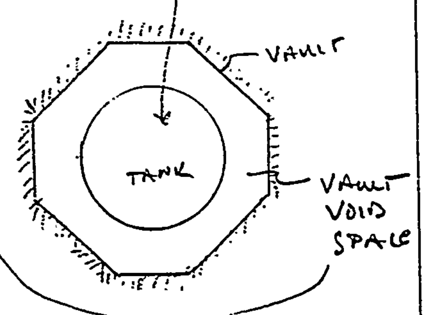
VAULT AREA LESS PILLARS

$2882\ ft^2 - 145.2\ ft^2 \Rightarrow \boxed{2737.4\ ft^2}$ ←

VAULT AREA

FIND AREA of TANK

$A_T = \frac{1}{4}\pi(D)^2 \Rightarrow A_T = \underline{1963.4\ ft^2}$

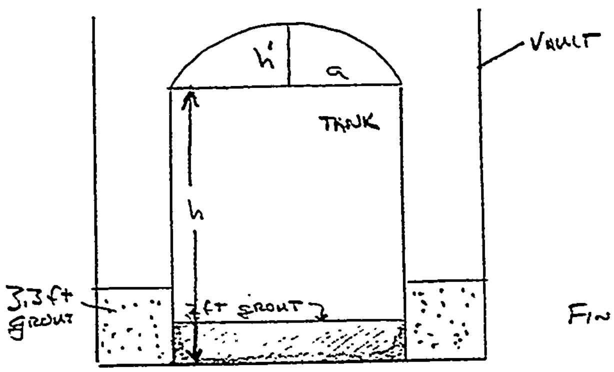


FIND AREA of VAULT VOID

VAULT AREA − TANK AREA

$2737.4 - 1963.4 \Rightarrow \boxed{774.0\ ft^2}$

Determine, if tank floats, how much will sit into liquid grout



B = Buoyancy $= \rho_f V_f g$

W_{TANK} = weight $= mg = \rho_T V_T g$

$W_{TANK} = 665.8E3$ (lb wt) $= \rho_T V_T = W_T$

Find density ρ_T of tank

$$\frac{665.8E3}{V_T} = \rho_T$$

(V_T = vol of tank)

$$\frac{665.8E3 \text{ lb ft/s}^2}{(54375.4) \text{ ft}^3} = \rho_T = 12.24 \text{ lb/ft}$$

Tank density

$V_T = V_{Dome} + V_{Cylinder}$

$$V_{Dome} = \frac{1}{6}\pi h' (3(a)^2 + (h')^2)$$

$$= \frac{1}{6}\pi (9') (3(25)^2 + (9)^2)$$

$$= \underline{9217.2 \text{ ft}^3}$$

$$V_{cyl} = \frac{1}{4}\pi D^2 h \qquad h = 21' \text{ \& } 23'$$

(23' used for bounding purposes)

$$= 1963.4 (23')$$

$$= \underline{45158.2 \text{ ft}^3}$$

$$V_T = 45158.2 + 9217.2$$

$$= \boxed{54375.4 \text{ ft}^3}$$

$$\boxed{2014 \text{ yd}^3}$$

Assume tank is a complete cylinder

$$\pi R^2 (h) = 54375.4 \text{ ft}^3$$

$\underline{h = 27.7 \text{ ft}}$ high cylinder like tank

$$\rho_f V_f = \rho_T V_T$$

$$\frac{V_f}{V_T} = \frac{\rho_T}{\rho_f} \Rightarrow \frac{12.24 \text{ lb/ft}^3}{150 \text{ lb/ft}^3} =$$

The fraction of tank that lies in liquid grout is:

$$\boxed{0.082}$$

Volume of fluid displaced by tank

$$V_f = 0.082 (V_T)$$

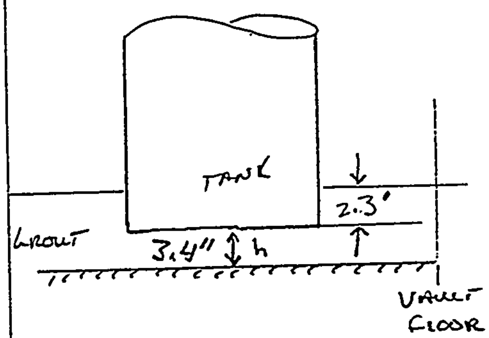
$$\underline{V_f = 4.44e^3 \text{ ft}^3}$$

$$V_f = \pi r^2 (h) \Rightarrow \frac{4.44 \text{ ft}^3}{\pi (25)^2} = h = \underline{2.3}$$

Depth tank w/ sink into the grout

Determine How high tank w/ float w/ 3.3 ft of grout

- Assume 3.3 ft of grout is placed in vault instantly



- Tank will always be 2.3' in grout
- 3.3 feet placed in vault void will transfer to below tank

3.3 ft of grout gives an extra 774 ft^3

$$2.3'(774\ ft^2) + 2737.4\ ft^2(h) = 774.0\ ft\ (3.3 ft)$$

$$2737.4\ ft^2(h) = 774$$

$$h = .283\ feet \Rightarrow \boxed{3.4\ in}$$

∴ - when tank is filled w/ 3.3 ft of grout tank could rise 3.4 in above vault floor

- Tank will always sit in the grout 2.3 feet

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 02B40

EDF Serial Number: EDF-TFC-025

Functional File Number: BC-17

Project/Task: CPP Tank Farm Closure Study

Sub task: Heel Solidification

TITLE: Grout and Concrete Formulas for Tank Heel Stabilization

SUMMARY

Conversation with Alan Herbst, LLW Grout Technical Lead at ICPP, by telephone on Sept. 9, 1997. We discussed the makeup of grout that could be used to solidify the tank heels (residual waste left in tank bottom after cease use). In order to achieve proper setting and curing of the grout, the heel pH must be in the range of 0.5 – 2.0. The grout mixture would have equal parts of Portland cement, blast furnace slag, and fly ash. By weight, 40 lbs. of water is added per 100 lbs. of solid mixture. The grout formula that could be used for heel solidification is shown below in Table 1.

Table 1. Grout Formula for Tank Heel Solidification (Specific Weight = 141 lb/ft^3).

Material (makes 1 ft^3)	Weight (lb)	Volume (oz)
Portland Cement Type I/II	33.3	
Blast Furnace Slag	33.3	
Fly Ash	33.3	
Water	40.0	
Plasticizer		15-20

We also discussed the possibility of using typical standard concrete as an alternative to solidifying tank heels with grout. If standard concrete (i.e. "Ready-Mix") were used, it would have to be self-leveling such that when dispersed through a grout delivery arm, it would flow evenly across the tank bottom. To be self-leveling, the rock in the aggregate must be small (<¾") and rounded. If coarse rock is used, the concrete will not distribute evenly but will tend to "heap" in the area where it's placed. The use of standard concrete should be evaluated further as a lower cost alternative to using grout.

The formula for typical concrete is shown below in Table 2.

Table 2. Typical "Ready-Mix" Formula* (Specific Weight = 146 lb/ft^3)

Material (makes 1 ft^3)	Weight (lb)
Portland Cement Type I/II	27.0
Rock (1/2 in. aggregate)	55.0
Sand	53.0
Water	11.0

* From Concrete Mixing—How-To-Booklet #62, Fred Meyer Home Improvement Centers

Distribution: D.J. Harrell, B.R. Helm, A.K. Herbst, J.A. McCray, LMITCO;
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Date 1·28·98		Date 1/28/98	Date 1/28/98

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: ~~02B40~~ 73501

EDF Serial Number: EDF-TFC-026

Functional File Number: SPR-02

Project/Task: CPP Tank Farm Closure Study

Sub task: Heel Stabilization

TITLE: Tank Heel pH Requirements

SUMMARY

At the Value Engineering Session held in July 1997, three scenarios were selected to stabilize the tank heels with grout. In each scenario, the heel will be displaced with liquid grout and then removed with a steam jet or submersible pump. As the heel is being displaced, the leading edge of the liquid grout will be in contact with the heel. If the heel is too acidic, cured grout that has been in contact with the heel will be structurally deficient. To ensure that grout added to the heel will be structurally stable when cured (compressive strength ≥ 500 psi), the heel acidity will be reduced to a specified pH range.

Descriptions and discussions of grouting experiments are included in a status report titled "Idaho Chemical Processing Plant Low-Activity Waste Grout Stabilization Development Program FY-97 Status Report". The experimental results were reviewed and follow-up telephone conversations with the report authors (Alan Herbst, John McCray) took place November 4 – 6, 1997.

Based on experimental results, it was determined that the heel should be diluted 3 – 4 times until a heel pH in the range of 0.5 - 2.0 has been obtained. Refer to the EDF writeup for further discussion of the status report results.

The status report is included as an attachment to the EDF.

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WTP EIS Studies Library, Tank Farm Closure Library

Authors	Department	Reviewed	Approved
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Rick A. Gavalya [signature]	11.10.97	Date 11/10/97	Date 11/10/97

Introduction

At the Value Engineering Session[1] held in July 1997, three options were selected for stabilizing the tank heels with grout. In each option, liquid grout placed in the tank would displace the heel towards a steam jet or submersible pump (depending on the option). The displaced heel would be removed as grout is added to the tank.

As grout is added to the tank, the leading edge of the grout will be in contact with the acidic heel solution. To ensure that the grout/heel interface will be structurally stable when cured and that chemical reactions do not occur that are destructive to the grout, the acidic level of the heel will have to be within a specified pH range.

A status report[2] titled "Idaho Chemical Processing Plant Low-Activity Waste Grout Stabilization Development Program FY-97 Status Report" was prepared and distributed in October 1997. The authors were A. K. Herbst, D. W. Marshall, and J. A. McCray. Results for tank farm heel grouting experiments are presented in the report. This report is included as an attachment to the EDF.

In one of the experiments, liquid grout was added to a full-strength solution of waste simulant (acid molarity = 1.57, pH $\approx$ -0.20) in a pan and allowed to cure. Although the main body of grout did cure and harden, the grout did remain soft at the interface area where the grout was in contact with the waste simulant. The report states, "After three days of exposure, a significant amount of solid had sloughed at the interface and settled at the pan bottom. After eleven days of exposure, significant further grout decomposition had occurred and a considerably larger quantity of solids had settled to the pan bottom." These results indicate that if the grout is in contact with the waste simulant for an extended period of time, the grout will not cure and harden at the grout/simulant interface.

In another experiment, liquid grout was poured into two-inch cube molds and allowed to cure for 24 hours. The cubes were then submerged in waste simulant solutions that varied in concentration from 12.5%, 25%, 50% and 100% of the full strength waste simulant. The cubes were submerged for either 15 days or 40 days and then tested for compressive strength. The results in Table 9 of the status report show that the cubes increased in compressive strength as the waste simulant concentration decreased.

Compressive strengths for all of the samples were above the 500 psi minimum. However, weight decreased for the samples submerged in the 25%, 50% and 100% waste simulant solutions (decreases of 0.6%, 5.8% and 22.2% respectively). The weight losses were due to "sloughing off" of the cured grout at the interface. The samples submerged in the 12.5% solution increased in weight by 2.3%, similar to the weight increase (2.2%) of a cube that was submerged in water.

These results indicate that grout cured in a less acidic heel would be more structurally stable than grout that has been cured in an undiluted, full-strength heel. The report concludes that based on initial research results, heel displacement with grout is "feasible if the heel is diluted to at least 12.5% of the original concentration."

Discussion

After reading the report, follow-up telephone conversations took place with Alan Herbst and John McCray on November 4-6, 1997, to further define heel pH requirements. Initially, it was assumed that the heel would be diluted with water or aluminum nitrate to adjust the heel acidity to a pH range of 1.5 – 3.0 before adding liquid grout to the heel.

However, upon further review and discussion of the data in Table 9, it was decided that the required heel pH range of 1.5 – 3.0 was too conservative. Based on the experimental results in Table 9, grout will set and cure in a more acidic environment than initially estimated. In effect, the heel would not require as many dilutions as originally anticipated . Minimizing the number of heel dilutions will reduce the overall volume of diluted waste that requires processing.

It was concluded by Mr. Herbst that a heel pH range of 0.5 – 2.0 should be sufficient to achieve a solidified grout with adequate compressive strength and minimal decomposition at the grout/heel interface.

Table 9 shows that the cubes placed in a 12.5% waste simulant concentration had compressive strengths greater than 6000 psi. The weight gain of 2.3% also indicates that the cube did not "slough off" material at the grout/simulant interface. The 12.5% waste simulant had a pH of about 0.71.

It appears that if liquid grout were added to a heel with a pH of about 0.70, the resulting solidified grout form would be more than adequate for heel stabilization. However, in the experiment, the grout cubes were allowed to cure for 24 hours in the molds before they were placed in the waste simulant. The physical characteristics of the solidified grout might have been different if the liquid grout were placed directly in the 12.5% solution. The grout/simulant interface may be more prone to chemical decomposition since the grout would initially be in liquid form.

Further experiments with liquid grout in varying waste simulant concentrations should be performed to verify that the recommended pH range of 0.5 – 2.0 is acceptable for heel stabilization. If necessary, the heel pH requirement will be modified to reflect experimental results.

Conclusions

Based on current recommendations, the required pH range will be set at 0.5 – 2.0. It is anticipated that the tank heels will have to be diluted 3 to 4 times in order to be within this pH range. Setting the pH range at these values should act to bound costs that are related to processing the diluted heel. If necessary, tank heel pH requirements will be changed if experimental results indicate that a different heel pH is required for liquid grout.

References

1. Jim Wixson. *Summary of the ICPP High-Level Waste Tank Farm Closure Option(s) Selection Using a Value Engineering (VE) Workshop*, JRW-03-97, September 5, 1997.

2. A. K. Herbst, D. W. Marshall, J. A. McCray, *Idaho Chemical Processing Plant Low-Activity Waste grout Stabilization Development Program FY-97 Status Report,* October 1997.

LOCKHEED MARTIN

Lockheed Martin Idaho Technologies Company

INTERDEPARTMENTAL COMMUNICATION

Date:	October 20, 1997		
To:	J. H. Valentine	MS 3211	6-3267
From:	A. K. Herbst	MS 5218	6-3939
Subject:	FY-97 STATUS REPORT ON THE LOW-ACTIVITY WASTE GROUT STABILIZATION DEVELOPMENT PROGRAM - AKH-02-97		

The attached document is a detailed report of the experimentation and results for the Low-Activity Waste Grout Stabilization Development Program conducted during fiscal year 1997. This work included formulation of a grout for the tank farm heels and continued research on grouting sodium-bearing waste, such as the decontamination and process equipment waste. In addition to grouting denitrated solids, two methods of grouting the liquid sodium-bearing low-activity waste were found. For FY-98, these formulations and the tank heel grout formulation will be validated by thermal cycle and immersion testing. Grout properties, i.e. set time, cure rate, heat generation, flow, etc., and process tolerances will also be studied.

If you have any questions or comments, please contact me at 6-3939 or by e-mail at alan@inel.gov.

rmg

Attachment

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Idaho Chemical Processing Plant Low-Activity Waste Grout Stabilization Development Program FY-97 Status Report

October 1997

A. K. Herbst
D. W. Marshall
J. A. McCray

Lockheed Martin Idaho Technologies

Summary

The general purpose of the Grout Development Program is to solidify and stabilize the liquid low-activity wastes (LAW) generated at the Idaho Chemical Processing Plant (ICPP). It is anticipated that LAW will be produced from the following: 1) chemical separation of the tank farm high-activity sodium-bearing waste, 2) retrieval, dissolution, and chemical separation of the aluminum, zirconium, and sodium calcines, 3) facility decontamination processes, and 4) process equipment waste. Grout formulation studies for sodium-bearing LAW, including decontamination and process equipment waste, continued this fiscal year. A second task was to develop a grout formulation to solidify potential process residual heels in the tank farm vessels when the vessels are closed.

For sodium-bearing LAW, the grouting of denitrated solids continues to be a viable process to achieve maximum volume reduction. A grout made with 35 wt% denitrated solids meets minimum strengths and leach resistance while only producing 1/5 the original volume. If volume continues to be a driving requirement, this process is the most effective.

Two methods of grouting the liquid sodium-bearing LAW were found this year. The waste can be grouted if the pH is between 1 and 3 or if the pH is greater than 11. Both processes produce acceptable strength and leach resistance while increasing the volume by 1 1/2 times. The short-term tests look promising, but long-term tests (thermal cycling and immersion) need to be completed. If volume ceases to be a driver, these processes could become cost effective.

It was determined that the tank farm vessel process residual heels can be grouted if the heels are diluted. The heel could be diluted by repeatedly adding an equal volume of aluminum nitrate solution or water to the heel and jetting off as much solution as possible. It is recommended that premixed grout be used to displace heel so that it could be further jetted or pumped out of the tank. This method would remove as much heel as possible from the tank and leave a solid grout for tank closure.

For FY-98, continued wasteform qualification is planned in the areas of compressive strength following sample immersion and thermal cycle testing. The grout formulations for both LAW and tank heels will be refined and characterized for mixture tolerances, order of addition, fluid flow, set time, cure rate, and heat of hydration. A grout pilot plant is planned for 2004 to test the equipment needed to concentrate, denitrate, and mix the grout and waste. Wasteform qualification testing is needed on full-scale disposal drums produced in the pilot plant to qualify the grout process and the grouted waste.

List Of Abbreviations And Acronyms

Al LLW	Low-level waste derived from aluminum calcine
ASTM	American Society for Testing and Materials
BFS	Blast furnace slag
CFR	Code of Federal Regulations
Comp. Str.	Compressive strength
DOE	U. S. Department of Energy
FA	Fly ash
ICPP	Idaho Chemical Processing Plant
INEEL	Idaho National Engineering and Environmental Laboratory
LAW	Low-activity waste
LLW	Low-level waste
Na LLW	Low-level waste derived from sodium-bearing waste
NO_x	Oxides of nitrogen
NRC	U. S. Nuclear Regulatory Commission
PC	Portland cement
TCLP	Toxicity Characteristic Leaching Procedure
UTS	Universal Treatment Standards
Zr LLW	Low-level waste derived from zirconium calcine

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IDAHO CHEMICAL PROCESSING PLANT LOW-LEVEL WASTE GROUT STABILIZATION DEVELOPMENT PROGRAM FY-97 STATUS REPORT

INTRODUCTION

The High-Level Waste Program Plan for the Idaho Chemical Processing Plant (ICPP) calls for the sodium-bearing liquid waste in the tank farm to be separated into high-activity and low-activity radioactive wastes. The calcine in the storage bins will be retrieved, dissolved in nitric acid, and separated. The small volume, high-activity waste will be vitrified and disposed of in a geological repository. The large volume, low-activity waste (LAW) will be grouted and either returned to the tank farm vessels or disposed of in drums. In addition to the LAW derived from separations, facility decontamination and the process equipment waste system will continue to generate low-level waste (LLW) liquids to be grouted. These decontamination and process equipment solutions are also a form of sodium-bearing waste. Further details of the grout program can be found in Section 4.5 of the High-Level Waste Program Plan. This research provides data on the various alternatives being proposed by the Department of Energy (DOE) High-Level Waste and Facilities Disposition Environmental Impact Statement.

During fiscal year 1997, two main tasks were worked. The first task was continued development of grout formulations to dispose of the sodium-bearing liquid waste from separations, facility decontamination, and process equipment waste. The second task was the development of a formulation to grout the tank farm vessel process residual heels. This second task was a new item added in the second quarter and is related to the closure of tank farm vessels. Once the sodium-bearing waste has been removed from the tanks, it is expected that 2 to 4 inches of liquid will remain on the tank floor (2500 to 5000 gallons). This heel will need to be stabilized in a solid form for tank closure.

The results are divided into three main sections. Section I discusses the grouting of thermally calcined, denitrated sodium-bearing LAW. Section II reports on the grouting of liquid sodium-bearing LAW by direct grouting (no pretreatment), partial neutralized (pH < 3) acidic liquid grouting, and fully neutralized (pH > 11) basic liquid grouting. Section III notes the results of vessel heel solidification by cement powder addition and by premixed grout displacement.

The criteria for an acceptable grout formulation and wasteform are governed by the Department of Energy and augmented with guidelines from the U.S. Nuclear Regulatory Commission. These documents are Department of Energy Order 5820.2a, "Radioactive Waste Management," and the "Technical Position on Waste Form," published by the Low-Level Waste Management Branch of the U.S. Nuclear Regulatory Commission (NRC). The NRC guidelines are specifically directed at grouted wasteforms and contain definitive qualifications in the areas of compressive strength, leach resistance, thermal cycling, immersion testing, and irradiation.

I – Grouting Of Denitrated Solid Sodium-Bearing Law

Research on grouting sodium-bearing low-activity waste (LAW) has continued for about 3 years and a proposed process flowsheet and grout formulation have been developed. During this fiscal year, the grout formulation was "pushed" to increase waste loading and improve volume reduction. Additionally, alternative processes were explored to determine if simpler processes could be found that would decrease costs and improve waste loading and volume reduction.

The selection of a method to dispose of sodium-bearing waste is important as this is the type of waste will continue to be produced at the Idaho Chemical Processing Plant (ICPP) for several years to come. Currently, any facility decontamination (decon) solutions and process equipment waste (PEW) are collected and evaporated in the PEW evaporator. The overhead off-gas is condensed and disposed of via the service waste system. The evaporator bottom solution is discharged to the vessels in the tank farm and is known as sodium-bearing waste. The majority of the sodium comes from the decontamination solutions. Since the tank farm is to be closed, the evaporator bottoms will need to be diverted to another storage tank pending grouting and disposal. The sodium-bearing waste is difficult to calcine due to agglomeration problems; thus, the separation processes are proposed to remove the waste from the tank farm.

The simulants used in this study are noted in Table 1. The sodium-bearing LAW is the projected waste from the separations process. The tank farm heel simulant is the expected waste remaining in the tanks to be grouted for tank closure. In discussions with plant personnel, it was determined that vessel WM-186 currently contains a majority of decon/PEW evaporated wastes. As can be seen in Table 1, the decon/PEW is very similar to the sodium-bearing waste simulants tested in previous years, except for the acidity. With the denitration preconditioning step, the acidity is destroyed as well as the nitrates.

Denitration is the thermal calcination of the liquid waste at 650°C to produce a solid for grouting. The percent of nitrates destroyed is noted in Table 2 for sodium-bearing LAW with various additives. Denitration without additives is about 80% effective for nitrate destruction. The denitrated solids can be grouted up to 35 weight percent (wt%) while maintaining strength and a volume reduction of about 5. The grout also passed the thermal cycle test. The use of clay to promote denitration results in about 98% nitrate destruction, but the added clay sacrifices volume and waste loading while maintaining strength. The addition of aluminum compounds, such as aluminum hydroxide and aluminum nitrate, to the denitration process slightly reduced the efficiency rather improve it as was expected. Additional denitration and grouting tests were run where the grout formers slag and fly ash were added during denitration rather than in the grouting step. These solids were then grouted at 25 wt%. The denitration efficiency again dropped as well as compressive strength and volume reduction.

One other test was completed where the liquid LAW was evaporated to dryness at 300°C and grouted at waste loadings from 7 to 35 wt%. In each case the grout failed to set. It was noted that if the evaporated solids were rehydrated, the solution retained its acidity. It is postulated that the remaining high nitrate content and the acidity do not allow the grout to cure. Thus, simple evaporation to dryness is not recommended. It could be used as a step prior to thermal calcination, but not as a stand alone process.

Table 1. Simulant Concentrations

Species	Sodium-Bearing LAW (molarity)	WM-186 Decon/PEW (molarity)	Tank Farm Heel (molarity)
H	7.70E-01	1.49E+00	1.57E+00
Al	3.37E-01	3.50E-01	6.39E-01
As	3.11E-05		
Ba	3.21E-05		6.10E-05
B	9.47E-03	2.00E-02	1.80E-02
Cd	1.47E-03	1.70E-03	2.76E-03
Ca	2.79E-02	6.30E-02	5.27E-02
Cl	1.53E-02	2.00E-02	2.87E-02
Cr	1.95E-03		3.71E-03
Cs	5.79E-10	3.30E-06	1.06E-05
F	3.63E-02	4.00E-02	6.89E-02
Fe	1.16E-02	1.80E-02	2.20E-02
Pb	7.37E-04		1.43E-03
Mn	8.42E-03		1.22E-02
Hg	5.73E-04		1.13E-03
Mo	3.68E-04		6.37E-04
Ni	8.42E-04		1.64E-03
NO_3	2.67E+00	2.93E+00	5.17E+00
PO_4			1.40E-02
K	1.08E-01	1.60E-01	2.04E-01
Se	1.50E-05		
Ag	1.21E-05		
Na	1.10E+00	9.60E-01	1.89E+00
Sr			5.10E-06
SO_4	2.63E-02	3.30E-02	5.04E-02
Zr	5.26E-04		2.85E-03

H^+

The grout samples were subjected to the Toxicity Characteristic Leaching Procedure (TCLP). Table 3 notes that all of the grout samples passed the universal treatment standards. Thus, the 3-way blend grout formulation continues to be recommended. This blend consists of equal parts of portland cement, blast furnace slag, and coal-fired power plant fly ash.

Table 2. Denitration and Grouting Results for Sodium-Bearing Waste Simulants

Denitration Additives	Denitration (%)	Waste Loading (wt%)	Vol_{grout}/Vol_{sim}	28 Day Comp. Strength (psi)	Thermal Cycle (psi)
None	79.5	25.0	0.26	2350	3570
None	79.5	35.0	0.18	810	510
Clay *	97.8	9.2	0.43	2380	
Clay *	97.8	16.0	0.26	1040	
$Al(OH)_3$	75.1	**			
$Al(NO_3)_3$	76.1	**			
Slag	65.7	25.0	0.29	1630	
Fly Ash	71.5	25.0	0.27	1530	
Slag and Fly Ash	74.3	25.0	0.28	1580	
Evaporation at 300°C	0	7 to 35	1.0 to 0.25	<50	

* FY-96 results

** Not grouted

Table 3. Leach Results for Sodium-Bearing Waste Simulants

Hazardous Element	Universal Treatment Standards (µg/mL)	Na LLW at 25% in 3-Way Blend (µg/mL)	Na LLW at 25% with Clay in 3-Way Blend (µg/mL)	Na LLW at 43% in High Slag Grout (µg/mL)
Arsenic	< 5.0	0.0180	*	< 0.10
Barium	< 7.6	0.5863	*	0.79
Cadmium	< 0.19	0.0125	0.1304	< 0.050
Chromium	< 0.86	0.5001	0.0780	< 0.050
Lead	< 0.37	< 0.0352	0.0799	< 0.050
Mercury	< 0.20	< 0.0002	< 0.0004	< 0.0020
Nickel	< 5.0	0.0337	*	< 0.050
Selenium	< 0.16	0.0902	*	< 0.10
Silver	< 0.30	0.0091	*	< 0.050

* Element not added to sample simulant

II – Grouting of Aqueous Sodium-Bearing LAW

Low-activity aqueous sodium wastes may be grouted following dilution, concentration, and/or acid reduction without presolidifying the waste. A parametric scoping study was conducted to explore the effects of aqueous waste acidity, grout composition, and waste loading on the compressive strengths of the resulting grouts. Approximately one-third of the grout formulations containing hazardous metal salts were subjected to TCLP to determine if the grouts exhibit characteristic toxicity.

Three ranges of waste acidity were tested; namely, directly grouted solution (~0.77 N H^+), partially neutralized acidic solution ($1.3 \leq pH \leq 2.8$), and basic solution ($11.9 \leq pH \leq 12.1$). Near neutral pH values for the simulant is undesirable because aluminum and iron precipitates form which (apparently) interfere with hydration of the cement, slag, and fly ash. Attempts to grout neutralized simulant were unsuccessful because the grout did not fully set, but remained plastic. The precipitates can be avoided when the pH is either less than 3 or greater than 11.

A. Direct Grouting

Scoping tests were completed on grout formulations with a 25 wt% waste loading and various quantities of type I/II portland cement (PC), blast furnace slag (BFS), and Class F fly ash (FA). The acidic simulant was diluted somewhat with water to provide a liquid to solids ratio of 0.4 mL/gm and added to the preblended powders. The resulting "mud" was mixed for 5 minutes before placement in 2-inch cubes for curing. In all cases, the acid reacted with the slag to evolve hydrogen sulfide gas. For each formulation, two cubes were produced. One of these cubes was crushed after 7 days of curing and another after 28 days to determine the compressive strengths. As grout cures, changes in crystalline speciation occur that cause an increase in compressive strength. The grout formed from directly grouted simulants, however, often exhibited atypical behavior. Four of the nine formulations tested showed a negative trend, where the compressive strength after 28 days of curing was less than the strength measured after 7 days of curing. In general, a high fly ash content in the powder blend suppresses the compressive strength, especially with limited curing time.

Two samples were submitted for TCLP analysis to determine whether the hazardous constituents were adequately immobilized. The grout formulations were both 25 wt% simulant and with PC:BFS:FA blends of 1:1:1 and 1:6:1, respectively. Both samples returned results below the Universal Treatment Standard (UTS) limits for all characteristically toxic metals that had been included in the simulant.

B. Acidic Solution

A stronger grout is produced if the simulated waste is partially neutralized with a sodium hydroxide solution prior to the powder additions than if the simulant is grouted directly. Partial neutralization allows the grout to cure normally (i.e., increasing in compressive strength with time). Only one formulation out of 40 showed the anomalous behavior of decreasing strength after 28 days of curing when compared with the strength after 7 days of curing. This anomalous grout was formed by adding the acidic simulant to preblended solids with a PC:BFS:FA mass ratio of 1:1:1 and 25 wt% simulant. The 28-day compressive strength of this grout formulation was nearly 4300 psi, more than 8 times the minimum requirement.

The formulations for grouting acidic simulants ranged in composition from 1 – 6 parts slag (by weight), 1 – 3 parts fly ash, and all with 1 part cement. Waste loadings ranged from a low of 25 wt% simulant with a liquid-to-solids ratio of 0.40 mL/gm to 33 wt% with concentrated simulant and a ratio of 0.46 mL/gm.

Compressive strengths were nearly as good for grout with waste loadings of 31 wt% (concentrated simulant) as for the grout with 25 wt% simulant. A marked decrease in compressive strength was noted for grout with 33 wt% (concentrated simulant) waste loadings. With any waste loading, the 28-day compressive strength was inversely proportional to the amount of fly ash in the formulation. At 25 wt% waste loadings, the compressive strengths increased with increasing slag content, but the converse was true for the 33 wt% (concentrated simulant) grout formulations. With the higher waste loadings, the quantity of acid that must be destroyed is larger, but proportionally less cement is available to react with the acid when high slag formulations are used. Average properties of the acidic grout formulations are given in Table 4.

Table 4. Average Properties of Grouted Acidic Simulants

Na-LAW Simulant	Waste Loading (wt%)	Avg. Cube Density (gm/cm^3)	28-day Comp. Strengths (psi)	Vol_{grout}/Vol_{sim}
Unneutralized	25	1.86	1640 – 6850	2.4
Acidic ($1.6 \leq pH \leq 2.8$)	25	1.89	280 – 7850	2.4
Acidic (pH=1.3)	30	1.96	4800 – 8820	1.9
Acidic ($1.2 \leq pH \leq 1.9$)	31 (conc.)	1.95	70 – 6930	1.6
Acidic ($1.3 \leq pH \leq 1.4$)	33 (conc.)	1.88	70 – 6820	1.3

When grouting the simulant with or without partial neutralization, the acid in the simulant reacts with the slag, fly ash, and cement to varying degrees. Acidities were measured on three slurries after adding a single powder to the simulated waste. The extent of acid destruction capacity for each solid is as follows: PC > BFS >> FA (see Table 5, below). Because the slag reacts with the acid to release hydrogen sulfide, one might hypothesize that the addition order of the slag, fly ash, and cement would have a profound effect on the compressive strength and the leachability of heavy metals from the grout. To test the hypothesis, 13 sample sets were prepared from a common waste simulant solution, using identical waste loadings (30 wt%), liquid-to-solid ratios (0.40 mL/gm), and powder ratios (1:3:1 PC:BFS:FA). These are comparable to grouting the Na-LAW without concentration or dilution, except for the sodium hydroxide solution that was added to partially neutralize the simulant. All components were weighed out to reduce the measurement error to no more than 0.1%. The grout forming powders were added to the simulant individually and/or in binary blends to ascertain the effects of the addition order on the grout properties. After each powder addition the slurry was mixed for about 5 minutes before subsequent powder additions or placement in the molds. The 28-day compressive strengths ranged from 4800 psi to 8800 psi (Figure 1) and appear to be independent of the total mixing time for a given sample.

Table 5. Single Component Slurry Acidities

Component(s)		pH of Solution/Slurry
Partially Neutralized Simulant		1.3
Portland Cement + Simulant	(111 gm/ 214 mL)	9.8
Blast Furnace Slag + Simulant	(333 gm/ 214 mL)	8.0
Class F Fly Ash + Simulant	(111 gm/ 214 mL)	3.2

When ranked by compressive strength, the top five formulations were produced by adding the slag before the cement, five of the weakest six formulations were produced by adding the cement prior to the slag, and the remaining three formulations involved preblended admixtures of cement and slag. Formulations which included fly ash in the initial powder addition, either solo or as a binary mixture, dominated the mid-range compressive strength values.

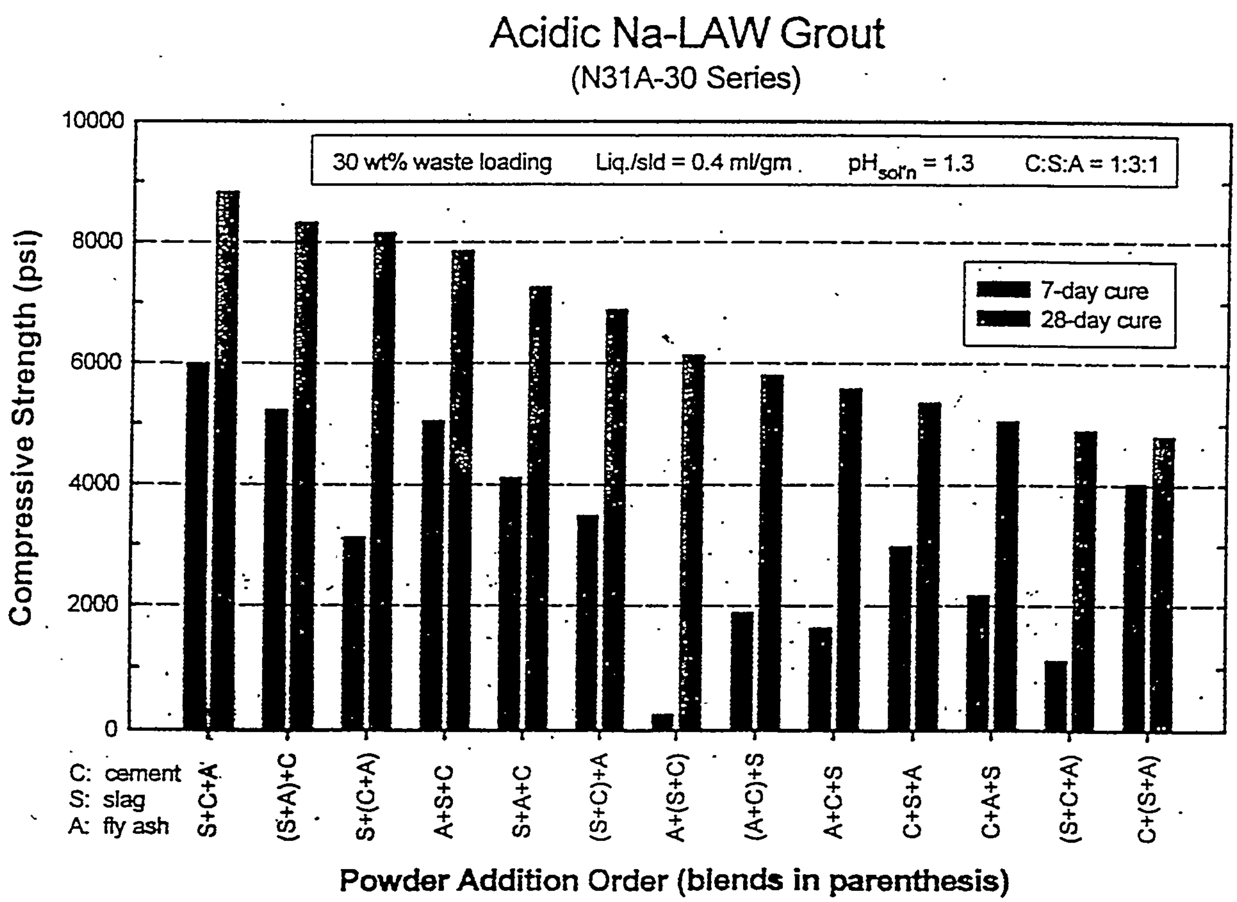


Figure 1. Effect of Powder Addition Order on the Compressive Strength of Grout

TCLP data for the 13 sample sets found detectable levels of barium leaching from all samples, but the concentrations in the leachates were approximately one-tenth of the UTS limit. Only one formulation leached a quantifiable amount of mercury from the grout at 0.0031 mg/L or one-eighth of the UTS limit for mercury. All others were less than 0.002 mg/L of mercury. No quantifiable amounts of arsenic, cadmium, chromium, lead, nickel, selenium, or silver were measured and all were below their respective UTS limits.

Another method of partial neutralizing the sodium simulant was tried with solid calcium hydroxide. This was done at waste loadings of 17 wt% to 54 wt%. Calcium hydroxide was added at the rate of 1 mole calcium hydroxide to 2 mole of hydrogen ion (acid). This results in a pH of 2 to 3 and leaves undissolved/unreacted calcium hydroxide in the solution. The solution was grouted with the 3-way cement blend. As can be noted in Table 6, the compressive strength drops off rapidly with increasing waste loading. At a waste loading of about 30 wt% there is a break even point in the volume in vs. volume out. The 17 wt% to 42 wt% samples were submitted for TCLP and all the results were less than detection limits. The two high loading samples did not set up and were not leach tested.

Table 6. Calcium Hydroxide Treated Sodium-Bearing LAW

Waste Loading (wt%)	Cube Density (gm/cm^3)	28-day Crush Strength (psi)	Vol out / Vol in
17.2	1.91	8310	1.56
25.5	1.87	4770	1.10
33.7	1.83	1370	0.86
42.0	1.75	270	0.73
48.1	*	*	0.67
53.9	*	*	0.65

* Sample did not set up

C. Basic Solution

Several grout formulations were prepared with sodium LAW simulant that was treated with sodium hydroxide to produce a caustic solution. Data for this series were sorted by their 28-day compressive strengths and are given in Table 7. It can be observed that slag contributes more to the compressive strength than does fly ash. This is observed by comparing the formulations with identical mass fractions of portland cement and by comparing samples with constant cement:slag ratios. Only the formulation with equal parts of cement, slag, and fly ash lost strength after curing for 7 days. Grout formulations containing a large fraction of fly ash exhibit higher compressive strengths when grouting basic wastes than acidic wastes. The converse is true for low-ash formulations.

Table 7. Basic Grout Formulations (25 wt% aqueous waste loading, liq./slds. = 0.4 mL/gm)

Powder Ratio Cement:Slag:Ash	Simulant pH	Cube Density (gm/cm³)	28-day Crush Strength (psi)	Vol_{grout} / Vol_{sim}
1:4:1	12.0	1.95	5580	2.29
1:2:1	11.9	1.87	5050	2.38
1:6:3	11.9	1.94	4120	2.30
1:6:2	11.9	1.92	4000	2.32
1:6:1	12.1	1.97	3980	2.26
1:4:3	11.9	1.93	3220	2.31
1:2:3	11.8	1.89	2570	2.36
1:2:2	11.9	1.90	2500	2.35
1:1:1	11.9	1.98	2170	2.25
1:4:2	11.9	1.90	2160	2.35

A second type of basic grout was prepared following a formulation developed by AEA Technologies of the United Kingdom under a DOE international contract. The formulation preconditions the waste to a pH of 12 prior to grouting with 1 part portland cement and 9 parts slag. The liquid waste simulant is added to sodium hydroxide and allow to sit for 3 days. Next, calcium hydroxide is added and allowed to sit another day. The rest periods allows the reactions to reach chemical equilibrium to avoid precipitation. Finally, the basic solution is cemented with portland cement and slag and some additional calcium hydroxide. This produces a waste loading of 43.3 wt% and the 28 day strength is about 920 psi (Table 8). By TCLP, all of the hazardous metals were below detectability, except barium at 0.79 micrograms per milliliter, which is well below the limit (Table 3). For this formulation the volume increases by 1.55, i.e. one liter of waste will produce 1.55 liters of grouted waste. The strength reduced to 810 psi after thermal cycle tests. AEA Technology grouted a 55 gallon drum of our sodium LAW simulant and found similar results. The grout formulation looks promising in that minimum strengths are met while achieving a high waste loading; however, the long term durability (90 day immersion test) needs to be evaluated. If volume is not a driver, this formulation appears favorable.

Table 8. Sodium Hydroxide and Calcium Hydroxide Treated Sodium-Bearing LAW Grout

Waste Loading [illegible]	[illegible]	28-day Crush Strength (psi)	[illegible] Cycle [illegible]	Vol_{grout} / Vol_{sim}
43.4	1.63	920	810	1.55

III – Tank Farm Heel Grouting- Preliminary Results

As a part of the future closure of the tank farm, remaining heels will require removal and/or in situ immobilization. Two options that would be relatively inexpensive and pose minimal risk to worker health and safety were identified for initial immobilization testing. The first option involves displacing the heel solutions with fluid grout addition to the tanks, forcing the solutions towards the existing jet transfer lines for subsequent removal. The waste solutions would then be treated in existing facilities (i.e. HLW evaporator, NWCF calciner). The second option involves adding dry grout powders to the tank heels to achieve in-place immobilization. Although the tank heels do contain a significant amount of undissolved solids that are potentially very high in radionuclide content, it is assumed for this testing that their presence will have no impact on either grouting method.

Adding water to the tank heels to dilute them, followed by removing the excess solution to the original heel levels, would be reasonable process steps to achieve acceptable tank farm heel immobilization using existing equipment. Thus, different degrees of heel dilution have been incorporated into the testing for both treatment options defined above.

A. Heel Displacement

All heel displacement tests were performed using non-toxic tank farm waste simulant, and grout made with equal weight percentages of portland cement, blast furnace slag, and Type F fly ash (3-way blend). The testing consisted of a pan test and a submersion test. The pan test involved actual displacement of waste simulant in a bake pan with fluid grout. The submersion test involved submerging partially cured (24 hours) grout samples, in solutions representing tank farm waste at different degrees of dilution or neutralization, for extended time periods (15 and 40 days, respectively). Both tests were performed to determine the effects the grout and simulant have on the other.

Results of the pan test showed that the fluid grout did cure and harden when used to displace the heel solution. However, the grout did remain soft at the interface area with the acidic solution. The grout slowly reacted with the solution and decomposed at the interface area. After three days of exposure, a significant amount of solid had sloughed at the interface and settled at the pan bottom. After eleven days of exposure, significant further grout decomposition had occurred and a considerably larger quantity of solids had settled to the pan bottom. The solution appeared to be partially gelled with a thin crystalline solid sheet (assumed aluminum hydroxide) covering the solution surface. The solution pH remained < 2.

Test results for the submersion test are presented in Table 9. These results verify that grout will decompose over time when exposed to acidic solution. Additionally, the effects of the acid exposure penetrate the grout beyond the immediate interface area and ultimately are detrimental to the wasteform strength.

B. In Situ Heel Immobilization by Dry Grout Addition

The dry grout addition tests were performed with tank farm simulant that included average tank farm waste concentrations of toxic metals. Dry grout addition testing involved the preparation of two similar sets of grout samples, allowing each set to cure for a specific time period, performing compression strength tests on the samples, and performing TCLP analysis for each sample type. The sample curing periods for Tests 1 and 2 were 36 days and 55 days, respectively. The grout samples for each test set differed in levels of tank farm waste simulant dilution or neutralization.

Molarity = 1.57 ⇒ pH = -0.20

Table 9. Grout Submersion Test Results

Submersion Solution*	Compressive Strength (psi) Following Submersion		Sample Weight (g)**		
	15-Day Submersion	40-Day Submersion	Before	After	Weight Change (%)
pH ≈ -0.20 100% Waste Simulant	1090	1220	241.5	188.0	-22.2
pH ≈ +0.11 50% Waste Simulant	2070	3000	237.9	224.0	-5.8
pH ≈ +0.41 25% Waste Simulant	5700	4880	241.5	240.0	-0.6
pH ≈ +0.71 12.5% Waste Simulant	6350	6770	238.5	244.0	+2.3
Water	2980***	7980	240.7	246.1	+2.2
Waste Simulant Neutralized to pH 2	1900	1750	237.5	222.8	-6.2
Waste Simulant Neutralized to pH 10	6380#	5730	242.2	251.5	+3.8
Control ##	6380#	7010	241.5	238.9	-1.1

* Balance of percentages is water.

** The before and after sample weight measurements were taken as a part of the 40-day test, prior to the submersion step and following the drying step after retrieval from submersion, respectively.

*** This low reading is likely the result of a faulty sample.

\# For the 15-day submersion test samples, the compression strength apparatus was set on low range. This reading is the maximum measurement for this range.

\## Grout sample was enclosed cured, without any submersion.

Each sample was prepared in a 2-inch cube plastic mold by first adding enough liquid (tank farm simulant at different levels of dilution or neutralization) to ultimately achieve a liquid-to-solid weight ratio of approximately 30%, and "spooning" the dry, 3-way blend grout powder on top. Excess dry grout powder was scraped off to achieve a level surface at the mold open end. Test parameters and compression test results are presented in Table 10.

Table 10. Parameters and Results for In Situ Heel Immobilization by Dry Grout Addition

Liquid* Composition	Waste Wt% (Test 1/Test 2)	Volume Change Factor** (Test 1/Test 2)	Density (g/cm^3) (Test 1/Test 2)	Compressive Strength (psi) (Test 1/Test 2)
100% Waste Simulant	35.3/36.3	0.37/0.37	1.30/1.26	150/100
50% Waste Simulant	16.4/16.3	0.18/0.18	1.40/1.40	310/370
25% Waste Simulant	7.8/7.5	0.09/0.09	1.47/1.52	800/860
12.5% Waste Simulant	3.8/3.8	0.05/0.05	1.54/1.54	680/440
Water	0/0	na/na	1.63/1.65	1170/670
Waste Simulant Neutralized to pH < 2	33.8/33.0	0.34/0.34	1.24/1.26	140/190
Waste Simulant Neutralized to pH 5	30.1/31.4	0.31/0.31	1.29/1.24	210/230
Waste Simulant Neutralized to pH 10	--/30.9	--/0.30	--/1.21	--/100

* Balance of percentages is water.
** Based on a tank farm waste solution specific gravity of 1.24

TCLP leach tests were performed on the crushed grout fragments from each of the first set of in situ grouting samples (Test 1). The results of these leachability tests are presented in Table 11. A significant amount of precipitate had formed in both samples that had been partially neutralized prior to adding the dry grout powder. These precipitates were forced to the bottom of the sample cube mold upon the powder addition, ultimately forming two distinct solid layers; the solidified grout at the top and the precipitate at the bottom. For these two samples, separate TCLP analysis was done for each solid layer, as indicated in Table 11.

Leachate from all tests showed hazardous constituent concentrations well below the specified limits. Even the non-grouted precipitate layers of the partially neutralized test samples failed to produce leachate containing hazardous elements at concentrations of concern.

Table 11. In Situ Heel Grouting TCLP Leachate Concentrations

Grout Sample Liquid Composition*	Waste Loading (wt%)	Hg (μg/mL)	Pb (μg/mL)	Cd (μg/mL)	Cr (μg/mL)	Ni (μg/mL)
100% SBW Simulant	35.3	ND	ND	ND	0.0043	0.0076
50% SBW Simulant	16.4	ND	ND	ND	0.0045	ND
25% SBW Simulant	7.8	ND	ND	ND	ND	ND
12.5% SBW Simulant	3.8	ND	ND	ND	ND	ND
Water	0	ND	ND	ND	0.0050	ND
SBW Simulant Neutralized to pH < 2 Grout (Top) Layer	33.8	ND	ND	ND	0.0051	ND
SBW Simulant Neutralized to pH <2 Precipitate (Bottom) Layer	33.8	ND	ND	ND	0.0083	ND
SBW Simulant Neutralized to pH 5 Grout (Top) Layer	30.1	ND	ND	ND	0.0119	ND
Na Simulant Neutralized to pH 5 Precipitate (Bottom) Layer	30.1	ND	ND	ND	0.0048	ND

* Balance of percentages is water

ND Not Detected -- Below analytical detection limits.

C. Tank Farm Heel Grout Discussion

From the test results presented above, several generalized initial conclusions have been drawn. These are listed and discussed below.

1. Tank farm heel removal could be accomplished by displacing the solution with fluid grout and forcing it to the existing jet transfer line for each tank. However, the heel solution must be transferred out of the tank immediately, unless it is significantly diluted with water prior to grout addition. Many more reasonable scenarios for removing the tank heel can be developed using grout displacement and water dilution. For example, for an individual tank, adding water to double the volume (approximately 10,000 gallon), jetting the excess solution out using existing equipment, and repeating this process one additional time, would result in a heel that contains only 25% of the original waste solution. Grout could then be added to fill the tank to near the jet transfer line level, with the elevated solution also jetted out. Additional grout could then be poured in at the end of the tank opposite the transfer line to "push" any remaining solution to the line for removal. A final step might be to drop dry grout powder around the transfer line to solidify the small volume of remaining solution. This process would provide the removal of nearly all of the tank heel without any major changes to existing equipment. The final grout in the tank would be little over a foot deep, strong, and virtually free of contaminants. Removed diluted heel solutions could easily be treated using existing facilities (HLW evaporator, NWCF calciner).

2. Heel neutralization should not be included as a part of either heel displacement or in situ grouting. Without mechanical mixing, concentrated hydroxide solutions do not readily disperse when added to heel solutions. Partial neutralization (to pH 2) provides less reduction in grout degradation than does one 100% dilution (to 50% original waste solution). Partial neutralization also results in some precipitate formation. Although waste solution fully neutralized (pH > 7) has little or no impact on displacement grout quality, a significant amount of flocculent precipitate does result. This precipitate will be difficult to remove from the tanks by displacement and no facilities exist at the ICPP for the treatment of radioactive alkaline precipitates. Precipitate formed prior to in situ grouting without mixing will be pushed to the bottom of the respective tank upon addition of the dry grout powder and be trapped between the solid grout and the tank bottom. The majority of the hazardous and radioactive constituents will not be in an immobilized form and the compression strength of the total solid mass will be well below minimum acceptable limits.

3. Dry grout addition to the tank farm heels, without mixing, results in a grout with very poor compression strength. Although compression strength generally improves as the waste solution is further diluted, a grout with compression strengths consistently above the minimum allowed for low-level waste immobilization (500 psi) cannot be guaranteed, regardless of the dilution factor. This is due to inconsistencies in the grout from the powder addition, off-gassing, etc. The two samples prepared with dry grout addition to water demonstrate the extreme differences in compression strength that can occur for no

apparent reason (Test 1 results nearly double that of Test 2). The poor quality of grout made with dry powder addition is further demonstrated by the fact that grout produced by active mixing of the same ingredients typically have compression strengths seven times that of the best sample from dry grout addition testing.

4. The heel solution in each tank must be characterized, particularly for both the quantity and composition of the undissolved solids. It is likely that water dilution of the heels will result in minimal removal of these solids. Heel displacement with grout will result in limited mixing of the solids with the grout. Dry grout powder addition will result in the undissolved solids not being immobilized, i.e. trapped between the upper grout layer and the tank bottom.

CONCLUSIONS, RECOMMENDATIONS, AND FUTURE STUDIES

The preconditioning of the sodium-bearing low-activity waste prior to grouting has been shown to be a necessity. This can take the form of thermal calcination and denitration, reducing the acidity, or rendering the waste chemically basic. The viability of grouting calcined or denitrated solid waste simulants has been demonstrated by laboratory studies conducted over the past three years. Grouting of acidic and basic aqueous simulants has been introduced this year to the development program and lacks sufficient maturity to determine its viability.

The denitration and solidification process is done by thermal calcination at 650°C. Studies of the process with and without additives were completed. Previously clay was used. This year aluminum compounds were tried. The aluminum compounds did not result in higher denitration efficiencies than the waste treated without any additives. As noted in last year's report, the clay improves denitration, but adds significant volume and needs excess water for grouting. Again, the results show that denitration without additives is the preferred denitration method.

Grouting of the denitrated solid waste continues to produce a viable grout product. The grout meets compressive strength and leach requirements and significantly reduces the volume of the grout. Waste loading can go as high as 35 wt% of the denitrated solids and meet minimum stability requirements. It is estimated that 30 wt% loading will allow for operational tolerances (to be studied in FY-98). Initial thermal cycling tests have proved satisfactory. In the case of 25 wt% grout, the strength actually increased after thermal cycling.

The denitration process is energy intensive and requires an extensive off-gas system, but is the best method found to date for reducing the waste volume. During FY-98, the long-term durability of the denitrated sodium-bearing LAW will be studied through continued thermal cycling and immersion tests. Additionally, grout properties will be studied, such as set time, cure rate, heat of hydration, viscosity, density, etc.

It was determined that the sodium-bearing LAW could be grouted by controlling the pH of the waste solution and increasing the slag content. The waste can be grouted at $1 < pH < 3$.. This can be done by adding sodium hydroxide to partially neutralize the acidity and then adding slag to the solution prior to the cement powder. It was found that this order of mixing was critical in forming a much stronger grout. Apparently, the slag neutralizes the waste to allow the portland cement to provide the initial set. If the portland cement is added first or as a mixed blend, the acidity attacks the portland cement for neutralization and there is insufficient cement for THE initial cure. The remainder of the slag and fly ash react later in the cure process and provide higher strengths. This process produces high strength grouts with waste loadings that increase the waste volume to about 1 1/2 to 2 times the original volume, which is much better than the 3 to 4 volume increase with diluted waste in the 3-way blend. The short-term results look promising, but the long-term tests have not been completed and are scheduled for FY-98.

The AEA Technologies grout formulation, where the waste is completely basic (pH=12), also shows promise. The waste loading is maximized at 43% and results in a volume increase about 1 ½ times the original volume. The samples passed the thermal cycle test and a 90 day immersion test is in progress. The immersed sample cubes do not show any cracking to date (60 days). This grout formulation is intended for in-drum mixing as the wet grout is rather viscose. If the grout is to go to the tank farm for disposal, a more fluid grout formulation would be required for this process.

Current cost projections utilize the cost of disposal and storage as the dominant cost factor. Thus disposal volume is a critical driver. If the grout goes to drums for later disposal, preliminary cost estimates show the denitration process to be cost effective due to the greatest volume reduction. This includes adjustments for the higher process energy costs and off-gas treatment. However, if volume ceases to be a driver, the alternative processes of liquid waste grouting would be more cost effective. Table 12 illustrates the estimated amounts of materials needed to produce a cubic meter for the grout formulations studied.

Initial research on grouting of the tank farm vessel process residual heel shows that it is feasible if the heel is diluted to at least 12.5% of the original concentration. The grouting of full strength wastes was shown to be ineffective. Neutralization by caustics is not recommended due to mixing problems and precipitate formation. Additionally, the use of powdered cements is not recommend due to low strength results. Based on preliminary results, heel displacement by premixed grout recommended. The heel should be diluted with water or aluminum nitrate solutions to double the heel volume and jet off half of the resulting solution. This would be repeated 3 or 4 times to lower to pH to about 2. At this point, premixed grout could be added to the heel to raise the level and allow further jetting. A Value Engineering group recommended this method to remove as much heel/waste as possible. During FY-98, the heel grout will undergo thermal cycle and immersion testing. Additionally, the grout formulation used by Savannah River to close their tanks will be evaluated.

Table 12. Estimated Grout Formulations to Produce a Cubic Meter of Grouted Low-Activity Waste *

Grout Type	Liquid LAW (m^3)	Treated Waste (kg)	50% NaOH (kg)	$Ca(OH)_2$ (kg)	Waste Loading (wt%)	Portland Cement (kg)	Slag (kg)	Fly Ash (kg)	Water (kg)	Cured Density (kg/m^3)	28 Day Strength (psi)	Grout Volume (m^3)	Vol_{grout}/ Vol_{slim} Ratio
Denitrated LAW Grout	4.75	Dentr. 548	n/a	n/a	Solids 30.0	253	253	253	519	1826	1600	1.0	0.21
Acidic LAW Grout	0.53	587	29	n/a	Liquid 30.0	269	806	269	0	1960	7200	1.0	1.87
Basic LAW Grout	0.63	693	101	117	Liquid 42.5	72	647	0	0	1630	900	1.0	1.44

* Based on Scale-up Estimates – Not Actual Results

Table updated 10/22/97

GLOSSARY

Blast Furnace Slag is a finely ground non-metallic waste produce developed in the manufacture of pig iron, consisting basically of a mixture of lime, silica, and alumina, the same oxides that make up portland cement, but not in the same proportions or forms.

Calcination is the process of converting a liquid to a solid product called calcine.

Cement refers to type I/II portland cement.

Fly Ash is a pozzolan of finely divided residue that results from the combustion of ground or powdered coal. Class C fly ash may contain 10% lime, has cementitious properties, and reacts with water to form a solid. Class F fly ash does not use water and aids in grout flow.

Grout is a mixture of portland cement, other powdered additives, waste, and water. It may contain fine-grained sand and does not include large aggregate material. For this study, grouting is the process of solidifying and stabilizing low-level waste in cement based materials.

Leaching is the process whereby a liquid agent will dissolve hazardous materials within a waste mass and transport these materials through the mass and beyond. The most widely used laboratory leaching test is the TCLP (Toxic Characteristic Leaching Procedure) specified by the EPA in several regulations. For many treated and untreated wastes, the results of this test determine whether the EPA considers the material toxic or not.

Low-Activity Waste is low-level waste derived from the solvent extraction, ion exchange, and chemical extraction separation processes on the tank farm sodium-bearing waste and on the dissolved calcines.

Portland Cement is the product obtained by pulverizing clinker consisting essentially of hydraulic calcium silicates.

Pozzolan is a siliceous or siliceous and aluminous material that reacts with liquid calcium hydroxide in the cement gel to form compounds possessing cementitious properties.

3-Way Blend is a 1:1:1 blend of portland cement, blast furnace slag, and coal fired power plant fly ash on a mass basis.

Solidification is the process of producing from liquid, sludge, or loose solids a more or less monolithic structure having some integrity. Occasionally, solidification may refer to the process that results in a soil-like material rather than a monolithic structure. Solidification does not necessarily reduce leaching of hazardous materials. However, when a waste is solidified, its mass and structure are altered, decreasing migration of solutions within the mass.

Stabilization generally refers to a purposeful chemical reaction that has carried out to make waste constituents less leachable. This is accomplished by chemically immobilizing hazardous materials or reducing their solubility by a chemical reaction.

Water-to-cement ratio is defined as the mass of the water divided by the mass of the cements used (portland cement plus cement additives). In the case of the three way blends of portland cement, blast furnace slag, and fly ash, the mass of the water was divided by the total mass of the three cementing agents. The mass of the waste is not included in this calculation.

Waste form is the final product for long-term storage. This includes the solidified/stabilized waste as well as the container. The waste form must pass extensive qualification testing prior to release for storage.

Waste loading is the mass of the waste on a dry basis that is added to the mass of the waste solidification/stabilization additives, also on a dry basis. The mass of the waste reflects only the amount of original waste placed in the final grout. The mass of preconditioning additives or off-gas products are not used in the calculation.

Vitrify is the process of placing waste material in a glass form. This is a thermal process where the waste material is placed in a melter with glass beads or frit, then heated together, poured into a storage container, and cooled to a solid form.

Vol_{grout} / Vol_{sim} is the ratio of the volume of grout produced from a given volume of the original liquid low-level waste volume. For a ratio of 4, the volume of grout would be 4 times greater than the original volume of the liquid waste. If the ratio is less than 1.0, the volume of grout would be less than the original liquid waste volume. An objective of the preconditioning and grouting processes is to optimize (reduce) this ratio; thus, reducing final repository costs based on volume.

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501
EDF Serial Number EDF-TFC-027
Functional File Number BC-18

Project/Task CPP TANK FARM CLOSURE STUDY
Sub task ANCILLARY PIPING

TITLE: TANK COOLING WATER SENT TO PEW		
SUMMARY Telephone conversation with Mr. Frank Ward on August 18, 1997 about sending TFF cooling water to PEW Telephone conversation with Mr. Dave Machovec on October 21,1997 on the same subject.		
Distribution:; D. J. Harrell, MS 3211 B. R. Helm, MS 3765; B. C. Spaulding, MS 3765 F. S. Ward, MS 5111; D. Machovec, MS 5111;; Project Files (Original +1)		
Authors Department K.C. DeCoria MC&IE 4130	Reviewed Date 12/15/97	Approved Date 12/15/97

Mr. Ward stated that it seemed to make the most sense to process the cooling water (which contains chromate) through the PEW evaporator (PEWE). The PEWE would remove most of the water from the waste and the bottoms would then be sent to the tank farm. It could then be blended with sodium bearing waste and be calcined or it could be blended with the Type 2 low-level waste and grouted when the grout plant comes on line. The amount of liquid that would be processed would not measurably change the amount of calcine produced.

There is a question of liability for the company if an independent vendor is used to remove and dispose of cooling water. The vendor would need to bring equipment on to the tank farm, which is a concern for load limits, operating in the RMA, and operating in the RCRA unit. If the vendor failed to perform proper storage or disposal, LMITCO could be held liable.

At the present time only radioactive and mixed liquid wastes are to be processed by the PEW evaporator. DOE must approve all new waste streams, so if the legal hurdles can be removed, the transfer of the cooling water to the PEW could be accomplished. There was one sample of the cooling water that detected radioactivity and several samples that did not. If it is radioactive or cannot be proved to not contain any radioactivity then it would be a mixed waste and PEW evaporator would be an acceptable treatment and outside vendors may not be available to treat the mixed waste.

Mr. Machovec was also in agreement on transferring the cooling water to PEW. He stated that a procedure (not approved) exists for the transfer, this would require installing an above ground line because the existing piping did not pass pressure testing.

ENGINEERING DESIGN FILE

Project File Number 73501

Project/Task CPP TANK FARM CLOSURE

Subtask Vault Void Grout Emplacement

Title: Evaluation of Conservatism of Vehicle Loading on Vaults
Summary: This summary briefly defines the problem or activity to be addressed in the EDF, gives a summary of the activities performed in addressing the problem and states the conclusions, recommendations, or results arrived at from this task.

The objective of this task was to assess whether or not excess conservatism was included in an evaluation of vehicle loading on the vaults as performed and reported by Advanced Engineering Consultants (AEC) in August 1993.

A cursory review of AEC's report was performed and scoping calculations were made to assess whether or not excess conservatism may have been included in the evaluation of the existing HLWTF vaults. The results of the review and scoping caculations are:

- Standard engineering practice was used to develop soil and vehicle loading on the vaults.
- Over 90% of the predicted loading on the vaults is due to the soil alone.
- All of the vaults have various structural components over loaded (some by large margins) irrespective of the vehicle loads.
- Scoping calculations for the roof beam (RB-1) and west wall indicate AEC's results may be unconservative.

Based on the scoping calculations it is recommended that the original calculations by AEC be reviewed in more detail to ascertain whether or not they are conservative and meet code requirements. This was beyond the scope of this task.

Distribution (complete package): B. R. Helm, MS 3765; D. J. Harrell, MS 3211; K. D. McAllister, MS 3765; B. C. Spaulding, MS 3765; R. Gavalya, MS 3765; WTP EIS Studies Library; R. K. Blandford, V. W. Gorman, R. G. Rahl, G. K. Miller, AMG 4 File, MS 3760

Distribution (summary package only): A. G. Ware, MS 3760

Author	Dept.	Reviewed	Date	Approved	Date
V. W. Gorman VW Gorman	41A0	R. K. Blandford RKBlandford	10-29-97	A. G. Ware AGWare	10/30/97
		LMITCO Review	Date	LMITCO Approval	Date

See Management Control Procedure (MCP) 6 for instructions on use of this form.

CURSORY REVIEW OF AEC REPORT

REF: "EVALUATION OF EXISTING VAULTS FOR VEHICLE LOADS, HLWTFR PROJECT," ADVANCED ENGINEERING CONSULTANTS, INC., AUGUST 1993.

THE REFERENCED REPORT WAS REVIEWED IN ORDER TO DETERMINE WHETHER OR NOT EXCESS CONSERVATISM WAS INCLUDED IN THEIR EVALUATION. THE RESULTS OF THE CURSORY REVIEW ARE:

1) IT APPEARS THEY FOLLOWED STANDARD ENGINEERING PRACTICE IN DEVELOPING THE "AT REST SOIL PRESSURES" AS WELL AS THOSE DUE TO VEHICLE LOADING.

2) OVER 90% OF THE LOADING IS DUE TO THE SOIL ALONE.

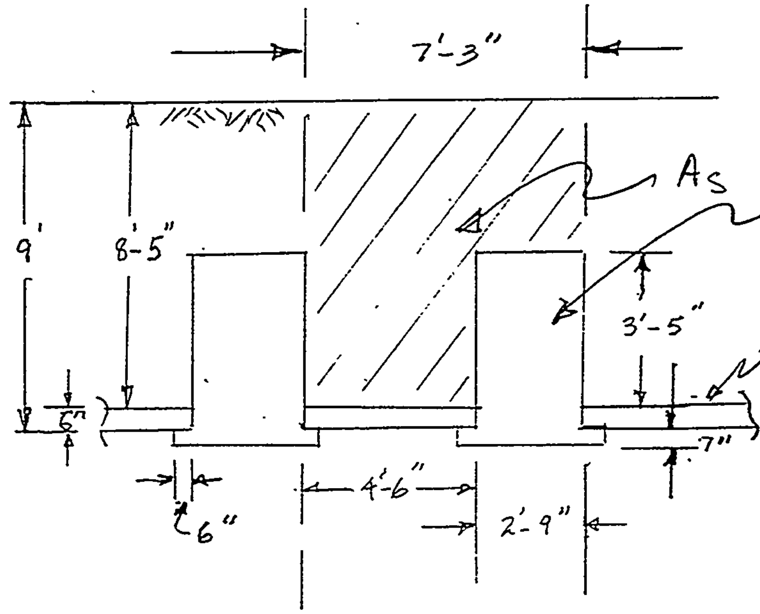
3) VARIOUS PORTIONS OF ALL THE VAULTS ARE OVER STRESSED WITHOUT INCLUDING VEHICLE LOADS - SOME BY LARGE MARGINS.

4) CALCULATIONS (WHICH FOLLOW) INDICATE AEC'S RESULTS MAY BE UNCONSERVATIVE. SOMEONE SHOULD REVIEW THEIR CALCULATIONS TO VERIFY WHETHER OR NOT THIS IS TRUE. [PRESENT REVIEW OF THEM WAS BEYOND THE SCOPE OF THIS TASK.] IT APPEARS THAT A LOAD FACTOR OF 1.4 RATHER THAN 1.7 WAS USED FOR SOIL LOADING BASED ON "QUICK LOOK" CALCULATIONS.

EVALUATION OF VAULT CPP-713 ROOF BEAM (RB-1)

CALCULATE DEMAND

WEIGHT PER UNIT LENGTH OVER WIDTH SHOWN BELOW



$$A_s = \{[8(12)+5][7(12)+3] - [2(12)+9][3(12)+5]\}/144$$

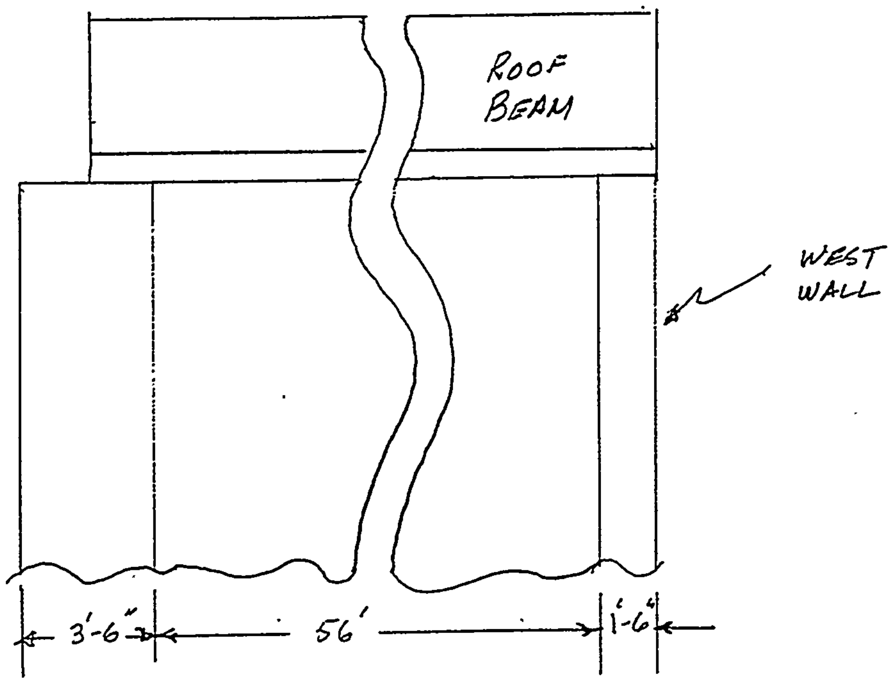
$$= 51.63 \text{ FT}^2$$

$$W_{SOIL} = \gamma_s A_s = 0.125(51.63) = 6.45 \text{ K/FT}$$

$$W_{PANEL} = \gamma_c A_p = 0.150\,(4.5 \times 0.50) = 0.34 \text{ K/FT}$$

$$W_{BEAM} = \gamma_c A_B = 0.150\,(4.5 \times 2.75 + 1 \times 0.583) = 1.94 \text{ K/FT}$$

$$D = W_p + W_B = 2.28 \text{ K/FT} \quad \text{(CONC. DEADWEIGHT)}$$



MOMENT FOR SIMPLE SUPPORTED BEAM IS $M = \frac{wl^2}{8}$

DEAD WEIGHT MOMENT IS

$$M_D = \frac{Dl^2}{8} = \frac{2.28(56)^2}{8} = 893.76 \text{ FT-K}$$

SOIL WEIGHT MOMENT IS

$$M_S = \frac{W_S l^2}{8} = \frac{6.45(56)^2}{8} = 2528.40 \text{ FT-K}$$

ASSUMING SOIL LOAD IS A LIVE LOAD THEN M_T PER UBC (OR DEMAND) IS

$$U = M_T = 1.4 M_D + 1.7 M_S$$

$$= 1251.26 + 4298.28 = 5549.54 \text{ FT-K}$$

ASSUMING A 1.4 FACTOR TIMES THE SOIL LOAD CAN BE USED FOR VERTICAL LOADING

$$U' = M_T' = 1.4 M_D + 1.4 M_S$$

$$= 1251.26 + 3539.76 = 4791 \text{ FT-K}$$

(AEC, TABLE 6 LISTS A VALUE OF $D = 4948.0$ FT-K)

USING A 1.4 FACTOR AGAIN FOR SHEAR

V_u (AT SUPPORTS) = $[1.4(2.28)+1.4(6.45)](28) = 342$ K

V_u (AT "d" FROM SUPPORT) = $342 - 12.22(49/12) = 292$ K

NOMINAL SHEAR STRESS IS

$$v_u = V_u/\varphi b_w d = 292300/0.85 \times 33 \times 49 = 213 \text{ psi}$$

$$v_c = \left(1.9\sqrt{f'_c} + 2500 \rho_w \frac{V_u d}{M_u}\right) \quad \text{(ACI, EQ'N 11.6)}$$

$$\rho_w = \frac{A_s}{b_w d} = \frac{36.5}{33 \times 49} = 0.023 \quad , \quad \frac{V_u d}{M_u} = 1$$

$$v_c = (1.9\sqrt{3000} + 2500 \times 0.023) = 160.5 \text{ psi}$$

$$V_c = v_c \varphi b_w d = .1605(.55)(33)(49) = 221 \text{ K}$$

$$V_s = \frac{A_v f_y d}{s} = \frac{2(.31)(40)(49)}{4} = 304 \text{ K}$$

$$\varphi V_n = \varphi(V_c + V_s) = 0.85(221 + 304) = 446 \text{ K} > 292 \text{ K} \quad \text{OK}$$

(AEC, TABLE 6 LISTS A VALUE OF 276 K FOR CAPACITY)

ASSUMING AEC USED A 1.4 FACTOR FOR SCALING THE SOIL LOAD ON THE BEAM, THE AGREEMENT BETWEEN AEC'S CALC'S AND THESE ARE GOOD. HOWEVER, BY CODE (ACI 318 OR UBC CHAP. 19) A 1.7 FACTOR SHOULD NORMALLY BE USED UNLESS DENSITY OF SOIL IS WELL KNOWN WHICH IN THIS CASE IS TRUE.

THE NEXT 3 PAGES PROVIDE AN APPROXIMATE BEAM MOMENT CAPACITY IN THAT THE REBAR WAS LUMPED TOGETHER AS SHOWN ON THE FIGURE. THE BEAM DETAILS WERE TAKEN FROM THE SECOND SET OF CONSTRUCTION DRAWINGS FOR THE VAULT, NAMELY, DWG 117980. [AN EARLIER DWG FOR CONSTRUCTION OF THE FIRST PORTION OF THE VAULT (DWG. 106317) INDICATES THE BEAM HAD LESS REBAR.] THE CALCULATED CAPACITY OF 6665 K-FT IS CLOSE TO AEC'S PREDICTION OF 6833 K-FT.

General Information:

File Name: C:\PCACOL\DATA\VWGRB3.COL
Project:
Column: BEAM RB-1 (DWG. 117980)
Engineer:

Code: ACI 318-89
Units: US in-lbs
Date: 09/17/97 Time: 16:52:37

Run Option: Investigation
Run Axis: X-axis

Short (nonslender) column
Column Type: Structural

Material Properties:

f'c = 3 ksi
Ec = 3320.56 ksi
fc = 2.55 ksi
eu = 0.003 in/in
Stress Profile: Parabolic

fy = 40 ksi
Es = 29000 ksi
erup = 0 in/in

Geometry:

Rectangular: Width = 33 in   Depth = 54 in

Gross section area, Ag = 1782 in^2
Ix = 433026 in^4   Xo = 0 in
Iy = 161717 in^4   Yo = 0 in

Reinforcement:

Rebar Database: ASTM

Size	Diam	Area	Size	Diam	Area	Size	Diam	Area
3	0.38	0.11	4	0.50	0.20	5	0.63	0.31
6	0.75	0.44	7	0.88	0.60	8	1.00	0.79
9	1.13	1.00	10	1.27	1.27	11	1.41	1.56
14	1.69	2.25	18	2.26	4.00			

Confinement: Tied; phi(c) = 0.7, phi(b) = 0.9, a = 0.8
#3 ties with #10 bars, #4 with larger bars.

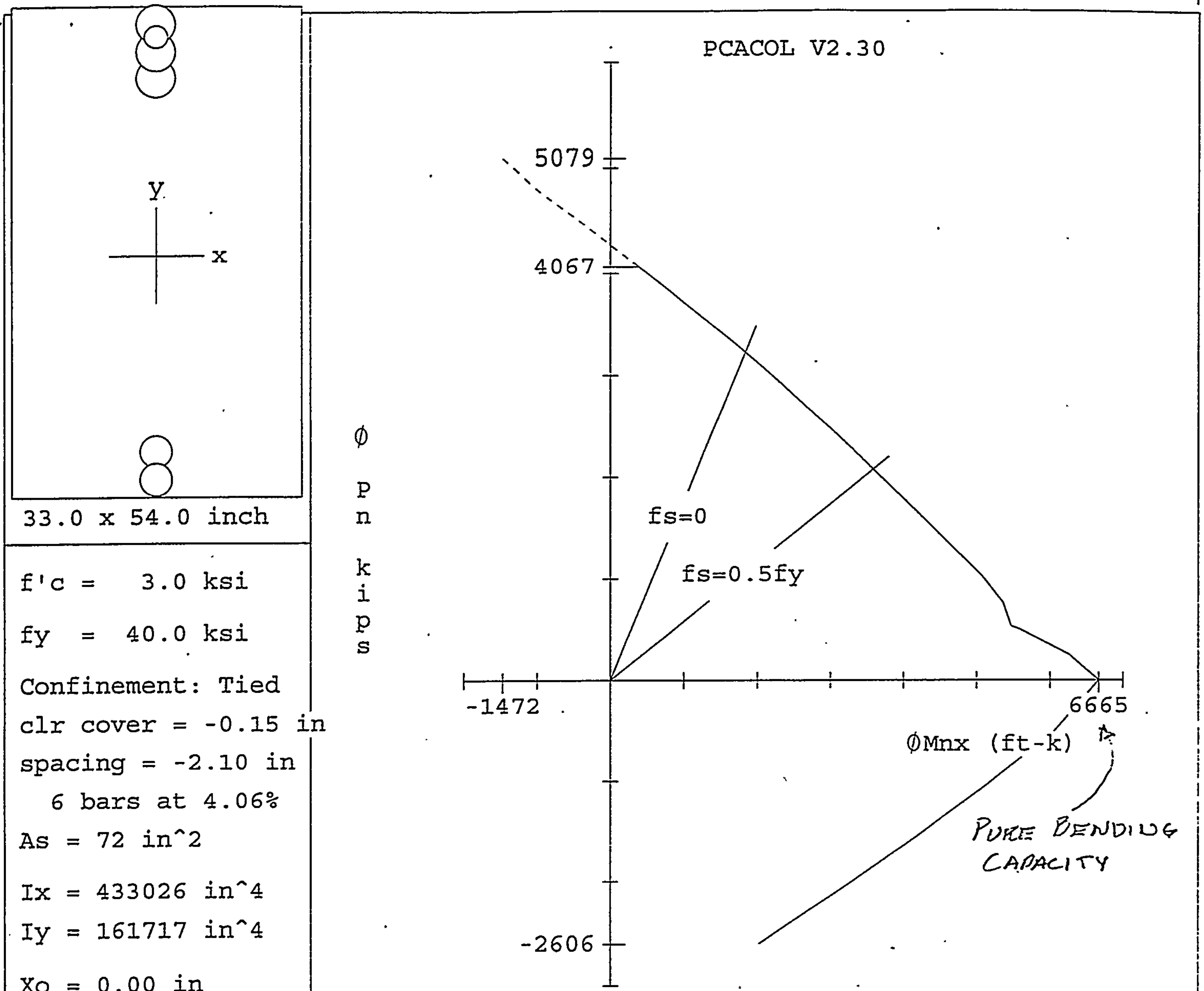
Pattern: Irregular

Total steel area, As = 72.40 in^2 at 4.06%

Area (in^2)	X-Loc (in)	Y-Loc (in)	Area (in^2)	X-Loc (in)	Y-Loc (in)	Area (in^2)	X-Loc (in)	Y-Loc (in)
15.60	0.0	18.9	15.60	0.0	21.9	15.60	0.0	24.9
10.16	0.0	-21.9	10.16	0.0	-24.9	5.28	0.0	23.5

Bending about		Load, P (kips)	X-Mom. (ft-k)	Y-Mom. (ft-k)	N.A. depth (in)
X	Pure Comp.	5079	-1472	-0	110.65
	Balanced	1066	5023	-0	35.57
	Pure Bend.	-0	6665	-0	18.95

Program completed as requested!



f'c = 3.0 ksi

fy = 40.0 ksi

Confinement: Tied

clr cover = -0.15 in

spacing = -2.10 in

6 bars at 4.06%

As = 72 in^2

Ix = 433026 in^4

Iy = 161717 in^4

Xo = 0.00 in

Yo = 0.00 in

Licensed To: LITCO, Idaho Falls, Idaho

File name: C:\PCACOL\DATA\VWGRB3.COL

Project:

Column Id:

Engineer:

Date: 09/17/97 Time: 16:52:37

Code: ACI 318-89

Material Properties:

Ec = 3321 ksi eu = 0.003 in/in

fc = 2.55 ksi Es = 29000 ksi

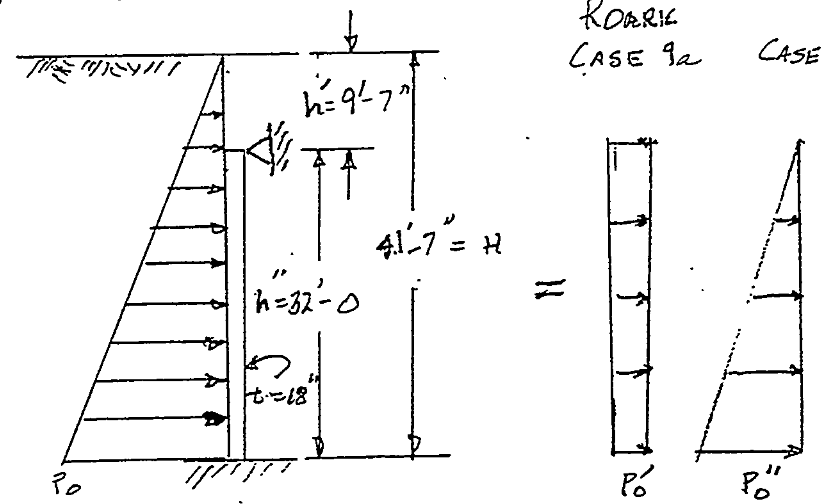
Stress Profile: Parabolic

phi(c) = 0.70, phi(b) = 0.90

X-axis slenderness is not considered.

DEMAND ON WEST WALL OF CPP-713 VAULT

ASSUME PLATE IS FIXED AT BOTTOM AND SIDES WITH SIMPLE SUPPORT AT TOP EDGE. USE ROARK TO DETERMINE MOMENT AT WALL BASE. WALL WIDTH = 17.67'.



SOIL PRESSURES ARE: (PER AEC RPT.)

$P_o = \gamma_s K_o H = .125(0.38)(41.5833) = 1.975$ ksf

$P_o' = \gamma_s K_o h' = .125(0.38)(9.5833) = 0.455$ Ksf

$P_o'' = P_o - P_o' = 1.975 - 0.455 = 1.520$ Ksf

WHERE K_o IS AT REST SOIL PRESSURE FACTOR

FROM ROARK (SEE FOLLOWING PAGE), THE BENDING STRESSES AT THE BASE OF THE WALL FOR CASE 9a & 9b ARE, RESPECTIVELY, −139.853 AND −358.595 psi. THE TOTAL BENDING STRESS IS −498.45 psi.

THE TOTAL MOMENT TO PRODUCE ABOVE STRESS IS

$$M = \frac{\sigma b t^2}{6} = \frac{-498.45(1)(18)^2}{6} = -26916.30 \text{ IN-lb/IN}$$

OR +26.916 K-FT/FT

THE DEMAND IS 1.7 × (+26.916) = +45.76 K-FT/FT

USING A FACTOR OF 1.4 × (+26.916) = +37.68 K-FT/FT, A CLOSER AGREEMENT WITH AEC'S CAL'C OF 36.9 K-FT/FT IS OBTAINED!

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ëëëëëëëëëëëëëëëëëëëë VARIABLE SHEET ëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë
St Inputáááá Nameááá Outputááá Unitááááá Commentáááááááááááááááááááááááááááááá
                                         Table 26 - Roark & Young (6 ed)
                                         Formulas for Flat Plates with Straight
                                           Boundaries and Constant Thickness
                                         Case 9a - Rectangular plate, three
                                         edges fixed, one edge simply supported
                                         Uniform load over plate.  (p.466)
           case     'Case_9a             Reference Number
           caution  '_                   Caution Message
   .2      nu                            Poisson's Ratio
   212     a                  in         Side a (One fixed, one supported)
   384     b                  in         Side b (Both fixed)
   18      t                  in         Plate thickness
   3.16    q                  psi        Uniform load
                                         Bending Stresses:
           maxsigb  -139.853  psi          At x=0, z=0, || to b
           siga2    104.767   psi          At x=0, z=0.6b, || to a
           sigb2    35.607    psi                          || to b
           siga4    -209.029  psi          At x=+/-(a/2), z=0.6b, || to a
                                         Reaction Forces:
           R1       307.898   lb/in        At x=0,z=0
           R3       237.239   lb/in        At x=0,z=b
           R4       344.284   lb/in        At x=+/-(a/2), z=0.6b
```

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St Inputáááá Nameááá Outputááá Unitááááá Commentáááááááááááááááááááááááááááááá
                                         Table 26 - Roark & Young (6 ed)
                                         Formulas for Flat Plates with Straight
                                           Boundaries and Constant Thickness
                                         Case 9d - Rectangular plate, three
                                           edges fixed, one edge simple support
                                           Load uniformly decreasing from fixed
                                           to simply supported edge.  (p.467)
           case     'Case_9d             Reference Number
           caution  '_                   Caution Message
   .2      nu                            Poisson's Ratio
   212     a                  in         Side a (One fixed, one simple support)
   384     b                  in         Side b (Both fixed)
   18      t                  in         Plate thickness
   10.556  q                  psi        Max Value - Uniformly decreasing load
                                         Bending Stresses:
           maxsigb  -358.595  psi          At x=0, z=0, || to b
           siga2    -384.106  psi          At x=+/-(a/2), z=0.4b, || to a
                                         Reaction Forces:
           R1       854.956   lb/in        At x=0, z=0
           R2       673.83    lb/in        At x=+/-(a/2), z=0.4b
```

INEL ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 73501
EDF Serial Number: EDF-TFC-029
Functional File Number: RD-01

Project/Task: CPP TANK FARM CLOSURE STUDY
Sub task: Tank and Vault Void Volumes and Dimensions

Title: TYPICAL VAULT DIMENSIONS AND APPROXIMATE TANK AND VAULT VOID VOLUMES

SUMMARY

This document gives definitive vault and pillar dimensions, total vault, tank void and vault void volumes pertaining to the ICPP Tank Farm vaults. The dimensions were taken from the drawing collection of Mike Swenson. The dimensions are close to the dimensions found in several drawings (see attachments)

Vault void volume is the space between the tank and vault walls. Tank void volume is the space inside the tank. Total vault volume is the entire vault space excluding the tank. These volumes have been calculated for each of the three vault designs (i.e. Cast in Place, Pillar and Panel, and Square vaults) and two tank designs. Pillar volumes for vaults WM 180-186 were subtracted from the vault volume for accuracy.

The following volumes are close approximations and are preliminary in nature. Additional work and further study is needed to obtain better accuracy:

WM 180-181 (drawings 103362, Chicago Bridge and Iron 5-7915)			
Total Vault Volume:	3,386 yd^3	2,589 m^3	91,421 ft^3
Tank Void Volume:	2,001 yd^3	1,530 m^3	54,038 ft^3
Vault Void Volume:	1,384 yd^3	1,059 m^3	37,383 ft^3
WM 182-186 (drawings 106217, 106220, 106230, 106214,105164,105588)			
Total Vault Volume:	3,229 yd^3	2,469 m^3	87,194 ft^3
Tank Void Volume:	1,826 yd^3	1,396 m^3	49,299 ft^3
Vault Void Volume:	1,404 yd^3	1,073 m^3	37,895 ft^3
WM 187-190 (drawings 106308, 106310, 106242)			
Total Vault Volume:	3,737 yd^3	2,857 m^3	100,902 ft^3
Tank Void Volume:	1,826 yd^3	1,396 m^3	49,299 ft^3
Vault Void Volume:	1,911 yd^3	1,461 m^3	51,603 ft^3

Distribution: B.R. Helm, D.J. Harrell, B.C. Spaulding, R.A Gavalya and WTP EIS Studies Library on distribution.

Authors	Department	Reviewed	Approved
K.D. McAllister	4130		
Date 12-23-97		Date 1/12/98	Date 1/12/98

Finding Vault Volume for
Cast in Place Vaults WM - 180 & 181

106311
23' tall tanks

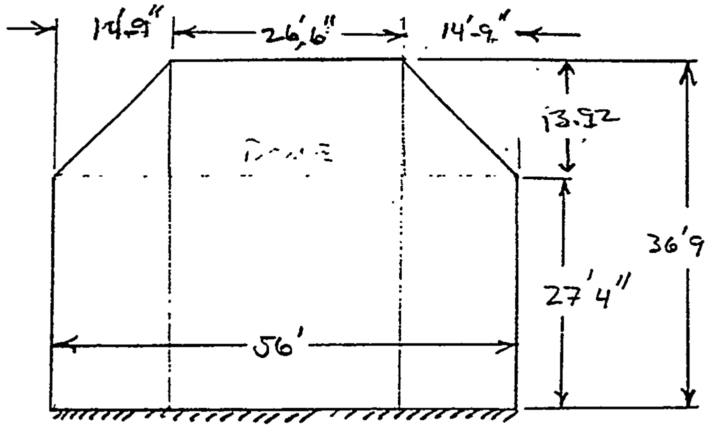


Figure #1

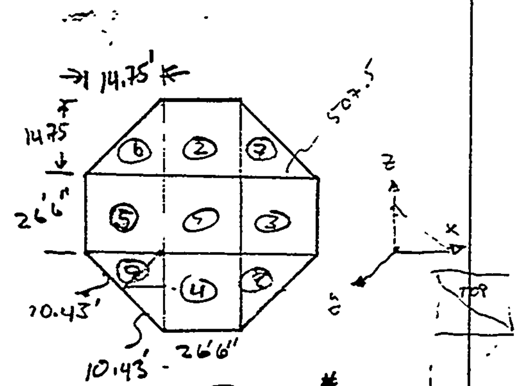


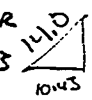
Figure #2

Ⓐ Vault wall thickness .... 2'4"
Ⓑ octagonal sloping Roof
Ⓒ Assume Pillars similar to WM 182-186
Ⓓ Assume Equal distance of sloping roof

Ⓔ Assume Vault Area Has Pillars
Ⓕ Dimensions From Mike Swenson & "Evaluation of Existing Vaults for vehicle Loads, HLWTFR Project," L.E. Mauk & S. Bolourchi, Aug. 1993

$\sqrt{(14.75)^2 + (14.75)^2} = 20.86$

$\sqrt{(9.33)^2 + (14.75)^2} = 17.45$



TOTAL Volume = Vault Dome Volume + Octagonal Volume

<u>Octagonal Volume</u>

$56' \times 56' = 3136 \text{ ft}^2$

Find & Sub. corner area => $14.75 \times 14.75 \times 2$ => 435.125 ft^2 (for 4 corners)

Total octagonal Area = 2701 ft^2 => $(3136 - 435.125)$

Octogonal Volume = $2701 \text{ ft}^2 \times 27.33 \text{ ft}$ = <u>$73,824 \text{ ft}^3$</u>

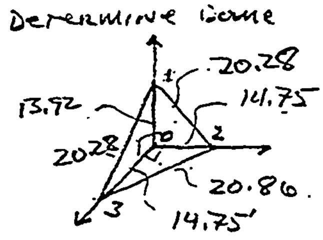
<u>2734 yd^3</u>

<u>Vault Dome Volume</u>

Finding Volume of each Section (see Figure #2) to Determine Dome Volume.

①	$26.5' \times 26.5' \times 13.92'$	=>	9775 ft^3
②③	$26.5' \times 14.75' \times 13.92'$		5441 ft^3
④⑤	$26.5' \times 14.75' \times 13.92'$		5441 ft^3
⑥⑦⑧⑨	Tetrahedron		2019 ft^3

=> 22,667



Finding Volume for Sections ⑥⑦⑧⑨

Tetrahedron volume

$$V = \sqrt{\frac{|\Delta|}{288}} \Rightarrow \Delta = \begin{vmatrix} 0 & 1 & 1 & 1 & 1 \\ 1 & 0 & d_{01}^2 & d_{02}^2 & d_{03}^2 \\ 1 & d_{01}^2 & 0 & d_{12}^2 & d_{13}^2 \\ 1 & d_{02}^2 & d_{12}^2 & 0 & d_{23}^2 \end{vmatrix}$$

From Pg-309 Standard Mathematical

$$\begin{vmatrix} 0 & 1 & 1 & 1 & 1 \\ 1 & 0 & 193.77 & 217.56 & 217.56 \\ 1 & 193.77 & 0 & 411.28 & 411.28 \\ 1 & 217.56 & 411.28 & 0 & 435.14 \\ 1 & 217.56 & 411.28 & 435.14 & 0 \end{vmatrix}$$

$\sqrt{(18.67)^2 + (18.67)^2} = 26.40$

$(13.92)^2 = 193.77$
$(14.75)^2 = 217.56$
$(20.28)^2 = 411.28$
$(20.86)^2 = 435.14$

$V = \sqrt{\dfrac{|\Delta|}{288}} \Rightarrow \sqrt{254766.4} \Rightarrow 504.74$

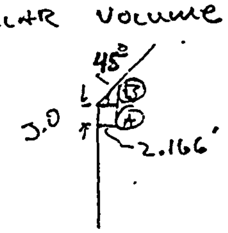
Volume under one corner → $V = 504.74\ ft^3$

Total volume under 4 corners: ⇒ $504.74(4)$
$2019\ ft^3$

Total volume of vault dome $22,667\ ft^3$ ← w/o pillars subtracted

Octogonal volume $73,824\ ft^3$

Pillar volume



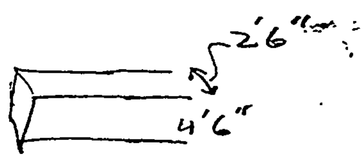
Ⓐ $2.167 \times 3.0 = 6.5$
Ⓑ $\dfrac{2.167 \times 2.167}{2} = 2.35$ } Pillar areas
$8.85\ ft^2$

$8.85 \times 8 = 70.78\ ft^2$ ← total area

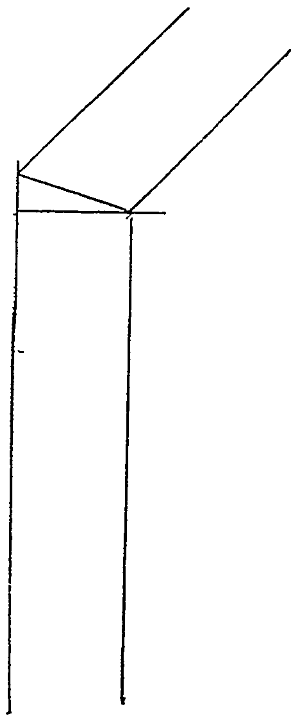
Pillar volume → Volume $= 70.78(27.33) = 1935\ ft^3$

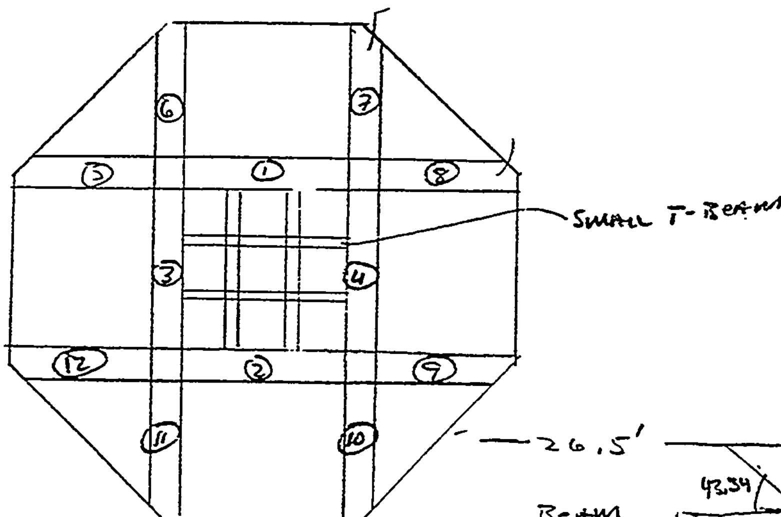
Dome T-Beams Volumes

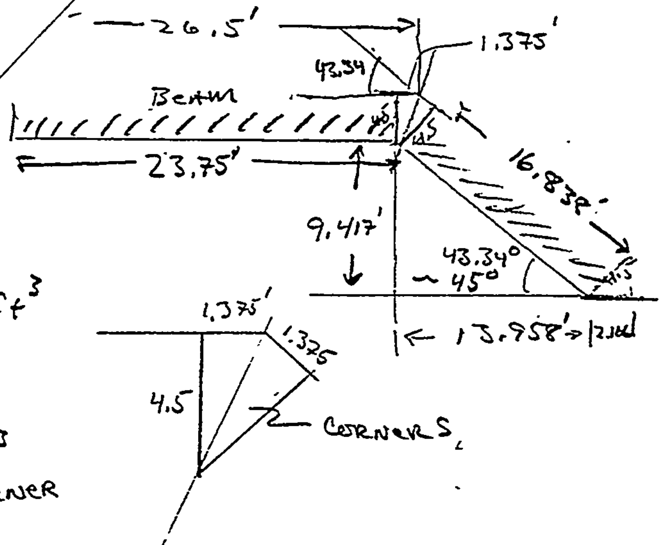
Large T-Beam Size ⇒



Small T-Beam







①②③④

$23.75' \times 4.5' \times 2.5'$

$= 267.2\ ft^3$
Horiz. Beam

$1.375' \times 4.5 \times 2.5$

$= 15.5\ ft^3$
Horiz. Beam Corner

$267.2\ ft^3 + 15.5\ ft^3 = \underline{282.7\ ft^3}$ ← for 1 Horiz. Beam

$282.7 \times 4 = \underline{1130.6\ ft^3}$ ← Total Horiz Beam (4)

⑤-⑫

$16.838' \times 4.5' \times 2.6'$

$= 197.0\ ft^3$
Ang. Beam

$1.375' \times 4.5' \times 2.6'$

$= 16.1\ ft^3$
Ang Beam Corner

$197.0 + 16.1 = 213.1\ ft^3$ ← for 1 Horiz Beam

SMALL T-BEAMS

2.5' x 1.5' x 21.5'
= 80.625 ft³

80.625 ft³ x 2 => 161.25 ft³

2.5' x 1.5' x 6.917
= 25.94 ft³

25.94 x 2 = 51.88 ft³

2.5' x 1.5' x 4.667'
= 17.5 ft³

(51.88 + 17.5) 2 = 138.76

161.25 + 138.76 = 300 ft³ ← TOTAL SMALL BEAMS VOLUME

VOLUMES OF ALL DOME BEAMS

1130.6 ft³ + 1705 ft³ + 300 ft³
= 3135 ft³

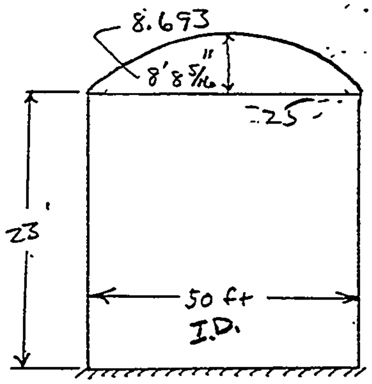
VOLUMES OF PILLAR

= 1935 ft³

FINAL VAULT VOLUME

22,667 + 73,824 - 3135 - 1935 ft³
= 91,421 ft³
3386 yd³
2589 m³

Finding tank volume for WM-180 & 181



Volume of cylindrical portion of tank

$\pi r^2 (h) \Rightarrow 45160\ ft^3$

$1673\ yd^3$

Volume of Dome Portion

Equation from CRC Standard Mathematical Tables & Formulae 30th edition, Daniel Zwillinger p 314

$\frac{1}{6}\pi h(3a^2+h^2) =$

$= \frac{1}{6}(\pi)(8.693)(3(25)^2+(8.693)^2)$

$= 8878\ ft^3$

$329\ yd^3$

TOTAL TANK VOLUME $= 45160 + 8878 = 54038\ ft^3$

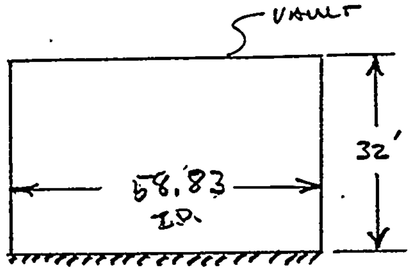
$= 2001\ yd^3$

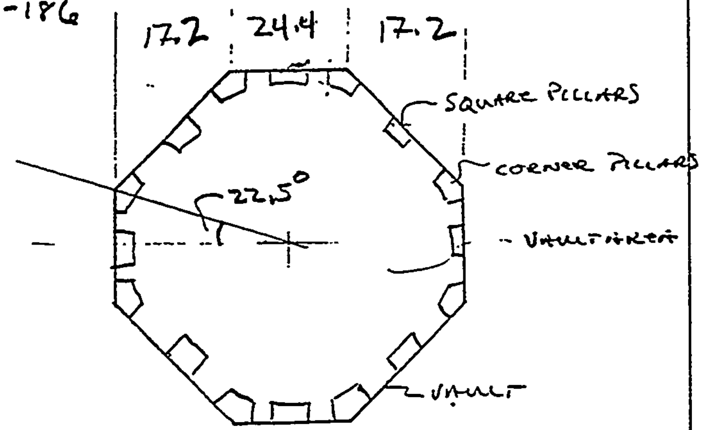
VAULT VOID VOLUME (TANK IN VAULT) $= 91421 - 54038 = 37383\ ft^3$

$= 1384\ yd^3$

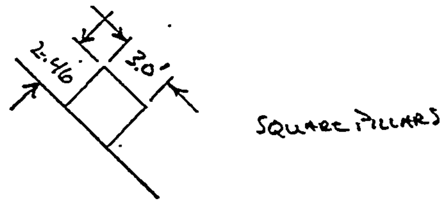
$= 1059\ m^3$

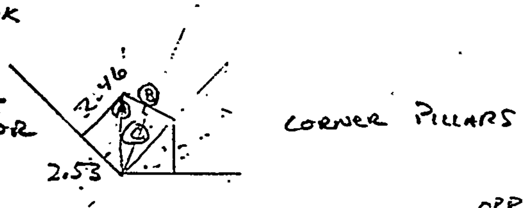
Finding Vault Volume for
Pillar & Panel Vaults WM-182-186





(A) Vaults have Pillars
(B) Vault wall thickness = 0.6'
(C) Dimensions from Mike Swenson and "Evaluation of Existing Vaults for Vehicle Loads, HLWTFR Project," L.E. Mauk and S. Bolourchi, Aug 1993
** (D) Volume of T-Beams protruding from ceiling are negligable for these calculations





$TAN\,\theta = \frac{OPP}{Adj}$

OPP = .22 ft

2.75 − .22 ft => 2.53'

Finding length (A)

$(A) = \sqrt{(2.53)^2 + (2.46)^2} \Rightarrow$ **3.53 ft**

Finding length (B)

from Drawing 106220 $2'\ 9\frac{1}{2}'' \Rightarrow$ 2.79 ft

Finding length (C)

$x^2 + y^2 = z^2 \Rightarrow x^2 - z^2 = -y^2 \Rightarrow \sqrt{-x^2 + z^2} = y = (C)$

$\sqrt{-\left(\frac{2.79}{2}\right)^2 + (3.53)^2} = (C) \rightarrow$ **3.24 ft**

Finding area of 1 corner Pillar

$\frac{2.79}{2} \times 3.2 = 4.46\ ft^2$

$2.46 \times 2.53 = 6.22\ ft^2$

$10.69\ ft^2$

Finding Area of 8 Corner Pillars

$10.69 (8) = \underline{85.5 \; ft^2}$

Finding Area of 8 Square Pillars

$(2.46)(3.0)(8) = \underline{59 \; ft^2}$

Total Pillar Area

$85.5 \; ft^2 + 59 \; ft^2 \Rightarrow \boxed{144.5 \; ft^2}$

Finding Vault Area w/o Pillars

$(58.8)^2 = \underline{3461.4 \; ft^2}$

full corners $(17.2)(17.2) = 295.8 \; ft^2$

Area of Missing Corners $2(295.84) \Rightarrow \underline{591.7 \; ft^2}$

Octogonal Vault Area w/o Pillars $= 3461.4 - 591.7 \; ft^2$

$= \underline{2869.3 \; ft^2}$

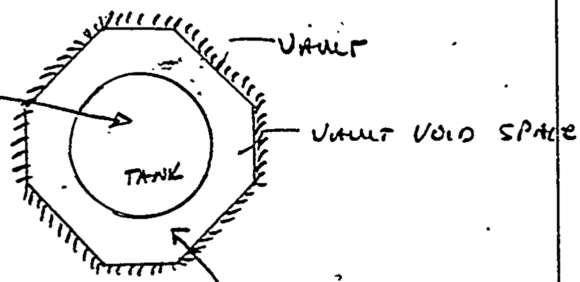
Total Vault Area including Pillars $2869.3 - 144.5$

$\boxed{2724.8 \; ft^2}$

Finding tank area

$A_T = \frac{1}{4}\pi (D)^2$

$A_T = 1963.4\ ft^2$



Finding Area of Vault void space

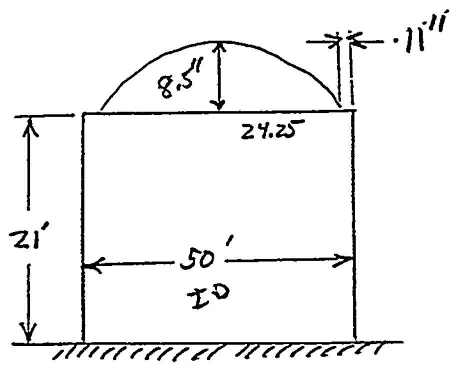
$2724.8\ ft^2 - 1963.5\ ft^2 \Rightarrow$ **$761.3\ ft^2$**

TOTAL
Volume of Vault (Including Pillars)

$2724.8\ ft^2 (32\ ft) = 87194\ ft^3 \Rightarrow$ **$3229\ yd^3$**

Drawing 105588

Finding Volume of tank



πr^2 height =

$\pi (25)^2 (21') = 41233\ ft^3$

Cylindrical Volume

Dome Volume

$\frac{1}{6}\pi h(3a^2 + h^2) = 8066\ ft^3$

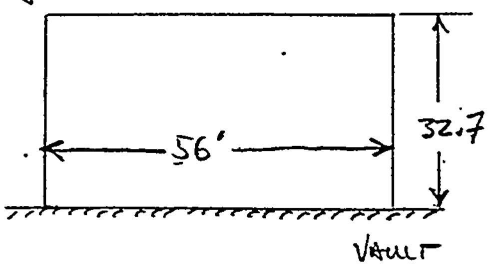
$h = 8.5$
$a = 24.1$

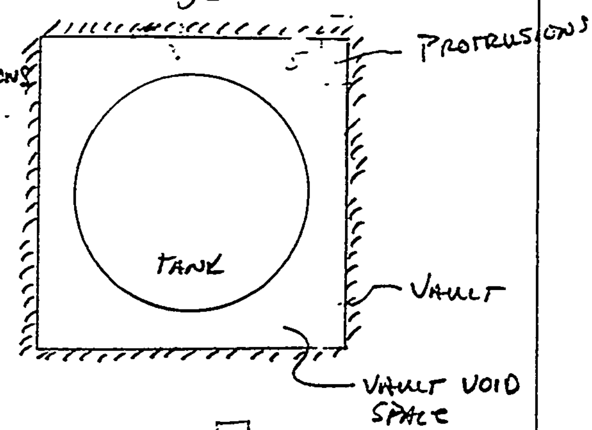
TOTAL tank volume = $41233 + 8066 = 49299\ ft^3$
$= 1396\ m^3 = 1826\ yd^3$

Vault void space Volume = $87194 - 49299 =$ **$37895\ ft^3$ / $1404\ yd^3$ / $1073\ m^3$**
(Tank in Vault)

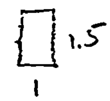
Finding Vault Volume For Square Vaults
WM - 187 - 190

* Volume of T-Beams Protruding From Ceiling Are Negligable For These Calculations





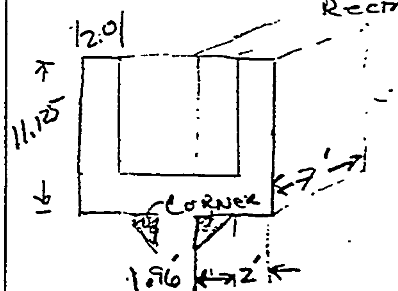
Roof Beams



Approximate Vault Volume

56' x 56' x 32.6' => 102234 ft^3

Rectangle Protrusions =>



11.125 x 7' x 3.96' => 308.4 ft^3

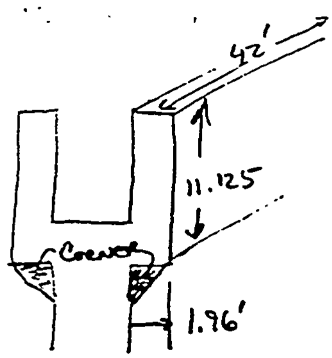
56' - 14' => 42'

42' x 11.125' x 1.96' => 915.81 ft^3

Add in corners

$\frac{1.96 \times 1.96 \times 56'}{2}$ => 107.6 ft^3

TOTAL 1332 ft^3



Subtract Protrusions

102,234 - 1332 => 100,902 ft^3

Total Vault Volume → 3737 yd^3
2857 m^3

Vault Void

100,902 ft^3 - 49299 ft^3 => 51,603 ft^3
1911 yd^3
1461 m^3

Tank Volumes Are Same As Tank 182-186

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501

EDF Serial Number EDF-TFC-030

Functional File Number BC-19

Project/Task Tank Farm Closure Study

Sub task Total Removal/Vessel Offgas System

TITLE: Mac McCoy Interview – Radiological Concerns for Temporary Vessel Offgas System

SUMMARY

This Engineering Design File includes a number of miscellaneous radiological topics regarding the temporary vessel offgas system. An interview was held with Mac McCoy (Radiological Engineer) on October 22, 1997.

The topics in this EDF include:

Environmental conditions within the TFF tanks.

Necessary equipment for the installation of a temporary VOG system.

Radiation levels within the TFF vacuum relief pits.

HEPA filter change-out procedures.

Optional equipment to be used for the temporary VOG system.

Flow rates for the temporary system.

Distribution: B. R. Helm, MS 3765; B. C. Spaulding, MS 3765; M. M. Dahlmeir, MS 3765; G. C. McCoy, MS 5209; S. P. Swanson, MS 3765; Project File (Original +1)

Authors	Department	Reviewed	Approved
Steven Swanson	MC&IE/4130	Date 10/22/97	Date 10/23/97

According to Mac McCoy, the environment within the TFF storage tanks is different from what ICF Kaiser Engineers had predicted. The temperatures within the tanks should be between 60°and 70° F. The temperature used by ICF Kaiser Engineering (80° F) took into account the heat generated by large mixing equipment.

The Tank Farm vessel offgas system has been shut down for maintenance purposes for up to several (5) days at a time. This should be enough time to tie the temporary vessel offgas system into the tanks and isolate other lines.

Mac indicated that the worst case radiation levels for the control pits are on the order of 5mR to 10mR. Most likely, however, the radiation levels will be below 5mR.

When installing the temporary VOG system at the relief valve pits, temporary tents will be needed. These tents will require HEPA filters and will impose a negative pressure of approximately .1 inch of water column on the pits. Personnel within the tent must wear personal protective equipment (PPE). The blowers on the tents can produce flow rates of either 500 cfm or 1600 cfm. The blowers operate on 120 Volts AC. The tent HEPA filter must be replaced when radiation levels reach 50mR/hr (according to MCP-90). The filters do not have to be replaced after usage at each pit unless the radiation levels exceed the previously mentioned level or differential pressure across the filter is excessive or lower than normal.

Dual HEPA filters are recommended on the temporary vessel offgas system due to good practice methods (currently being done at CPP). However, only one HEPA filter is required by regulation.

Mac suggested placing the VOG demister and HEPA filters outside of the containment tents (Large Area Containments) to allow access to the filters for change-outs. The demisters should be designed with a back-flush system to remove collected contaminants from the equipment. HEPA filters should have bag-in/bag-out capabilities. No tent is required for the change-out of the HEPA filters.

Double contained piping is necessary between the tank and the demister as well as the drain line between the demister and the PEW system. These lines should not have shielding placed over them unless radiation levels exceed 5mR/hr. Monitoring would be accomplished by placing a radiation area monitor (RAM) near the demister inlet. Another RAM could possibly be placed near the HEPA filters. Piping downstream of the HEPA filters should not require double containment, shielding, or monitoring. A superheater is recommended between the demister and HEPA filter to prevent the condensation of any moisture on the HEPA filter.

Mac suggested it is unlikely that large amounts of contamination will be picked up by water vapor or water droplets during tank cleaning activities. Experience has shown that when a vault riser is opened during the cooler months of the year, "steam" (water vapor) is emitted from the vault. Monitoring, however, shows that the "steam" is not radioactively contaminated. Should the steam encapsulate a particle of contamination, it normally drops back into the tank or vault. According to McCoy, the flow rates on a temporary vessel offgas system would not be high enough to pick up contaminated particles.

Breather filters would be necessary after the tank is fully isolated. Daily fluctuations in the tank temperature cause the tank atmosphere to expand and contract, thus creating an airflow. Filters are required to capture any remaining airborne contaminants that would otherwise escape into the environment.

Mac suggested using the HEPA/blower units used on the containment tents for the temporary vessel offgas system. A demister would be attached to the tank VOG line and would feed into a superheater. The superheater would mate with a standard 24 x 24 x 12 inch HEPA filter. This HEPA filter would then mate with the HEPA filter used on the containment tent systems. Blower skids would not be necessary, as the tent blowers are capable of providing an airflow of up to 1600 cfm. Discussions with environmental regulation experts are required to determine if it is necessary to vent the offgas at the CPP-708 stack.

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 02B40

EDF Serial Number: EDF-TFC-031

Functional File Number: C-06

Project/Task: CPP Tank Farm Closure Study

Sub task: Heel Solidification

TITLE: Flushing Calculations for "Scenario A" Heel Stabilization

SUMMARY

Flushing calculations were performed to determine the heel pH at different stages of the "Scenario A" heel solidification procedure. As a "worst case", the tank with the most acidic contents was chosen to determine liquid volume required for adjusting the pH between 0.5 to 2.0. Currently, WM-188 is the most acidic tank with a concentration of 2.65 moles H^+/liter (pH = -0.42).

Discussion:
Spreadsheet #1 shows that a tank wash down with 12,000 gallons of liquid followed by two 7,000 gallon liquid flushes yields a tank heel pH of 1.50, somewhat lower than the target pH of 2.00.

Spreadsheet #2 shows that a tank wash down with 12,000 gallons of liquid followed by two 13,500 gallon liquid flushes yields a tank heel pH of 2.01.

Spreadsheet #3 shows that a tank wash down with 12,000 gallons of liquid followed by three 5,000 gallon liquid flushes yields a tank heel pH of 1.97.

Conclusions:
A calculation of the first spreadsheet yields a pH of 1.50, which should be adequate for heel grouting purposes. A 2.0 pH could be obtained by increasing the volume of water per flush (as calculated in Spreadsheet #2). A 1.97 pH could be obtained by increasing the number of flushes while decreasing the water volume per flush (as calculated in Spreadsheets #3). Cost comparisons between the two methods outlined in the second and third spreadsheets could determine the most cost efficient method for adjusting the heel pH.

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"Scenario A" Flushing Calculations

Introduction

Calculations were performed to determine the heel acidity (measured as pH) at distinct stages of the "Scenario A" heel solidification process. In "Scenario A", the tank interior will be washed down and then flushed to adjust the heel pH. After the heel pH has been adjusted, grout will be added to stabilize the heel. Experimental results indicate that the heel pH must be in the range of 0.5 – 2.0 for the grout to set and cure satisfactorily.

Currently, tank contents vary in acidity from 0.43 moles H+/liter (pH = +0.37) to 2.65 moles H^+/liter (pH = -0.42). In this model, calculations are based on tank WM-188 (2.65 moles H^+/liter, pH = -0.42) as a "worst case" to determine the maximum volume of flush water required to adjust the heel pH from –0.42 to +2.00.

Tanks heel volumes are expected to vary from 5,000 to 15,000 gallons. A tank heel of 15,000 gallons is assumed in order to determine the maximum volume of flush water required for adjusting the heel pH.

Three spreadsheet examples are shown in which the flush volume and/or number of flushes have been varied in order to achieve the target pH.

Assumptions

The following assumptions were made when performing these calculations:

1. The initial heel volume is 15,000 gallons (heel depth is approximately 1 foot from tank bottom).
2. No chemical reactions occur between the heel and liquids used to wash down or flush the tank.
3. Liquids used for cleaning and flushing will mix completely with the tank heel.
4. The initial heel pH will be –0.42.
5. The final heel pH will be about 2.0.
6. 12,000 gallons of liquid will be used to wash the tank dome, walls, cooling coils, and flooring.
7. A submersible pump that removes tank liquids to a depth of 1" or less will be installed.

Procedure

Calculations to determine heel pH were based on the following steps:

1. The tank interior will be washed with 12,000 gallons of liquid using a remote system (i.e. robotic arm). This wash down liquid is added to the initial heel volume of 15,000 gallons for a total liquid volume of 27,000 gallons.
2. A submersible pump placed in the tank will remove all but 1,200 gallons of the combined heel and wash down liquid.
3. The 1,200 gallon heel left in the tank will be flushed (liquid added) with a predetermined amount of water (5000-13,500 gallons).
4. The submersible pump will remove all but 1,200 gallons of the combined heel and flush water for the second time.
5. The 1,200 gallon heel will be flushed (liquid added) again with a predetermined amount of water.
6. The submersible pump will remove all but 1,200 gallons of the combined heel and flush water for the third time.
7. If necessary, steps 5 & 6 will be repeated until the correct heel pH has been obtained.

Whenever water is added to the heel, the H^+ concentration of the heel will be reduced. The H^+ concentration of the diluted solution can be easily found with the following formula:

$$\left(\frac{moles\ H^+}{liter\ solution}\right)_s = \left(\frac{moles\ H^+}{liter\ solution}\right)_{s-1} * \frac{Heel\ Volume_s}{Heel\ Volume_s + Liquid\ Added_s} \quad (1)$$

where s = current step,
$s\text{-}1$ = previous step.

The formula for determining the theoretical heel pH is:

$$pH = -\log_{10}\left(\frac{moles\ H^+}{liter\ solution}\right) \quad (2)$$

"Excel 97" spreadsheets were used to perform the calculations. Results of these calculations are included as attachments.

Discussion

A review of Spreadsheet #1 shows that a tank wash down with 12,000 gallons of liquid followed by two 7,000 gallon liquid flushes would yield a tank heel pH of 1.50, somewhat lower than the target pH of 2.00.

Since the target pH of 2.0 was not achieved, additional calculations (shown in Spreadsheet #2) were performed to determine the approximate liquid volume that would be required to reach a pH of 2.0 with a tank wash down (12,000 gallons) and two flushes. At 13,500 gallons per flush, a pH of 2.01 would be obtained.

To minimize the volume of liquid added to the heel while still achieving the target pH of 2.00, the heel was flushed three times with 5,000 gallons of water. As shown in Spreadsheet #3, this yielded a theoretical pH of 1.97.

The second and third spreadsheet examples yielded pHs (2.01 and 1.97) that are very close to the target pH of 2.00. In Spreadsheet #2, a pH of 2.01 was obtained by flushing the heel twice with 13,500 gallons of water per flush while in Spreadsheet #3, a pH of 1.97 was obtained by flushing the heel three times with 5,000 gallons of water per flush.

The total volume of flush water differed significantly between the second and third spreadsheet examples. The second example required 27,000 gallons of flush water while the third example required only 15,000 gallons. However, three flushings were required for the third example as compared to two flushings for the second example.

Costs associated with increasing the number of flushes should be compared to the processing costs for treating a larger volume of diluted liquid waste before deciding the best method for adjusting the heel pH.

It should also be recognized that the "worst case" situation was assumed for the initial tank heel volume and heel pH (most acidic 15,000 gallon heel). In the first example, even though the target pH of 2.00 was not achieved, the final heel pH of 1.50 should be adequate for grouting purposes since the required heel pH range is 0.5 – 2.0 according to EDF-TFC-026.

Conclusions

A calculation of the first spreadsheet yields a pH of 1.50, which should be adequate for heel grouting purposes. A 2.0 pH could be obtained by increasing the volume of water per flush (as calculated in Spreadsheet #2). A 1.97 pH could be obtained by increasing the number of flushes while decreasing the water volume per flush (as calculated in Spreadsheets #3). Cost comparisons between the two methods outlined in the second and third spreadsheets could determine the most cost efficient method for adjusting the heel pH.

"Scenario A" Flushing Calculations
Spread Sheet #1

Initial Heel Volume = 15,000 gallons
Initial pH = -0.42, H^+ concentration = 2.65 moles H^+/liter

Final Heel Volume = 1,200 gallons
Target pH = 2.00, H^+ concentration = 0.01 moles H^+/liter

pH = $-\log_{10}$(moles H^+/liter)
(moles H^+/liter)$_s$ = (moles H^+/liter)$_{s-1}$ x (heel volume)$_s$ / [(heel volume)$_s$ + (liquid added)$_s$] where s = current step, $s-1$ = previous step

Flush Volume = 7,000 gallons/flush

Step #	Action	Heel Volume (gal)	Liquid Added (gal)	Liquid Removed (gal)	Total Tank Liquids (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
1	Starting Conditions	15,000			15,000	2.6500	-0.42
2	Tank Wash Down	15,000	12,000		27,000	1.4722	-0.17
3	Remove Liquid With Submersible Pump	1,200		25,800	1,200	1.4722	-0.17
4	1st Flush of Heel	1,200	7,000		8,200	0.2154	0.67
5	Remove Liquid With Submersible Pump	1,200		7,000	1,200	0.2154	0.67
6	2nd Flush of Heel	1,200	7,000		8;200	0.0315	1.50
7	Remove Liquid With Submersible Pump	1,200		7,000	1,200		
			---------------	---------------			
			26,000	39,800			

Note: Washing the tank with 12,000 gallons of liquid followed by two 7,000 gallon flushes adjusts the pH from -0.42 to 1.50. The volume of liquid that would be added is 26,000 gallons. Since the target pH is 2.00, the flush volume will be adjusted to achieve this pH with two flushes. See Spreadsheet #2 for these calculations.

"Scenario A" Flushing Calculations
Spread Sheet #2

Initial Heel Volume = 15,000 gallons
Initial pH = -0.42, H^+ concentration = 2.65 moles H^+/liter

Final Heel Volume = 1,200 gallons
Target pH = 2.00, H^+ concentration = 0.01 moles H^+/liter

pH = $-\log_{10}$(moles H^+/liter)
(moles H^+/liter)$_s$ = (moles H^+/liter)$_{s-1}$ x (heel volume)$_s$ / [(heel volume)$_s$ + (liquid added)$_s$] where s = current step, $s-1$ = previous step

Flush Volume = 13,500 gallons/flush

Step #	Action	Heel Volume (gal)	Liquid Added (gal)	Liquid Removed (gal)	Total Tank Liquids (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
1	Starting Conditions	15,000			15,000	2.6500	-0.42
2	Tank Wash Down	15,000	12,000		27,000	1.4722	-0.17
3	Remove Liquid With Submersible Pump	1,200		25,800	1,200	1.4722	-0.17
4	1st Flush of Heel	1,200	13,500		14,700	0.1202	0.92
5	Remove Liquid With Submersible Pump	1,200		13,500	1,200	0.1202	0.92
6	2nd Flush of Heel	1,200	13,500		14,700	0.0098	2.01
7	Remove Liquid With Submersible Pump	1,200		13,500	1,200		
			39,000	52,800			

Note: Washing the tank with 12,000 gallons of liquid followed by two 13,500 gallon flushes adjusts the pH from -0.42 to the target pH of 2.01. The volume of liquid that would be added is 39,000 gallons. To minimize the volume of waste that will require processing, calculations will be performed for three smaller flushes to reach a pH of 2.0. See Spreadsheet #3 for calculations.

"Scenario A" Flushing Calculations
Spread Sheet #3

Initial Heel Volume = 15,000 gallons
Initial pH = -0.42, H^+ concentration = 2.65 moles H^+/liter

Final Heel Volume = 1,200 gallons
Target pH = 2.00, H^+ concentration = 0.01 moles H^+/liter

pH = $-\log_{10}$(moles H^+/liter)
(moles H^+/liter)$_s$ = (moles H^+/liter)$_{s-1}$ x (heel volume)$_s$ / [(heel volume)$_s$ + (liquid added)$_s$] where s = current step, $s-1$ = previous step

Flush Volume = 5,000 gallons/flush

Step #	Action	Heel (gal)	Liquid Added (gal)	Liquid Removed (gal)	Total Tank Liquids (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
1	Starting Conditions	15,000			15,000	2.6500	-0.42
2	Tank Wash Down	15,000	12,000		27,000	1.4722	-0.17
3	Remove Liquid With Submersible Pump	1,200		25,800	1,200	1.4722	-0.17
4	1st Flush of Heel	1,200	5,000		6,200	0.2849	0.55
5	Remove Liquid With Submersible Pump	1,200		5,000	1,200	0.2849	0.55
6	2nd Flush of Heel	1,200	5,000		6,200	0.0552	1.26
7	Remove Liquid With Submersible Pump	1,200		5,000	1,200	0.0552	1.26
8	3rd Flush of Heel	1,200	5,000		6,200	0.0107	1.97
9	Remove Liquid With Submersible Pump	1,200		5,000	1,200		
			27,000	40,800			

Note: Washing the tank with 12,000 gallons of liquid followed by three 5,000 gallon flushes adjusts the pH from -0.42 to 1.97, close to the target pH of 2.0. The volume of liquid that would be added is 27,000 gallons.

ENGINEERING DESIGN FILE

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Project File Number: 02B40

EDF Serial Number: EDF-TFC-032

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Project/Task: CPP Tank Farm Closure Study

Sub task: Heel Solidification

TITLE: General Flushing Calculations for Tank Heels

SUMMARY

Flushing calculations were performed to determine the liquid volume required to adjust the tank heel with the highest acidity to a pH of 2.0. Currently, WM-188 is the most acidic tank with a concentration of 2.65 moles H^+/liter (pH = -0.42).

The following assumptions were made when performing these calculations:

1. The initial heel H^+ concentration is 2.65 moles H^+/liter (pH = -0.42).
2. The final heel H^+ concentration will be approximately 0.01 moles H^+/liter (pH = +2.0).
3. Water will be used as the flushing agent.
4. The flush water and heel will mix completely.
5. Flushed waste will be removed from the tanks with existing waste transfer equipment (steam jets or air lifts).

In the model, the heel is flushed with an equal volume of water and allowed to passively mix. Half of the diluted heel is then removed. The process is then repeated by flushing the heel again with an equal volume of water, removing half of the diluted heel, etc., until a heel pH of approximately 2.00 is obtained.

Calculations were made for initial heel volumes of 5,000 gallons, 10,000 gallons, and 15,000 gallons.

Eight flushes would be required to adjust the heel pH from –0.42 to +2.00. The following quantities of water would be required for adjusting the heel pH:

- A 5,000 gallon heel would require 40,000 gallons of water to flush the heel to a pH of 2.0
- A 10,000 gallon heel would require 80,000 gallons of water to flush the heel to a pH of 2.0
- A 15,000 gallon heel would require 120,000 gallons of water to flush the heel to a pH of 2.0.

As the initial heel volume increases, an increasingly larger volume of water is required to flush the heel to the desirable pH level. Consequently, efforts to minimize the initial heel volume would minimize the amount of diluted waste generated by heel flushing.

Please refer to the writeup for further details. Three spreadsheets are attached with calculations and results.

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Flushing Calculations for Tank Heels

Introduction

If the decision is made to solidify the tank heels with grout, it will be necessary to adjust the concentration of acid in the tank heel before grout is added to the tank floor. Experimental results indicate that the final heel pH must be in the range of 1.5 – 3.0 (by definition, pH = $-\log_{10}$[moles H^+/liter]) for the grout to set and cure satisfactorily.

Currently, levels of acidity in the eleven tanks range from 0.43 moles H+/liter (pH = +0.37) to 2.65 moles H^+/liter (pH = -0.42). Levels of acidity are expected to change in the future since tank wastes will be evaporated and blended for calcination purposes.

Calculations were performed for the most acidic tank (WM-188) as a "worst case" to determine the volume of water and the number of flushes required to adjust the heel pH from –0.42 to +2.00.

Tanks heels are expected to range in volume from 5,000 to 15,000 gallons. Flushing calculations were made for heel volumes of 5,000 gallons, 10,000 gallons, and 15,000 gallons.

Assumptions

The following assumptions were made when performing these calculations:

1. The initial heel H^+ concentration is 2.65 moles H^+/liter (pH = -0.42).
2. The final heel H^+ concentration will be approximately 0.01 moles H^+/liter (pH = 2.0).
3. Water will be used as the flushing agent.
4. The flush water and heel will mix completely.
5. Flushed waste will be removed from the tanks with existing waste transfer equipment (steam jets or air lifts).

Flushing Procedure

Flushing calculations were based on the following steps:

1. The heel is flushed with an equal volume of water (for example, 10,000 gallons of water would be added to a 10,000 gallon heel).
2. One-half of the diluted heel is removed from the tank.
3. Steps 1 & 2 are repeated until a pH of about 2.0 is reached.

Each time the heel is flushed with an equal volume of water, the H^+ concentration of the flushed solution will be reduced to one-half the H^+ concentration of the solution before it was flushed.

The H^+ concentration of the flushed solution can be easily found with the following formula:

$$\left(\frac{moles\,H^+}{liter\ solution}\right)_f = \left(\frac{moles\,H^+}{liter\ solution}\right)_{f-1} * \frac{Volume_{heel}}{Volume_{heel} + Volume_{flush}} \qquad (1)$$

where f = current flush,
f-1 = previous flush.

Since the heel volume and the flush volume are equal, equation (1) reduces to

$$\left(\frac{moles\,H^{+}}{liter\,solution}\right)_{f} = \frac{1}{2} * \left(\frac{moles\,H^{+}}{liter\,solution}\right)_{f-1} \tag{1a}$$

The formula for determining the theoretical heel pH is:

$$pH = -\log_{10}\left(\frac{moles\,H^{+}}{liter\,solution}\right) \tag{2}$$

"Excel 97" spreadsheets were used to perform the calculations. Results of these calculations are included as attachments.

Discussion

A review of the three spreadsheets shows that eight (8) flushes would be required to increase the heel pH from −0.42 to +1.98. The volume of water required to flush the heels is dependent upon the initial heel volume. The following observations were made:

- An initial heel volume of 5,000 gallons would require adding water in 5,000 gallon increments (total volume of 40,000 gallons) to reach the desired pH.
- An initial heel volume of 10,000 gallons would require adding water in 10,000 gallon increments (total volume of 80,000 gallons) to reach the desired pH.
- An initial heel volume of 15,000 gallons would require adding water in 15,000 gallon increments (total volume of 120,000 gallons) to reach the desired pH.

It should also be noted that each time the heel is flushed with an equal volume of water, the heel pH will increase by approximately 0.30. Fairly accurate estimates for the number of flushes required for adjusting other tank heels can be quickly obtained if initial heel pHs are known.

Conclusions

As the initial heel volume increases, an increasingly larger volume of water is required to flush the heel to the desirable pH level. From above, an initial heel volume of 5,000 gallons would require 40,000 gallons of flush water whereas a 15,000 gallon heel would require 120,000 gallons of flush water.

Each time the heel is flushed, the portion removed from the tank will require further treatment such as evaporation and calcination. To minimize the generation of additional waste, it may be beneficial to reduce the heel volume as much as possible before flushing with water or other liquids.

A submersible pump could be used to further lower the initial heel level before flushing. However, installation and operation of a submersible pump could subject personnel to higher radiation exposures than if the existing waste transfer equipment were used for removal of the diluted heel. The cost of processing a larger waste volume would have to be weighed against the risk of potentially higher radiation exposures. These issues may be evaluated at a later date.

Flushing Calculations
5,000 Gallon Heel

Initial Heel Volume = 5,000 gallons
Initial pH = -0.42, H^+ concentration = 2.65 moles H^+/liter

Final Heel Volume = 5,000 gallons
Target pH = 2.00, H^+ concentration = 0.01 moles H^+/liter

pH = $-\log_{10}$(moles H^+/liter)
(moles H^+/liter)$_f$ = 1/2 x (moles H^+/liter)$_{f-1}$ where *f* refers to the current flush and *f-1* refers to the previous flush

Flush #	Action	Water Added (gal)	Liquid Removed (gal)	Total Tank Liquid (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
	Starting Conditions			5,000	2.6500	-0.42
1	Flush heel	5,000		10,000	1.3250	-0.12
	Remove 1/2 of Tank Liquids		5,000	5,000	1.3250	-0.12
2	Flush heel	5,000		10,000	0.6625	0.18
	Remove 1/2 of Tank Liquids		5,000	5,000	0.6625	0.18
3	Flush heel	5,000		10,000	0.3313	0.48
	Remove 1/2 of Tank Liquids		5,000	5,000	0.3313	0.48
4	Flush heel	5,000		10,000	0.1656	0.78
	Remove 1/2 of Tank Liquids		5,000	5,000	0.1656	0.78

Flushing Calculations
5,000 Gallon Heel

Flush #	Action	Water Added (gal)	Liquid Removed (gal)	Total Tank Liquid (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
5	Flush heel	5,000		10,000	0.0828	1.08
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0828	1.08
6	Flush heel	5,000		10,000	0.0414	1.38
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0414	1.38
7	Flush heel	5,000		10,000	0.0207	1.68
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0207	1.68
8	Flush heel	5,000		10,000	0.0104	1.98
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0104	1.98
9	Flush heel	5,000		10,000	0.0052	2.29
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0052	2.29
10	Flush heel	5,000		10,000	0.0026	2.59
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0026	2.59

Flushing Calculations
5,000 Gallon Heel

Flush #	Action	Water Added (gal)	Liquid Removed (gal)	Total Tank Liquid (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
11	Flush heel	5,000		10,000	0.0013	2.89
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0013	2.89
12	Flush heel	5,000		10,000	0.0006	3.19
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0006	3.19
13	Flush heel	5,000		10,000	0.0003	3.49
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0003	3.49
14	Flush heel	5,000		10,000	0.0002	3.79
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0002	3.79
15	Flush heel	5,000		10,000	0.0001	4.09
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0001	4.09
16	Flush heel	5,000		10,000	0.0000	4.39
	Remove 1/2 of Tank Liquids		5,000	5,000	0.0000	4.39

Flushing Calculations
10,000 Gallon Heel

Initial Heel Volume = 10,000 gallons
Initial pH = -0.42, H^+ concentration = 2.65 moles H^+/liter

Final Heel Volume = 10,000 gallons
Target pH = 2.00, H^+ concentration = 0.01 moles H^+/liter

pH = $-\log_{10}$(moles H^+/liter)
(moles H^+/liter)$_f$ = 1/2 x (moles H^+/liter)$_{f-1}$ where *f* refers to the current flush and *f-1* refers to the previous flush

Flush #	Action	Water Added (gal)	Liquid Removed (gal)	Total Tank Liquid (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
	Starting Conditions			10,000	2.6500	-0.42
1	Flush heel	10,000		20,000	1.3250	-0.12
	Remove 1/2 of Tank Liquids		10,000	10,000	1.3250	-0.12
2	Flush heel	10,000		20,000	0.6625	0.18
	Remove 1/2 of Tank Liquids		10,000	10,000	0.6625	0.18
3	Flush heel	10,000		20,000	0.3313	0.48
	Remove 1/2 of Tank Liquids		10,000	10,000	0.3313	0.48
4	Flush heel	10,000		20,000	0.1656	0.78
	Remove 1/2 of Tank Liquids		10,000	10,000	0.1656	0.78

Flushing Calculations
10,000 Gallon Heel

Flush #	Action	Water Added (gal)	Liquid Removed (gal)	Total Tank Liquid (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
5	Flush heel	10,000		20,000	0.0828	1.08
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0828	1.08
6	Flush heel	10,000		20,000	0.0414	1.38
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0414	1.38
7	Flush heel	10,000		20,000	0.0207	1.68
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0207	1.68
8	Flush heel	10,000		20,000	0.0104	1.98
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0104	1.98
9	Flush heel	10,000		20,000	0.0052	2.29
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0052	2.29
10	Flush heel	10,000		20,000	0.0026	2.59
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0026	2.59

Flushing Calculations
10,000 Gallon Heel

Flush #	Action	Water Added (gal)	Liquid Removed (gal)	Total Tank Liquid (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
11	Flush heel	10,000		20,000	0.0013	2.89
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0013	2.89
12	Flush heel	10,000		20,000	0.0006	3.19
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0006	3.19
13	Flush heel	10,000		20,000	0.0003	3.49
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0003	3.49
14	Flush heel	10,000		20,000	0.0002	3.79
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0002	3.79
15	Flush heel	10,000		20,000	0.0001	4.09
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0001	4.09
16	Flush heel	10,000		20,000	0.0000	4.39
	Remove 1/2 of Tank Liquids		10,000	10,000	0.0000	4.39

Flushing Calculations
15,000 Gallon Heel

Initial Heel Volume = 10,000 gallons
Initial pH = -0.42, H^+ concentration = 2.65 moles H^+/liter

Final Heel Volume = 10,000 gallons
Target pH = 2.00, H^+ concentration = 0.01 moles H^+/liter

pH = $-\log_{10}$(moles H^+/liter)
$(\text{moles } H^+/\text{liter})_f = 1/2 \times (\text{moles } H^+/\text{liter})_{f-1}$ where *f* refers to the current flush and *f-1* refers to the previous flush

Flush #	Action	Water Added (gal)	Liquid Removed (gal)	Total Tank Liquid (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
	Starting Conditions			15,000	2.6500	-0.42
1	Flush heel	15,000		30,000	1.3250	-0.12
	Remove 1/2 of Tank Liquids		15,000	15,000	1.3250	-0.12
2	Flush heel	15,000		30,000	0.6625	0.18
	Remove 1/2 of Tank Liquids		15,000	15,000	0.6625	0.18
3	Flush heel	15,000		30,000	0.3313	0.48
	Remove 1/2 of Tank Liquids		15,000	15,000	0.3313	0.48
4	Flush heel	15,000		30,000	0.1656	0.78
	Remove 1/2 of Tank Liquids		15,000	15,000	0.1656	0.78

Flushing Calculations
15,000 Gallon Heel

Flush #	Action	Water Added (gal)	Liquid Removed (gal)	Total Tank Liquid (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
5	Flush heel	15,000		30,000	0.0828	1.08
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0828	1.08
6	Flush heel	15,000		30,000	0.0414	1.38
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0414	1.38
7	Flush heel	15,000		30,000	0.0207	1.68
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0207	1.68
8	Flush heel	15,000		30,000	0.0104	1.98
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0104	1.98
9	Flush heel	15,000		30,000	0.0052	2.29
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0052	2.29
10	Flush heel	15,000		30,000	0.0026	2.59
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0026	2.59

Flushing Calculations
15,000 Gallon Heel

Flush #	Action	Water Added (gal)	Liquid Removed (gal)	Total Tank Liquid (gal)	H^+ Concentration (moles H^+/liter)	Heel pH
11	Flush heel	15,000		30,000	0.0013	2.89
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0013	2.89
12	Flush heel	15,000		30,000	0.0006	3.19
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0006	3.19
13	Flush heel	15,000		30,000	0.0003	3.49
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0003	3.49
14	Flush heel	15,000		30,000	0.0002	3.79
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0002	3.79
15	Flush heel	15,000		30,000	0.0001	4.09
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0001	4.09
16	Flush heel	15,000		30,000	0.0000	4.39
	Remove 1/2 of Tank Liquids		15,000	15,000	0.0000	4.39

INEL ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 73501
EDF Serial Number: EDF-TFC-033
Functional File Number: BC-22

Project/Task: CPP Tank Farm Closure
Sub task: Grout Lift Depth Determination

Title: GROUT LIFT DEPTH ANALYSIS

SUMMARY

This EDF documents (from WCF Closure Project Summary of Fiscal Year 1995, Brent Helm) the grout lift (grout layer) depth that can be placed in an underground void space at one time. Due to its size and location the void space modeled for grout lift placement was the WCF (Waste Calcining Facility) off-gas cell (35 feet long, 21 feet wide and 35 feet high, see drawings 106351, 106352).

The off-gas cell model was developed to show theoretical temperatures within a volume of grout as it cures. The grout depth and cement content were varied in the model. Information from this model may be used to determine the maximum grout lift depth that can be placed in a void space at one time without exceeding temperatures and large thermal gradients that could reduce grout strength and cause excessive cracking.

It was assumed that a 200-degrees F peak temperature and a 20-degree F per foot gradient would produce satisfactory grout. The grout lift will be cooled by conduction to the cell walls and floor or previous lift, and also by air passed above the grout by existing and temporary ventilation systems. Tanks and piping, present in the off-gas cell, were not included in this model for conservatism and model simplification.

From the model it seems that a 4-foot lift at a 4-day interval is possible with the lower cement content (376 lb/yd^3) grout, and a 2-foot lift at a 7-day interval is possible with high-cement content (658 lb/yd^3) grout. WCF cell grouting isotherms are attached to show the temperature distribution representation.

Distribution: B.R. Helm, D.J. Harrell, B.C. Spaulding, R.A. Gavalya and WTP EIS Studies Library on distribution.

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Date 12-19-97		Date 12·22·97	Date 12/22/97

be dropped or thrown to the ground and must be removed from the roof by the end of the work shift, either by being carried or passed to the ground by hand or lowered to the ground via a covered, dust-tight chute, crane, or hoist. Before starting the job, the material must be examined by a qualified person to determine whether it is intact and likely to remain intact throughout the job. The employees must be trained in the hazards of asbestos exposure and the proper work practices and prohibitions applicable to such work. If these conditions are not met, the job must be treated as a Class II job.

If tools (flat blade, slicing tools, axes, pry bars, shovels, etc.,) are used to slice, cut, strip off, shear under, or pry up the material, in accordance with standard practice in the roofing industry, their use is acceptable under new paragraph (g)(11). If these tools are used in ways that cause the material to crumble or become pulverized, or if other tools or methods that render the material nonintact are employed, then the new paragraph (g)(11) does not apply. Additionally, new training requirements are necessary for work in accordance with the new standard.

Required methods of wet removal can now be eliminated if a safety concern exists for roof work, such as slipping, etc. This was implemented primarily for sloped roofs but may apply to WCF because of existing radiation conditions that are incompatible with the use of water.

Saw cutting of roof material into sections for removal will probably have to be completed in wet conditions. Therefore, the area must be immediately vacuumed with a high-efficiency particulate air (HEPA) vacuum. Because of heat stress, protective clothing requirements for asbestos roof removal in hot conditions has been reduced and respirator use is no longer required. Of the material is lowered to the ground, no later than the end of the work shift, the employer is not required to wrap or bag intact material while it remains on the roof.

Although the above conditions are still subject to an initial exposure assessment, requirements for removal of asbestos from a roof have been significantly eased.

Of additional concern is the new requirement for isolation or shutdown of air intakes as they apply to WCF's off-gas system. This factor may prevent conducting abatement with an operable off-gas system.

6.2 Mechanical Engineering Studies

6.2.1 Thermal Analysis Results

Hydration of cement generates significant amounts of heat. This hydration occurs while the cement hardens and cures. Concrete placed at about 70°F will generate more than half its heat of hydration in the first 4 to 7 days and then generates the remainder in about another 21 days. Hydration time decreases as placement temperature is increased; therefore, warming concrete or mixing it warm will accelerate the rate of heat generation.

Because high concrete temperatures and large thermal gradients reduce the strength and produce more cracking, the peak temperature and maximum temperature gradient in the concrete must be controlled. The concrete will be cooled by conduction to the cell walls and floor or previous lift, and also by air passed above the pour by existing and temporary ventilation systems.

Depth of lift and lapse time between lifts are two key parameters that may be varied to control peak temperature and gradient. These parameters directly affect the time required to grout the facility, therefore, cost needs to be optimized.

Grout placed in the facility will not have a significant weight load, therefore, the main criteria for the concrete are that it is not unduly cracked, porous, or shrunk away from the existing structures. Because ultimate strength is largely a function of cement content in concrete and moderate ultimate strengths will be acceptable, reducing the amount of cement in the mix and, thus, reducing heat generation becomes another parameter for reducing peak temperature and gradient.

A simple thermal model was developed to allow optimization of the grout placement process. Based on engineering experience, it was assumed that a peak temperature of 200°F and gradient of 20°F per foot would produce satisfactory concrete. The off-gas cell was modeled because of its size and location. To keep the model simple, tanks and piping were not included, which would be conservative because these items would probably enhance heat transfer in the concrete around them.

The cell was modeled as a two-dimensional representation, with the concrete confining walls and 5 ft of soil on the bottom and one side. The cell volume was defined as grout, because the physical description and subroutine for heating cannot be redefined during the transient. A convective coefficient of 1 Btu/h-ft^{2}°F was also defined on the exterior cell surfaces that were not in contact with soil. A convective coefficient of 1 Btu/h-ft^{2}°F was placed on the surface of the pour and then set to zero when the pour on top was completed. A large convective coefficient was placed on the layer of grout that had not been poured to maintain its temperature near 75°F.

The heating rate was a fit to the data from an American Concrete Institute (ACI) committee report for cement Type III with 376 lb/yd^3 of cement. For the grout with 658 lb/yd^3 of cement, the heating was increased 1.75 times. Appendix J includes several isotherms. It seems that a 4-ft lift at a 4-day interval is possible with the lower cement content concrete, and a 2-ft lift at a 7-day interval is possible with high-cement content grout. Gradients in the new pour appear to be less than 20°F.

6.2.2 Grout Pumping Requirements Evaluation

Filling the belowgrade process tanks and vessels at the WCF with grout requires that a grout pumping system be used. To provide preliminary requirements for this grout pumping system, calculations were made to determine the required grout flow rates, pressure loss in the grout fill lines to the tanks, and maximum allowable pressure within the fill lines. When this evaluation was started, several questions were raised concerning the technique to be used for determining the pumping requirements of an unknown grout mixture. The following are the more significant of these questions:

Appendix J

Thermal Analysis Results

Thermal Analysis Methodology

The off-gas cell at CPP is representative of WCF substructures and has been modeled to predict the temperature response as it is filled with grout, and to indicate the thermal gradients in the grout as the fill proceeds.

Model

The cell was modeled as a two-dimensional representation with five feet of soil on the bottom and right side. The confining concrete walls were modeled as defined by the drawing 5775-CPP-G33-A-3. The model was constructed and nodalized using PATRAN[1]. The physical description was the input to ABAQUS[2] for the thermal analysis.

The heating rate was obtained from temperature rise data for the type III cement type with 106 cal/gm heat of hydration (376 lb/yd^3 of cement)[3]. The data was fit from 0 to 96 hours and from 96+ hours to 2000 hours with quadratic equations.

The heating was input via the subroutine DFLUX. The pour height was assumed to be accomplished over a one hour interval.

A heat transfer rate of 1 Btu/hr ft^2 F was assumed on the grout surface after placement, and the confining walls exterior surfaces. A large heat transfer coefficient was placed on the surface above the pour to maintain temperatures at approximately 75°F prior to the next pour. After the pour, the heat transfer was set to zero and redefined on the next surfaces.

The heating rates for grout with other amounts of cement were obtained by a multiplier equal to the ratio of cement.

Results

Analyses were completed for three cases: (1) a two foot pour every seven days with a heating rate for 658 lb/yd^3 cement, (2) a four foot pour every four days with 376 lb/yd^3 cement, and (3) a four foot pour every seven days with 376 lb/yd^3 cement. Data was printed for 24 hours, 48 hours, 72 hours, and 96 hours for each pour interval, where pours were performed every four days. For the seven day pour intervals, data were printed for 84 hours, and 168 hours. Temperature distributions were plotted near middle and end of the fill intervals and are included as Figures 1 through 8.

References

1. PATRAN Plus User Manual, PATRAN, A Division of PDA Engineering, July 1987

2. ABAQUS/Standard User's Manual, ABAQUS Version 5.3, Hibbett, Karleson and Sorenson, Inc., 1993

3. ACI Committee Report, Figure 2.2

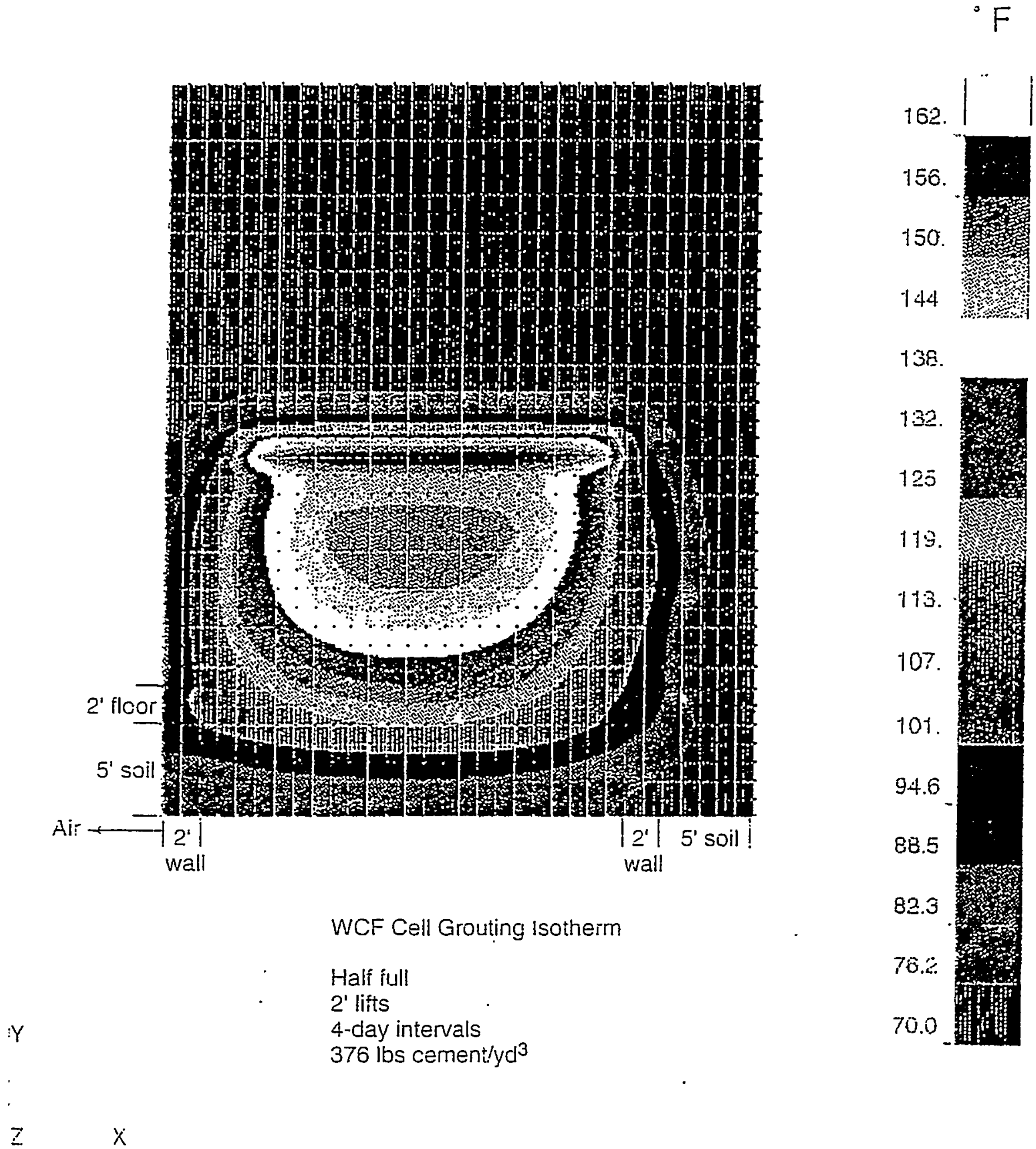


Figure J-1. WCF cell grouting isotherm (half full, 2' lifts, 4-day intervals).

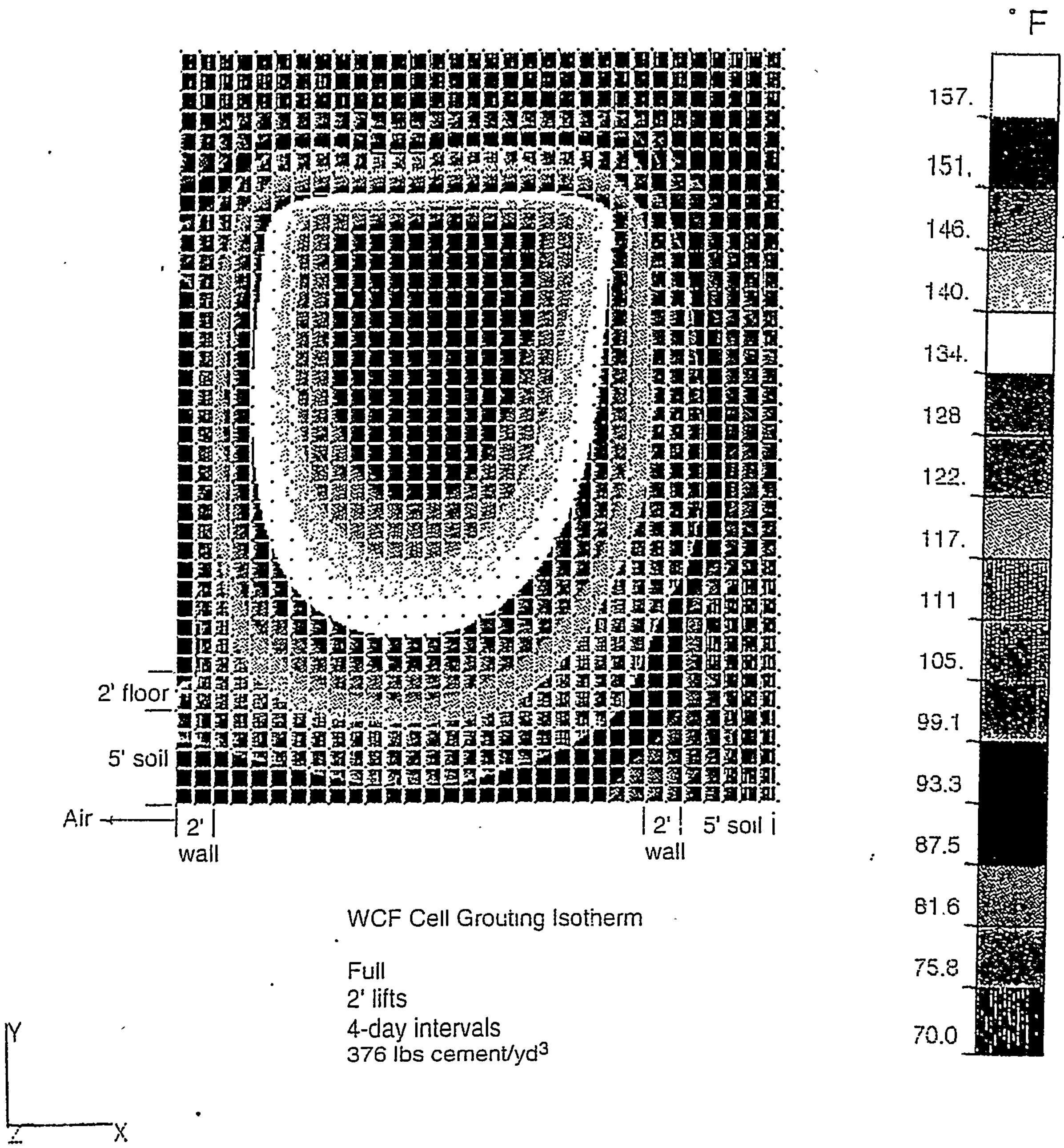


Figure J-2. WCF cell grouting isotherm (full, 2' lifts, 4-day intervals).

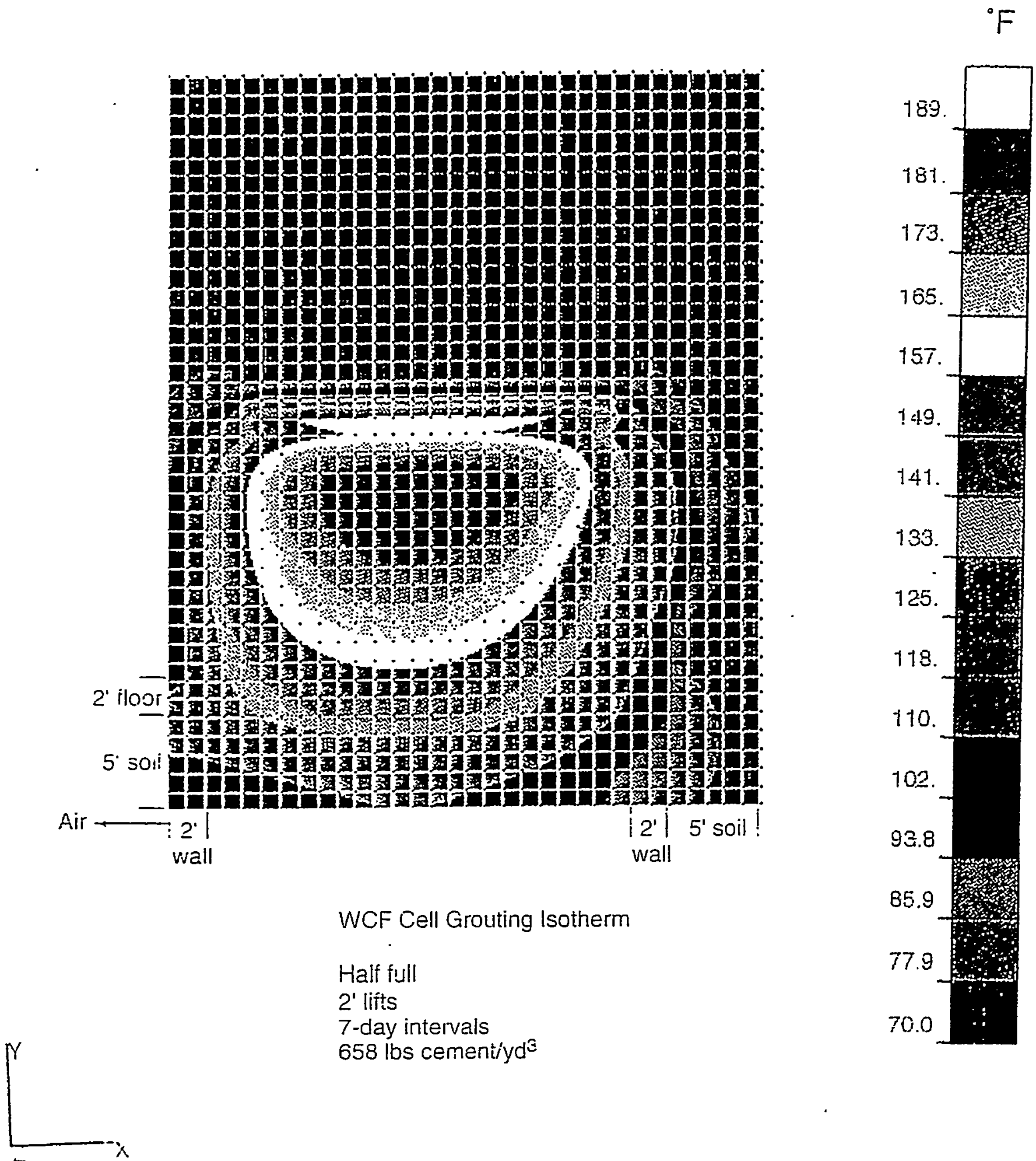


Figure J-3. WCF cell grouting isotherm (half full, 2' lifts, 7-day intervals).

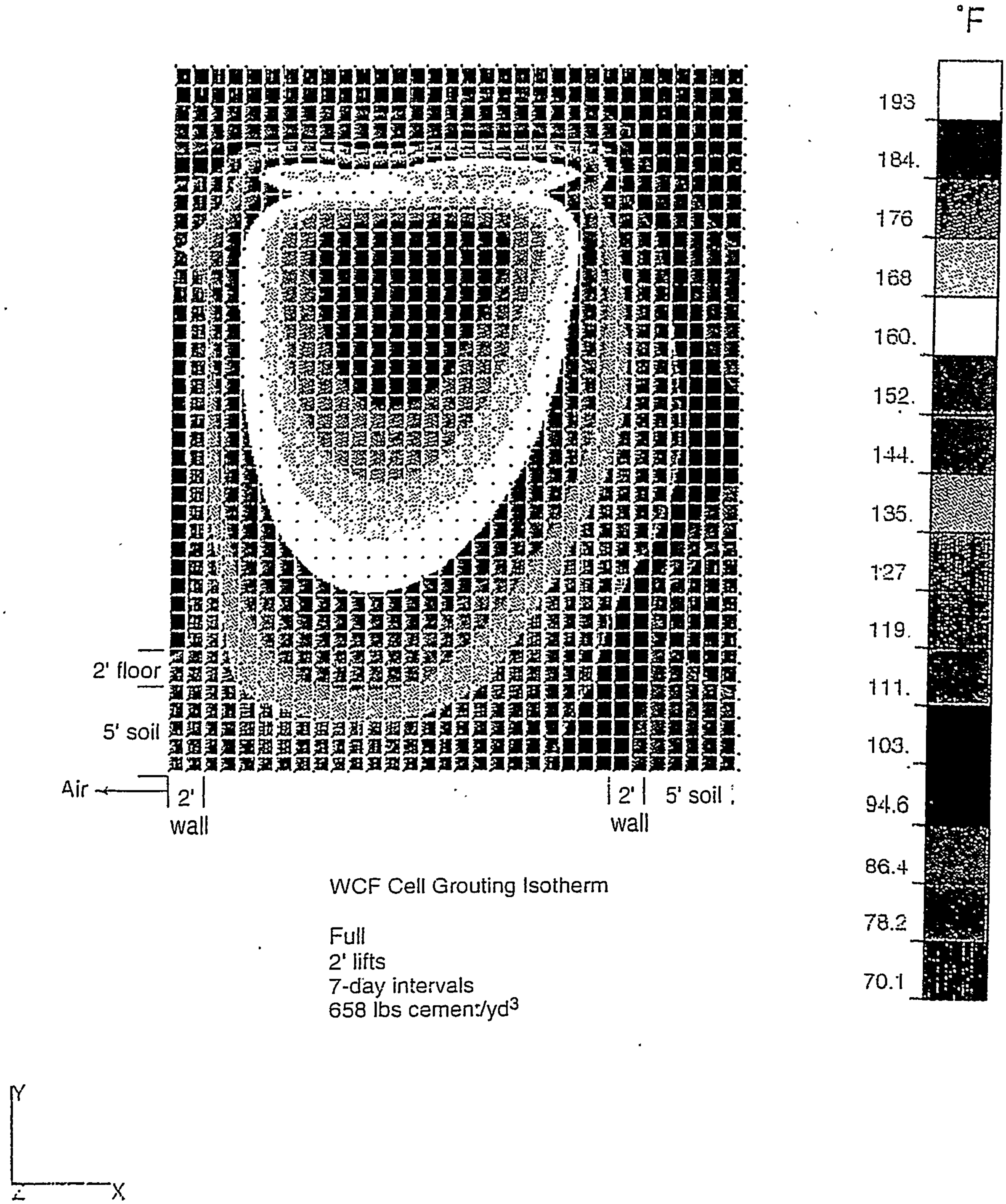


Figure J-4. WCF cell grouting isotherm (full, 2' lifts, 7-day intervals).

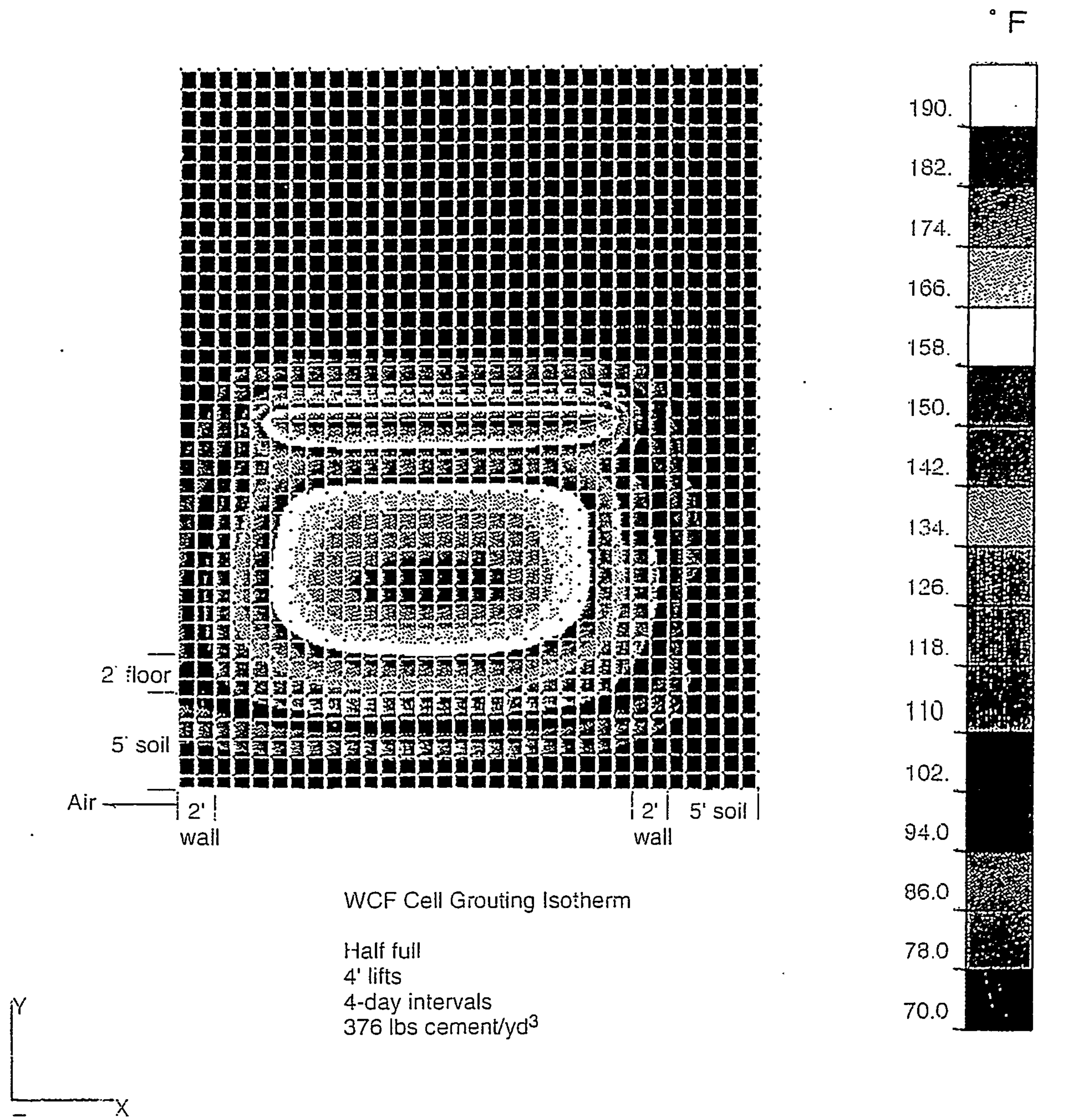


Figure J-5. WCF cell grouting isotherm (half full, 4' lifts, 4-day intervals).

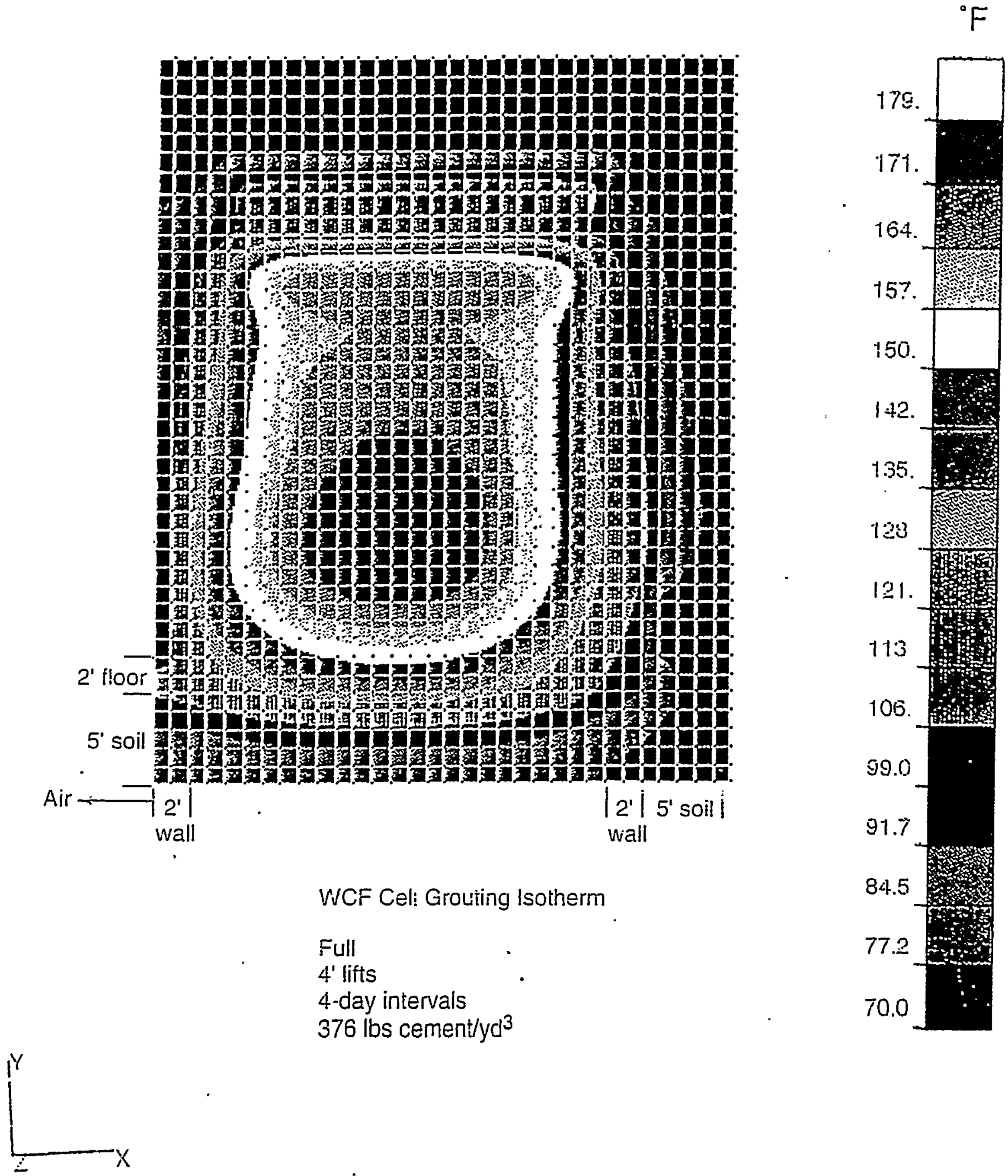


Figure J-6. WCF cell grouting isotherm (full, 4' lifts, 4-day intervals).

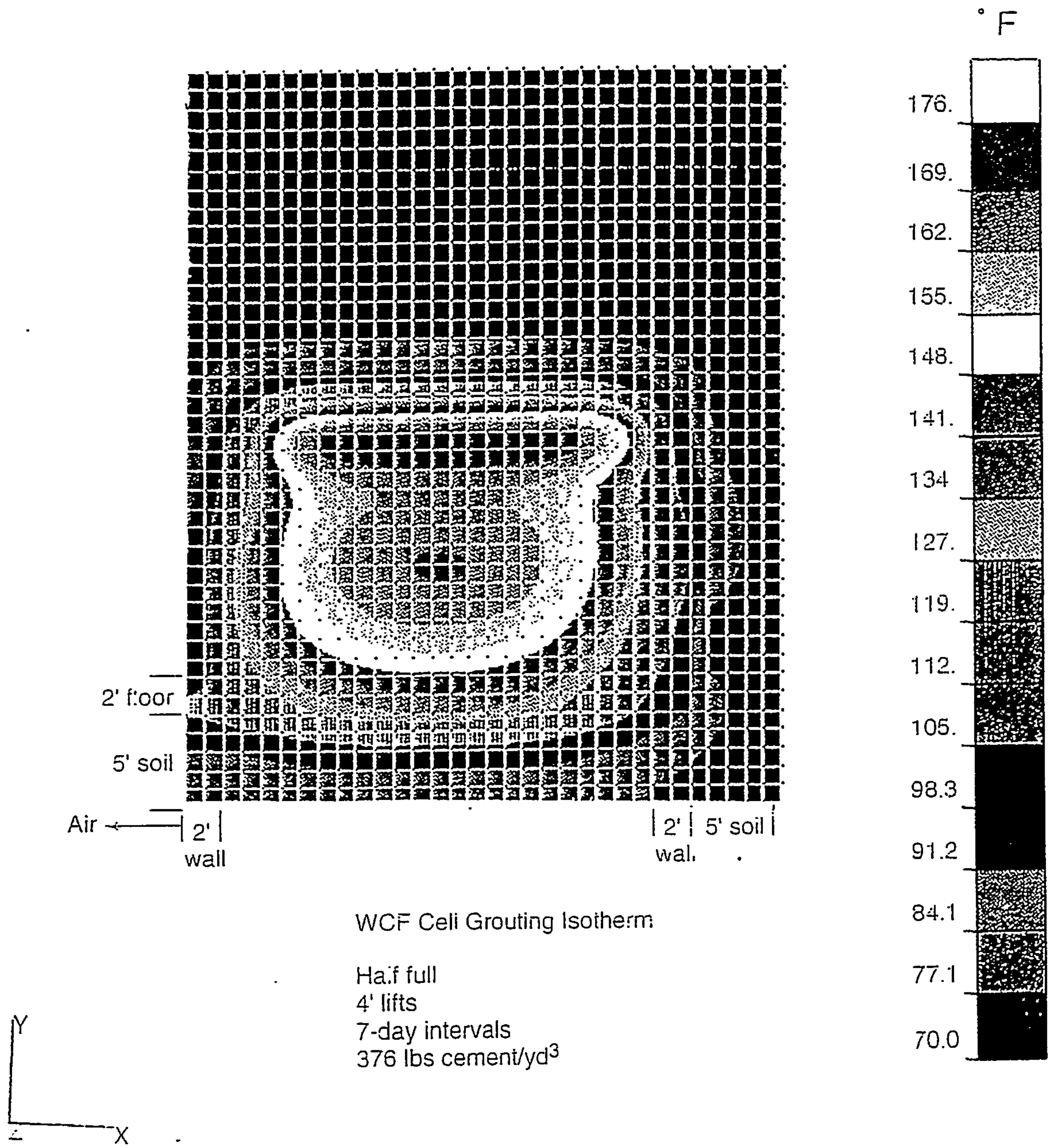


Figure J-7. WCF cell grouting isotherm (half full, 4' lifts, 7-day intervals).

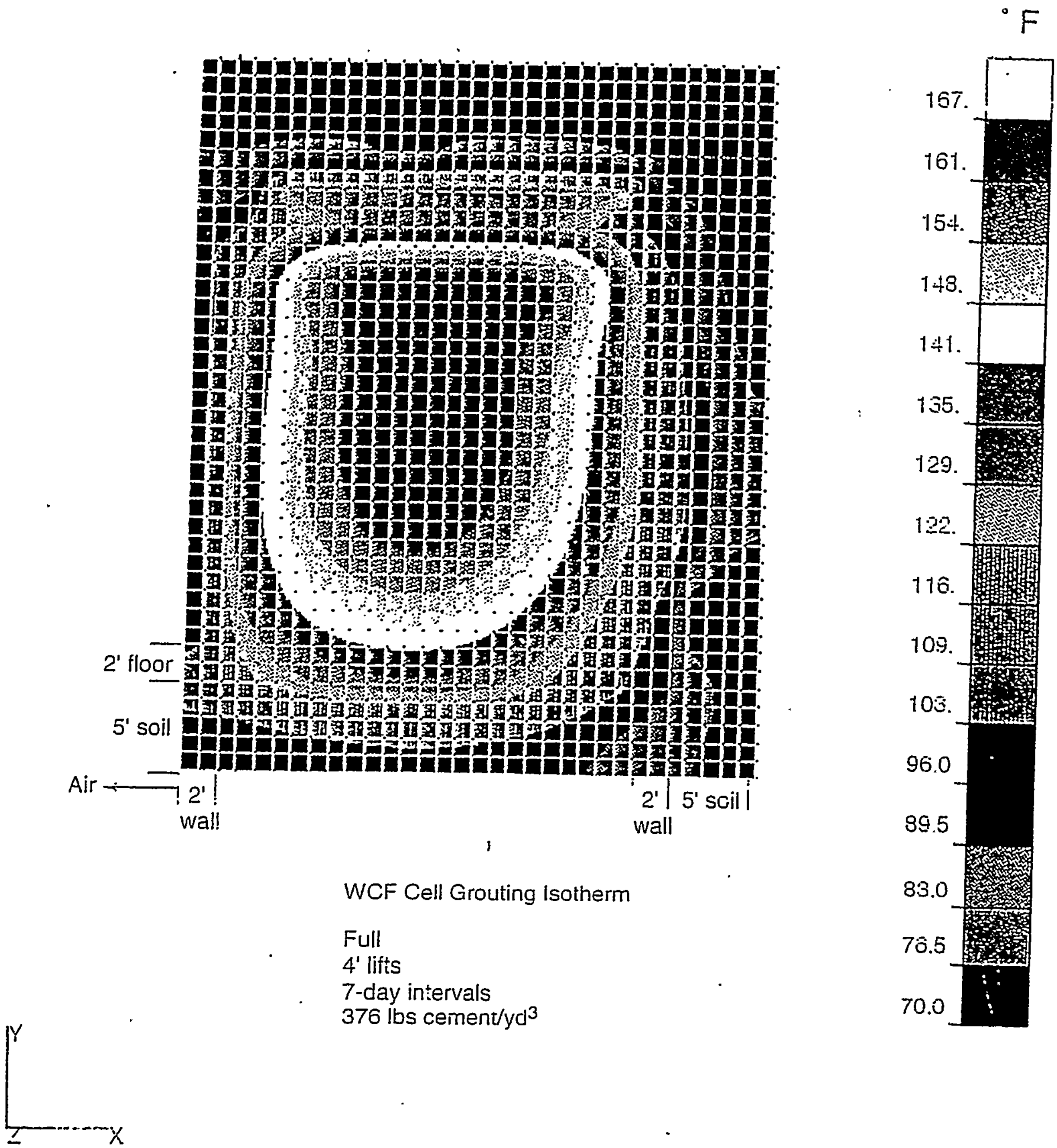
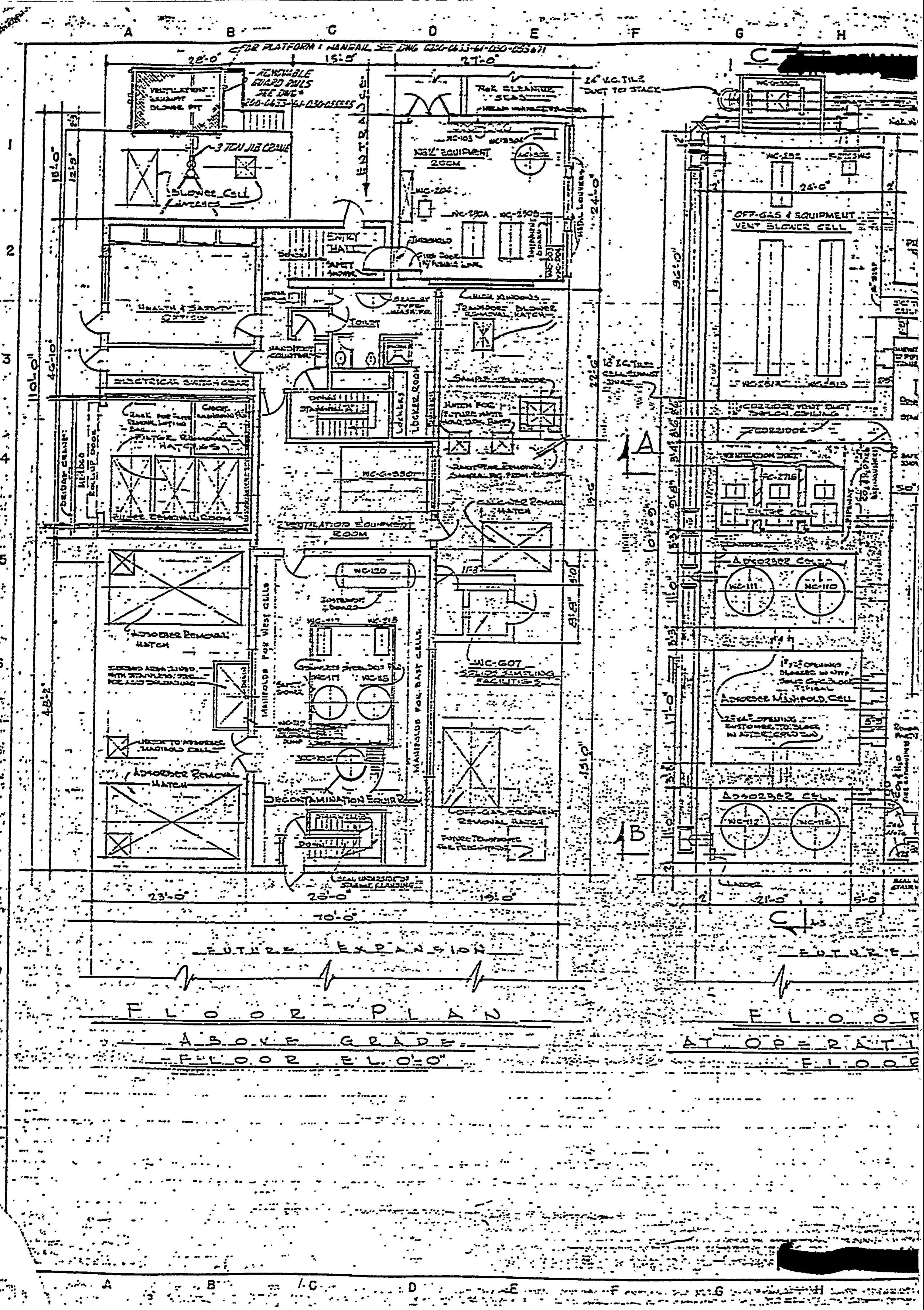


Figure J-8. WCF cell grouting isotherm (full, 4' lifts, 7-day intervals).


FOR PLATFORM & HANDRAIL SEE DWG
REMOVABLE GUARD RAILS
3 TON JIB CRANE
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NO. 2 EQUIPMENT ROOM
ENTRY HALL
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HEALTH & SAFETY OFFICE
TOILET
ELECTRICAL SWITCH GEAR
LOCKER ROOM
SAMPLE ELEVATOR
FILTER REMOVAL HATCHES
FILTER REMOVAL ROOM
VENTILATION EQUIPMENT ROOM
FILTER CELL
ADSORBER CELLS
ADSORBER REMOVAL HATCH
MANIFOLDS FOR WEST CELLS
MANIFOLDS FOR EAST CELLS
WC-607
SOLIDS SAMPLING FACILITIES
ADSORBER MANIFOLD CELL
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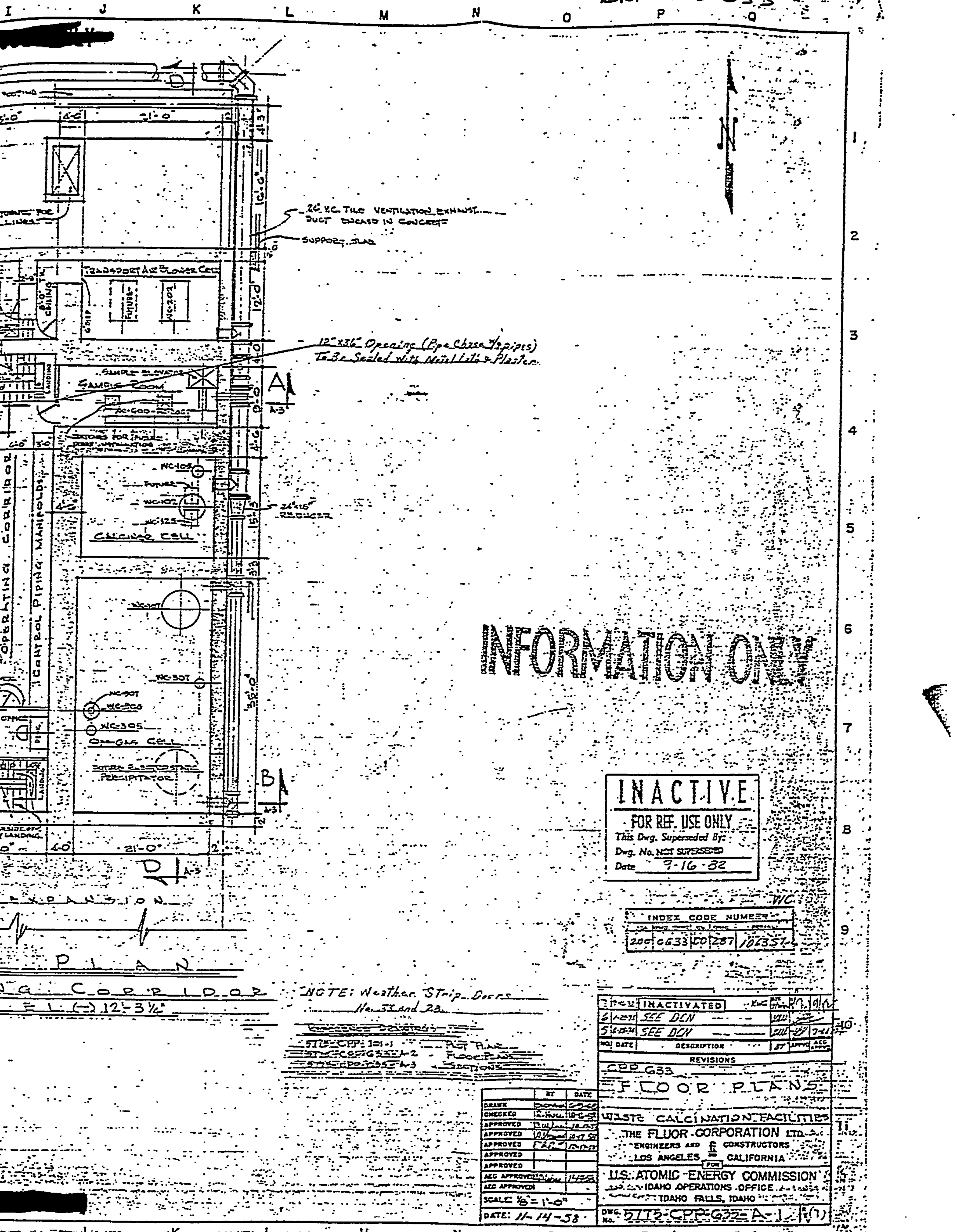
EDF-TFC-033


I J K L M N O P Q
1 2 3 4 5 6 7 8 9 10 11
26" V.C. TILE VENTILATION EXHAUST DUCT ENCASED IN CONCRETE
SUPPORT SLAB
TRANSPORT AIR BLOWER CELL
FUTURE
WC-202
12" x 36" Opening (Pipe Chase for pipes) To Be Sealed With Metal Lath & Plaster
SAMPLE ELEVATOR
SAMPLE ROOM
CALCINING CELL
WC-105
FUTURE
WC-102
WC-125
24" x 15" REDUCER
WC-307
WC-307
WC-306
WC-305
OFF-GAS CELL
ELECTROSTATIC PRECIPITATOR
CONTROL PIPING MANIFOLDS
OPERATING CORRIDOR
21'-0"
4'-0"
EXPANSION
PLAN
OPERATING CORRIDOR
EL (-) 12'-3½"
NOTE: Weather Strip Doors No. 33 and 23.
REFERENCE DRAWINGS
5115-CPP-101-1 PLOT PLAN
5115-CPP-633-A-2 FLOOR PLAN
5115-CPP-633-A-3 SECTIONS
INFORMATION ONLY
INACTIVE
FOR REF. USE ONLY
This Dwg. Superseded By:
Dwg. No. NOT SUPERSEDED
Date 9-16-82
WC
INDEX CODE NUMBER
200 0633 C0 287 102357
INACTIVATED
6 SEE DCN
5 SEE DCN
NO. DATE DESCRIPTION BY APPVD AEC
REVISIONS
CPP-633
FLOOR PLANS
WASTE CALCINATION FACILITIES
THE FLUOR CORPORATION LTD.
ENGINEERS AND CONSTRUCTORS
LOS ANGELES FOR CALIFORNIA
U.S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO
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AEC APPROVED
SCALE: ⅛" = 1'-0"
DATE: 11-14-58
DWG. No. 5115-CPP-633-A-1 (7)

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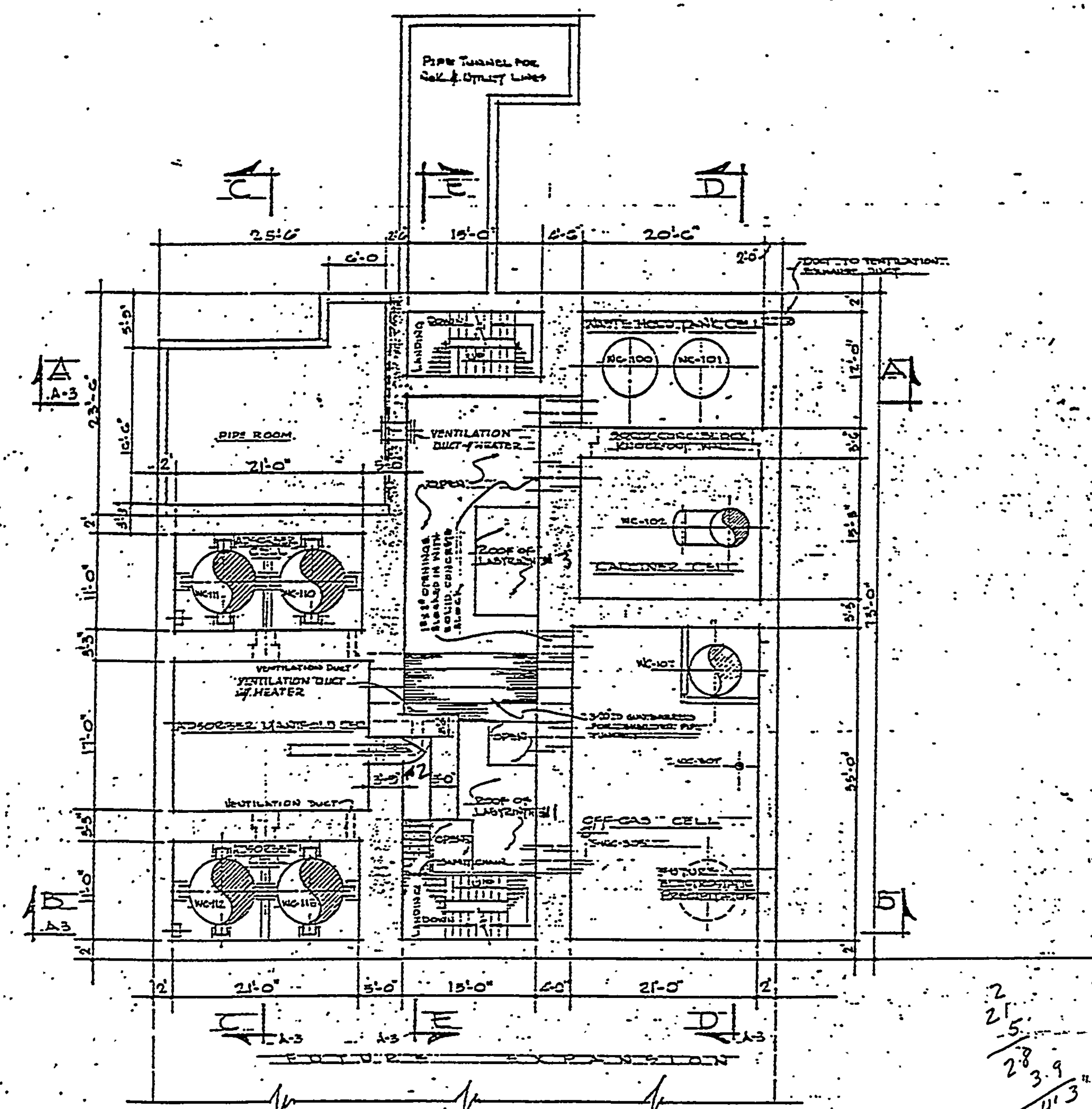
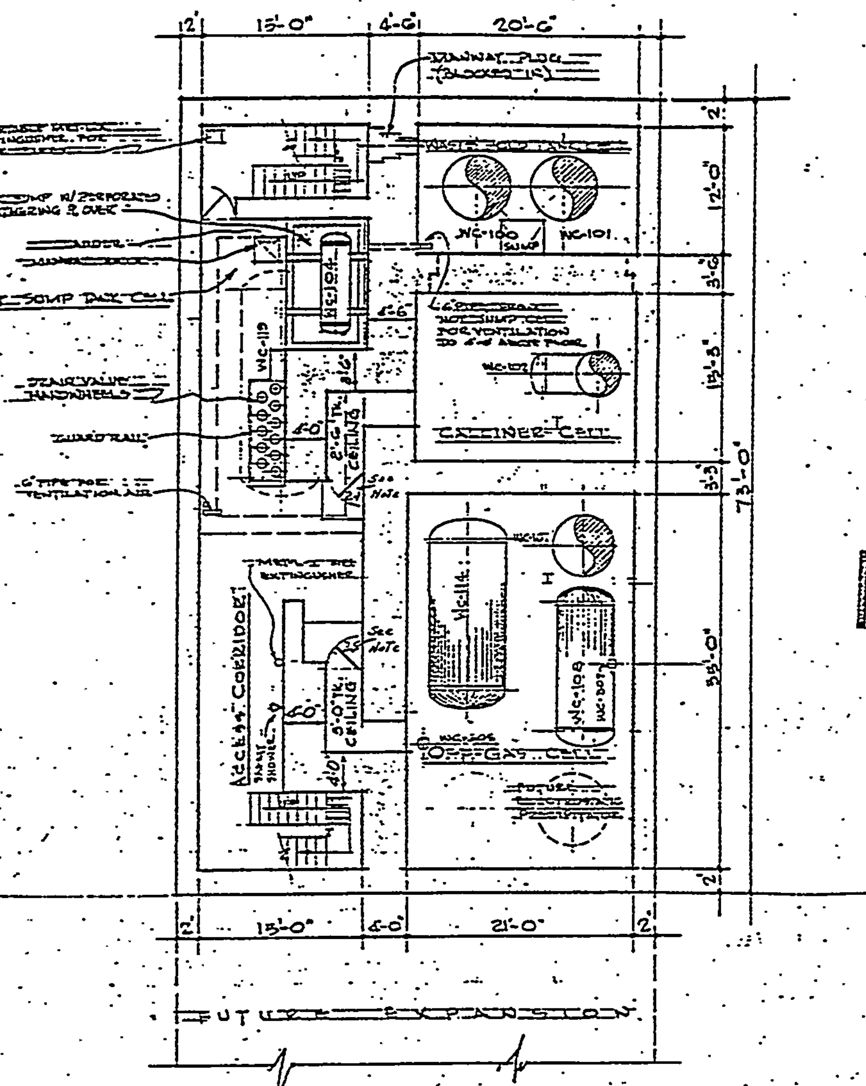


FLOOR PLAN
AT ACCESS CORRIDOR
MEZZANINE FLOOR EL. 22'-7¼"

[redacted]

[redacted]



FLOOR PLAN AT ACCESS CORRIDOR FLOOR EL (-) 34'-2 3/4"

INFORMATION ONLY

INACTIVE
FOR REF. USE ONLY
This Dwg. Superseded By:
Dwg. No. NOT SUPERSEDED
Date 9-16-82

WC

INDEX CODE NUMBER
200 | 0633 | 00 | 287 | 106352

NO	DATE	DESCRIPTION	LOC.	APPVD	AEC APPVD
5		INACTIVATED			
4		ADDED IN-PLANT CODE			
3		As Built			
2		AS BUILT			
1					

REVISIONS

NOTE: Ventilating Grill In Doors 24x24 Covered With Sheetmetal

REFERENCE DRAWINGS
5775-CPP-633-A-1 FLOOR PLANS
5775-CPP-633-A-3 SECTIONS

	BY	DATE
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SCALE: 1/8" = 1'-0"		
DATE: 11-12-58		

CPP 633
FLOOR PLANS
WASTE CALCINATION FACILITIES

THE FLUOR CORPORATION LTD.
ENGINEERS AND CONSTRUCTORS
LOS ANGELES FOR CALIFORNIA

U.S. ATOMIC ENERGY COMMISSION
IDAHO OPERATIONS OFFICE
IDAHO FALLS, IDAHO

DWG. No. 5775-CPP-633-A-2 (5)

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INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501
EDF Serial Number EDF-TFC-034
Functional File Number BC-20

Project/Task CPP Tank Farm Closure Study
Sub task Ancillary Piping

TITLE: Decontamination Solution and method for waste transfer piping

SUMMARY

This EDF is a summary of information gather from Mr. David Machovec and Mr. Frank Ward.

Telephone conversation with Mr. David Machovec on August 4, 1997 concerning the type of decontamination solution to use on waste transfer piping.

Telephone conversation with Mr. Frank Ward on August 13,1997 about aluminum nitrate solution.

Distribution:; D. J. Harrell, MS 3211 B. R. Helm, MS 3765; B. C. Spaulding, MS 3765; F. S. Ward, MS 5111; D. Machovec, MS 5111;; Project Files (Original +1)

Authors	Department	Reviewed	Approved
K.C. DeCoria	MC&IE 4130	Date 12/15/97	Date 12/15/97

Mr. Frank Ward and Mr. Machovec recommended using 0.5 molar aluminum nitrate as a decontamination solution for flushing the tank farm tanks, if calcination continues to be the method to process the tank farm waste. If other processing methods are used then the tank farm decontamination/flush solutions need to be evaluated for that process. Reasons for this recommendation are:

1. Aluminum nitrate must be added to enhance the calcination process. Using aluminum nitrate gives double value for the money expended because it will help decontaminate the piping as it is transferred from the tank farm tanks and adds the aluminum nitrate needed for the calcination process. The HLLWE can then remove much of the water as it concentrates the waste and the concentrated waste solution will require much less aluminum nitrate to be added when the waste is calcined.

2. Aluminum nitrate is slightly acidic. This helps keep solids in suspension and minimizes precipitation from the liquid waste solution. Aluminum nitrate has a pH $\approx$ 4 and will reduce the acid content of the waste in the tank farm waste since the acid content is in the 1-2 N acid range.

3. Aluminum nitrate will decontaminate the piping better than raw or demineralized water.

Two raw or demineralized water flushes should follow the aluminum nitrate flush to remove any remaining solution of aluminum nitrate in the waste transfer piping and further reduce the acid in the waste solution remaining in the tanks. The water will also be removed by the HLLWE when it is concentrated

A solution of three to six molar nitric acid could be used for decontamination of waste transfer piping and would be very effective. The disadvantage with using nitric acid is that the resulting acidic waste stream will require further processing to remove the acid from the waste stream as the HLLWE will not be able to process the nitric acid and nitric acid is difficult to calcine due to the amount of additives (aluminum nitrate) that must be added.

INEL ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 73501
EDF Serial Number: EDF-TFC-035
Functional File Number: C-08

Project/Task: CPP Tank Farm Closure
Sub task: Tank and Vault Void Filling

Title: GROUT LIFT DETERMINATION FOR FILLING TANK AND VAULT VOID

SUMMARY

Tank Farm closure require vault and/or tank void grouting. The number of grout lifts required to fill the vaults and/or tank voids are determined here. There are two grout void filling situations: (1) Filling the vault void and leaving the tank void empty and (2) Filling the tank and vault void simultaneously. The typical tank and vault dimensions are as follows (see EDF-TFC-029):

1. 32 feet high vault ceiling
2. 21 feet tank side walls
3. 8.5 feet dome height
4. 50 feet diameter

All tanks are assumed to have 2-feet of grout emplaced in the tank void due to heel stabilization efforts.

Situation (1) deposits a 1.5-foot grout layer in the vault void bottom to eliminate tank buoyancy problems (see EDF-TFC-024). Approximately seventeen 4-foot grout lifts are required to fill the vault void to the tank dome commencement. Nine grout lift layers at specified depths are then used to cover the dome. (see EDF-TFC-022). Two more grout lifts will be placed above the tank dome to the vault roof in 2-foot or less lifts. Exceedingtwo foot lifts create heat dissipation problems inherent in large volume grout pours (see EDF-TFC-033).

Situation (2) uses 2-foot grout lifts to fill the tank and vault voids. Approximately 14 and 16 grout lifts will be used to fill the tank and vault respectively. Since the tank and vault voids are filled simultaneously, lift height concerns while covering the dome with grout and tank buoyancy issues disappear.

The results are as follows:
The estimated grout lift number for Situation (1) is **17**.

The estimated grout lift number for situation (2) is **16** for filling the vault and **14** for filling the tank.

Distribution: B.R. Helm, D.J. Harrell, B.C. Spaulding, R. Gavalya and WTP EIS Studies Library on distribution.

Authors / Department	Reviewed	Approved
K.D. McAllister 4130	[signature]	B. C. Spaulding [signature]
[signature] 12-18-97	Date 12/10/97	Date 12/10/97

10/27/97

# of grout lifts to Fill Tank & Vault

2 Filling Situations:

① Filling Vault w/ Tank Empty

② Filling Tank & Vault Simultaneously

Situation ①

Assume that:

Ⓐ using a 4 foot grout lift (see EDF-TFC-033)
Ⓑ using 1.5' initial grout layer for tank Buoyancy Prevention (see EDF-TFC-024)
Ⓒ There will be dome covering lifts
Ⓓ most tanks (except for 2) have 21' sidewalls
Ⓔ most tank domes are 8.5' High
Ⓕ most vaults (except for 2 are 32' High
Ⓖ Tanks have a 2' grout lift inside from the stabilization process

Layers	Grout Feet	Description	Total # of Lifts
1	1.5'	1.5' grout tank Buoyancy Prevention	1
5	19.5'	19.5' more to get to dome	6
9	8.5'	# of lifts to safely cover dome (see EDF-TFC-022)	15
2	2.5'	2.5' more to fill vault to vault roof. Assume 2' lifts max because of grout volume needed & heat dissipation	17

→ 17 grout lifts total to fill vault

Situation ②

Assume that:

Ⓐ using a 2 foot grout lift (see EDF-TFC-033)
Ⓑ most tanks (except for 2) have 21' sidewalls
Ⓒ most tank domes are 8.5' High
Ⓓ most vaults (except for 2) are 32' High
Ⓔ tank has 2' of grout lift inside from the stabilization process.

Layers Vault	Layers (Tank)	Grout Feet	Description	Total # of Lifts
11	(10)	22'	to fill vault and tank just past beginning of dome	11 (10)
4	(4)	8'	Layers to cover/fill dome	15 (14)
1	(0)	2'	to fill above dome to vault roof	16 (0)

16 grout lifts to fill vault
14 grout lifts to fill tank

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 02B40

EDF Serial Number: EDF-TFC-036

Functional File Number: ED-02

Project/Task: CPP Tank Farm Closure Study

Sub task: Site Preparation

TITLE: Sprung Structure Vendor Data

SUMMARY

The purpose of this Engineering Design File (EDF) is to present information and drawings for "Sprung Structures". Sprung Structures may be used for temporary enclosures during Tank Farm Closure activities as a low-cost, convenient method to provide protection from the environment (rain, snow, wind, cold temperatures, etc.). These structures are constructed using lightweight aluminum arches integrally connected to an all-weather outer membrane (vinyl fabric). Structure size can range from 30 to 120+ feet in width, 15 to 58+ feet high with unrestricted lengths.

Distribution: D.J. Harrell, B.R. Helm, A.K. Herbst, J.A. McCray, LMITCO;
WTP EIS Studies Library, Tank Farm Closure Library

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Date 1-28-98	Date 1·28·98	Date 1/28/98

Paul Shriver

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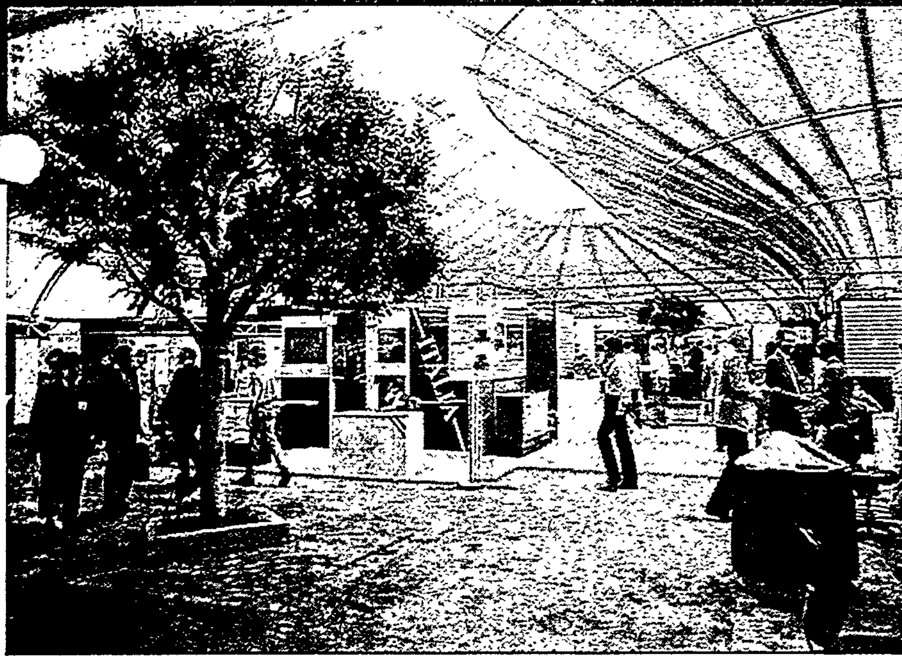
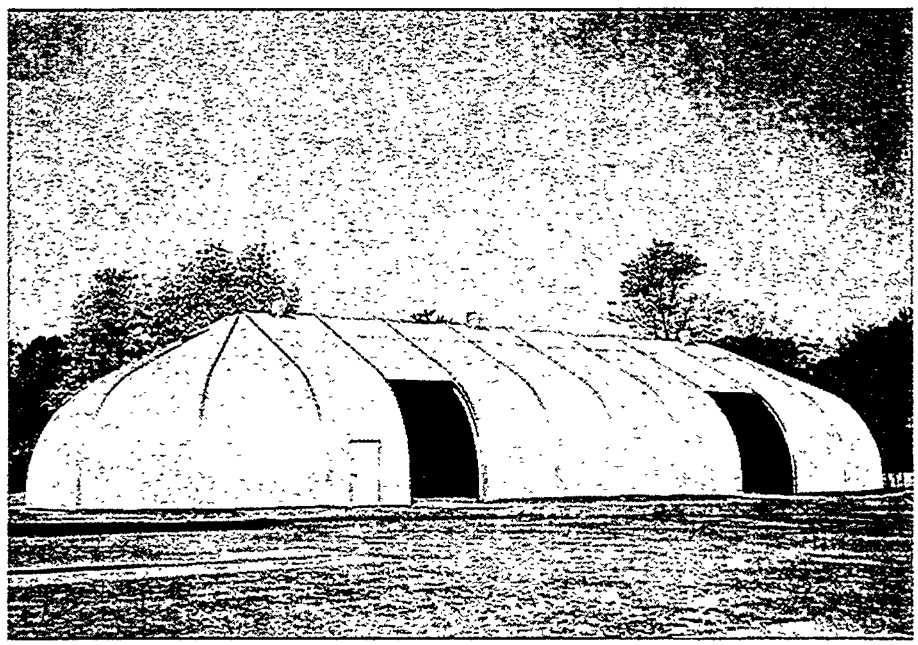




The Complete Shelter System

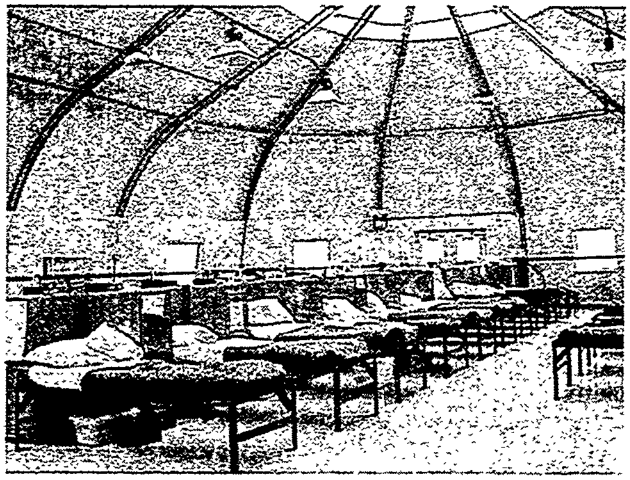
by

SPRUNG

Instant Structures

The Sprung Challenge: We challenge anyone to match our record for shipping, installing and servicing superior-quality portable structures anywhere in the world within days.

The Sprung Structure is designed and engineered to accommodate the world's need for enclosed space quickly and economically. As a member of the Sprung Group of Companies, in business since 1887, Sprung Instant Structures has achieved international recognition by providing shelter for hundreds of different applications in over fifty countries throughout the world.



Available Immediately

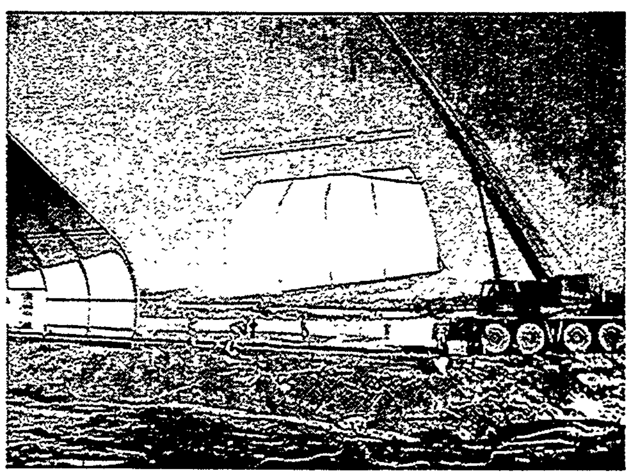
No matter what the need, Sprung Instant Structures is unlike any other company in the fabric enclosure industry in its ability to deliver superior quality, portable structures economically and directly from inventory. The company's reputation has been built on timely delivery of modular structures, especially in areas where transportation is difficult and speed of installation essential.

With over one million square feet of structures in inventory, Sprung Instant Sructures can react immediately to any shelter need. Immediate installation supervision is provided. Approximately 2,000 square feet can be erected per day with a crew of six unskilled laborers. If necessary Sprung Instant Structures can meet the challenge of even faster installation, having provided over 200,000 square feet of shelter in a single week.

Portable and Expandable to Any Size

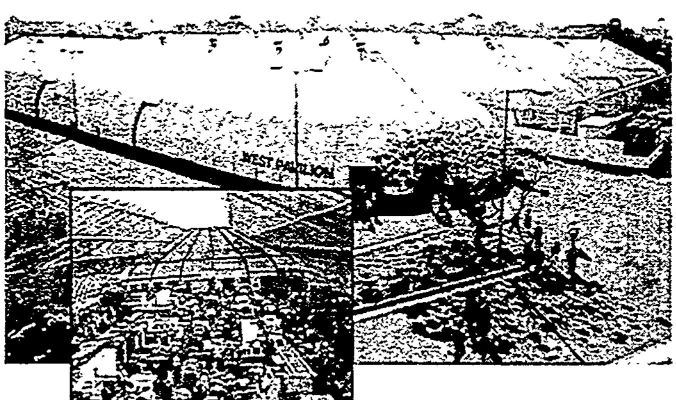
Sprung Structures have a unique design which makes them structurally sound yet light in weight, allowing for easy relocation, in some cases even without dismantling.

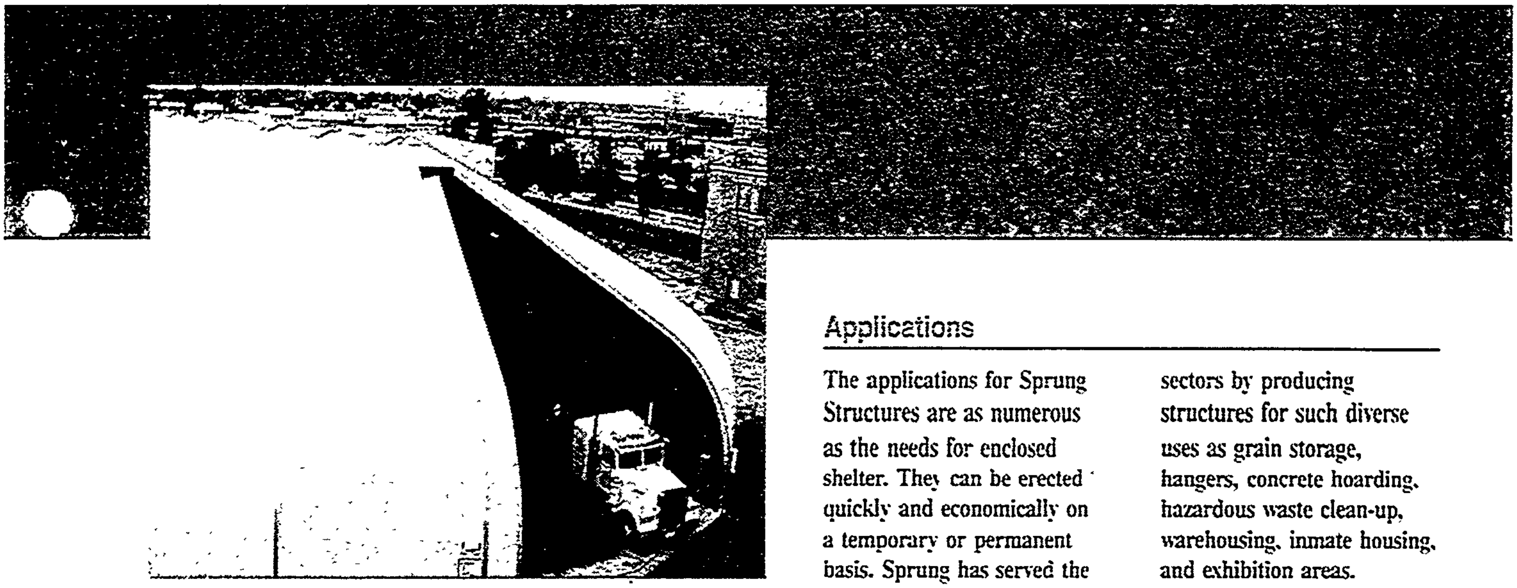
Not only are Sprung Structures 100% relocatable, they can be built to any length and expanded or contracted to adapt to changing needs. This flexibility is made possible because of their patented modular design.



Short and Long Term Leasing

Sprung Instant Structures can tailor a financial plan to meet customers' needs. Whether a shelter is required for as little as a few days or for several years. Sprung Instant Structures offers a number of leasing alternatives, all with options to purchase.





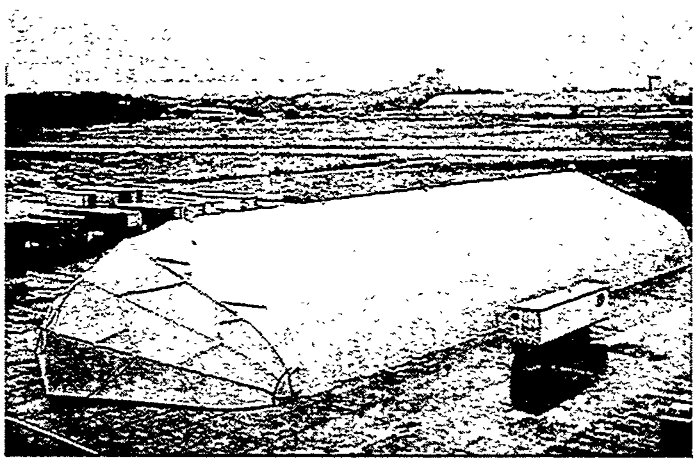
Applications

The applications for Sprung Structures are as numerous as the needs for enclosed shelter. They can be erected quickly and economically on a temporary or permanent basis. Sprung has served the needs of a long list of market sectors by producing structures for such diverse uses as grain storage, hangers, concrete hoarding, hazardous waste clean-up, warehousing, inmate housing, and exhibition areas.

Accessories

Every Sprung Structure is specially designed to accommodate doors of any size, providing ready access for vehicles, aircraft, freight or personnel. The modular design makes it possible to change door locations or add additional doors easily, at any time.

Window, fans and ventilators, all available from inventory, can be located anywhere within the structure. Environmental control of the structure is also possible as structures have been designed and operated in the freezing temperatures of the Arctic as well as in the extreme heat of the Middle East.



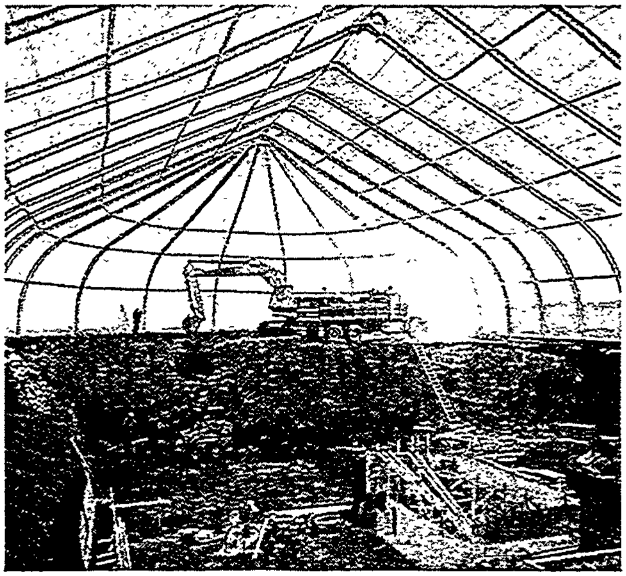
Quality and Service

Sprung Instant Stuctures has always been at the forefront of technology and delivers a level of quality and service that is unmatched in the fabric enclosure industry. Sprung Instant Structures are able to carefully specify the highest quality fabric available for any given installation.

Supporting this quality fabric are aluminum components which have been designed and manufactured to meet the most demanding structural integrity of any structure in its class that will last indefinitely.

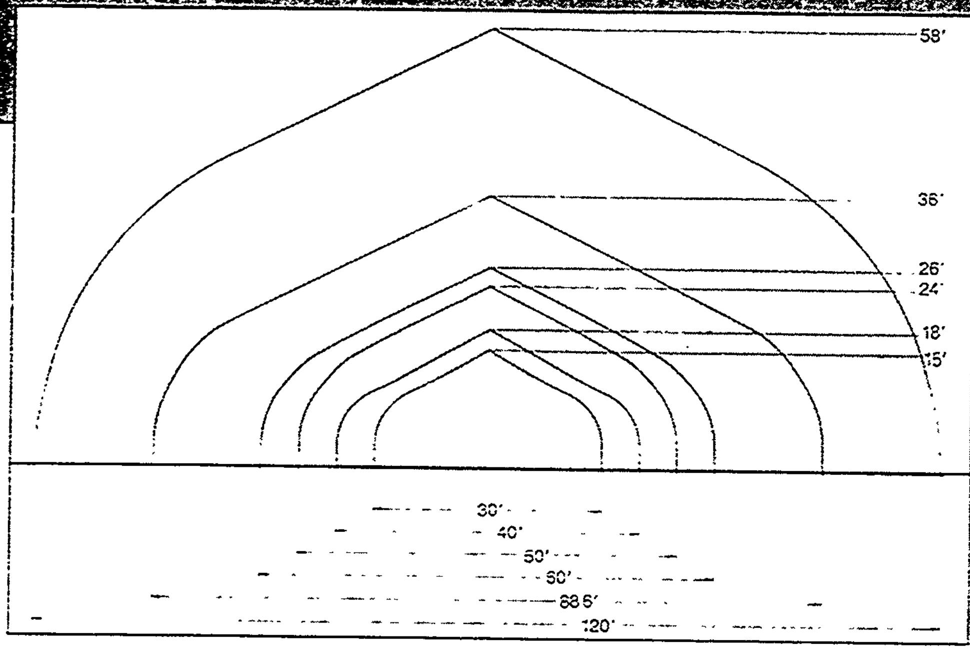
Sprung Instant Structures' personnel, who supervise the installation of all Sprung Structures, insure that they are erected professionally.

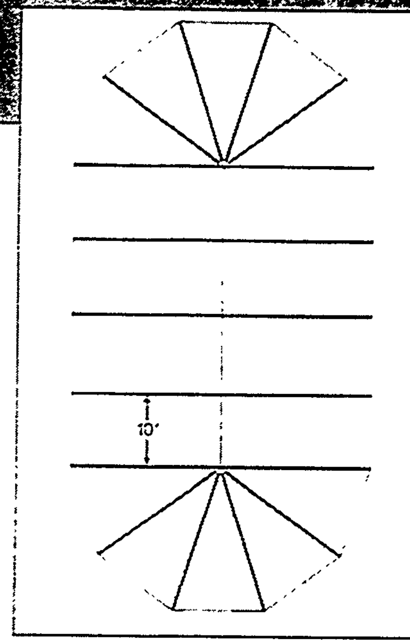
This dedication to quality and service has made the Sprung Structure the most desired and aesthetic structure in the temporary shelter market. And it's the reason why Sprung Instant Structures offers a superior guarantee and warranty program.



Custom Structures

A unique in-house engineering department makes Sprung Instant Structures unmatched in the industry in the design and manufacture of fabric structures for special applications. Sprung Structures can be designed to meet any requirement by utilizing standard components. Sprung Structures can be made any width, length, curved or straight, and can be put on wheels or tracks.





Fabric

The fabric is durable P.V.C. coated polyester scrim treated with inhibitors to prevent degeneration from ultraviolet rays of the sun. It is fire retardant (i.e self extinguishing), and passes the California State Fire Marshall, NFPA 701 and ULCS 109.

Normal life expectancy is 10-12 years and Sprung will provide a five year pro rata guarantee in any climate.

Translucent, opaque and Tedlar® coated fabrics available in a variety of colors.

Sprung Structure

- Can be designed to meet windloads of up to 130 mph.
- Can be erected in areas of heavy snow.
- Can be erected with unskilled laborers at a rate of 2,000 square feet per day or greater.
- Requires little or no maintenance.
- Can be erected on any reasonably firm flat ground. Foundations are not required for structures up to 60' in width — small footings required on wider structures.
- Can be constructed on a grade slope of up to 6%.
- Can be completely environmentally controlled.
- Fabric and components can be repaired or replaced in a minimum time frame without affecting the stability of the structure.

Sprung Instant Structures Inc.®

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10M JUNE '9*

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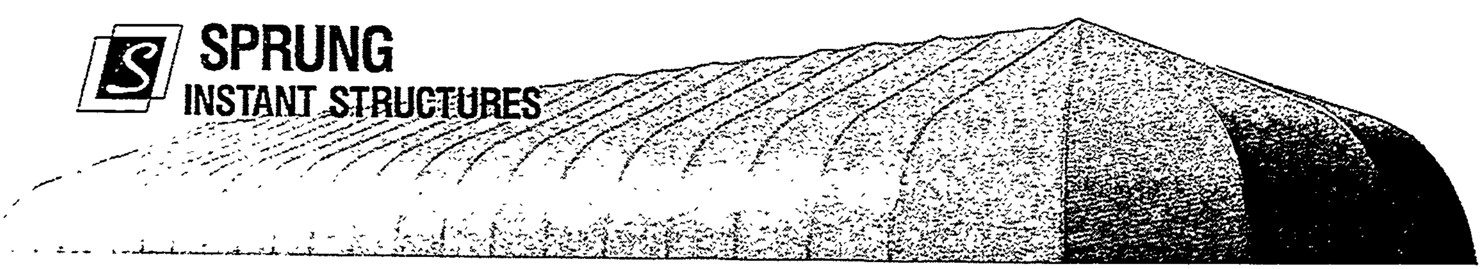
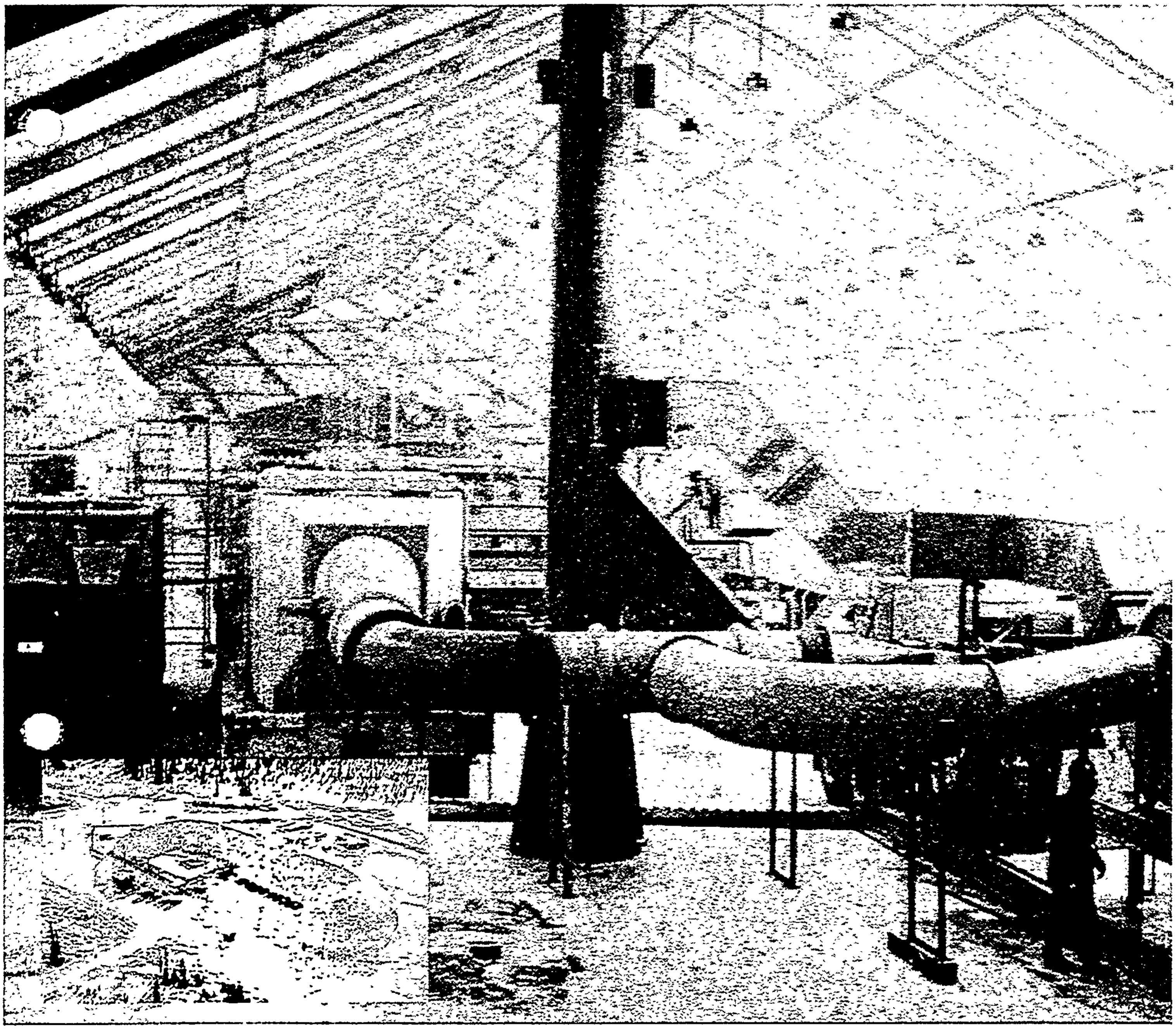
INSTANT STRUCTURES





The Hazardous Materials Shelter System

by

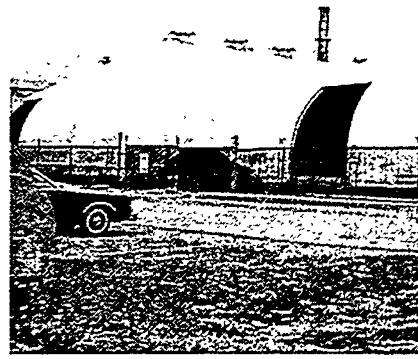
SPRUNG
Instant Structures

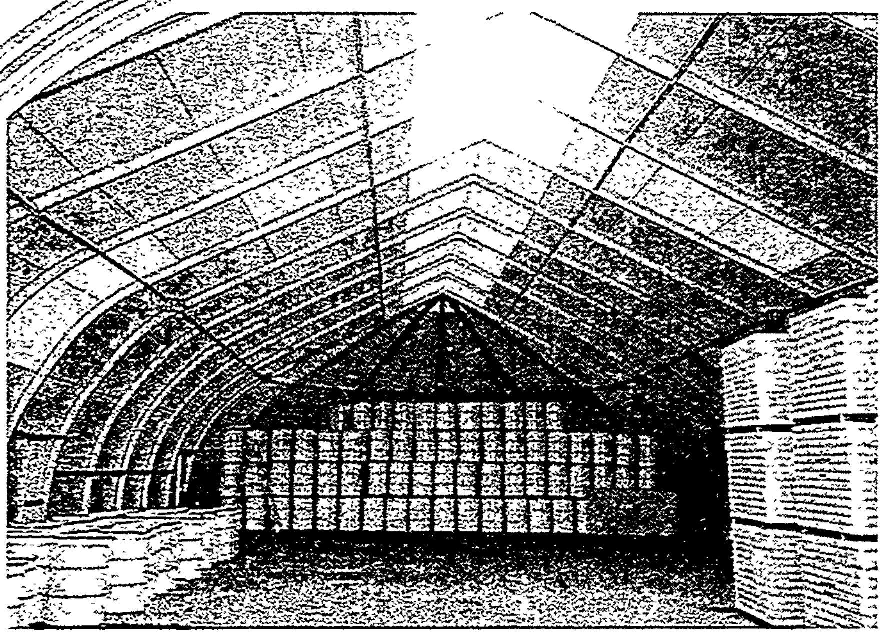
SPRUNG INSTANT STRUCTURES

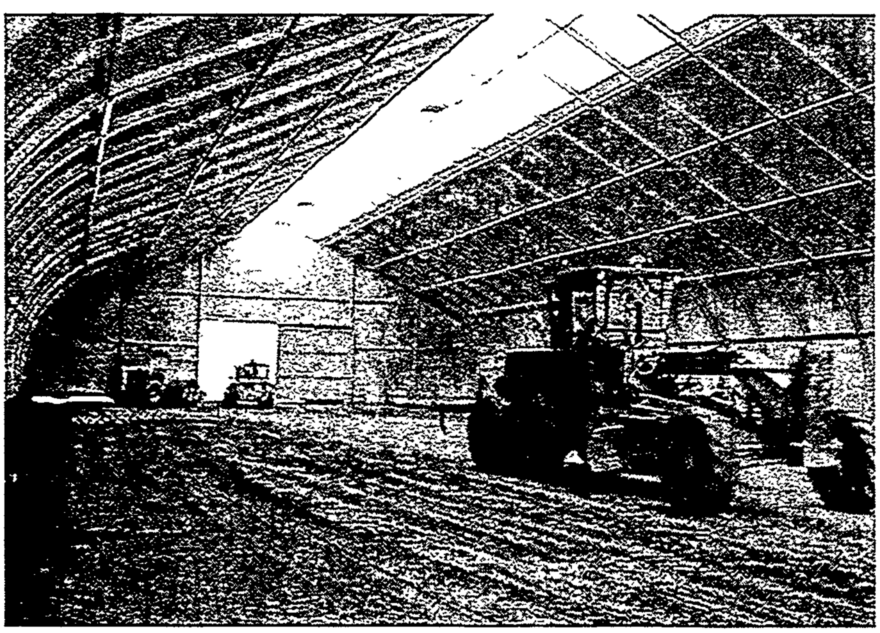
Sprung Instant Structures have provided shelter systems to a large segment of the hazardous waste industry. The Sprung Structure has become a recognized industry standard.

Sprung Structures are ideal for site remediation work by providing shelter for personnel, material, and equipment. The Sprung Structure provides a sealed environment thus offering effective containment of emissions from excavations.

A Sprung Structure was utilized on the McColl Superfund Site where it was concluded that emissions should be treated within an enclosure in order to provide maximum protection to the environment.

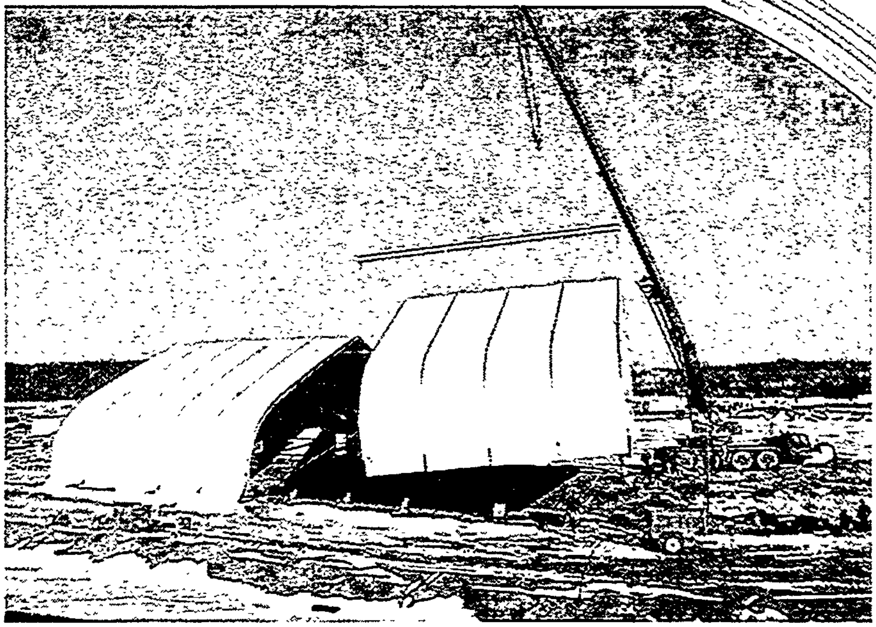


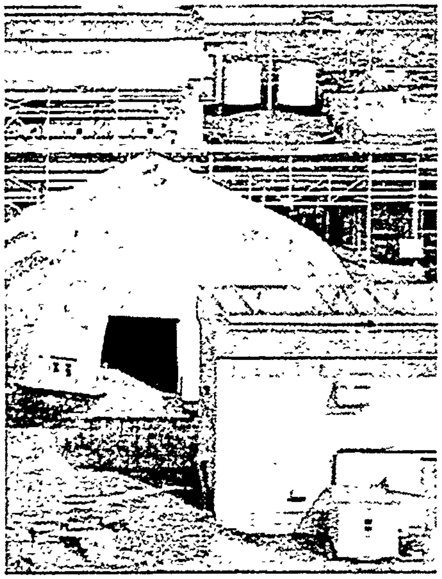


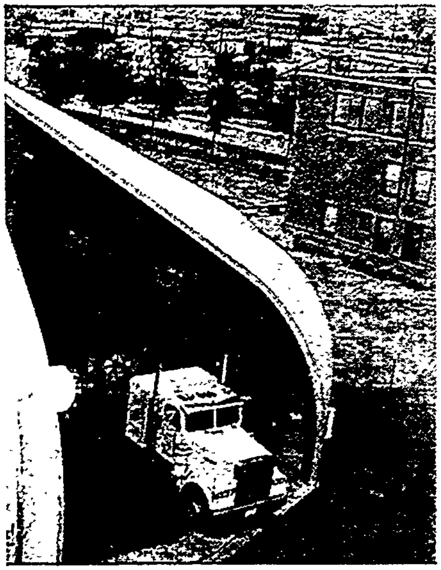


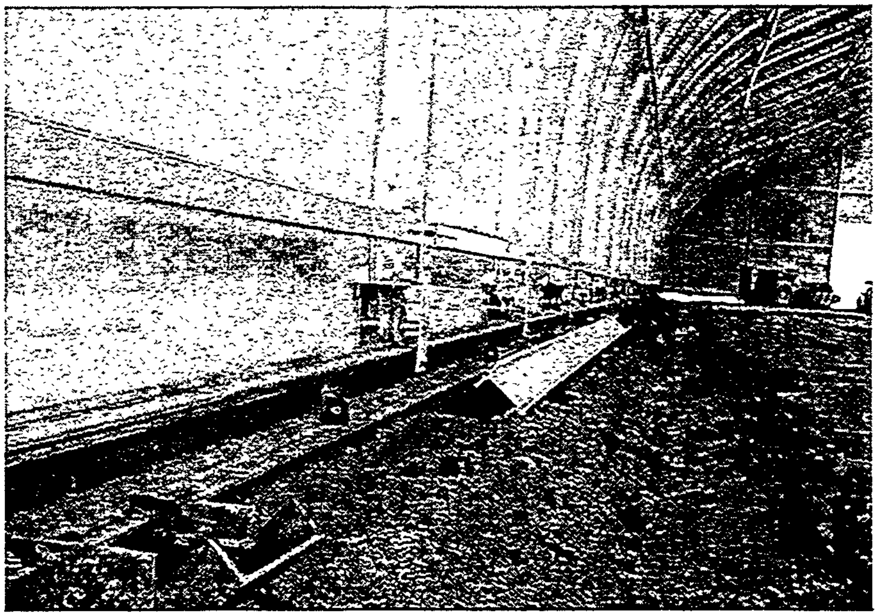
SPRUNG INSTANT STRUCTURES

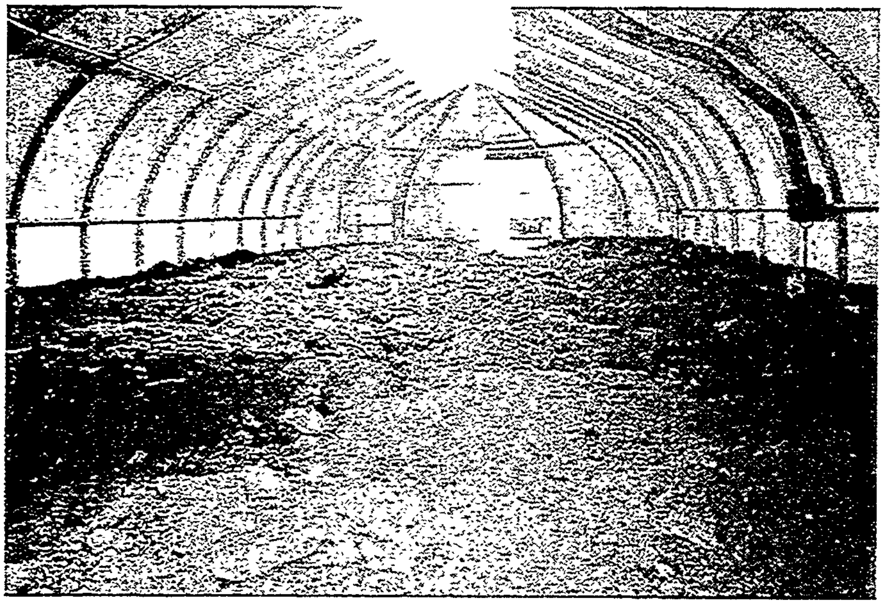
- Can be erected without footings or foundations on virtually any reasonably flat firm surface.
- Provides a sealed enclosure - Can be customized to maintain a positive or negative pressure.
- Available from inventory. Quickly erected and dismantled.
- Can be crane lifted or moved on a track wheel system.
- Custom designs are produced for specific situations.
- Sized to meet individual specific requirements.
- Can be easily heated or air conditioned.
- Portable and modular.

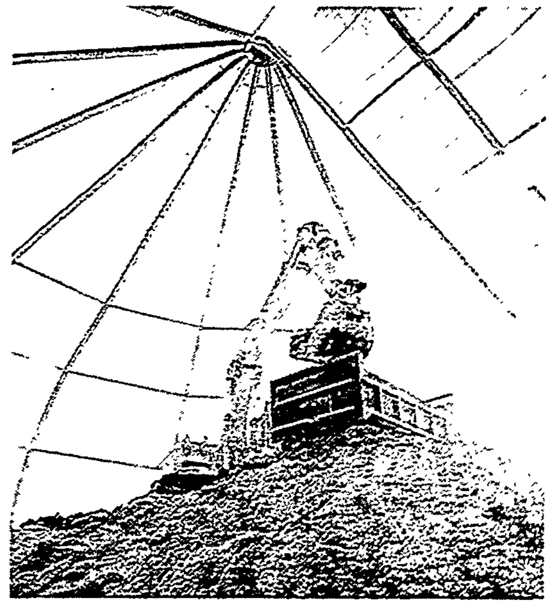


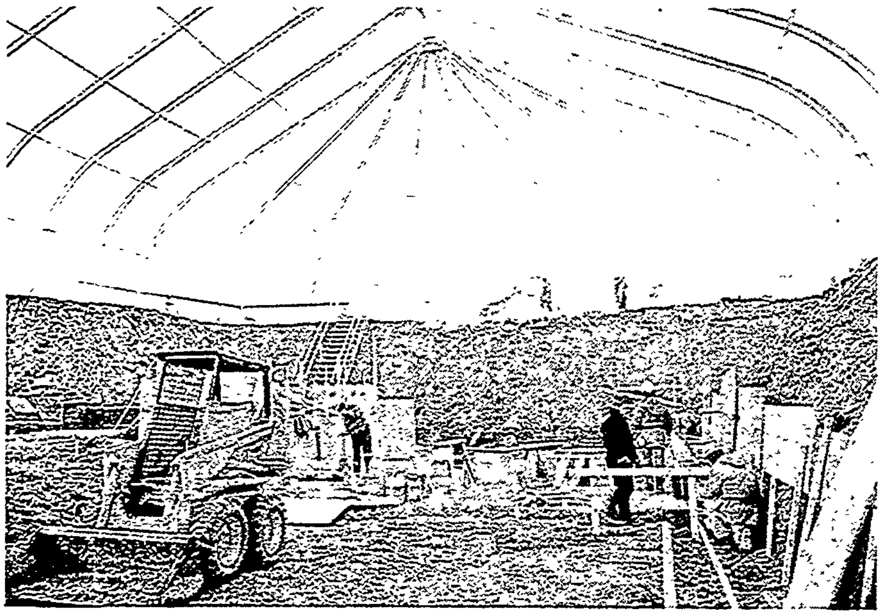






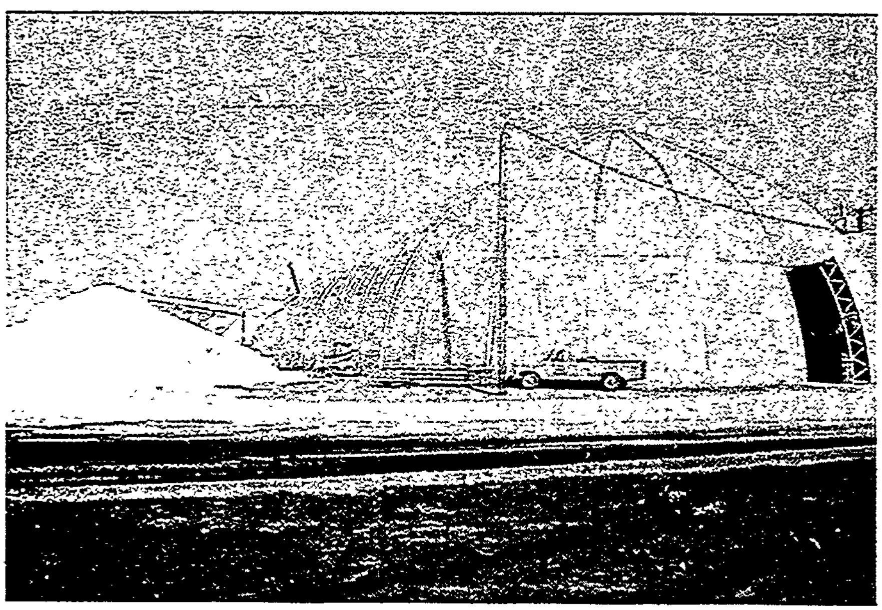






Past and Current Uses

- Transuranic Waste Treatment & Storage
- Radioactive Vault Storage
- Soil Remediation
- Asbestos Abatement
- Sludge Pond Covers
- Waste Remediation
- Earth & Clay Drying
- Environmental Protection
- Warehousing
- Vehicle Maintenance Shops
- Fabrication Shops



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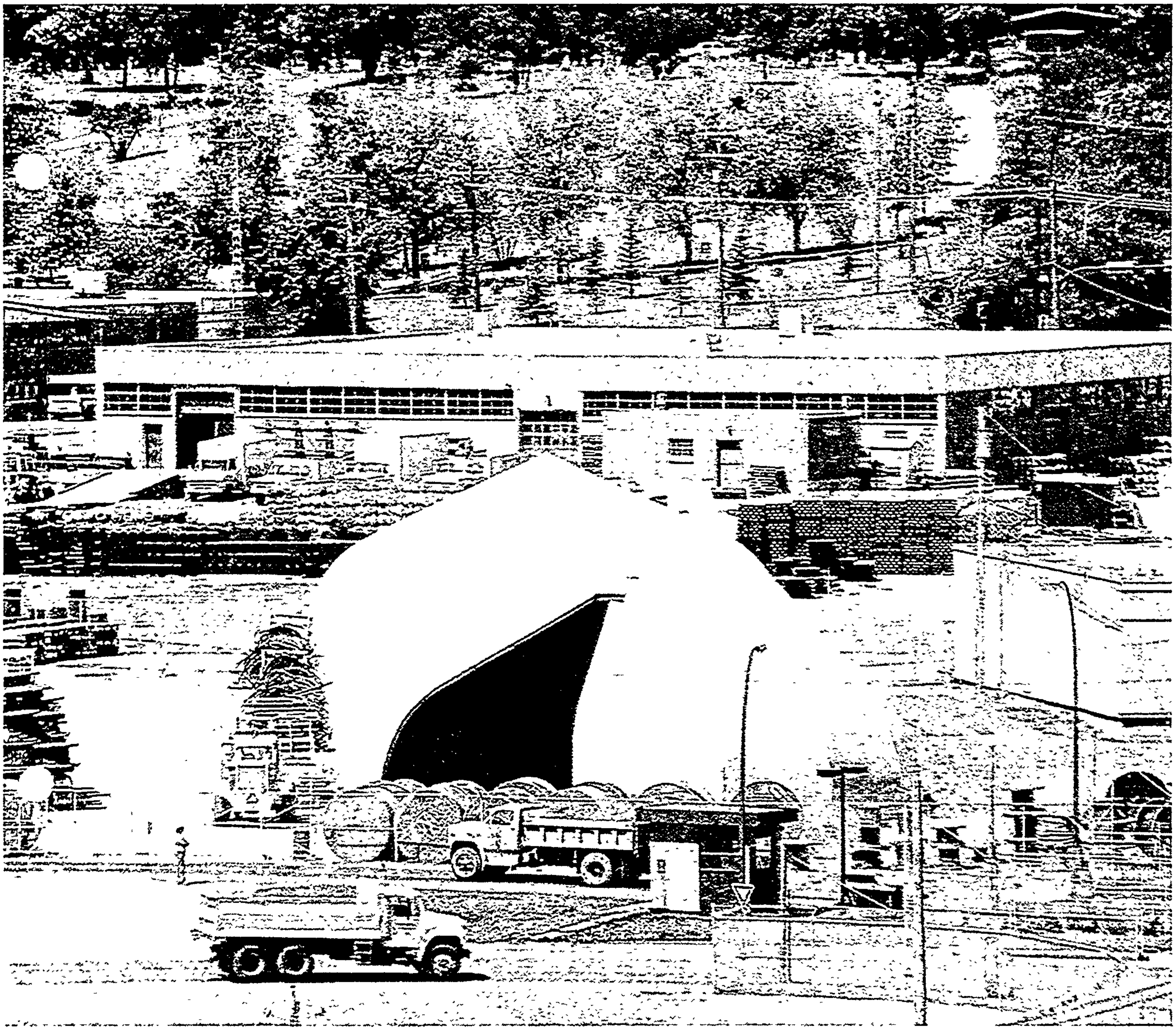
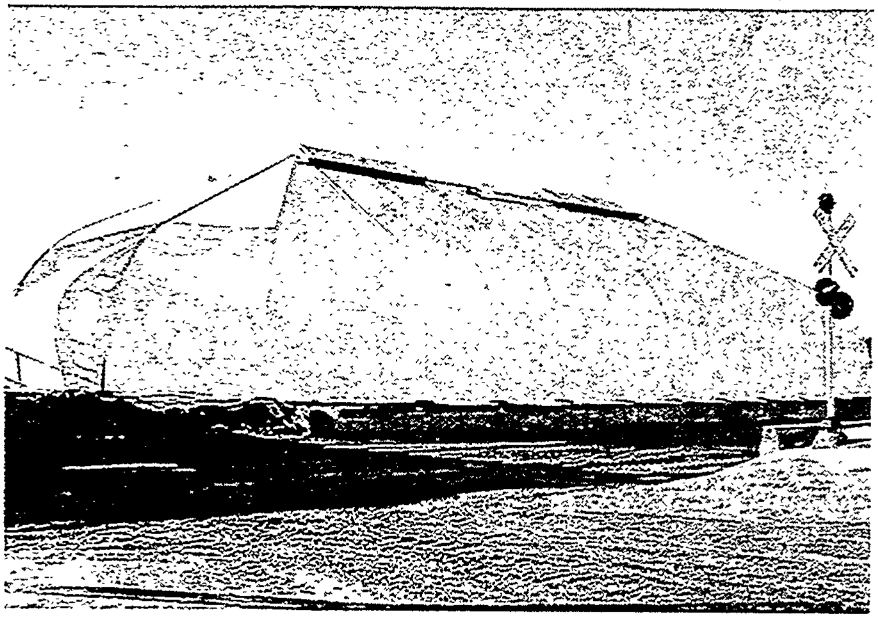


The Warehouse Shelter System

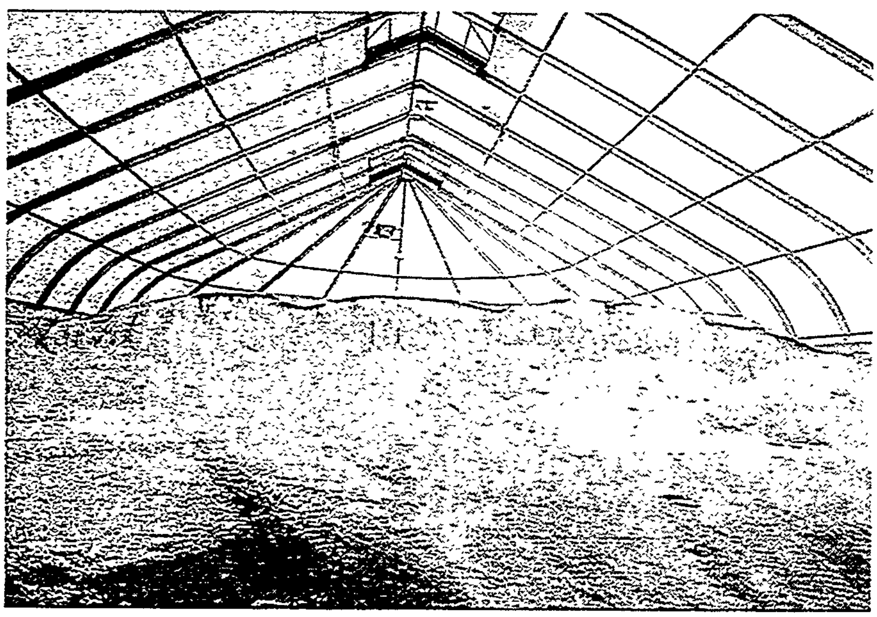
by

SPRUNG
Instant Structures

SPRUNG INSTANT STRUCTURES



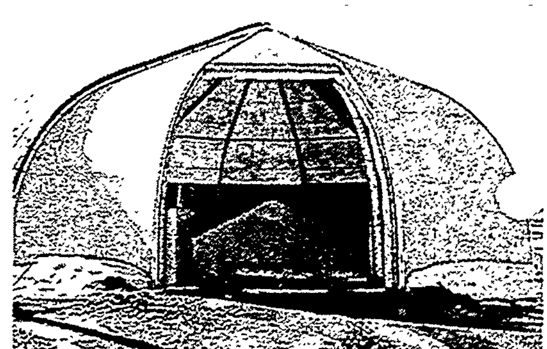
From bulk storage to vehicle warehousing Sprung Instant Structures has performed worldwide for a host of satisfied users.



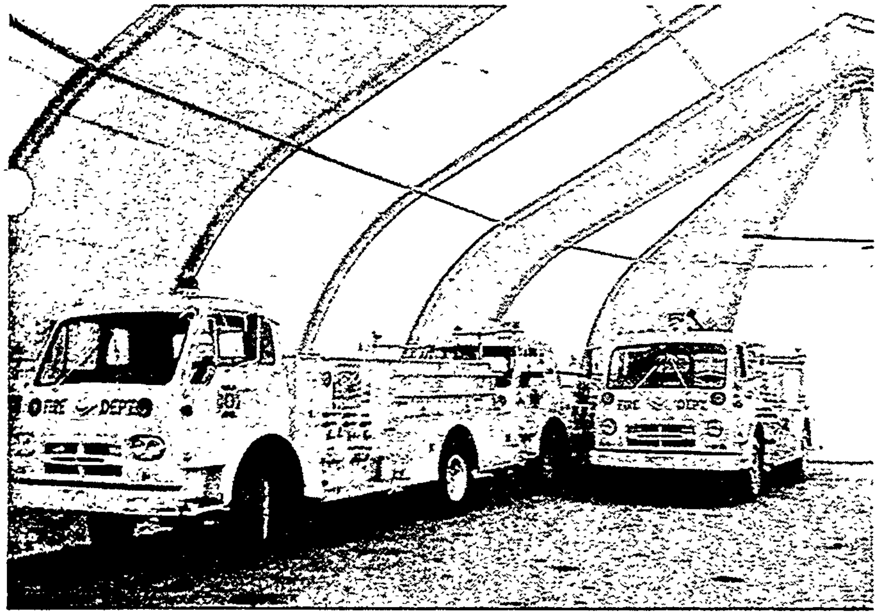
Fast and efficient, no-one else can offer the flexibility and economics of this unique shelter system.

- Available from inventory. Quickly erected and dismantled. Portable and Modular.

- Sized to meet your specific requirements.



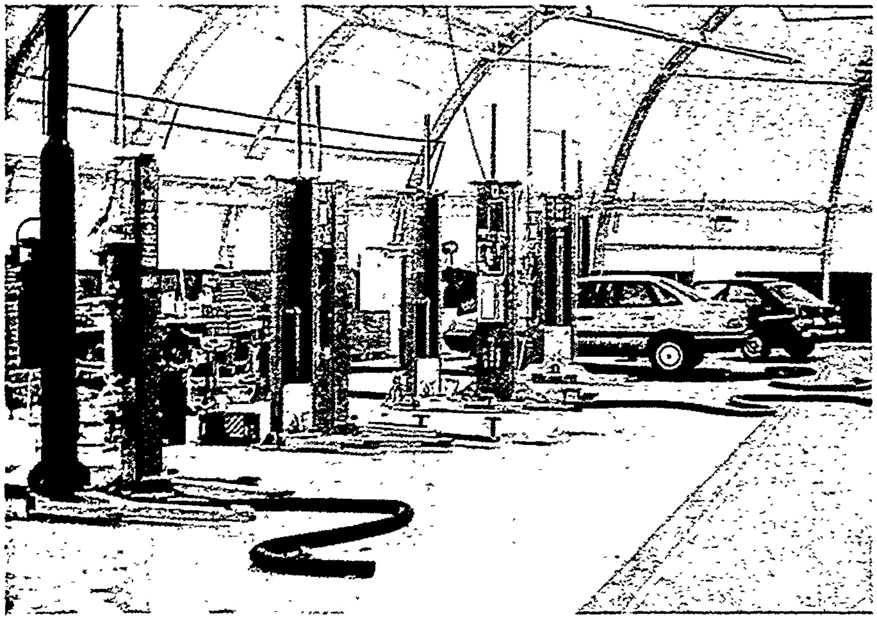
SPRUNG INSTANT STRUCTURES



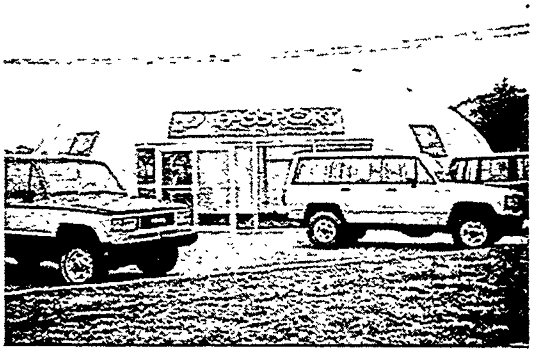
- Can be erected without footings or foundations on virtually any reasonably flat firm surface.

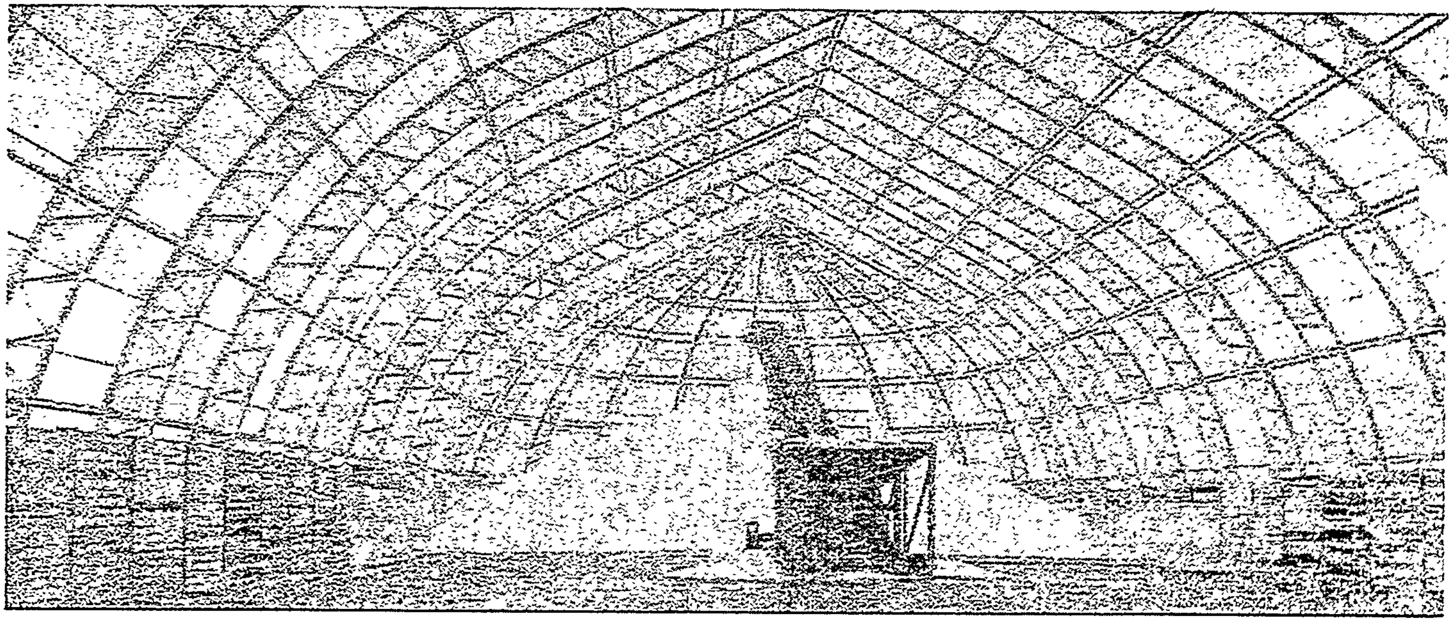
- Lease or Purchase, anywhere in the world.

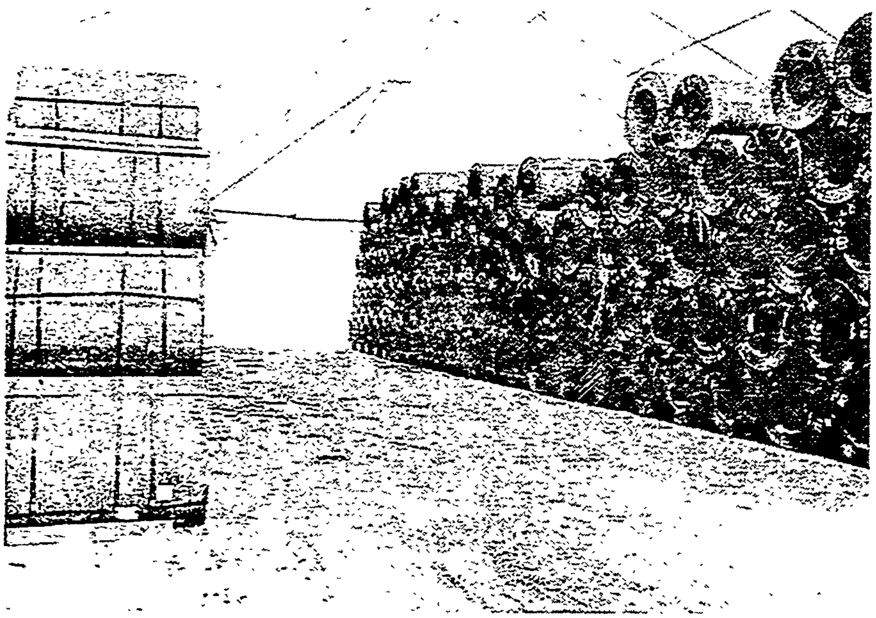
- May be used for many applications.



- Custom Designs are produced for specific situations.

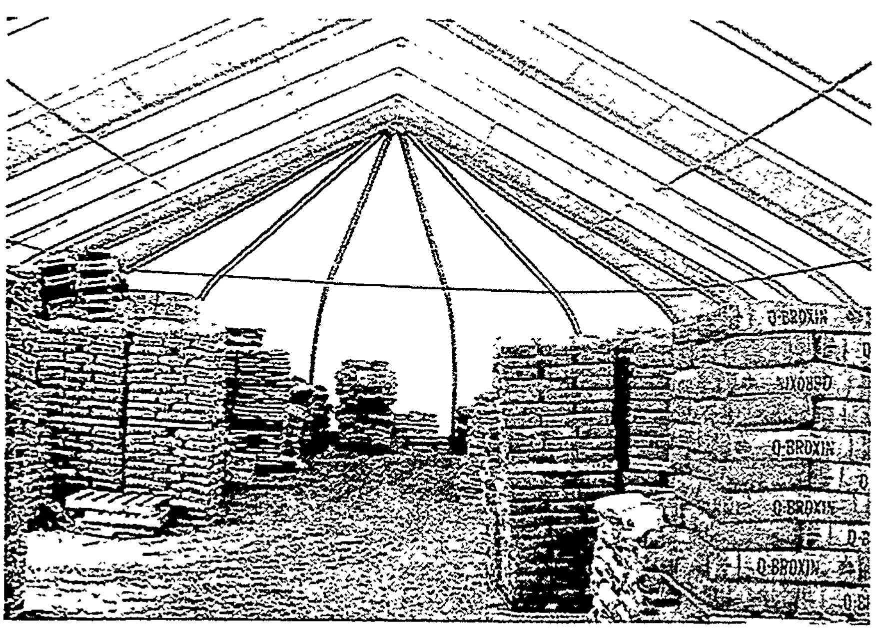






- Some other past and current uses include:

Warehousing
Vehicle Maintenance Shops
Portable Factories
Winter Storage
Environmental Protection
Bulk Storage
Showrooms and Retail Space
Accommodation and Recreation



FOR FULL DETAILS AND SPECIFICATIONS, CONTACT:

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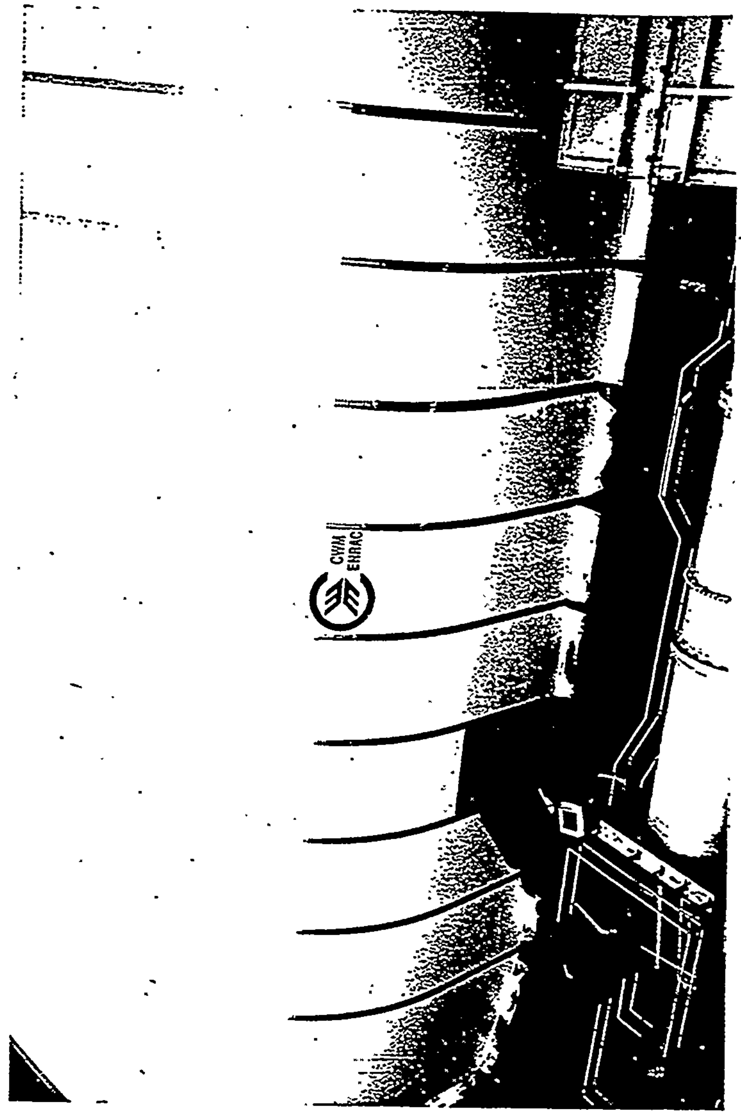
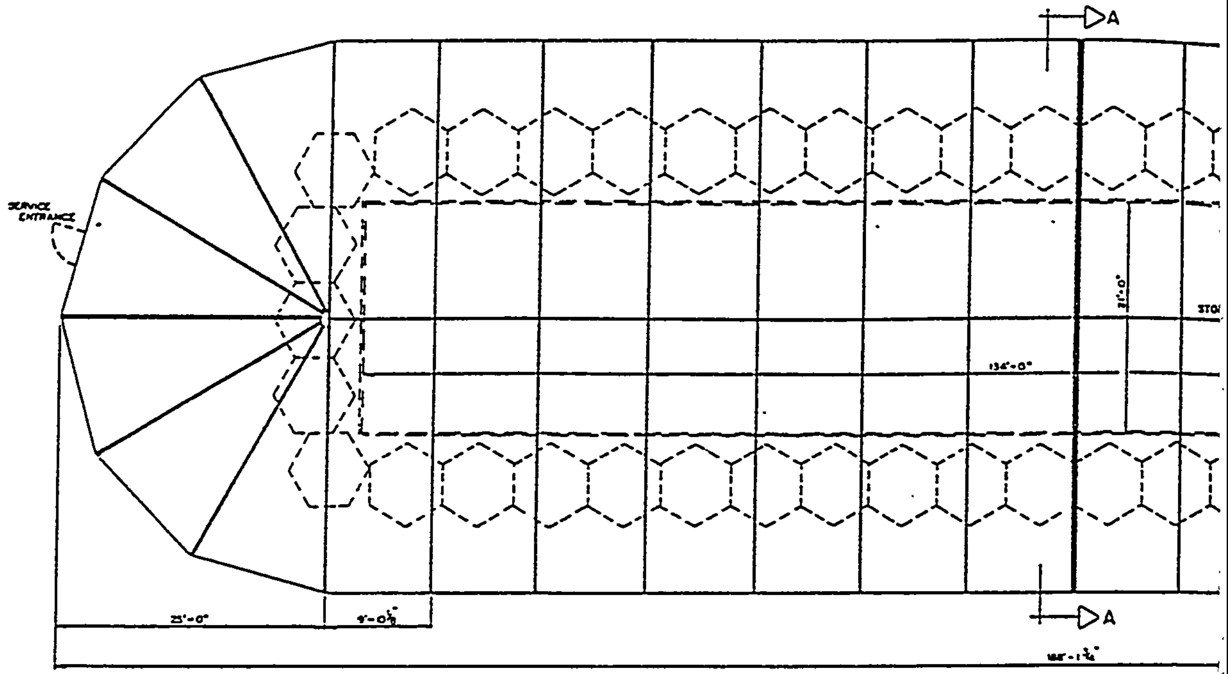
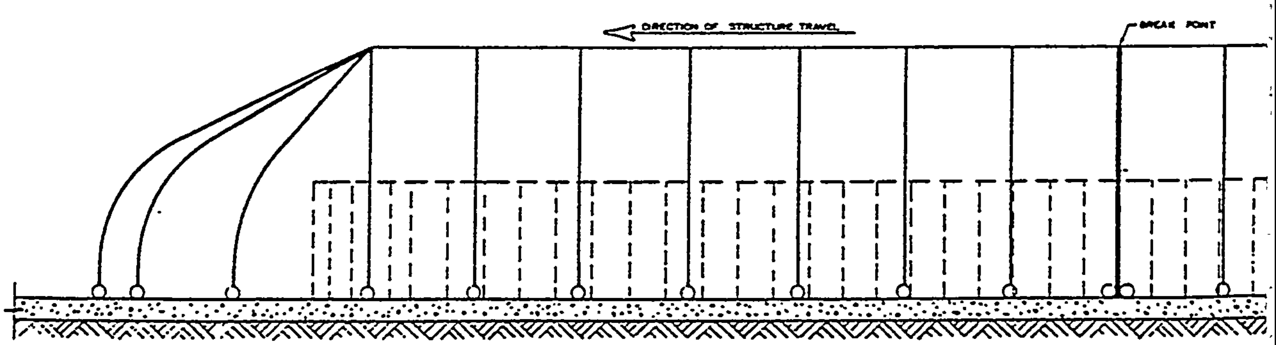
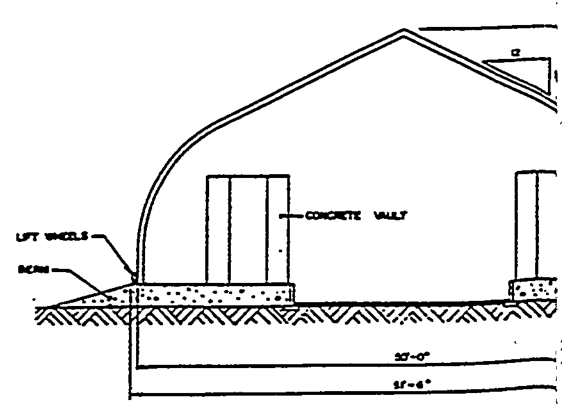




PLAN

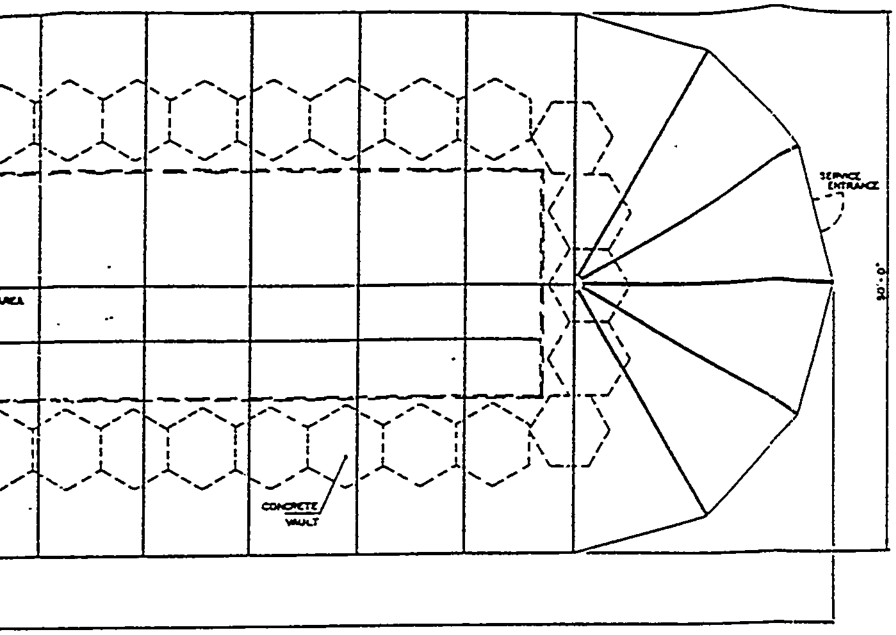


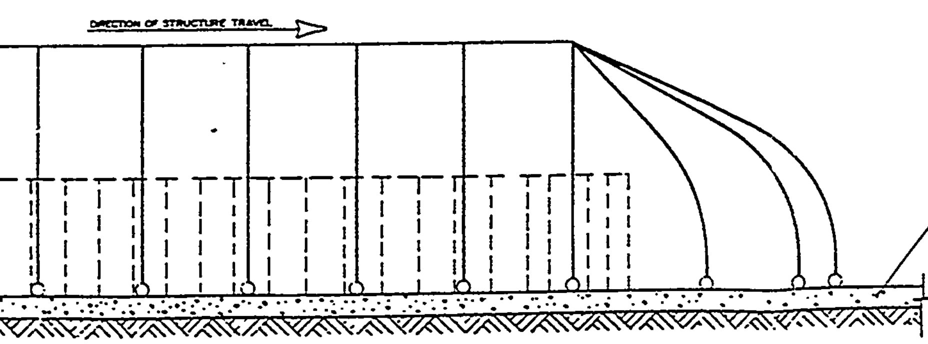
ELEVATION

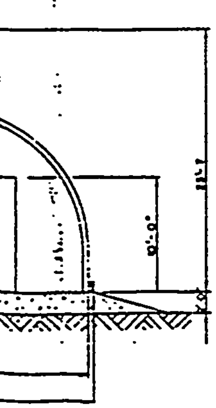


SECTION A-A

1







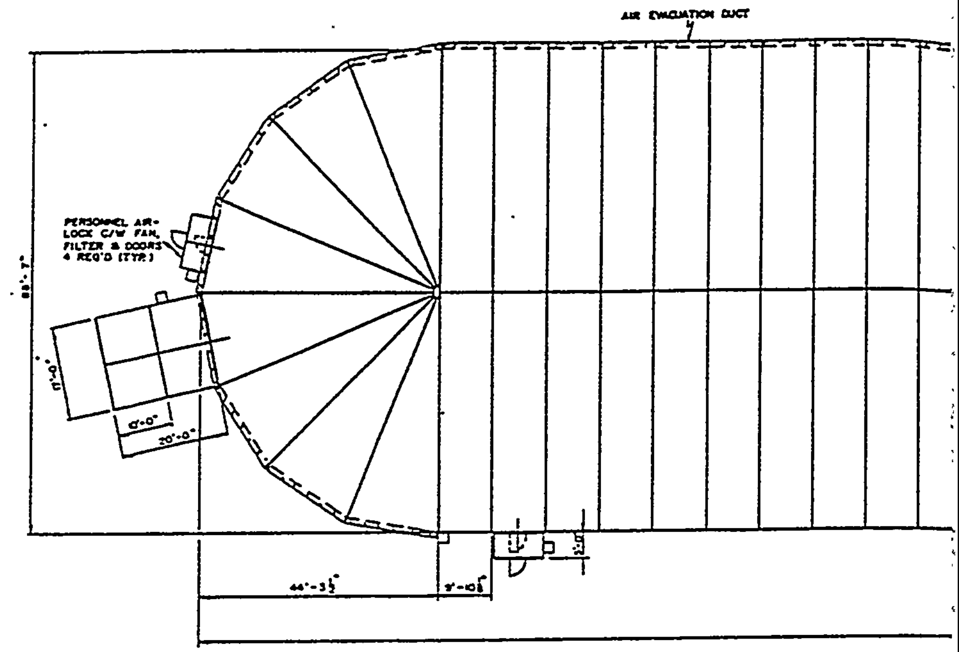
NOTE:
STRUCTURE TRAVELS ON LIFT WHEELS TO ACCOMADATE LOADING OF WASTE MATERIALS.
UPON CLOSING, STRUCTURE WILL BE SEALED AND LOCKED AT BREAK POINT.

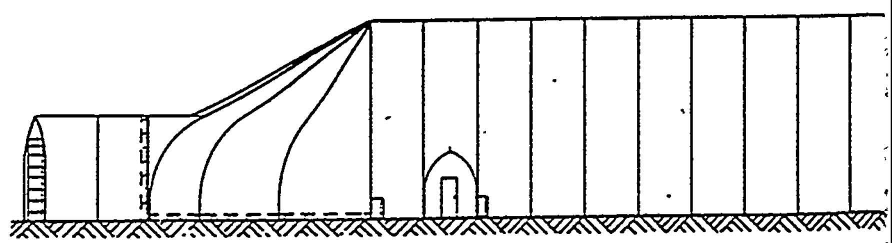
ITEM Nº	QUANT	DESCRIPTION	WT./PC.	LENGTH	PART Nº

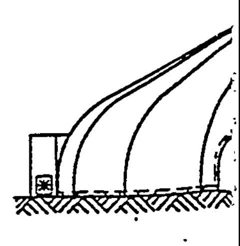
SPRUNG INSTANT STRUCTURES

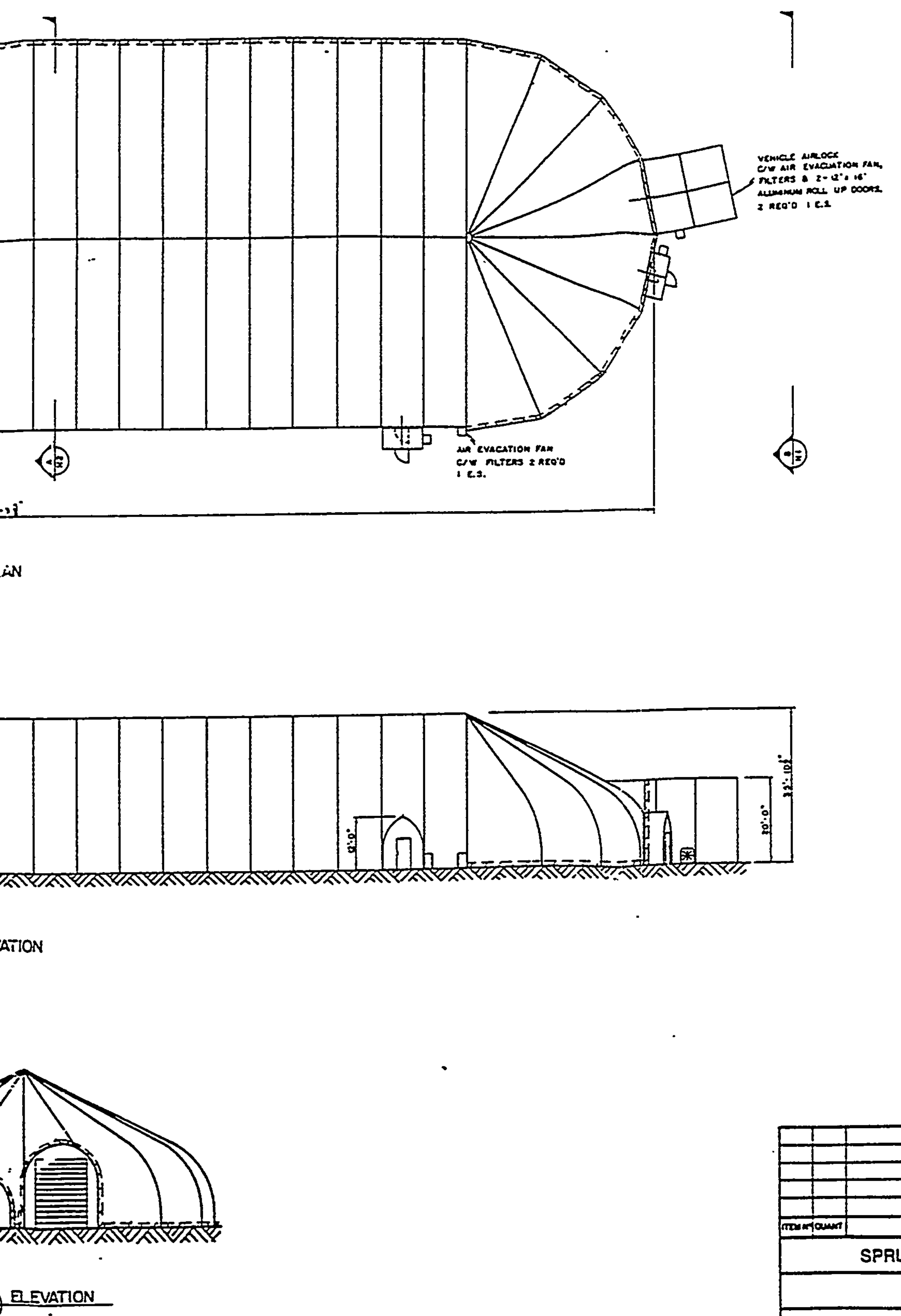
STORAGE STRUCTURE-A

DRAWN P BOS	DATE FEB 14, 1985	SCALE 1/8" = 1'-0"	DRAWING Nº P-83-04	REV 1
CHECKED	APP'D	CUST APP'L		


AIR EVACUATION DUCT
PERSONNEL AIR-LOCK C/W FAN, FILTER & DOORS 4 REQ'D (TYP.)
88'-7"
17'-0"
10'-0"
20'-0"
44'-3½"
9'-10⅝"





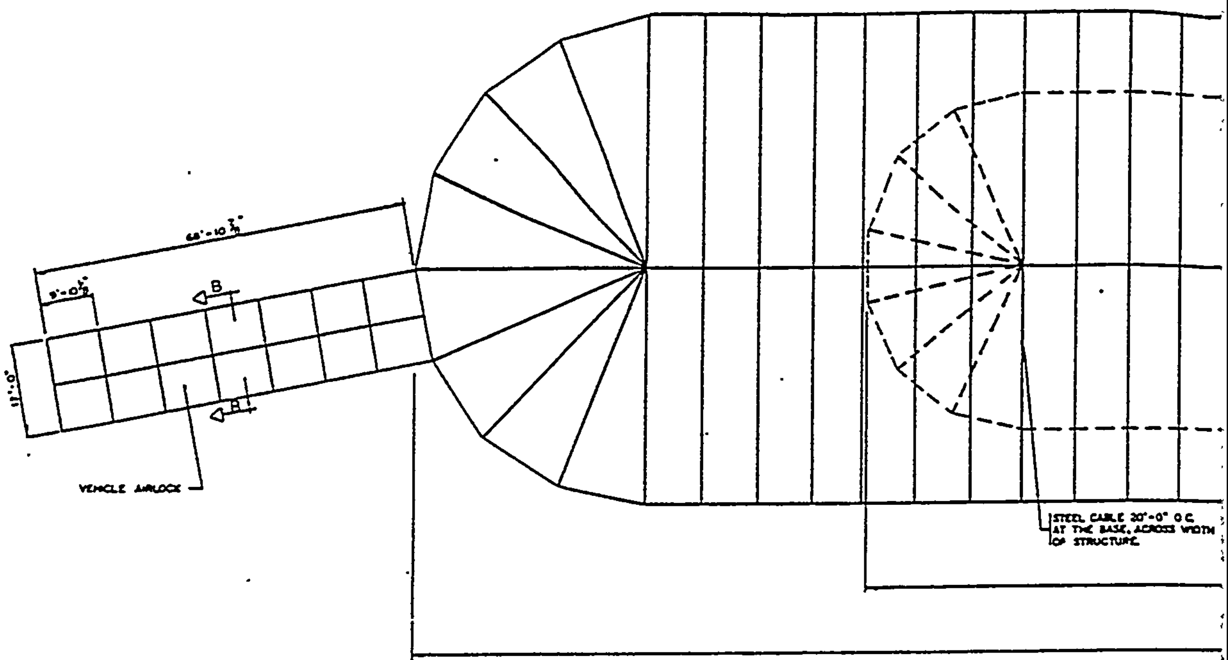


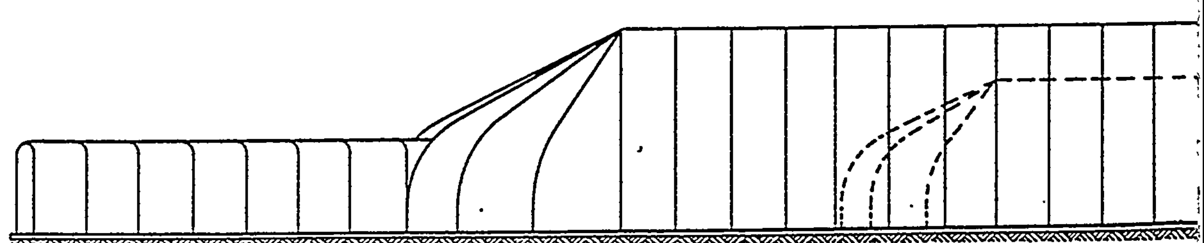
ITEM Nº	QUANT	DESCRIPTION	WT/PC	LENGTH	PART Nº

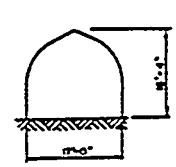
SPRUNG INSTANT STRUCTURES

NUCLEAR WASTE PROJECT
CONSTRUCTION SHELTER

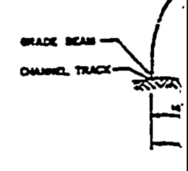
DRAWN P. BOS	DATE DEC. 19, 1983	SCALE 1/8" = 1'-0"	DRAWING Nº NE P.75-116	REV 1
CHECKED	APP'D	CUST APP'L		

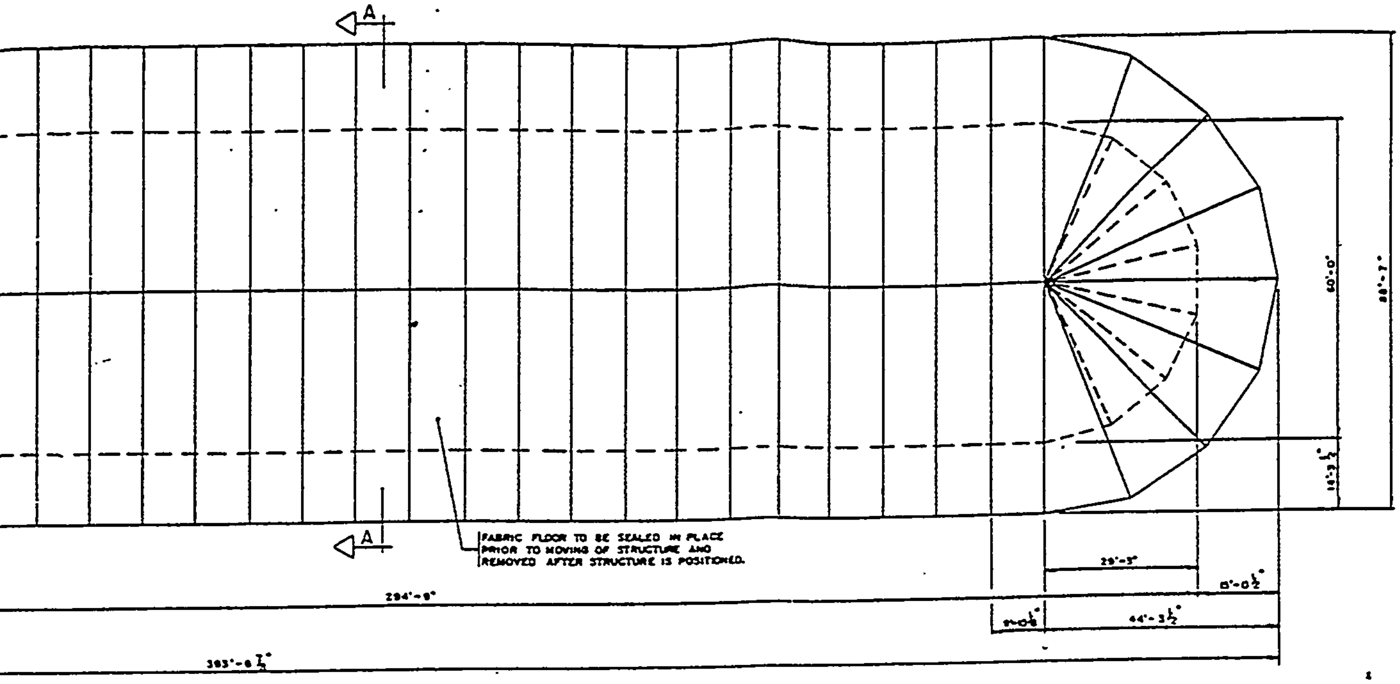

B
17'-0"
VEHICLE AIRLOCK
STEEL CABLE 20'-0" O.C.
AT THE BASE, ACROSS WIDTH
OF STRUCTURE.



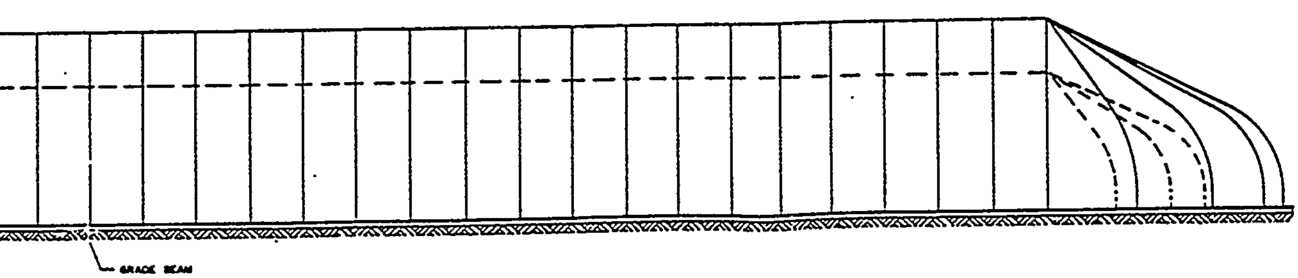

17'-0"

VIEW B-B

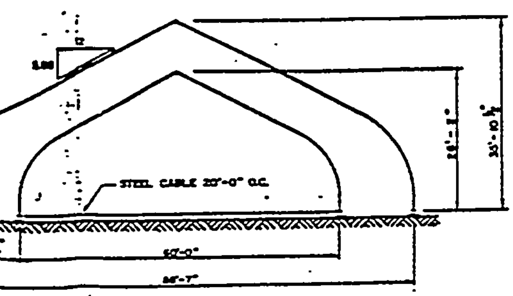

GRADE BEAM
CHANNEL TRACK



PLAN



ELEVATION



VIEW A-A

NOTE:
STRUCTURE TO BE MOVED AHEAD BY PLACING ROLLERS UNDER GRADE BEAM, TO RUN IN TRACK.
AIRLOCK TO BE MOVED SEPERATELY AND IN ONE PIECE.
ROLLERS, GRADE BEAM & TRACK TO BE SUPPLIED BY OTHERS.

PRELIMINARY DRAWING

ITEM Nº	QUANT	DESCRIPTION	WT./PC.	LENGTH	PART Nº

SPRUNG INSTANT STRUCTURES

ENVIRONMENTAL WASTE RECLAMATION

DRAWN P BOS	DATE FEB. 20, 1984	SCALE 1/8" = 1'-0"	DRAWING Nº P-84-08	REV
CHECKED	APP'D	CUST. APP'L		

Sprung Instant Structures, Inc.

A Texas Corporation

800-528-9899 • 800-661-1163 • (403) 245-3371 • Fax (403) 229-1980

January 17, 1995

Mr. Ed Baker
Litco - Lockheed
765 Lindsey Blvd
Idaho Falls, Idaho
83415

Phone: (208) 526-6331
Fax : (208) 526-8405

Dear Mr. Baker:

We are pleased to submit the following quotation on behalf of Paul Shriver for a structure to be located in Idaho.

STRUCTURE SIZE: Approximately 40 feet wide by 50 feet long.

COLOR: To be determined.

12 MONTH FIRM LEASE: Structure, including the following accessories:

1 - single personnel door;
1 - end sliding door.

Monthly Lease Price, F.O.B., Fontana, CA., sales and/or use taxes extra: US $ 983.00

TERMS, O.A.C.: Payable monthly in advance.

PURCHASE PRICE: Structure and accessories as above:

Total Purchase Price, F.O.B., Fontana, CA., sales and/or use taxes extra: US $27,000.00

TERMS, O.A.C.: 50% with order; balance upon delivery of the structure.

OPTION: 12 lifting brackets, F.O.B., Fontana, CA., sales and/or use taxes extra: US $ 1,020.00

PURCHASE OPTION: The Lessee has the option to purchase the structure as follows:

i) If all lease payments have been made on time during the first three months of the lease period, 100% of these payments will be credited towards the purchase price, <u>or</u>

ii) If all lease payments have been made on time during the first twelve months of the lease period, 50% of these payments will be credited towards the purchase price.

Either option can only be exercised by presentation of Lessee's cheque for the full purchase price, less the applicable credit.

DELIVERY: Normally from inventory.

DATE REQUIRED: To be determined.

ERECTION: We will supply one Technical Consultant, equipped with all hand tools, free of charge, to supervise the erection of this structure by your work force. It will be your responsibility to supply the following:

a) Scaffolding on wheels.
b) Electrical power to site.
c) 5 unskilled workmen for approximately 2, 8 hour working days.

TECHNICAL CONSULTANT: Although the Technical Consultant is supplied, his travel, accommodation and meals will be charged to you. Air travel is charged at cost; meals, accommodation and ground transportation at $150.00 per day. If circumstances dictate, overtime charges may occur, with your approval.

ANCHORAGE: Drift pins only.

Mr. Ed Baker
Litco - Lockheed
January 17, 1995
40' x 50'

DISMANTLING: Leased structures will require our Technical Consultant for dismantling. The same terms as outlined above under the heading "Erection" and "Technical Consultant" will apply, except that dismantling procedures will take approximately one-half of the erection time. It will be your responsibility to return the structure and tools, prepaid, to the depot at Fontana, California.

PERMITS AND LICENSES TAXES: It will be your responsibility to obtain all permits and licenses and pay all applicable taxes. Standard pre-engineered drawings are available upon request.

This quotation is valid for 60 days.

Thank you for the opportunity to submit this quotation. To demonstrate our confidence in the integrity of the Sprung Instant Structure, we enclose Guarantee certificate No: A-1229 for your review.

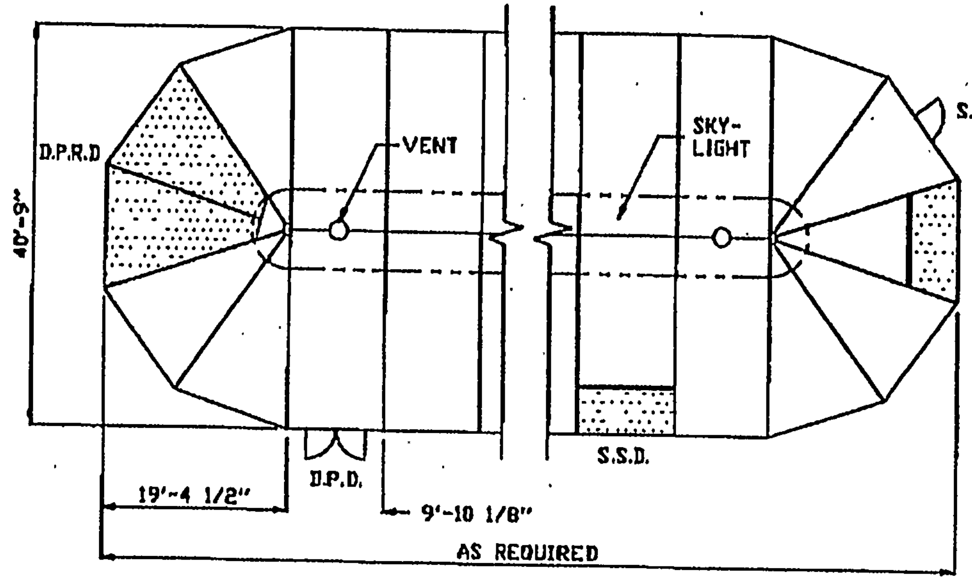
We look forward to being of service to you.

Yours very truly,

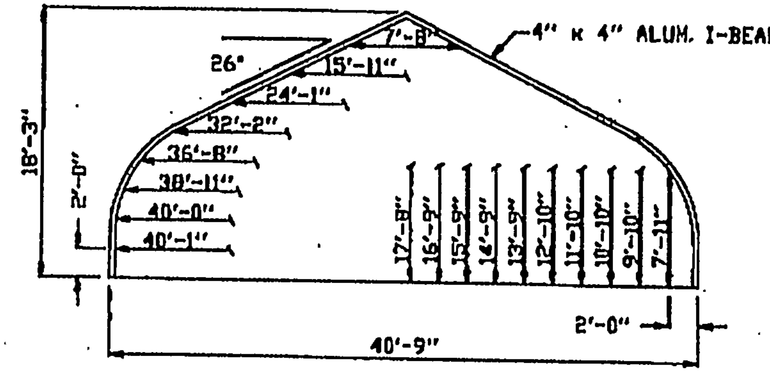
SPRUNG INSTANT STRUCTURES INC.

Dawn A. Sprung

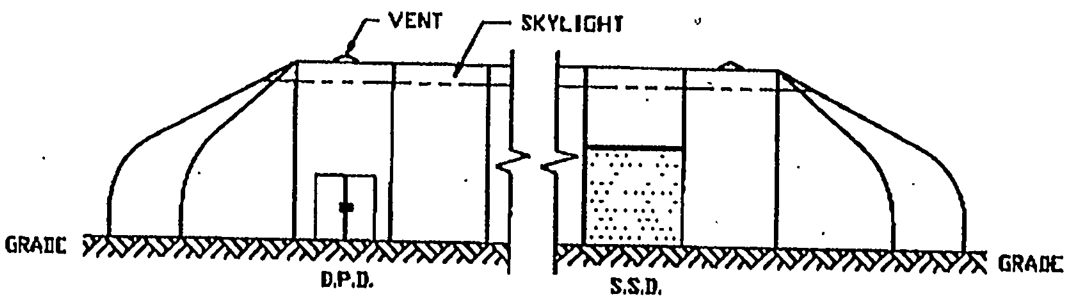
DAS/kl



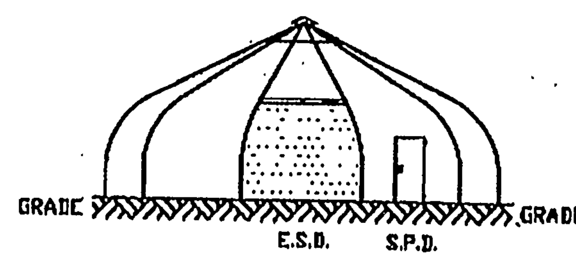
PLAN



SECTION
SCALE: 1"=15'-8"



ELEVATION



END ELEVATION

NOTES:
1. DOOR SIZES AVAILABLE.

	HEIGHT	BASE WIDTH	TOP WIDTH
E.S.D. - END SLIDING DOOR	10'-0"	12'-0"	9'-6"
S.S.D. - SIDE SLIDING DOOR	10'-0"	9'-6"	9'-6"
D.P.R.D. - DOUBLE PANEL ROLLING DOOR	16'-0"	23'-2"	4'-1"
D.P.D. - DOUBLE PERSONNEL DOOR	6'-8"	6'-0"	6'-0"
S.P.D. - SINGLE PERSONNEL DOOR	6'-8"	3'-0"	3'-0"

SPRUNG INSTANT STRUCTURES

40'-9" STRUCTURE

SCALE: -0"
DATE: CH 1... 94
DRAWING # S-40

Sprung Instant Structures Inc.

Guarantee

№ A-1229

The fabric and aluminum materials used in Sprung Instant Structures have been selected for their proven strength, durability and longevity. To show our sincere confidence in our product, Sprung Instant Structures Inc. is pleased to issue the following guarantees.

A. FABRIC

Fabrics used, composed of PVC coated polyester, are water and mildew resistant, insect proof, and flame retardant. They withstand extreme climatic variations and contain ultra-violet inhibitors to reduce degradation by the sun's rays. Flame retardant status has been warranted by the fabric supplier.

Sprung Instant Structures Inc. guarantees to supply new replacement fabric, on a pro-rata basis at the then current price, for fabric which deteriorates from any of the aforementioned factors within **EIGHT YEARS** *from the date of delivery of the structure, for regular fabric, and* **TWELVE YEARS** *for premium fabric. This guarantee applies to white and tan fabrics only.*

B. ALUMINUM

Aluminum used is professionally engineered and is of the highest quality and structural capability. Sprung Instant Structures Inc. guarantees to replace, on a pro-rata basis at the then current price, any aluminum which deteriorates from normal usage within TWENTY FIVE years from the date of delivery of the structure.

This guarantee applies to the owner of a Sprung Instant Structure. The guarantee will not be valid if Sprung Instant Structures Inc. has not supervised all erections and dismantlings of the structure during the guarantee periods.

V. K. Olson, Senior Vice President
& Secretary Treasurer

P. J. Sprung, President

"The Sprung Group of Companies have been in business for over 100 years."

The Construction, Exhibition, Warehouse, Military, Hazardous Waste and Prison Shelter Systems by *SPRUNG* Instant Structures

THE STRUCTURE
Designed and engineered on the principle of the "Membrane Stress Theory" the structure is the result of almost a decade of intensive research and development. The Sprung Instant Structure is constructed from extruded aluminum arches, integrally connected to an all-weather outer membrane of P.V.C. coated polyester scrim. This synthetic fabric is certified flame retardant.

APPLICATION
Sprung Instant Structures are the answer to any need for enclosed space, quickly and economically, especially where transportation is difficult and speed of installation is essential. Esthetically pleasing, the structures are available in different colours and sizes, and are suited to both the city and country environments.

ENGINEERING
Sprung Structures may be designed to meet special requirements or to comply with local and special usage codes and standards. By design the structures shed snow, however they can be designed to meet any loading requirement. They also withstand high winds and hail. Standard pre-engineered drawings are available upon request.

FLEXIBILITY
The free-span structure can be erected quickly, and needs little or no surface preparation. The modular design allows built-up areas of unlimited length, easy extension of existing structures and quick dismantling and re-location.

TECHNICAL SPECIFICATIONS

Width:	Feet Meters	30 (9.14)	40 (12.19)	50 (15.24)	60 (18.29)	88.6 (27)	120 (36.58)
Module Length:	Feet Meters	9.84 (3)	9.84 (3)	9.84 (3)	9.84 (3)	9.84 (3)	15 (4.57)
Height:	Feet Meters	15.9 (4.8)	18.4 (5.6)	23.6 (7.2)	26.2 (8)	35.9 (10.9)	58 (17.7)
Weight:	lbs./sq.ft. kgs./sq.m.	1.5 (7.3)	1.5 (7.3)	1.5 (7.3)	1.5 (7.3)	2.5 (12.2)	3.6 (17.6)

HEAD OFFICE:

Sprung Instant Structures Ltd.
1001 - 10th Avenue S.W.
Calgary, Alberta T2R 0B7, Canada

Telephone: (403) 245-3371
Fax: (403) 229-1980
Toll Free: 1-800-661-1163

PRINTED IN CANADA
MAY '91 5000

MODULAR RELOCATABLE STRUCTURES
Available From Inventory

Doors: A personnel door is provided with each structure. Doors can be placed in virtually any panel to meet your requirements.

Additional doors, double personnel doors, single or double personnel doors complete with panic hardware, vehicle doors and oversize vehicle doors are also available as optional extras.

Drainage: Drainage should be provided around the pad to permit adequate dissipation of rain water.

Asphalt, concrete or gravel pads should be crowned to assist in water runoff.

Equipment: All hand tools required for erection will be provided. It will be the customer's responsibility to provide a crane or cherry picker for a short period of time to erect structures 50 feet (15.24 m) wide to 88.6 feet (27 m) wide.

Scaffolding must also be supplied by the customer.

Erection: Erection, with a normal sized crew, should proceed at the rate of 1200 to 1500 square feet (110 to 140 sq. m.) per day, weather permitting. When necessary, this figure can be increased significantly by increasing the work force or extending the work day past 8 hours, or a combination of both. Dismantling should proceed at double this rate.

An erection consultant will be provided to direct the erection of the structure by the customer's unskilled work force. The consultant's transportation at cost, and living expenses are the customer's responsibility. The consultant will also be provided on the same terms for the dismantling of leased structures.

Fabric: The fabric is a durable P.V.C. coated polyester scrim treated with inhibitors to prevent degeneration from the ultraviolet rays of the sun and it is fire retardant (i.e. self-extinguishing). Normal life expectancy is 10 to 12 years. We provide a five year pro-rata guarantee.

Footings: Reasonably flat and firm ground requires no preparation or foundation for structures up to 60 feet (18.29 m) in width. Anchorage is obtained with two drift pins at each column base plate. Specific anchor systems are used for sand and muskeg. Structures 88.6 feet wide (27 m) should have concrete footings, if a concreate pad is not being installed. Alternative methods are available if ground conditions meet certain criteria.

Freight: Domestic sales are quoted "knocked down" F.O.B. Plant. International sales are quoted C+F Seaport, Country of Destination.

Return freight on all leases, is to the customer's account.

Labour: It is the customer's responsibility to provide a work force of 6-10 unskilled labourers for erection of single structures up to 88.6 feet in width.

Lease: Leases are available in North America for a minimum of one year, with the option to renew semi-annually, as often as required.

Patents: Patents are held in Canada, the United States and throughout the world.

Permits: It is the customer's responsibility to obtain all necessary building and/or development permits, licenses or clearances of any type for erection and use of the structure.

Purchase Option: Leases will have a purchase option exercisable anytime within 12 months from commencement, upon payment of the purchase price in full. Provided that lease payments have been made on time, a credit of 50% of paid lease amounts will be applied to the purchase.

Options to purchase will EXPIRE at the end of the first year of the lease.

Rental: Month to month rentals can be entered into subject to product availability.

Repairs: Fabric and components can be repaired or replaced in a minimum time frame without affecting the stability of the structure.

Taxes: All taxes and fees of any type are payable by the purchaser.

Terms:

Sales: 50% with order. Balance due upon erection. O.A.C.

Leases: 50% of lease payment plus all options with order, 50% of lease payment payable semi-annually in advance until lease cancelled by lessee. O.A.C.

Rentals: 1st month and all extras with order. Additional months in advance, upon receipt of invoice. O.A.C.

Ventilation: Electric fans, ventilators and wind driven turbines are available as optional extras.

INSTANT STRUCTURES
1001 - 10th Avenue S.W.
Calgary, AB T2R 0B7
Tel: 403-245-3371
Fax: 403-229-1980

FAX TRANSMITTAL

DATE: Jan 17, 1995

TO: ED BAKER LITCO

FAX:

FROM: DAWN SPRUNG

NUMBER OF PAGES 6 INCLUDING THIS COVER

URGENT ☐ REPLY ASAP ☐ NO REPLY NECESSARY ☐ ORIGINAL BY MAIL YES ☐ NO ☐

Reference your discussions with Jim Slack, please find a quote enclosed.

Mike Warder (from Calgary) and Paul Shriver (from Boise), will be in Idaho Falls tommorrow meeting with Litco.

They will contact you to see if you would like to meet.

Dawn Sprung

Sprung Instant Structures Inc.

MEMBER OF THE SPRUNG GROUP OF COMPANIES

Address Correspondence to:

Telephone Number 403 - 245-3371, Fax Number 403 - 229-1980

1001 - 10 Avenue S.W., Calgary, Alberta, Canada, T2R 0B7

October 22, 1991

E.G. & G. Idaho Inc.
1955 Fremont Avenue, W.C.B.
Mailstop 3528
Idaho Falls, Idaho
83415-3528

Attention: Mr. Ed Baker

Dear Mr. Baker,

Please find enclosed the following information for your evaluation.

1. A video tape on the McColl Superfund Site Experimental Project, as well as articles by the Environmental Projection agency on this project.

2. Plans and pictures of our single I Beam 112 foot wide structure, which will be used on our 120 foot wide structure.

3. A partial list of Hazardous Waste Sites.

4. A list of facilities and variety of uses.

We realized some years ago this was not an off the shelf project. With the assistance of many engineers, Hazardous Waste people and Government input, we have developed a product that meets the end use and the customer requirement.

The fabric is white opaque on the sides to keep out the heat, with a skylight so electricity is not require during daylight hours.

The structures may be used for other Hazardous Waste sites or used by the customer for warehousing, etc.

The aluminum may be decontaminated with a solution bath and the panels can be replaced at a cost of 18% or $2.25 per square foot, making the structure like new for reuse or sale.

Mr. Ed Baker
E.G. & G. Idaho, Inc.
October 22, 1991

Please advise how we may further assist you, as we look forward to being of service to you.

Yours truly,

SPRUNG INSTANT STRUCTURES LTD.

J. K. Slack
Senior Vice President

JKS/jn
Encl.

Sprung Instant Structures Inc.

MEMBER OF THE SPRUNG GROUP OF COMPANIES

Address Correspondence to:

Telephone Number 403 - 245-3371, Fax Number 403 - 229-1980

1001 - 10 Avenue S.W., Calgary, Alberta, Canada, T2R 0B7

INTER - OFFICE MEMORANDUM

TO: Mr. Ed Baker
E.G. & G. Idaho, Inc.

FROM: Jim Slack

DATE: October 22, 1991

RE: New 112' Wide Span
Single I Beam Structure

Please find attached photographs of our first Single I Beam 112 foot structure recently completed. The finished product is a fabulous success as evident in the photographs. This particular structure is being used on a Hazardous Waste project by Chemical Waste Management to contain atmospheric emissions resulting from the excavation activities inside the structure. The soil will be excavated and then fed on to a conveyer which will take it directly to an adjoining incinerator unit. This structure is complete with a vehicle entry air lock tunnel system measuring 40 feet long x 21 feet 5 inches high x 17 feet wide, complete with 2 large steel rolling doors measuring 16 feet x 14 feet. This air lock will allow for continuous excavation even when large equipment is moved in and out of the structure. The fabric is our regular high quality acrylic top coated blackout vinyl complete with a translucent skylight.

Chemical Waste Management purchased this structure with plans to relocate it to other hazardous waste sites once they have completed this project.

Sprung Instant Structures Inc.

MEMBER OF THE SPRUNG GROUP OF COMPANIES

Address Correspondence to:

Telephone Number 403 - 245-3371, Fax Number 403 - 229-1980

1001 - 10 Avenue S.W., Calgary, Alberta, Canada, T2R 0B7

INTER - OFFICE MEMORANDUM

TO: Ed Baker

FROM: Jim Slack

DATE: October 22, 1991

Dear Fred,

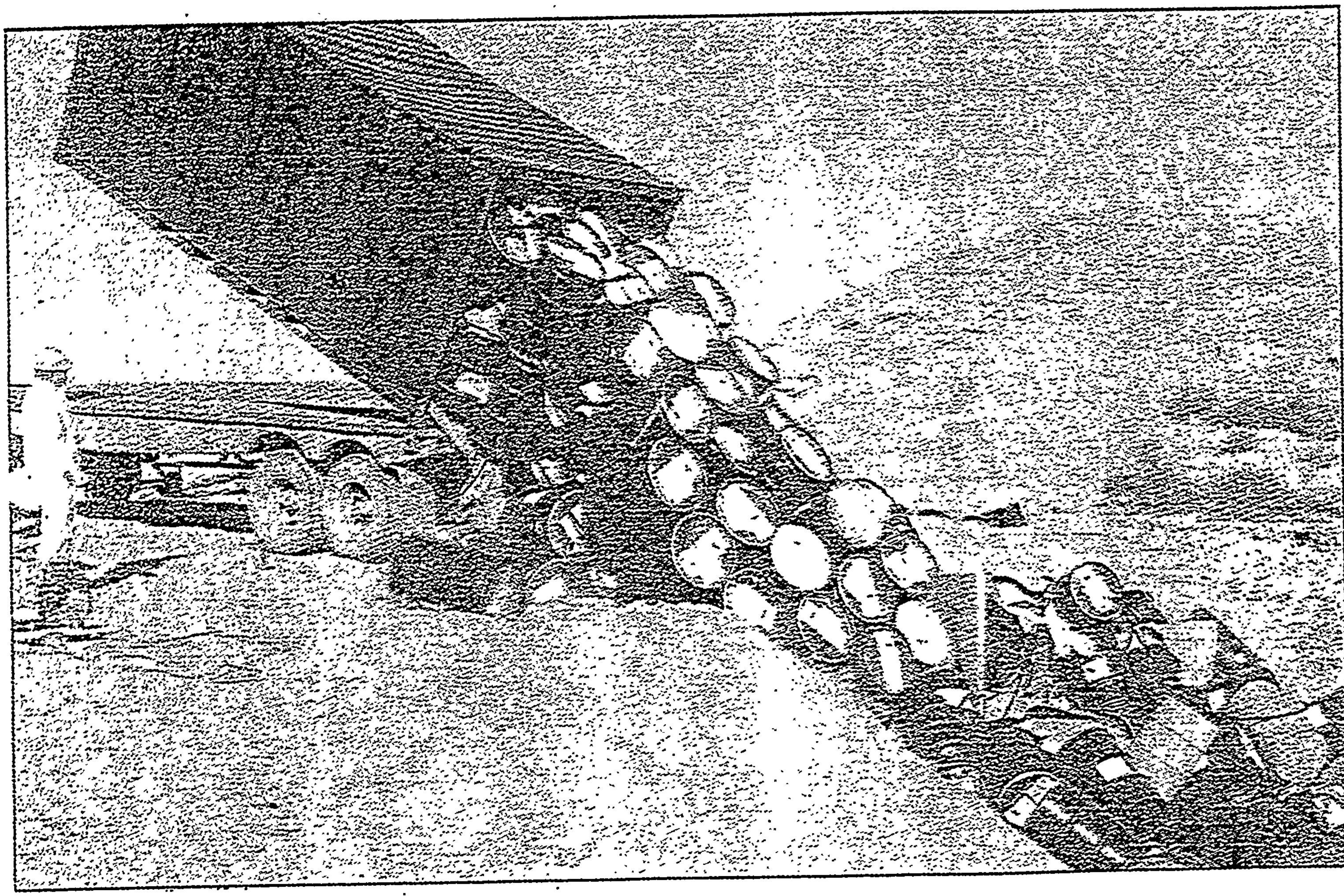
A. We are presently dealing as a supplier to D.O.E., D.O.D, and E.P.A.

B. At present the Sprung Instant Structure is being used in over 60 locations in the United States for the following purposes:

1. Transuranic waste treatment facilities
2. Transuranic waste storage facilities
3. Soil Treatment facilities
4. Contaminated soil bag storage facilities
5. Drum and container storage facilities
6. Radioactive vault storage facilities
7. Remediation facility negative pressure
8. PCB extraction facilities
9. PCB incineration facilities
10. Asbestos abatement/containment facilities
11. Sledge pond enclosure facilities
12. Process mill enclosure facilities
13. Water filter pump enclosure facilities
14. Filter press enclosure facilities
15. Land fill liner enclosure facilities.

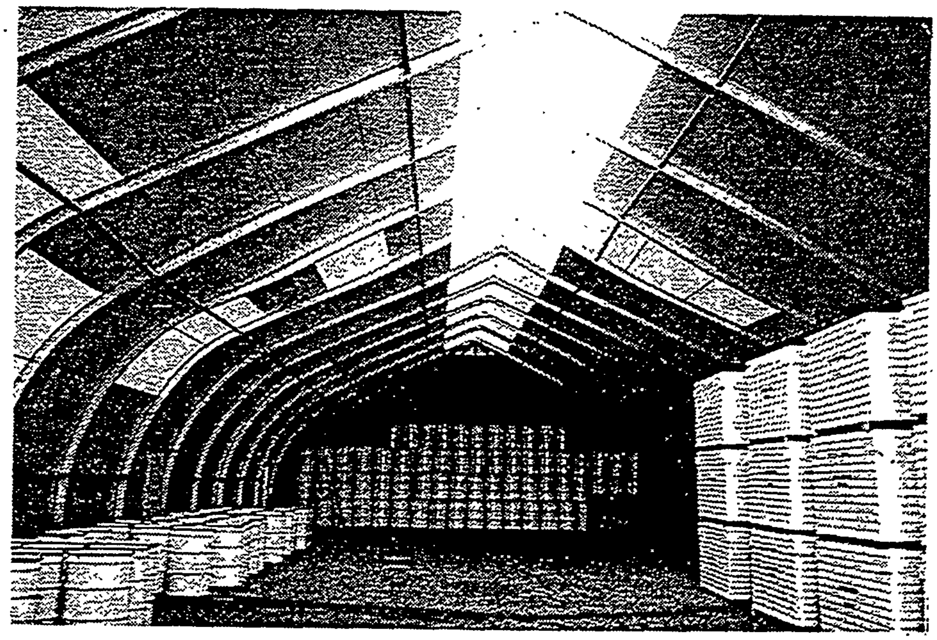
C. We are forwarding you a copy of the video tape on the McColl Superfund Site experimental project, as well as some articles by The Environmental Protection Agency on the same project.

Sprung Instant Structures, Inc.



When it's time to clean up problems,
Sprung Shelters are the only solution.

As America's Nuclear Facilities, Superfund sites and other toxic waste clean-up programs begin to move from design to remediation, there exists a growing demand for temporary shelter systems capable of providing economical, durable clear span enclosures for excavation covers, treatment facilities and storage buildings.



The ideal building to solve these and other problems would be one in which the structural system could be easily relocated, modular, inexpensive, durable and be available in unlimited sizes. Considering that this concept must also meet the structural demands of severe winds and snowloading, the engineering of such a system becomes limited.

At *SPRUNG INSTANT STRUCTURES* however, we have met these demanding requirements and have been incorporating our standard structural designs into the hazardous waste industry for the past several years.

THE STRUCTURE

This structure is a unique building design that encloses space quickly and economically either on a temporary or permanent basis. Within days, *Sprung* can provide free span structures of any size ranging in widths of 30' to 90' and of unlimited lengths, from an inventory of over 1,000,000 square feet. With little or no ground preparation, (no requirement for footings for structures 60' wide or less), structures can be erected in one to six days from delivery.

The basic structure is constructed using light weight aluminum arches integrally connected to an all-weather outer membrane. It can be designed to withstand windloads in excess of 130 mph, shed snow and has proven its viability in the harshest climates, from the extreme heat of the Middle East to the freezing temperatures of the Arctic.

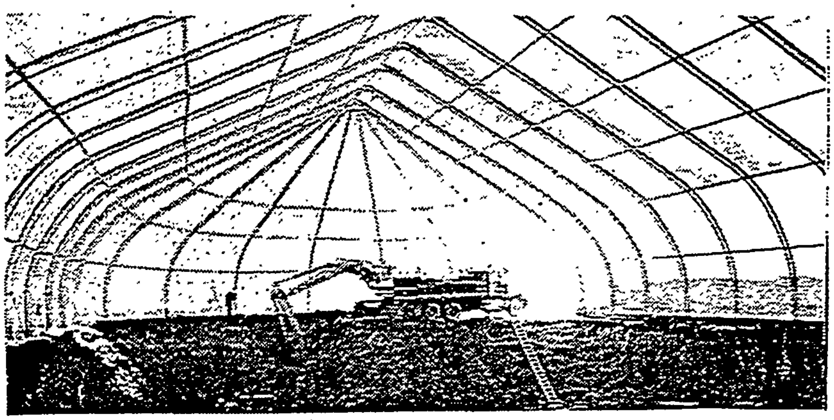
With structures in place at the Los Alamos National Lab, Idaho National Lab, Love Canal, West Valley Nuclear and several other hazardous waste sites, *Sprung* has met the demands of this market and continues to expand its portfolio.

APPLICATIONS

(i) Remediation

To meet the needs of temporary enclosures for excavation purposes, *Sprung* has designed a system of portable structures in all sizes which can be moved not only by dismantling and re-erecting, but by rolling entire structures on tracks or wheels and/or lifting the structure by crane. This flexible system allows remediation activities for large pits to take place in sections rather than attempting to cover un- manageable areas. This process reduces costs substantially as less square footage is required and operational equipment is minimized.

Designs are also available for double skinned structures or structures within structures to create double wall containment. Ventilation is easily installed in the flexible membrane, and structures can been completely



environmentally controlled as well as maintained at a NEGATIVE PRESSURE. Exceeding all of the requirements of relocatable structures, *Sprung* provides the assurance of a totally enclosed environment regardless of wind and snow conditions.

(ii) Storage/Treatment

The structures are also ideal as low-level radioactive drum storage and bulk material facilities for lesser toxic substances. The most attractive feature of the modular system is that the structure can be expanded in 10' sections. This allows storage facilities to be built as the need determines, rather than planning for worst case scenarios or to allow for flexible purchasing options to meet fiscal budget restraints. The ability to be constructed without the need for concrete also eliminates the necessity for concrete treatment or disposal at the end of the temporary storage period. Additionally, the structure's aluminum components and the fabric membrane take up a fraction of the space required for disposal when compared to conventional building materials.

Regardless of your shelter requirements, *SPRUNG INSTANT STRUCTURES* offers the most flexible alternative. With rental, lease and lease to purchase options available, an in-house design group for custom structures and a level of service and quality unmatched in the fabric structure industry, *Sprung* is prepared to meet any challenge.

Drawing Samples

1. Concrete Vault Storage

   – Structure is on wheels – Splits in center for crane removal and placement.

2. Single Wall Remediation Enclosure

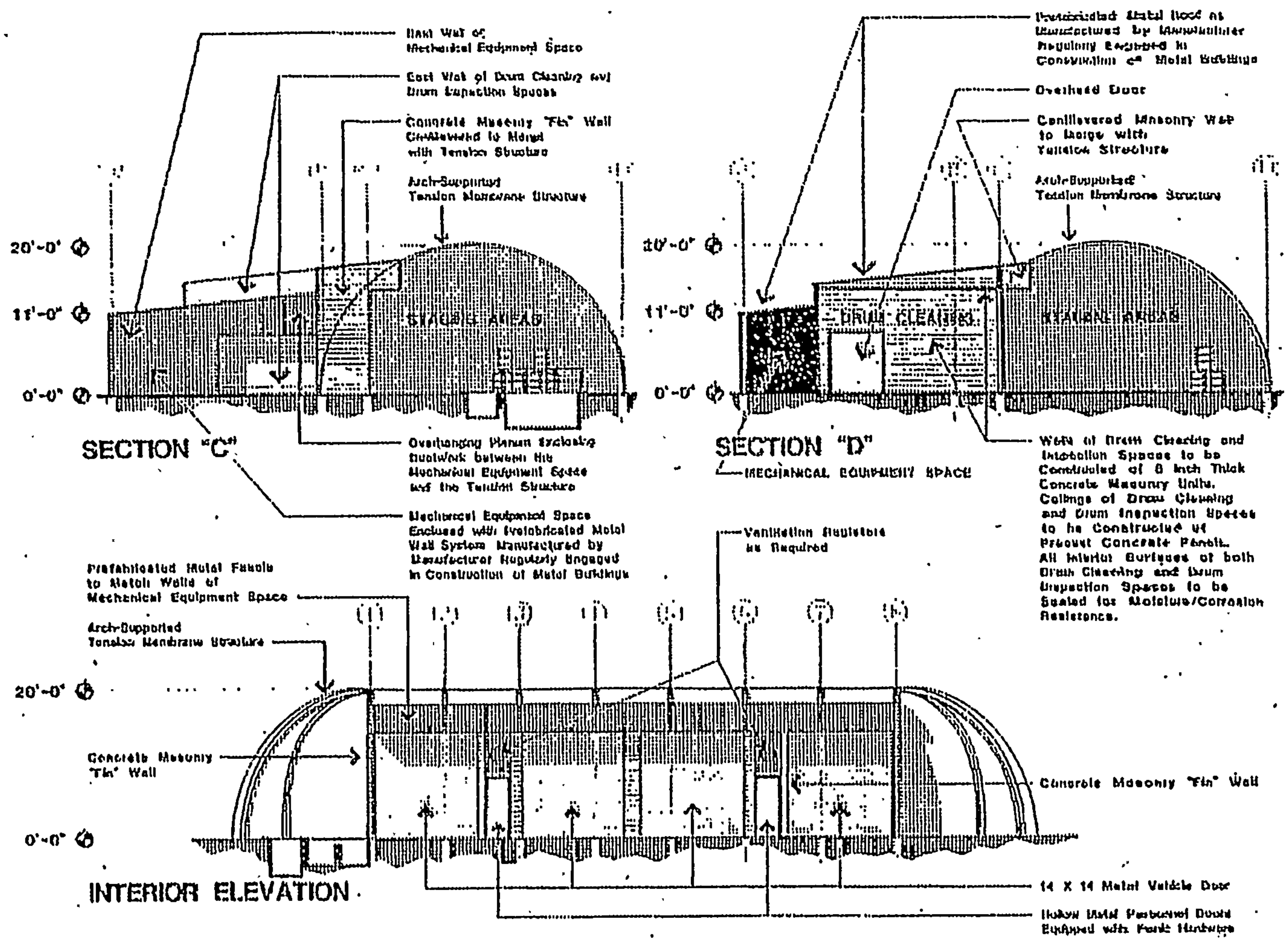
   – Structure can be relocated – has airlocks for containment.

3. Double Wall Remediation Enclosure

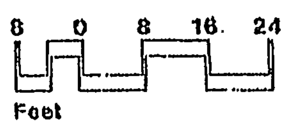
   – Structure moves within larger structure on rollers.

4/5. TRU Waste Preparation Facility

   – Structure integrally connected to permanent bldg to augment storage and treatment.



BUILDING SECTIONS



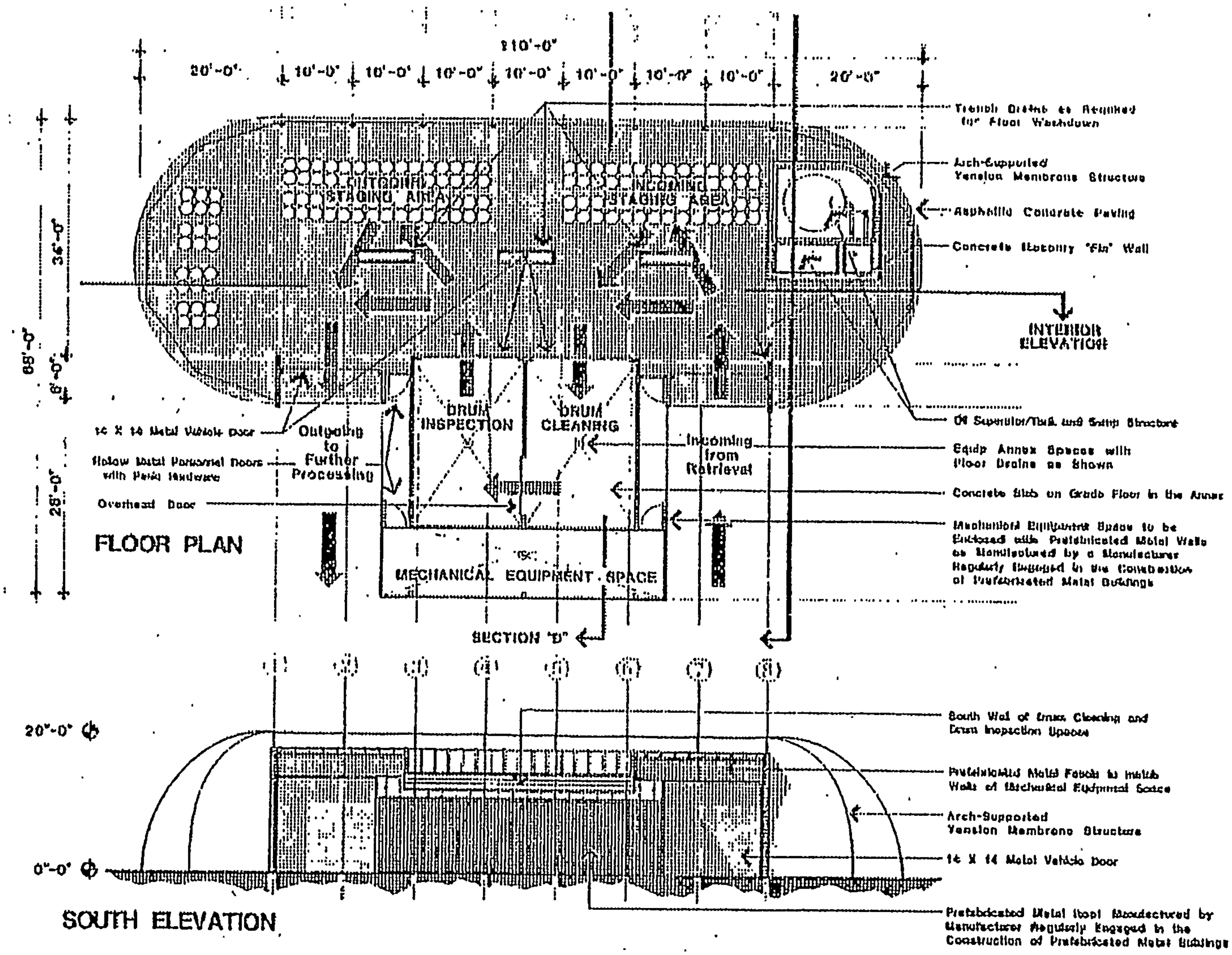
This design is intended solely as a preliminary design illustration. All dimensions and clearances should be verified and adjusted as the facility design is refined and the architectural details are established.

DESIGN SYNOPSIS:

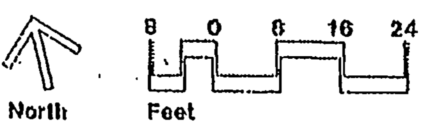
The design shown incorporates, where possible, standard, readily available, prefabricated building components. The tension structure is envisioned as the standard product of a manufacturer regularly engaged in the manufacture of similar structures. The arch roof system is shown as a similarly standard building component. The wall system used for the Mechanical Equipment Space is also indicated as a standard metal building system. The Drum Cleaning and Drum Inspection Spaces have been shown as concrete masonry and precast concrete construction to provide durability and moisture/corrosion resistance.

Containers will enter the facility through the east vehicle door and be processed either through the Incoming Staging Area or directly into Drum Cleaning. Flow from Drum Cleaning into Drum Inspection will be accomplished through a doorway linking the rear sections of these two spaces. From Drum Inspection, containers can either be processed through the Outgoing Staging Area or directly to the next step in the work-off procedure.

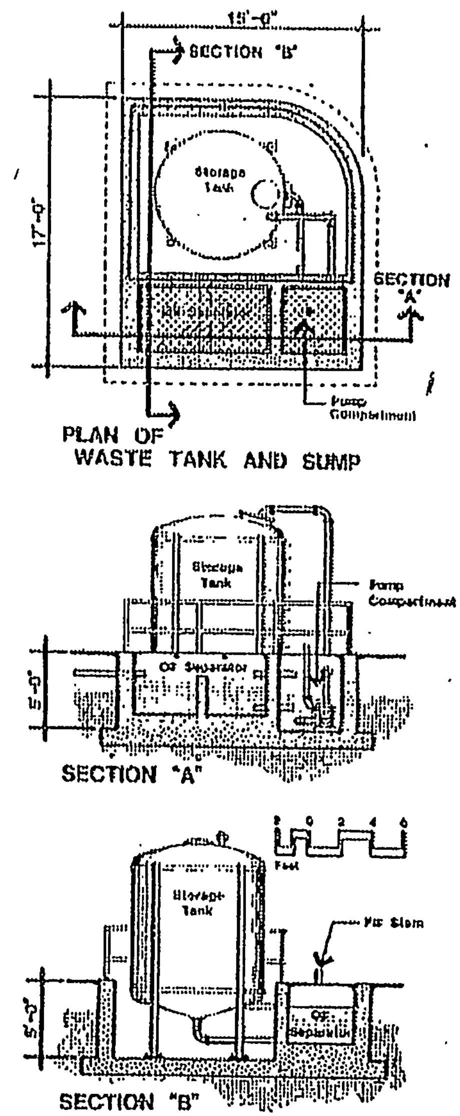
TRU WASTE PREPARATION FACILITY



PLAN AND ELEVATION



This design is intended solely as a preliminary design illustration. All dimensions and clearances should be verified and adjusted as the facility design is refined and the architectural details are established.



TRU WASTE PREPARATION FACILITY

McCOLL SUPERFUND SITE

Fullerton, California

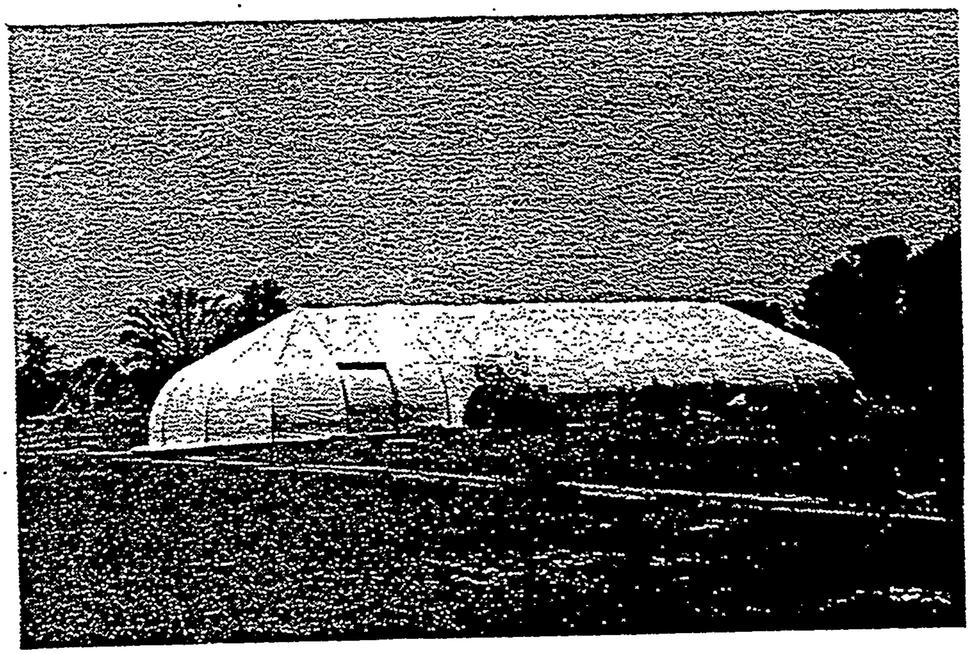
SITE
SUPERFUND INNOVATIVE TECHNOLOGY EVALUATION

November 1990

Final Results of McColl Trial Excavation

INTRODUCTION

A successful trial excavation of waste material was conducted at the McColl Superfund Site in Fullerton, CA during June and July, 1990. Participating in the multi-agency project were the U.S. Environmental Protection Agency (EPA) Region IX, the EPA Air and Energy Engineering Research Laboratory (AEERL), the EPA Superfund Innovative Technology Evaluation (SITE) Program and the California Department of Health Services (DHS).



The above enclosure was used to control emissions from the trial excavation.

Following is a site history, a summary of the trial excavation, and a listing of conclusions and observations based on the trial excavation. This final report on the project, titled "SITE Program Demonstration of a Trial Excavation at the McColl Superfund Site," will be the subject of a EPA community presentation Wednesday, Nov. 14, 1990 at 7:30 p.m. in the Parks Junior High School Music Room, 1710 Rosecrans Ave., Fullerton.

HISTORICAL OVERVIEW

The McColl Superfund Site is an inactive hazardous waste disposal facility used in the early and mid-1940's for the disposal of acidic refinery sludge, a byproduct of the production of World War II aviation fuel. A series of pits, or sumps were dug on about eight acres of the approximately 20 acre site and they received the sludge through 1946. From 1951 through 1962, fill soil and drilling mud from oil exploration activities in the nearby Coyote Hills were deposited in some of the pits in an effort to make the site suitable for future development.

By 1962, the Upper Ramparts area of the site, which contains six of the sumps (R-1 through R-6), had been covered with soil. That area has continued as unoccupied open space. In the early 1980's, a clay cap was placed on the Lower Ramparts area, in an attempt to reduce odors. The Los Coyotes area of the site was covered during the construction of the Los Coyotes Country Club Golf Course. The six sumps in that area, (L-1 through L-6) were covered with four to five feet of soil.

Areas east of the McColl Site were subdivided and developed for residential housing in the late 1970's and early 1980's. Recreational facilities were constructed west of the site at the Ralph B. Clark Regional Park. As population and development increased, residents began complaining of odors coming from the site. The Orange County Health Department first received complaints about odors in 1978. Subsequent environmental investigations at the site by EPA and DHS

Continued on page 2

Continued from page 1

identified extensive contamination.

In 1982, the McColl Site was placed on the EPA National Priority List (NPL), which made site cleanup eligible for federal funding through the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). From 1980 to 1983, DHS conducted a Remedial Investigation/Feasibility Study (RI/FS) to determine the best method to clean up the site. Based upon the investigation, a decision was made to excavate and redispose of the waste in an authorized landfill.

Through a bid process, a contractor was chosen to make the redisposal in Kern County. That county, however, challenged the decision in court, resulting in a California Superior Court order requiring DHS to prepare a Environmental Impact Report (EIR) for the project. The court action postponed cleanup measures at the site.

In February 1989, after a reevaluation of the alternatives, the EPA and DHS announced that thermal destruction was the preferred cleanup alternative. (See February 1989 EPA Fact Sheet on "Thermal Destruction is Preferred Clean-up Alternative" on file at the Fullerton Public Library Archives Room, McColl Repository, 353 West Commonwealth Ave., Fullerton.)

TRIAL EXCAVATION SUMMARY

The overall goal of the trial excavation was to obtain additional information to support thermal destruction as the preferred remedy. EPA and DHS have issued a proposed plan for McColl selecting thermal destruction, either on or offsite, as the preferred remedy. An important component of this remedy is the excavation and waste handling activities that must occur as pretreatment to thermal destruction.

The McColl waste is known to release volatile organic compounds (VOC's) and sulfur dioxide (SO_2) whenever it is disturbed. The trial excavation was necessary to determine if the McColl waste could be excavated with conventional equipment without releasing significant amounts of VOC's and SO_2 to the surrounding community. The trial excavation was also necessary to define the treatment needed, if any, to improve the handling characteristics of the waste, as pretreatment to thermal destruction.

The following objectives for the project were achieved:

(1) To excavate approximately 100 cubic yards of waste to assess handling characteristics and determine if any treatment is required to improve handling characteristics as a precursor to thermal destruction.

(2) To determine the atmospheric emissions resulting from the excavation activities.

(3) To assess the degree of SO_2 and total hydrocarbon (THC) control achieved through the use of an enclosure and an enclosure exhaust treatment system.

(4) To determine the emission levels for SO_2 and VOC's at the fence line as an indicator of impacts on the local community.

(5) To assess the effectiveness of vapor-suppressing foam.

(6) To assess potential problems that might occur during the excavation.

AIR EMISSION CONTROLS

Because previous investigations at the site indicated the potential to emit large amounts of VOC's and SO_2, there was a possibility that excavation of the waste would have an air emission impact on the nearby community. To safeguard against such a problem, a temporary enclosure, 60 feet wide, 160 feet long and 26 feet high was erected over the excavation area at sump L-4. In addition, vapor-suppressing foams were used to reduce emissions coming from the extracted waste. Air from the enclosure was vented through an enclosure exhaust treatment system before being released to the outside atmosphere. Measurements of THC and SO_2 emissions were continually taken prior to and upon discharge from the treatment system.

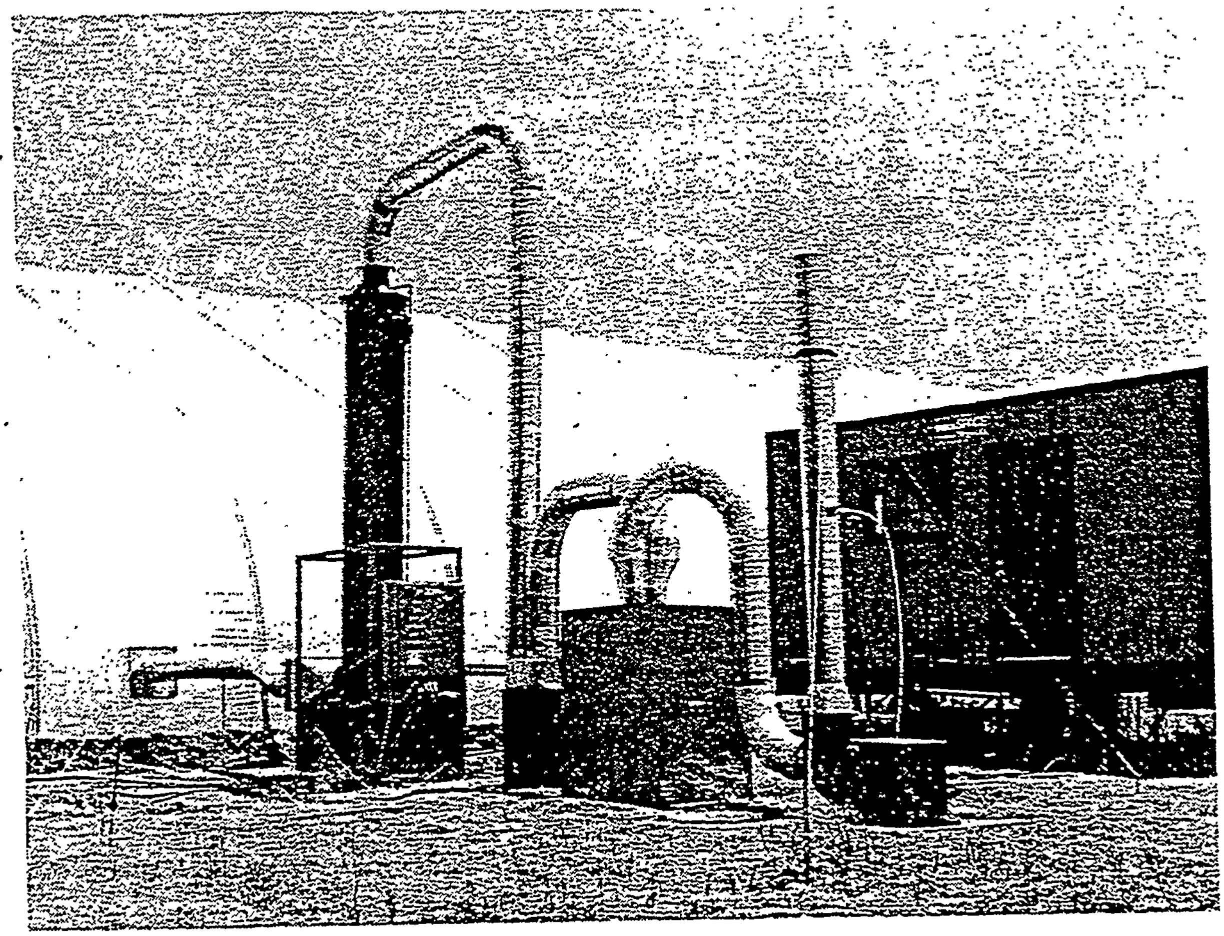
A Community Safety Contingency Plan was developed in 1987. The plan establishes response procedures designed to protect the health and safety of the community surrounding the McColl site during activities at the site. The Agencies adhered to the plan that establishes levels at the fence line for SO_2 and THC at which work will stop if exceeded. No fence line level was exceeded during the trial excavation.

When the excavation began, workers inside the enclosure wore Level B safety equipment (supplied air respirators and protective clothing.) During the excavation, unexpected high levels of SO_2 and THC were encountered. As a result, the Worker Health and Safety Plan was rewritten, causing some project downtime. Accordingly, the decision was made to upgrade to Level A safety equipment (totally encapsulated chemical protective suits with supplied air respirator.) The decision to dress in either Level A or B varied from day to day depending on emissions within the enclosure, during excavation.

The unexpected emission levels prompted the federal and state Occupational Safety and Health Administration (OSHA) to investigate in the excavation project. As a result, federal OSHA issued citations to EPA's contractor and subcontractors for activities that occurred on site. These citations were a result of the unexpected high concentration levels of SO_2 and THC.

Continued on page 3

Continued from page 2



The enclosure exhaust treatment system was effective in treating unexpectedly high emission levels during excavation activities.

EXCAVATION AND WASTE PROCESSING

Removal of the overburden soil and excavation of the underlying waste was performed with a diesel-powered trackhoe, equipped with an extended boom and a three-cubic-yard bucket. The waste was fairly well segregated into three layers: a soil, or "mud" layer; a tar layer; and then a hard, coal-like char layer.

During the tar excavation, SO_2 and THC levels within the enclosure increased dramatically and reached five-minute average values of 1000 ppm for SO_2 and of 492 ppm for THC. The enclosure exhaust treatment system removed up to 99.9% of the SO_2 and up to 90.7% of the THC.

Char excavation was also accompanied by high concentrations of SO_2 and THC, of 600 ppm and 350 ppm, respectively. The foams reacted with the extremely acidic waste, causing degradation of the foam.

In all, 101 cubic yards of overburden and 137 cubic yards of waste were excavated from L-4. The tar waste, being the most difficult to handle, was further processed to reduce its size and to form a more solid, and easier to handle material. This was successfully done by processing the tar with fly ash, cement and water in a pug mill, a cylindrical device which uses rotating paddles to mix materials. The mud and char waste did not require further processing.

Continued on page 4

CONCLUSIONS AND OBSERVATIONS

Continued from page 3

Significant information was obtained that will be used in the design phase of the McColl remediation process. The following conclusions and observations have been reached from data obtained in the McColl site trial excavation research project:

CONCLUSIONS

(1) Excavation of 130 cubic yards of waste from sump L-4 was accomplished with conventional excavation equipment and without significant adverse community impact.

(2) Excavation under an enclosure is technically feasible.

(3) Excavation and waste handling activities are not feasible without an enclosure and an air treatment system.

(4) SO_2 emissions generated from the excavation activities can be effectively treated (up to 99.9% removal efficiency) with existing technologies.

(5) THC emissions generated from the excavation activities can be effectively controlled (up to 90.7% removal efficiency) with existing technology.

(6) The waste material can easily be treated to facilitate processing through a thermal destruction unit.

(7) Excavation and treatment of McColl waste can be effectively done by workers wearing protective clothing.

(8) The trial excavation had no significant adverse impacts on the nearby community. Fence line emission levels never reached Community Contingency Plan action levels.

(9) The vapor-suppressing foam did not perform as anticipated in controlling SO_2 and THC emissions within the enclosure. It was determined it cannot be relied upon exclusively to control emissions during excavation activities.

(10) Based on Toxicity Characteristic Leaching Procedure (TCLP) results on the raw waste, it was determined the raw waste did not pass the Resource Conservation Recovery Act Land Ban toxicity characteristic (TC Rule) for the benzene in the tar and char. Based on these results, it is not possible to excavate and redispose of the waste without some type of treatment.

OBSERVATIONS

(1) Continued community communication about the trial excavation through fact sheets, special mailings, a visitor's day, press briefings and press releases appeared to be effective and necessary for future activities.

(2) Excess water in the enclosure from foaming activities impacted operations, making surfaces slippery for both workers and equipment.

(3) A trench shield placed into the pit was an effective tool in minimizing the amount of tar material that could seep into the excavation area. The shield was not necessary to shore up the soils or char material in the pit.

(4) Having workers in Level A protective clothing adversely affected productivity and communication but did not make excavation activities infeasible.

(5) Lower airflow rates through the emission control activated carbon unit increased THC removal efficiency.

(6) Contrary to original plans, the contractor had to move major equipment into and out of the enclosure during operations. There were no adverse impacts on either the community or workers when the enclosure was opened for short periods of time (under one hour).

(7) Neither char nor mud were processed during the trial excavation. However, based on the results of the tar processing, it is believed both char and mud could be processed in a pug mill during a thermal destruction remedy.

(8) Due to tar seepage into the pit, approximately 100 yards of excess waste remained once the excavation was complete. It was necessary to stockpile the leftover waste on the site. The waste has been covered with plastic and soil.

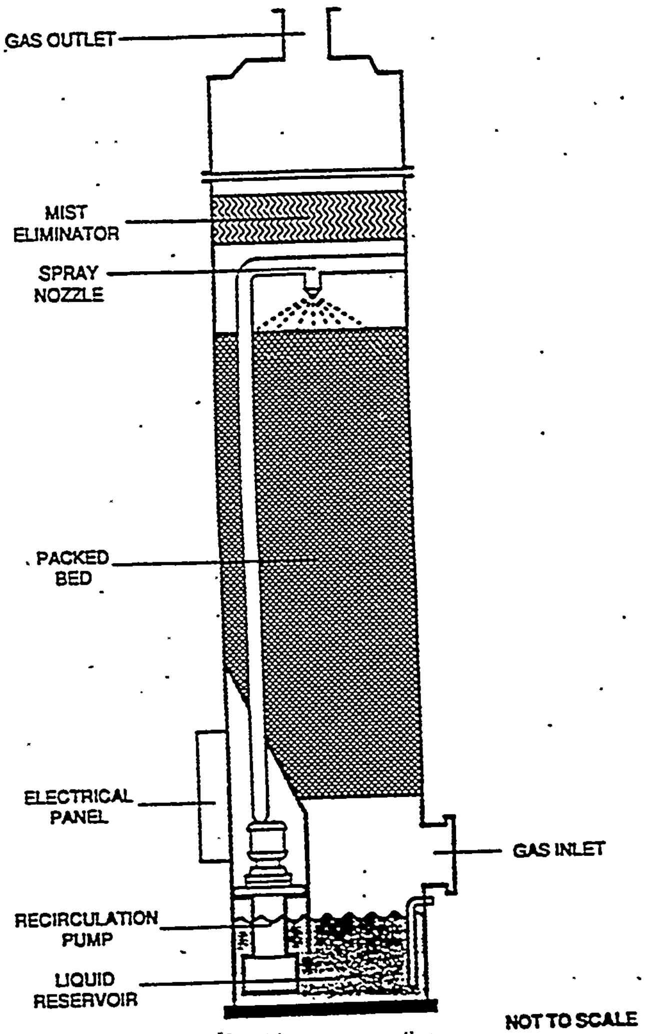
(9) The calculated excavation rates are artificially constrained to allow for data collection and visual observation. It is believed that the excavation rates to be achieved during actual remediation will be significantly higher.

(10) The recording camera installed in the enclosure was a valuable tool for monitoring excavation work, worker safety and for excavation project management decisions.

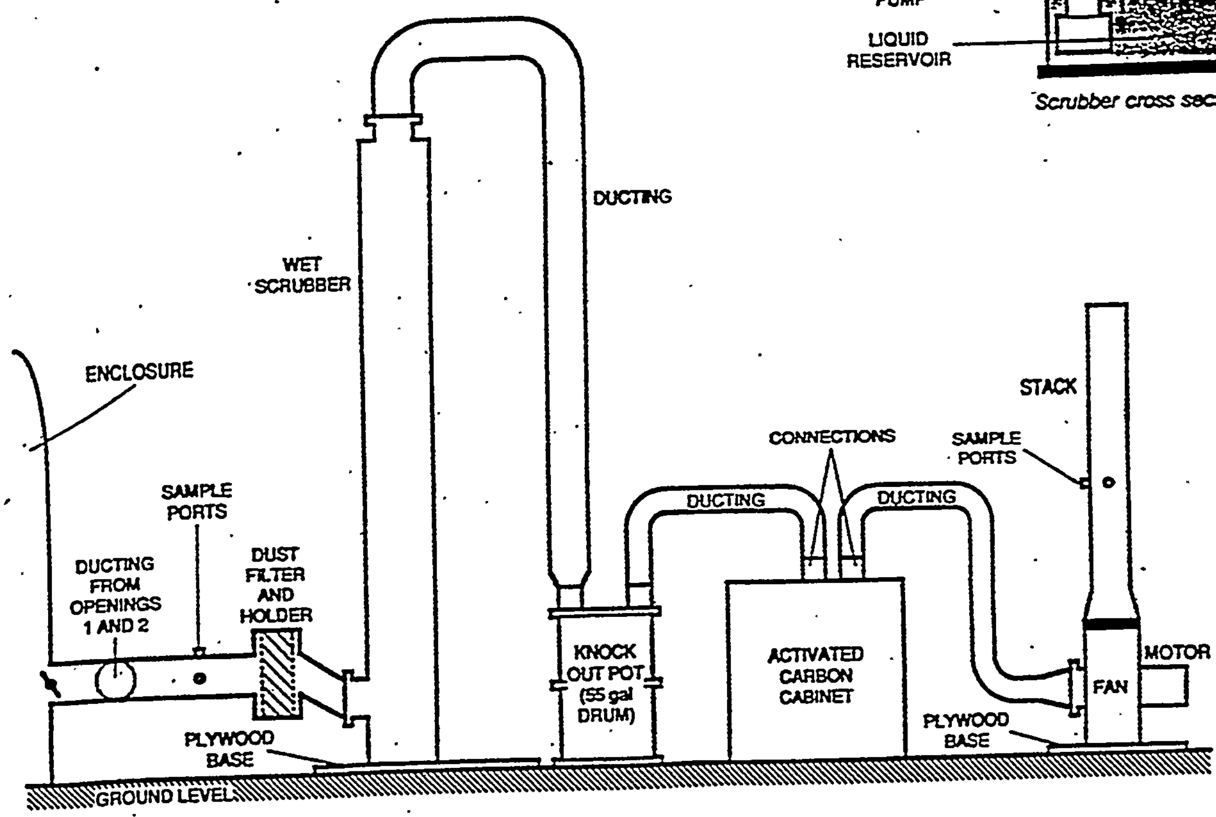
COSTS OF TRIAL EXCAVATION

The total cost for the trial excavation was approximately $1.3 million.

The enclosure exhaust treatment system removed up to 99.9% of the sulfur dioxide and up to 90.7% of total hydrocarbons emitted by the waste material during the McColl trial excavation. The activity at the site had no significant adverse impacts on the nearby community and fence line emission levels never reached Community Contingency Plan action levels.



Scrubber cross section.



Ventilation air cleaning equipment and ducting layout.

HARDY BBT LIMITED REPORT

BABOWAL BUILDERS & ENGINEERS LTD.
108, 208 - 57 AVENUE S.W., CALGARY, ALBERTA T2H 2K8 PHONE: 252-2999

February 25, 1982

Sprung Instant Structures Ltd.
1001 - 10th Avenue S.W.
Calgary, Alberta
T2R OB7

Attention: Mr. P. D. Sprung
President

Dear Sir,

Re: Wind Velocities

Based on:

a) Pressure distribution as determined by the wind tunnel test at the University of Calgary;
b) Wind velocity - pressure conversions as specified in the National Building Code of Canada;
c) Yield point stresses of aluminum alloy 6351-T6;
d) Combinations of dead and live load.

The Sprung Instant Structures can withstand the following maximum wind velocities:

Structure Size	Maximum Wind Velocity MPH
30'	137
40'	123
50'	130
60'	122
25m	141
27m	134

Yours truly,

W. Babowal, P. Eng.

BABOWAL BUILDERS & ENGINEERS LTD.

WB/ds

BABOWAL BUILDERS & ENGINEERS LTD.
108, 208 - 57 AVENUE S.W., CALGARY, ALBERTA T2H 2K8 PHONE: 252-2999

August 4, 1983

Sprung Instant Structures Ltd.
1001 - 10th Avenue S.W.
Calgary, Alberta
T2R OB7

Attention: Mr. Harry Lane

Dear Sir,

Re: Wind Pressures

The provision for wind design in the National Building Code of Canada is different from most codes and therefore causes difficulty in comprehension in other jurisdictions.

The pressures stipulated for design in the NBC are based on the standard formula $p = 0.0027 V^2$ where p is the pressure in pounds per sq. ft. and V is the wind velocity in miles per hour. The wind velocity used in design in the NBC is the average hourly wind. This pressure is then multiplied by a factor of 2 called a gust factor to allow for wind gusts. Thus if the design wind velocity is 75 m.p.h., the design pressure is 15 psf. With the gust factor of 2, this is equivalent to designing for a wind gust of 105-110 m.p.h.

The NBC also stipulates pressure coefficients that should be applied to the building for distribution of wind pressures. These coefficients are based on the shape of the building and because they must cover a variety of buildings, are generally conservative. They also do not take into account the special streamlined shape that makes up your building.

The wind tunnel tests conducted at the University of Calgary on the specific shape of your structure, indicates that the pressure coefficients are approximately half of those stipulated in the NBC.

Thus in the structures analyzed by this office, using the results of the tunnel tests, we have found the structures capable of withstanding winds in the order of 125-130 m.p.h.

Yours truly,

W. Babowal, P. Eng.

BABOWAL BUILDERS & ENGINEERS LTD.

WB/ds

BABOWAL BUILDERS & ENGINEERS LTD.
108, 208 - 57 AVENUE S.W., CALGARY, ALBERTA T2H 2K8 PHONE: 252-2999

April 19, 1988

Sprung Instant Structures Ltd.
1001 - 10th Avenue S.W.
Calgary, Alberta
T2R OB7

Dear Sir,

Re: Snow Loads on Sprung Structures

Considerable research has been done in Canada into snow loads on roofs. No research has been done on snow loads on Sprung Instant Structures because they are a proprietary structure and also a fairly recent development.

As part of the National Building Code of Canada, a supplement entitled "Design Data for Selected Locations in Canada", is published. This supplement lists ground snow loads for the selected locations.

The ground snow loads are based on a winter's accumulation of precipitation. This includes, snow, rain and ice.

Roof snow loads are usually a percentage of ground snow loads. For flat roofs and roofs with a slope of less than 30 degrees, the roof snow load is 80% of the ground snow load. In exposed conditions, where wind will blow the snow away, the load can be reduced to 60%. The code also makes provisions for accumulation of snow drifts and unbalanced snow loading.

For sloping roofs over 30 degrees, the code permits a reduction in the snow until at 70 degrees, there is zero snow loading. Again, this reduction is based on conventional type roof construction which has a certain amount of roughness and definite eave.

The Sprung Instant Structure is different from typical roof construction. The roof is constructed from a fabric membrane. The membrane is quite slippery. It is also flexible and can "flutter" to a limited extent in a breeze.

While the roof slope is 26 degrees (less than the 30 degrees permitting snow load reduction) the eaves are rounded and provide no obstruction to snow sliding.

Observations of structures in service has led to the conclusion that these structures do not accumulate snow but instead tend to shed snow. This is confirmed by pictures of Sprung Structures with clear roofs, piles of snow at the base with adjacent conventional roofs showing accumulation of snow.

Also Sprung Structures have been erected in high snow load areas (up to 110 psf ground snow). They have performed well under these circumstances even though they were designed for a fraction of the high snow load.

Photographs appended to this report illustrate the sliding of snow off the Sprung Structures.

The original membrane used in Sprung Structures was Herculite fabric. Recently, Sprung has switched to a Tedlar fabric which is more slippery and self cleaning. The orientation of the fabric is such that the ribs run up and down the structure resulting in the least coefficient of friction for sliding snow.

In March, 1988 the testing firm of Hardy BBT Limited was engaged to determine the coefficient of friction between snow and the various fabrics. A copy of their report is attached.

The results of the testing indicates that the greatest coefficient of static friction between snow and fabric is 0.12. This means that snow can start sliding at an angle of 7 degrees. The Tedlar fabric has a coefficient of friction as low as 0.06, allowing snow to start sliding at an angle as low as 4 degrees.

From years of field performance and confirmation by laboratory testing, it is evident that snow does not accumulate on the Sprung Structures but slides off the roof. The structures shed snow.

Therefore, in our opinion, it is not necessary to design these structures for a winter's accumulation of snow. A considerably reduced loading can be used. If the structures are designed to withstand the worst single snowfall for the area, they should then be adequate for the entire winter.

Yours truly,

W. Babowal, P. Eng.

BABOWAL BUILDERS & ENGINEERS LTD.

WB/ds

Hardy BBT Limited
CONSULTING ENGINEERING & PROFESSIONAL SERVICES

Our Project No.
Your Reference No. March 28, 1988

CA08538

Sprung Instant Structures Ltd.
1001 - 10th Avenue SW
Calgary, Alberta
T2R 0B7

Attention: Mr. P. Bos

Dear Sir:

Subject: Tedlar and Herculite Fabrics
Friction Coefficient With Snow

At the request of Mr. W. Babowal of Babowal Builders & Engineers Ltd., two fabrics were tested. The purpose of testing was to determine the coefficient of friction between snow and each fabric.

Tests were conducted at two temperatures, -15oC and -1oC using a walk-in freezer. A Karol-Warner Direct Shear Machine was used to measure the test parameters.

The fabrics were cut and glued to a movable shear table. Snow was then placed in a collar which was held stationary with respect to the fabric and table. Normal (vertical) loads were applied to the snow/collar assembly and a lateral force applied to the movable table. Two lateral forces per test were recorded, the maximum force required to initiate motion and the force required to maintain constant velocity. These are the static and kinetic friction forces respectively. Three normal loads were applied for each test sequence. The fabrics orientations were varied with respect to the direction of the motion. Direction one is perpendicular to direction two. The friction coefficients were calculated by dividing the lateral force by the normal force on the snow.

The results are presented below. These are average values of the the three normal loads per test. 'S' designates the static coefficient while 'K' designates the kinetic coefficient.

FABRIC	ORIENT.	TEST @ -15oC	TEST @ -1oC
Tedlar	1	S = 0.12 K = 0.10	S = 0.02 K < 0.01
	2	S = 0.06 K = 0.06	S = 0.01 K < 0.01

219 - 18 STREET S.E., CALGARY, ALBERTA T2E 6J5 TELEPHONE (403) 248-4331 TELEX 03-826717 FAX: (403) 248-2188
GEOTECHNICAL AND MATERIALS ENGINEERING — ENVIRONMENTAL, MATERIALS AND CHEMICAL SCIENCES
BONNYVILLE CALGARY EDMONTON FORT McMURRAY KAMLOOPS LETHBRIDGE LLOYDMINSTER MEDICINE HAT
PEACE RIVER PRINCE ALBERT PRINCE GEORGE RED DEER REGINA SASKATOON VANCOUVER

Herculite	1	S = 0.11 K = 0.09	S = 0.02 K = 0.01
	2	S = 0.12 K = 0.10	S = 0.02 K = 0.02

The friction coefficient at -1oC is approaching zero. This is likely caused by water, in equilibrium with snow, acting as a lubricant thereby reducing the frictional forces. At 0°C or greater, the friction would be zero since water cannot take shear.

The Tedlar fabric's coefficient is related to the stitching orientation. This results from the surface smoothness which is greatest parallel to the main chords and lowest perpendicular to theses chords.

To summarize, the maximum static coefficient is 0.12 on the Tedlar and Herculite fabrics. The minimum friction coefficient on the Tedlar fabric is 0.06 as discussed above.

We trust the above is all that is required. Should you have any questions, please do not hesitate to call Jeff Small at 248-4331.

Yours truly,

Hardy BBT Limited

Jeff Small, E.I.T.

Per:

Don Empey, P. Eng.

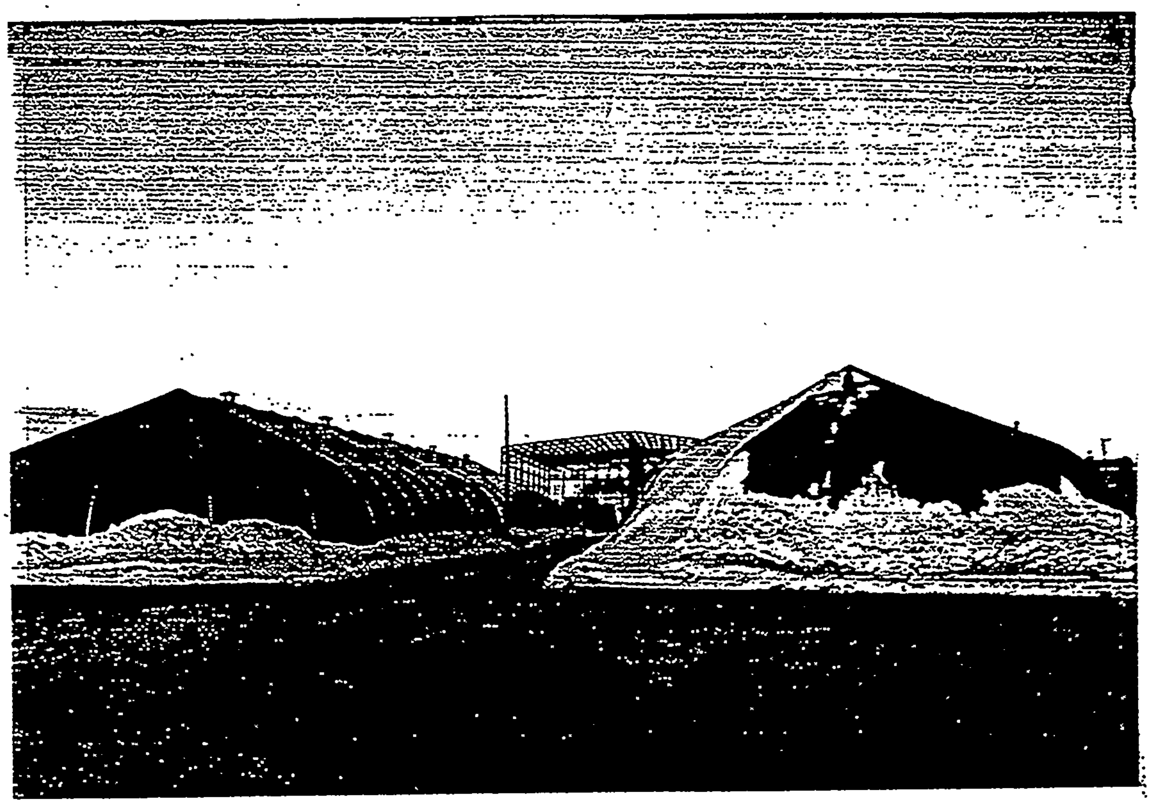
JS:ww

PERMIT TO PRACTICE
HARDY BBT LIMITED
Signature
Date 11.04 88
PERMIT NUMBER: P 4546
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

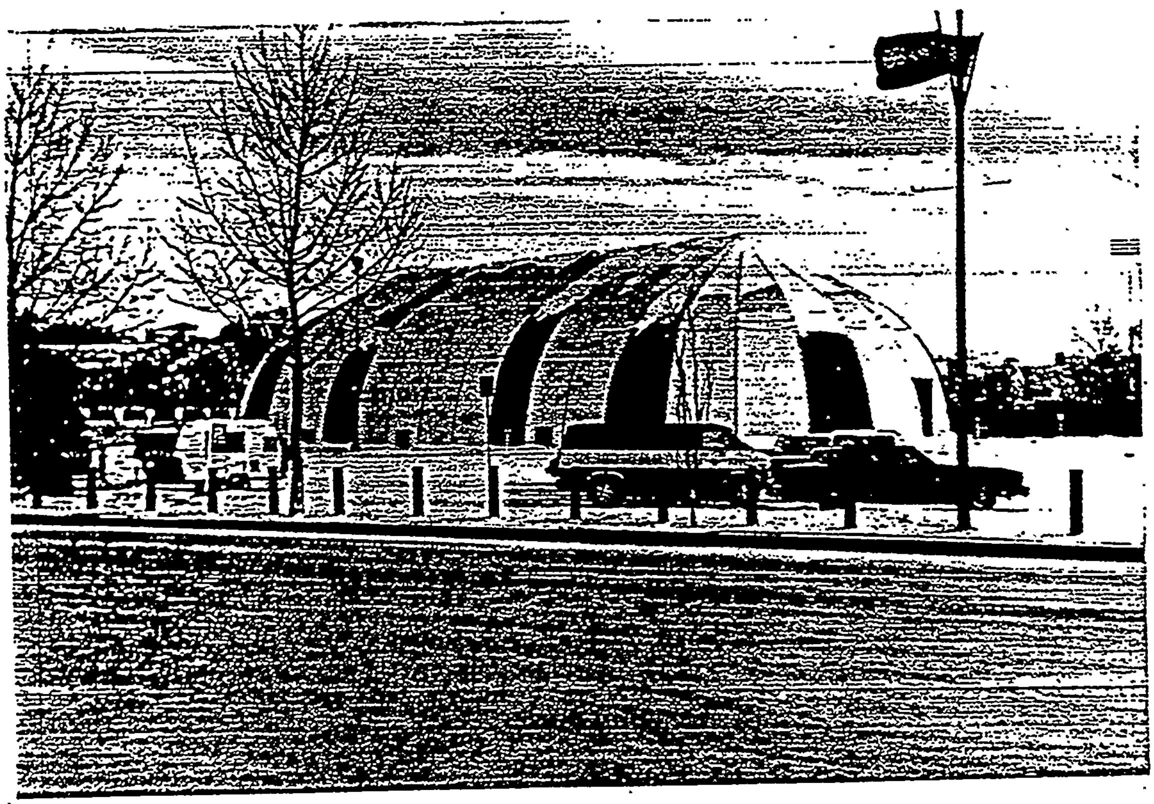
PROFESSIONAL ENGINEER
D. P. EMPEY
ALBERTA

cc: Mr. W. Bobowal
c/o Babowal Builders & Eng. Ltd.
108, 208 - 57th Avenue SW
Calgary, Alberta

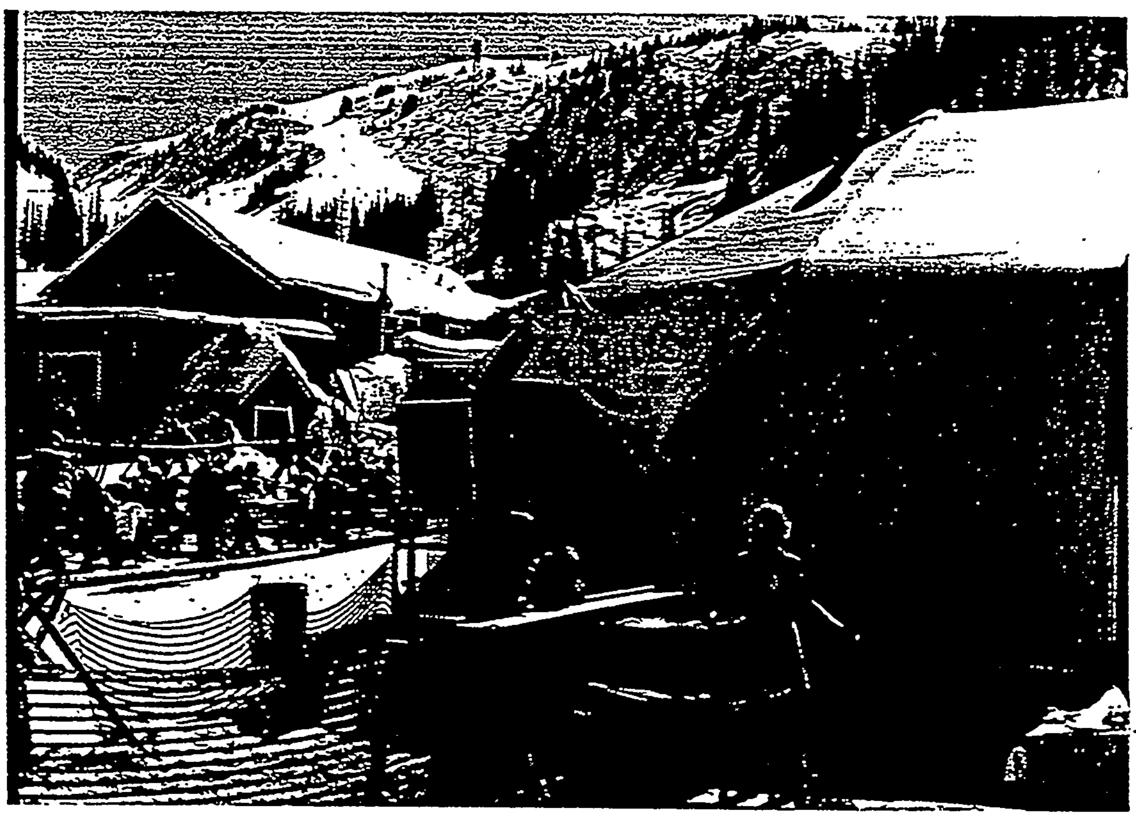
PICTURES OF STRUCTURES



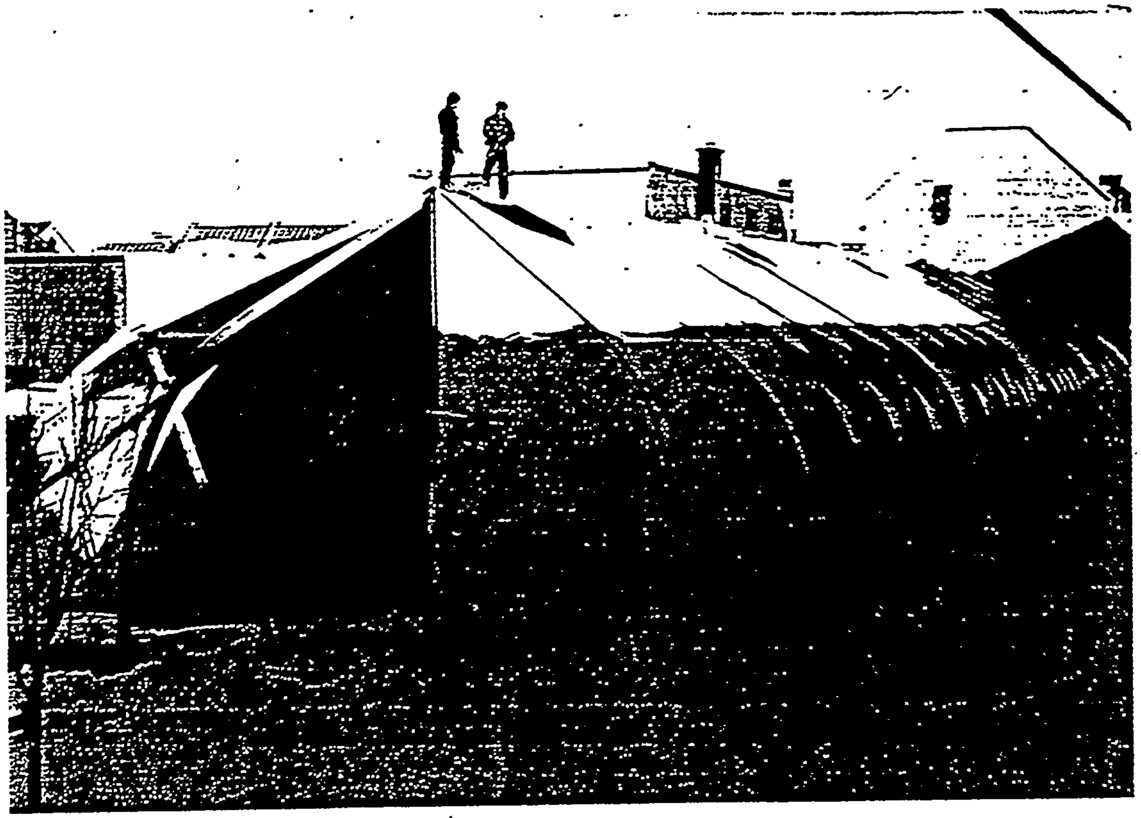
2- 60'x 200' ERECTED NOVEMBER 1987 IN
LAVSON, QUEBEC

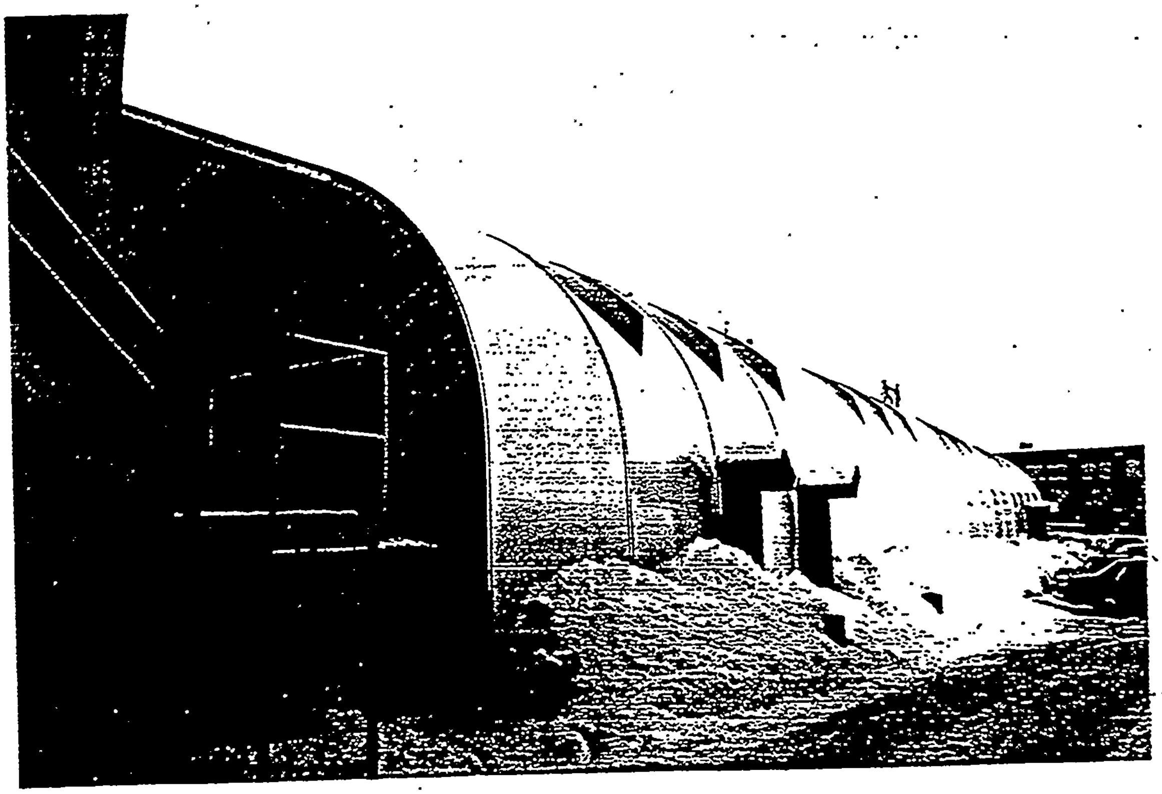


120'x 270' ERECTED 1981 FOR CALGARY STAMPEDE
CALGARY, ALBERTA GROUND SNOW LOAD 19 PSF
PICTURE TAKEN ONE DAY AFTER 4" SNOWFALL. NOTE
EVIDENCE OF SNOW SLIDING ON ROOF.

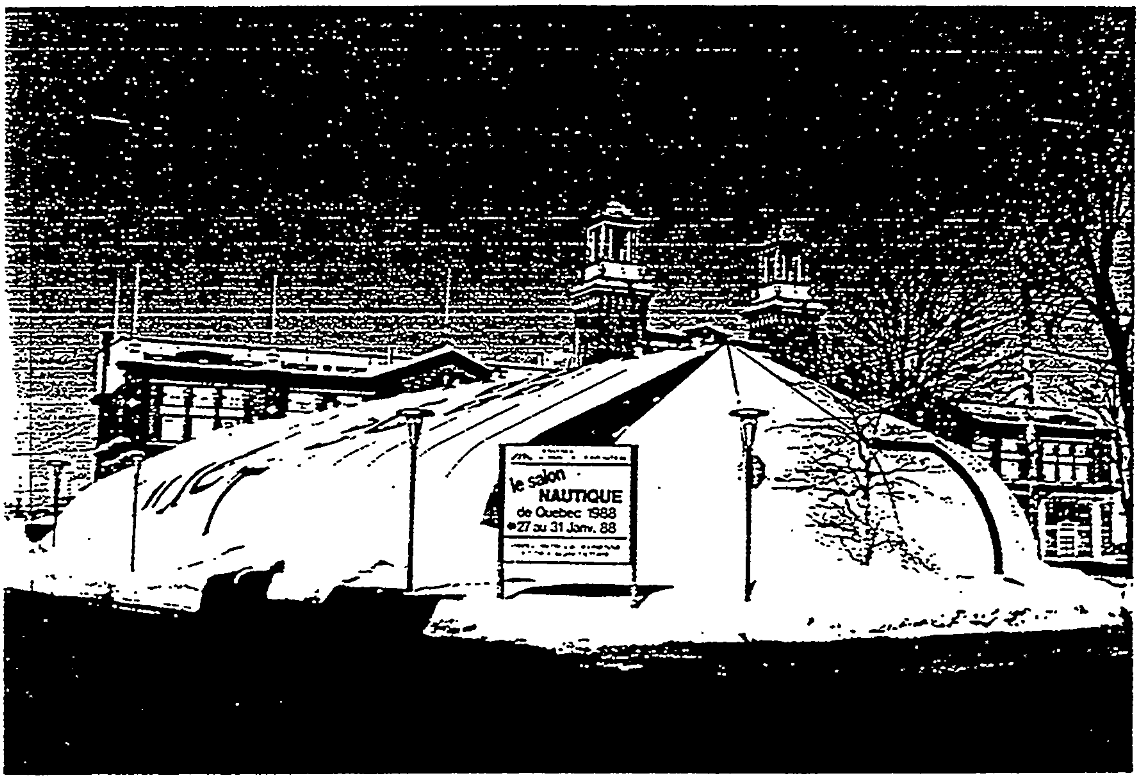


40'x 70' ERECTED 1981 SUNSHINE SKI AREA
BANFF, ALBERTA   GROUND SNOW LOAD 56 PSF
NOTE SNOW ON ROOF OF ADJACENT BUILDING



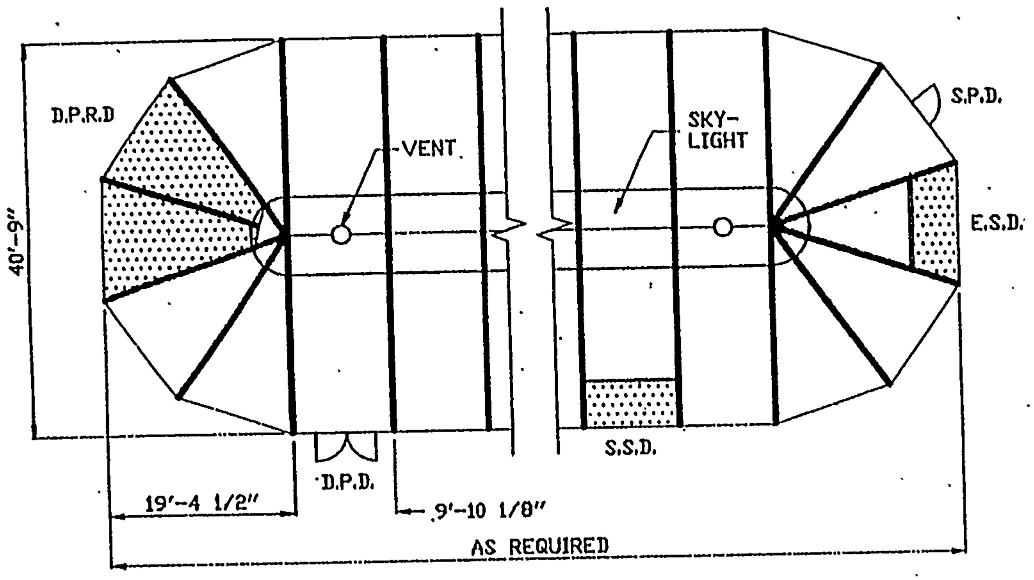


50'x 195' ERECTED DECEMBER 1987 FOR
J.L. PILOT CONSTRUCTION QUEBEC, P.Q.
GROUND SNOW LOAD 84 PSF
NOTE LARGE VOLUME OF SNOW SHED DURING ERECTION

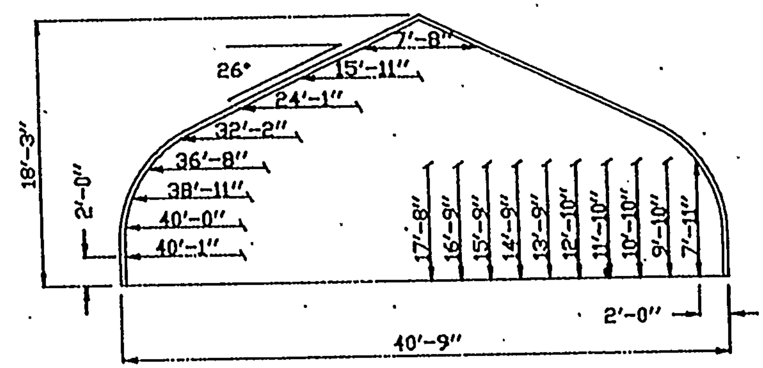


60'x 200' ERECTED JULY 1987 FOR
CITY OF QUEBEC, QUEBEC P.Q.
GROUND SNOW LOAD 84 PSF
NOTE FOLD OF FRESHLY SHED SNOW AT BASE

IN 1984 CITY HAD PURCHASED 2 STRUCTURES
- 60'x 310'
- 60'x 290'



PLAN



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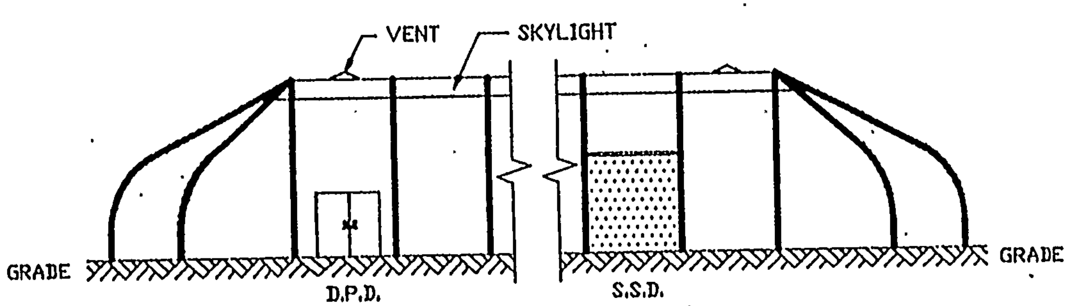
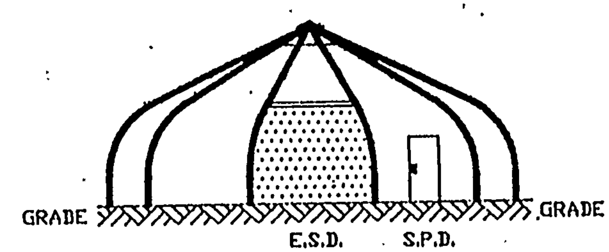


ELEVATION



END ELEVATION

NOTES:

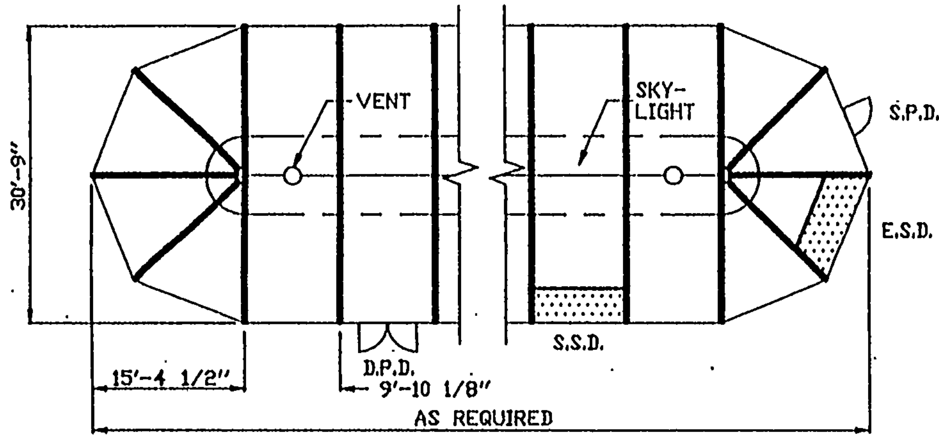
1. DOOR SIZES AVAILABLE.

	HEIGHT	BASE WIDTH	TOP WIDTH
E.S.D. - END SLIDING DOOR	10'-0"	12'-0"	9'-6"
S.S.D. - SIDE SLIDING DOOR	14'-0"	9'-6"	9'-6"
D.P.R.D. - DOUBLE PANEL ROLLING DOOR	16'-0"	23'-2"	4'-1"
D.P.D. - DOUBLE PERSONNEL DOOR	6'-8"	6'-0"	6'-0"
S.P.D. - SINGLE PERSONNEL DOOR	6'-8"	3'-0"	3'-0"

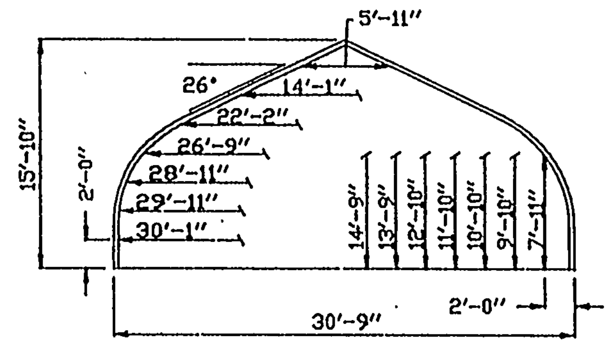
SPRUNG INSTANT STRUCTURES

40'-9" STRUCTURE

SCALE:	DATE:	DRAWING #
1"=20'-0"	MARCH 30, 1990	S-40



PLAN



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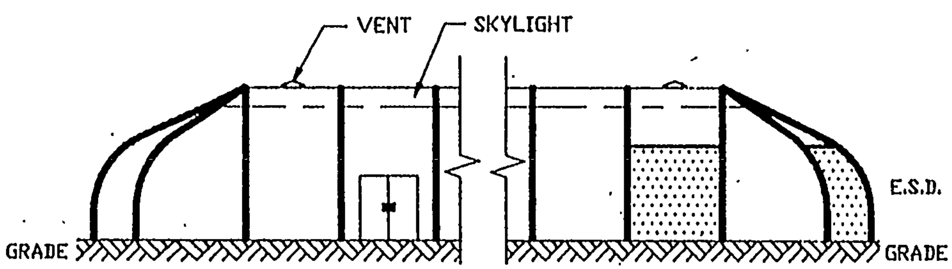
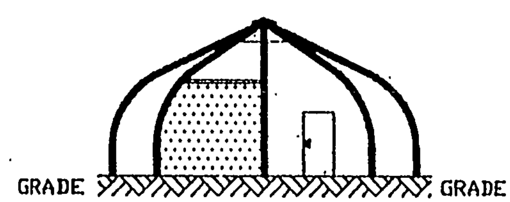


ELEVATION



END ELEVATION

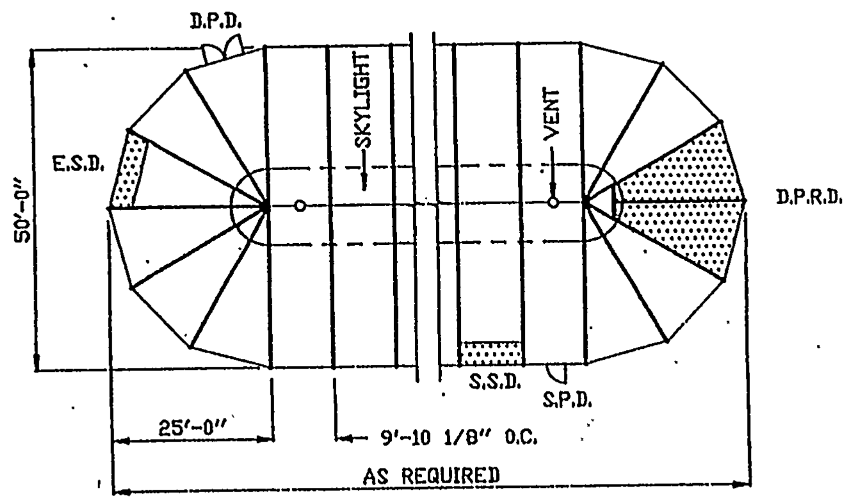
NOTES:
1. DOOR SIZES AVAILABLE.

	HEIGHT	BASE WIDTH	TOP WIDTH
E.S.D. - END SLIDING DOOR	10'-0"	11'-5"	8'-6"
S.S.D. - SIDE SLIDING DOOR	10'-0"	9'-6"	9'-6"
D.P.D. - DOUBLE PERSONNEL DOOR	6'-8"	6'-0"	6'-0"
S.P.D. - SINGLE PERSONNEL DOOR	6'-8"	3'-0"	3'-0"

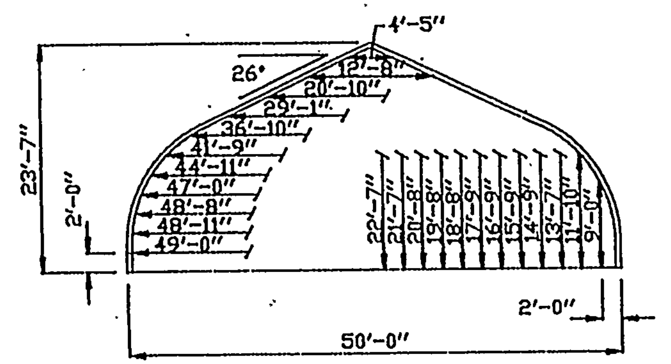
SPRUNG INSTANT STRUCTURES

30'-9" STRUCTURE

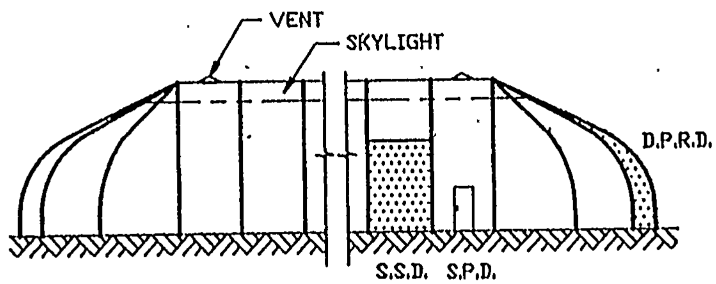
SCALE: "=20' DATE: AF ', 19 DRAWING #



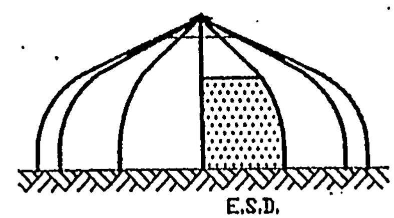
PLAN



SECTION
SCALE: 1"=20'



ELEVATION



END ELEVATION

NOTES:

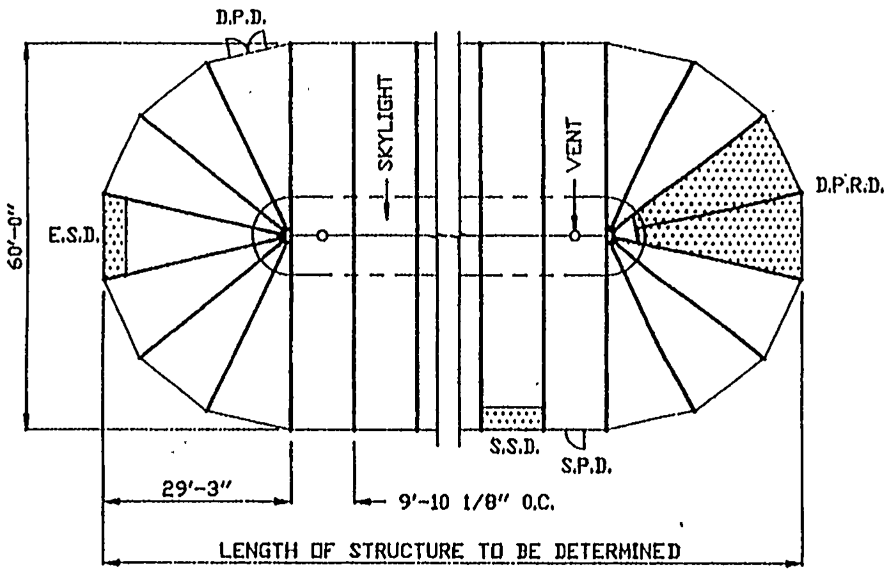
1. DOOR SIZES AVAILABLE.

	HEIGHT	BASE WIDTH	TOP WIDTH
E.S.D. - END SLIDING DOOR	14'-0"	12'-3"	9'-2"
S.S.D. - SIDE SLIDING DOOR	14'-0"	9'-6"	9'-6"
D.P.R.D. - DOUBLE PANEL ROLLING DOOR	20'-0"	24'-0"	6'-0"
D.P.D. - DOUBLE PERSONNEL DOOR	6'-8"	6'-0"	6'-0"
S.P.D. - SINGLE PERSONNEL DOOR	6'-8"	3'-0"	3'-0"

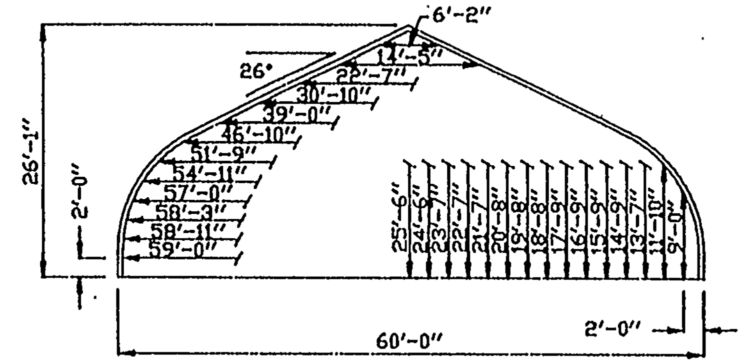
SPRUNG INSTANT STRUCTURES

50'-0" STRUCTURE

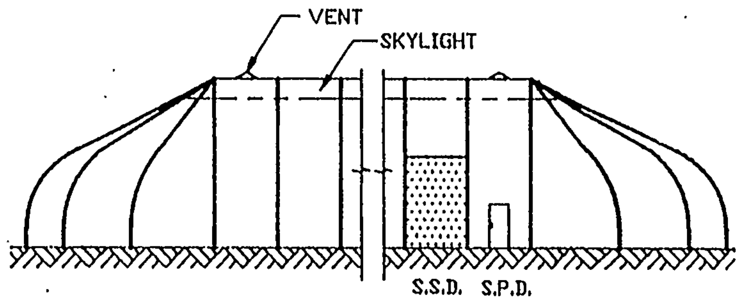
SCALE: 1"=30'-0" | DATE: MARCH 30, 1990 | DRAWING # S-50



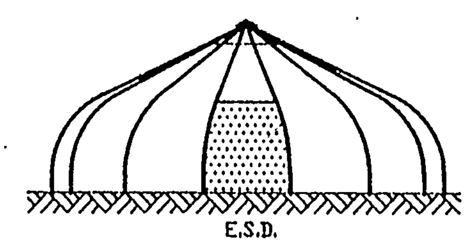
PLAN



SECTION
SCALE: 1"=20'



ELEVATION



END ELEVATION

NOTES:

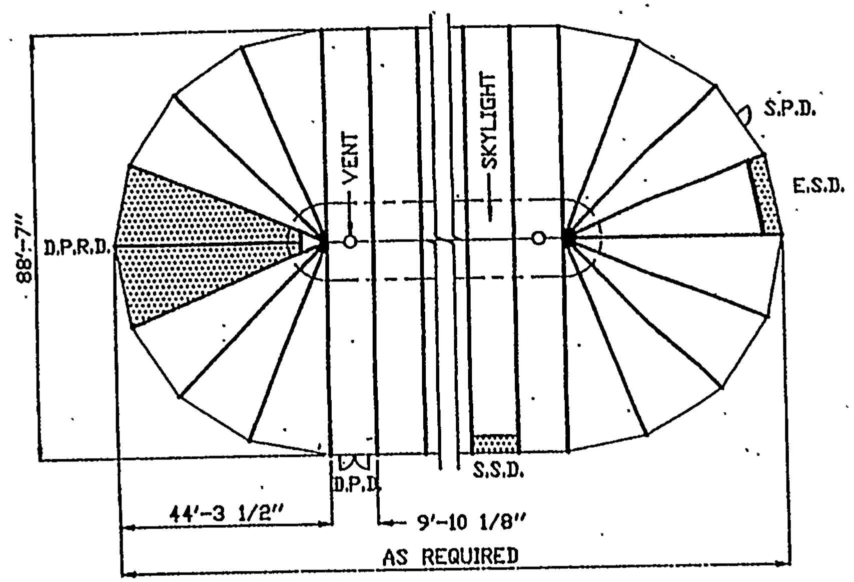
1. DOOR SIZES AVAILABLE.

	HEIGHT	BASE WIDTH	TOP WIDTH
E.S.D. - END SLIDING DOOR	14'-0"	12'-8"	10'-0"
S.S.D. - SIDE SLIDING DOOR	14'-0"	9'-6"	9'-6"
D.P.R.D. - DOUBLE PANEL ROLLING DOOR	22'-0"	25'-0"	6'-0"
D.P.D. - DOUBLE PERSONNEL DOOR	6'-8"	6'-0"	6'-0"
S.P.D. - SINGLE PERSONNEL DOOR	6'-8"	3'-0"	3'-0"

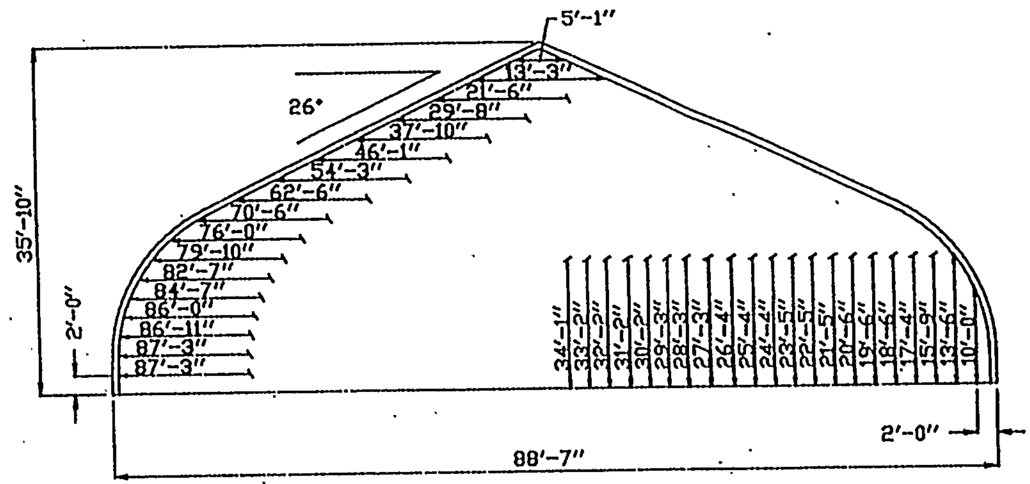
SPRUNG INSTANT STRUCTURES

60'-0" STRUCTURE

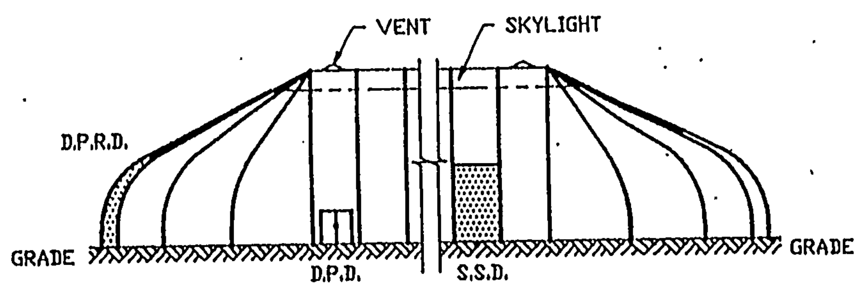
SCALE:	DATE:	DRAWING #
1"=30'-0"	MARC[illegible] 20, 199[illegible]	S-[illegible]



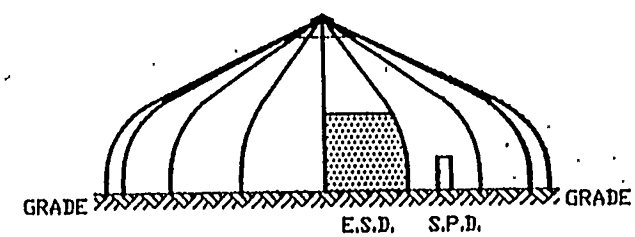
PLAN



SECTION
SCALE: 1"=20'-0"



ELEVATION



END ELEVATION

NOTES:
1. DOOR SIZES AVAILABLE.

	HEIGHT	BASE WIDTH	TOP WIDTH
E.S.D. - END SLIDING DOOR	16'-0"	16'-10"	14'-3"
S.S.D. - SIDE SLIDING DOOR	14'-0"	9'-6"	9'-6"
D.P.R.D. - DOUBLE PANEL ROLLING DOOR	32'-0"	33'-0"	5'-0"
D.P.D. - DOUBLE PERSONNEL DOOR	6'-8"	6'-0"	6'-0"
S.P.D. - SINGLE PERSONNEL DOOR	6'-8"	3'-0"	3'-0"

SPRUNG INSTANT STRUCTURES

88'-7" STRUCTURE

SCALE: 1"=40'-0"
DATE: MARCH 30, 1990
DRAWING # S-88

STRUCTURES IN PLACE

Abu Dhabi
Ajman
Algeria
Antarctica
Australia
Bahrain
Canada
Chile
China
Columbia
Dubai
Germany
Grand Cayman Island
Honduras
Iran
Iraq
Italy
Japan
Kenya
Korea
Libya
Mexico
Netherlands
New Zealand
Nigeria
North Yemen
Oman
Pakistan
Panama
Qatar
Ras Al Khaymah
Saudi Arabia
Sharjah
Sri Lanka
Sudan
Taiwan
U.S.S.R.
United Kingdom
United States of America
Venezuela
Zimbabwe

91.03.04

A PARTIAL LIST OF USES & APPLICATIONS

ACCOMMODATION:	Camp housing, barracks, mess halls, recreation centres, daycares.
AGRICULTURE & FARMING:	Grain storage, barns, repairs ships, winter storage sheds, riding arenas.
AUTOMOTIVE:	Sales display areas, winter showrooms, maintenance garages, wash bays, paint shops, body shop (panel-beating).
AVIATION:	Portable and semi-permanent hangars, workshops and overhaul facilities, parts and equipment storage, temporary or permanent walkways, receiving and loading area covers.
CONSTRUCTION:	Concrete hoarding, total enclosure of construction sites, equipment and materials on site storage, welding and fabricating shops, toilet and rest facilities, paint shops.
CONVENTIONS & DISPLAYS:	Covered display areas for large exhibitions, increase total display area, outdoor atmosphere meeting and function rooms.
CULTURAL:	Churches, theatres, stages, band shells, meeting areas, convention display rooms.
EDUCTION:	Temporary classrooms, gymnasiums, outside workshops, training areas, expansion of conventional facilities, emergency replacement, playground winter shelters.
EMERGENCY SHELTERS:	Housing units, schools, churches, stores.
EXHIBITION & FAIRS:	Total coverage for both temporary or and long term sites.
GOVERNMENT:	Federal - Provincial - Municipal; any cover for any application..
LUMBER:	Complete mill coverage, weather protection for high grade woods, retail outlet warehousing, forklift and equipment overhaul or storage sheds.
MANUFACTURING:	Complete coverage of work areas, assembly lines, product warehousing, paint shops, fabricating and welding shops, material storage.
MARINE:	Drydock boat covers, wharf boat houses, overhaul and repair facilities, retail outlet showrooms.
MILITARY:	Field accommodation, mess halls, offices, stores, warehousing, heavy equipment repair facilities, hangars, medical clinics.
MINING:	Refinery plant covers, heavy truck and equipment overhaul facilities, wash centres for equipment, parts storage.

PETROLEUM & OIL:	Drill rigs mud houses, central field warehouses, outfield buildings, parts depots, welding shops, accommodation and field recreation.
SPORTING FACILITIES:	Swimming pool enclosures, soccer arenas, golf driving ranges, ski starter huts, sport-aid facility, skating arenas, gymnasiums, daycares.
RESIDENTIAL:	Pool covers, sheds, car ports.
RETAILING:	Complete retailing areas for any product, cars, snowmobiles, sail boats, lumber and hardware.
TRANSPORTATION:	Bus sheds, cleaning stations, overhaul facilities, winter storage of diesel equipment.
WAREHOUSING:	Total warehousing facilities for any product or requirement.

Sprung Instant Structures Ltd.

Guarantee

Fabrics used in every Sprung Instant Structure have been selected for their proven strength, durability and longevity. They are highly waterproof, mildew proof and insect resistant. Because the fabric used contains ultra-violet inhibitors, it withstands extreme climatic variations and is not easily degraded by the sun's rays. This fabric has been warranted flame-retardant status by the Underwriters' Laboratories of Canada and the California State Fire Marshal.

To show our sincere confidence in our product, Sprung Instant Structures Ltd. guarantees to replace, on a pro-rata basis and at the current price, any fabric which deteriorates from any of the aforementioned factors within five years of the delivery of the building.

This guarantee applies only to the original purchaser of a Sprung Instant Structure and will not be valid if this Company has not supervised all erections and dismantlings of the structure during the five-year guarantee period.

P. D. Sprung, President

TEL. (403) 245-3371 FAX (403) 229-1980

Sprung Instant Structures Ltd.

1001 - 10TH AVENUE S.W. CALGARY, ALBERTA T2R 0B7 CANADA

The following is a tabulation of flame test performances and other data relative to the fire safety characteristics of all Sprung Fabrics.

TYPICAL PERFORMANCE PROPERTIES

PHYSICAL AND ENVIRONMENTAL PROPERTIES		TEST RESULTS		TEST METHOD
Fabric Weight (Avg)		18.0 oz per square yard		5041
		Warp	Fill	
Flame Resistance	Seconds after Flame (Avg)	0	0.2	5903
	Seconds after Glow (Avg)	0		HTM
	Inches Char Length (Avg)	3.2	3.2	5903
Break Strength - lbs (Avg)		266	245	5100
Tear Resistance - lbs (Avg)		81	85	5134
Hydrostatic Resistance - P.S.I. (Avg)		365		HTM
Resistance to:	- Oil	Excellent		HTM
	- Chemicals	Excellent		HTM
	- Greases	Excellent		HTM
	- Rot and Mildew	Excellent		HTM
Abrasion Resistance Cycles (Avg) (To Zero Tensile)		30,000		5304
Adhesion - lbs 2" (Avg) (Peel resistance)		35		5970
Thickness - Mils .00" (Avg)		26		5030
Cold Crack °F		No cracking/peeling at -30°		5874

1.	California Fire Marshal	Intermediate Scale	Pass
2.	National Fire Protection Association	701	Pass
3.	Underwriters' Laboratories	214	Pass
4.	Canvas Products Association International	84	Pass
5.	Federal Standards 191	5903	4.0 sec. max. / 4.5 in. max.
6.	ASTM (Burn Rate)	D635	Zero Burn Rate
7.	ASTM (Smoke Density)	D2843	39
8.	ASTM (Self Ignition Temp)	D1929	840 °F
9.	U.S. Testing Co. Combustion Toxicity Procedure		Slightly less toxic than red oak.

LAB REPORT

STYLE 9319 FRLTA w/TS103 Top Finish

Base - Type Fabric - Weight	Polyester 3.2 oz. / square yard
Coated Weight Method 5041	19 +2 oz. / square yard -1
Grab Tensile Method 5100	260/260 lbs
Strip Tensile Method 5102	200/200 lbs/inch
Tonque Tear Method 5134 8" x 10"	110/110 lbs
Trapezoid Tear Method 5136	35/40 lbs
Flame Resistance Method 5903	2-Second flame out California Fire Marshal req. UL214, NFPA-701 Tests
Cold Crack MIL-C-20696C Para. 4.4.1.3. -67° F	Pass -67° F
Dead Load Room Temperature 160° F./71° C.	1-1/2" Seam 100 lbs 50 lbs
Hydrostatic Resistance Method 5512	350 PSI
Wicking	1/8" Maximum.

LAB REPORT

STYLE 9319 FRLTC w/TEDLAR Top Finish

Base - Type Fabric - Weight	Polyester 3.2 oz. / square yard
Coated Weight Method 5041	19 +2 oz. / square yard -1
Grab Tensile Method 5100	260/260 lbs
Strip Tensile Method 5102	200/200 lbs/inch
Tonque Tear Method 5134 8" x 10"	110/110 lbs
Trapezoid Tear Method 5136	35/40 lbs
Flame Resistance Method 5903	2-Second flame out California Fire Marshal req. UL214, NFPA-701 Tests
Cold Crack MIL-C-20696C Para. 4.4.6 -40° F	Pass -40° F
Dead Load Room Temperature 160° F./71° C.	1-1/2" Seam 100 lbs 50 lbs
Hydrostatic Resistance Method 5512	350 PSI
Wicking	1/8" Maximum

Tedlar is a registered trademark of DuPont Co.

... helps keep outdoor vinyl ...ver.......... longer.

Keeps Fabrics Clean - Most air-borne dirt does not adhere to TEDLAR. If, however, soiling does occur—usually in environments with high concentrations of particulate matter—a simple hosing off usually cleans the fabric.

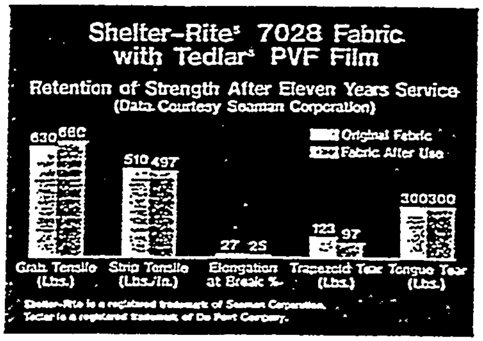
And, because there is no known solvent for TEDLAR, stubborn soils, such as graffiti, can easily be removed with common solvents or paint removers—without damage to the film.

TEDLAR® PVF Film helps keep outdoor vinyl fabrics WORKING LONGER...

'. while TEDLAR helps keep your outdoor vinyl fabrics bright and colorful, it also helps increase their useful service lives.

Reduces Cracking and Embrittlement - Both types of TEDLAR—clear, UV-screening and pigmented — help reduce the cracking and embrittlement that frequently occur to PVC-based fabrics. This also means there are fewer cracks for accumulation of dirt and soil which often causes replacement of unprotected fabrics in signs, structures, canopies and awnings.

Adds Strength and Retains Flexibility - TEDLAR PVF film is tough. It has high resistance to abrasion, thereby further protecting the vinyl fabric from damage due to wind blown particles. And, because TEDLAR contains no plasticizers, this helps it retain its inherent flexibility over a wide temperature range: from −100° to 225°F.



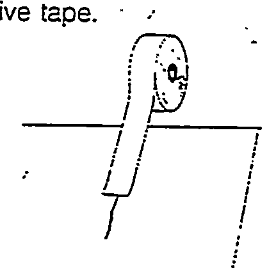
In fact, this chart shows how the strength of an 11-year-old fabric structure remained virtually unchanged when protected by a pigmented TEDLAR.

Resists Weathering - Resisting weathering means more than just resisting the harsh rays of the sun or atmospheric pollutants. Because TEDLAR PVF film is non-porous, when laminated to the PVC with a suitable adhesive, it forms a barrier to rain, snow or sleet and helps prevent the growth of mildew.

But, TEDLAR® PVF Film means much more...

Besides helping keep outdoor vinyl fabrics looking newer and lasting longer, TEDLAR also offers much more to the designer, fabricator and user of structures, signs, canopies, awnings and covers.

Easy Repair - All outdoor vinyl fabrics protected by TEDLAR may be repaired on-site quickly and easily using a simple patch-kit of color-matching, self-adhesive tape.



Low Combustibility - TEDLAR film will not readily burn nor support combustion.

Design Flexibility - Because TEDLAR is so lightweight (the laminated layer is only .0015" thick) there are generally no design constraints due to weight. It readily accepts most inks and paints used in the sign industry. And, of course, designers may utilize most standard outdoor fabric techniques such as eyeletting or grommeting when constructing outdoor fabric structures protected with TEDLAR.

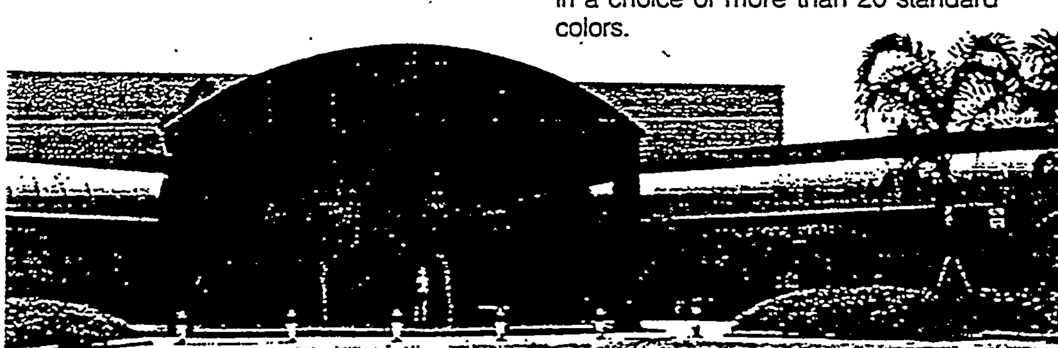
Light Transmission and Color Options - Using clear, UV-screening TEDLAR, designers can create outdoor fabric that displays the colors of the underlying PVC, while also providing the exact amount of light transmission needed.

If light transmission is not required, pigmented TEDLAR film provides the optimum UV protection and is available in a choice of more than 20 standard colors.

Cover and photo A: Back-lit awnings, San Francisco Hilton.
Courtesy of ECS Industries, Inc. and ABC Extrusion

F[illegible] B: Colorado Racquet Club, Englewood, CO
Courtesy of Facile Technologies, Inc. and Air Structures International, Inc.

Photo C: Loehmann's Shopping Plaza, Miami, FL
Courtesy of Seaman Corp.



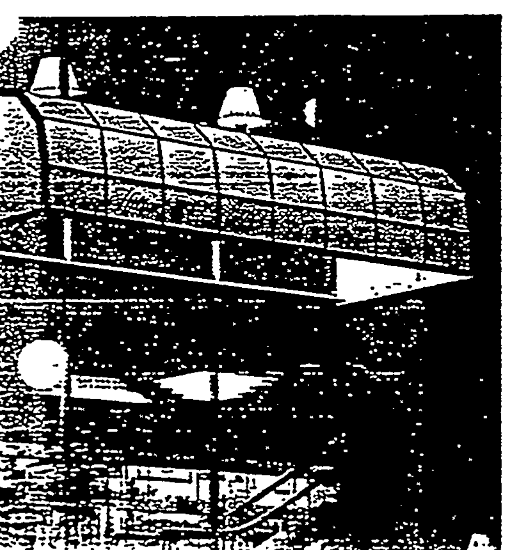
TEDLAR® PVF FILM the extra layer th fabrics looking n

Outdoor vinyl fabrics are now being used in a wide range of applications — from air-inflated and tension-supported structures to awnings, flexible signs, entrance canopies and "billboard" awnings to convertible boat tops. And, TEDLAR PVF film offers superior appearance and longer life for these vinyl fabrics in each application.

TEDLAR is a fluorocarbon-based film recognized worldwide for its outstanding weather-resistance, inertness and non-staining properties. When TEDLAR is laminated to a vinyl fabric, it provides unsurpassed protection against both soiling and weathering – two of the primary causes of failure in unprotected outdoor vinyl fabrics.

TEDLAR® PVF Film the extra layer that makes the difference...

Conventional outdoor vinyl fabrics can be made by sandwiching a layer of fabric or scrim, made from Du Pont DACRON®, between two layers of PVC (polyvinyl chloride) sheeting as shown in Fig. 1. This structure provides strength and flexibility, but leaves the PVC directly exposed to the effects of weather, ultraviolet rays, and air-borne pollutants.



By laminating TEDLAR PVF film to the exterior surface with a suitable adhesive as shown in Fig. 2, the outdoor vinyl fabric can be made far more resistant

Fig. 1.

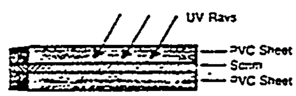
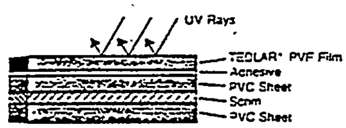


Fig. 2.



to the effects of weather, soil and fading that might otherwise shorten its useful life or spoil its appearance.

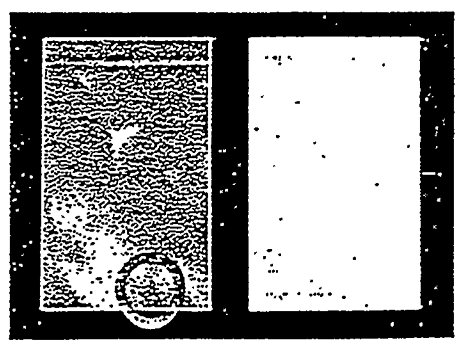
And, this protection is available in two forms – a clear, UV-screening film and a pigmented film offered in more than 20 colors. The clear, UV-screening film permits either underlying PVC colors to show through, or a high degree of translucency which is essential in applications such as back-lit canopies and flexible signs.

TEDLAR® PVF Film helps keep outdoor vinyl fabrics LOOKING NEWER LONGER...

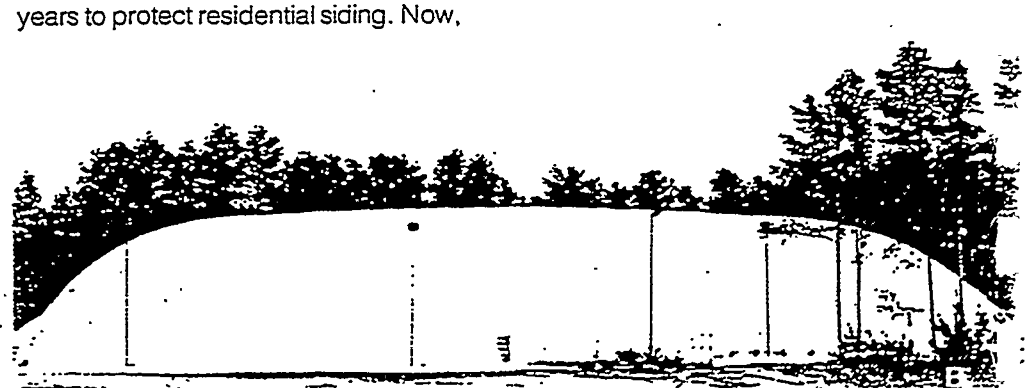
Fights Fading - Both the clear, UV-screening and pigmented TEDLAR films resist fading and color loss. As the ultimate UV protection, pigmented TEDLAR has been used for over 20 years to protect residential siding. Now, clear, UV-screening TEDLAR has also shown an excellent capacity to protect against fading. It has been keeping structures similar to the racquetball club dome shown in Figure B bright and new-looking for more than 11 years with no noticeable or significant fading.

Resists Discoloration - TEDLAR PVF film is chemically inert. It will not react to atmospheric pollutants which cause unprotected PVC to discolor or stain.

These two photos show the difference between an unprotected section of a swimming pool cover and a section protected with clear, UV-screening TEDLAR. The pool is located in an industrial city in the Midwest. After 16 months of service, the unprotected PVC became discolored and brittle, and the cover had to be replaced.



The circled area shows where the PVC has been rubbed and the dirt removed to reveal the discoloration.



Sprung Instant Structures Inc.

MEMBER OF THE SPRUNG GROUP OF COMPANIES

Phone Number (215) 391-9553 Fax Number (215) 391-0669

Address Correspondence to: 5100 Tilghman Street, Suite 215, Allentown, PA 18104-9102

October 21, 1991

Mr. Fred Merrill
The Finch Groupe
160 Federal Street
Boston, MA 02110

Dear Sir,

We are pleased to submit the following quotation for a Tennis Court cover, to be located at your site.

STRUCTURE SIZE: Approximately 60 feet wide by 236 feet long.

COLOR: White opaque, tedlar coated with skylight.

PURCHASE PRICE: Structure, including the following:

2 - single personnel doors complete with panic hardware;
1 - double personnel door complete with panic hardware;
2 - flat ends;
2 - electric fans;
1 - triple glass main entrance door.

Total Purchase Price, F.O.B. Lincoln, New Hampshire sales and/or use taxes extra: $223,380.00

TERMS: 50% with order; balance upon delivery of the structure.

DELIVERY: Normally from inventory.

ERECTION: We will supply one Technical Consultant, equipped with all hand tools, free of charge, to supervise the erection of this structure by your work force. It will be your responsibility to supply the following:

a) Scaffolding on wheels.
b) Electrical power to site.
c) 6 unskilled workmen for approximately 7, 8 hour working days.

The Finch Groupe
Mr. Fred Merrill
October 21, 1991

d) A crane with operator.
e) One manlift, one scissor lift.

ANCHORAGE: Drift pins only.

PERMITS AND LICENSES: It will be your responsibility to obtain all permits and licenses. Standard pre-engineered drawings are available upon request.

This quotation is valid for 60 days.

Thank you for the opportunity to submit this quotation. We look forward to being of service to you.

Yours very truly,

SPRUNG INSTANT STRUCTURES INC.

J. K. Slack
Senior Vice President

JKS/jn

c.c. Mr. Grant Cleverley

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501
EDF Serial Number EDF-TFC-037
Functional File Number C-09

Project/Task CPP TANK FARM CLOSURE
Sub task Tank and Vault Void Grouting

Title: GROUT FLOW PROPERTIES THROUGH A 2 TO 4 INCH PIPE (Rev. 2)

SUMMARY

The purpose of this Engineering Design File (EDF) is to provide information on cost and design bounding ranges. The actual pipe size must still be established and is beyond the scope of this study. To close the tank farm tanks to landfill standards, grout will be used to fill the tank voids. It has been proposed that NRC Class C grout, rather than clean grout be used to fill these voids. To minimize radiation fields and weight loading (due to shielding, piping and grout weight), a 2 to 4-inch pipe could be used to transfer the grout. It is necessary that the piping deliver the grout to the tank at 50 gallons/minute (2 foot grout lift in the tank in 10 hours). Due to head losses in the piping, the required pressure must be determined to choose the appropriate grout pump.

The head loss through a 2 to 4-inch pipe was obtained from the Darcy-Weisbach Equation and placed in a tabular format by Scott Jensen (6-0544). The table shows the pressure drop per foot of a 1 to 4 inch schedule 40 pipe. The pressure needed to move grout through a 500 foot pipe is also calculated.

The calculations were based on a 50 gallon/minute flow, a viscosity of 50 poise (average typical viscosity of grout is 20-80 poise, see attachment, "Measured WCF Grout Viscosities"), a specific grout weight of 120 pounds/cubic foot (typical sandy grout) and a pipe roughness of 0.002 inches (smooth steel pipe).

It was found that **374 psi/100 ft** is needed (or 1871 psi for 500 feet of pipe) to move grout through a 2-inch pipe at 50 gallons per minute. The flow velocity for the 2-inch pipe is 4.8 ft/sec. Conversely,**26 psi/100 ft** is needed (or 130 psi for 500 feet of pipe) to move grout through a 4-inch pipe at 50 gallons per minute. The flow velocity for the 4-inch pipe is 1.26 ft/sec. The approximate minimum flow velocity to prevent grout from building up on the pipe walls is 3.0 ft/sec.

The use of small diameter piping requires high pressure (i.e. 1871 psi for a 500-foot, 2-inch pipe) to move LLW grout or a pig (for cleaning purposes) through a pipeline. A high-pressure radioactive system may be unreasonable, considering a pipeline failure at any time will cause radioactive grout to discharge everywhere.

Distribution: B.R. Helm, D.J. Harrell, B.C. Spaulding, R.A Gavalya and WTP EIS Studies Library on distribution.

Authors	Department	Reviewed	Approved
K.D. McAllister	4130		B.C. Spaulding
Date 1-29-98		Date 1/28/98	Date 1/29/98

Pressure Drop for Fluid Flows Based on the Darcy-Weisbach Equation

Project: CPP Tank Farm Closure, Tank and Vault Void Grouting, Grout Flow Through a Two Inch Pipe

Engineer: Scott A. Jensen P.E. Fluid: Grout Date: 12/18/97

Flow = 50 gpm Flow = 0.111 cfs Pipe Length = 500 ft

Viscosity = 1.05E-01 lb-sec/ft^2 Specific weight = 120 lb/ft^3

Density = 3.73 slug/ft^3

Kinematic viscosity = 2.80E-02 ft^2/sec

Pipe equivalent roughness (ef) = 0.002 in

Nominal Pipe Size	Sch. 40 Pipe Wall O.D. (in)	Sch. 40 Pipe Wall Thickness (in)	Sch. 40 Pipe Wall I.D. (in)	Internal Area (sq in)	Flow Velocity (ft/sec)	Reynolds Number (Re)	Friction Factor (f)	Head Loss (hf/100 ft)	Grout Pressure Drop (psi/100 ft)	500 ft Grout Pressure Drop (psi)
1	1.315	0.133	1.049	0.864	18.56	58	1.106	6,768.7	5,640.6	**28,203**
1-1/4	1.660	0.140	1.380	1.496	10.73	44	1.455	2,259.9	1,883.3	**9,416**
1-1/2	1.900	0.145	1.610	2.036	7.88	38	1.698	1,219.8	1,016.5	**5,083**
2	2.375	0.154	2.067	3.356	4.78	29	2.179	449.0	374.2	**1,871**
2-1/2	2.875	0.203	2.469	4.788	3.35	25	2.603	220.6	183.8	**919**
3	3.500	0.216	3.068	7.393	2.17	20	3.235	92.5	77.1	**385**
3-1/2	4.000	0.226	3.548	9.887	1.62	17	3.741	51.7	43.1	**216**
4	4.500	0.237	4.026	12.730	1.26	15	4.245	31.2	26.0	**130**

Reference: Steady Flow Analysis of Pipe Networks, by Roland W. Jeppson, Utah State University

1 poise = 0.00209 lb-sec/ft^2

LOCKHEED MARTIN

Lockheed Martin Idaho Technologies Company

INTERDEPARTMENTAL COMMUNICATION

Date: July 1, 1997

To: A. K. Herbst MS 5218 6-3939

From: D. W. Marshall MS 5218 6-3657

Subject: MEASURED WCF GROUT VISCOSITIES - DWM-03-97

Grout was prepared to match the formulation designed for filling decommissioned Waste Calcining Facility (WCF) vessels. The composition is specified below.

Portland Cement	77.3 gm	(21.4 wt%)
Class F fly ash	180.2 gm	(50.0 wt%)
Water	103.1 gm	(28.6 wt%)
Master Builders Polyheed super-plasticizer	0.75 ml	(n/a)

The dry solids were blended prior to the addition of the water and the super-plasticizer and the slurry was hand mixed for five minutes before viscosity measurements were made. Each data set was obtained by immersing a viscosity spindle in the slurry and ramping the angular velocity from 20 rpm up to 70 rpm and back down to 20 rpm, while holding at each velocity for one minute. Data from the viscometer were recorded on 20 second intervals. Since grout has a non-newtonian rheology, it is difficult to define the viscosity at any given time or shear rate. The viscosity is dependent on the formulation and the time-shear history that the grout has experienced. Grout tends to shear-thin and is thixotropic. The higher the shear rate and the longer the shear history, the less viscous the grout becomes. As time progresses, the setting of the grout becomes inevitable due to the crystallization of hydrated mineral phases in the grout. This causes the viscosity of the grout to increase irreversibly over time.

The viscosities were measured with a spindle designed with two spokes that span the entire diameter of the enscribed spindle trace; positioned orthogonally to each other and each in a separate plane of rotation, about one spoke-wire diameter apart (see Figure 1). This spindle was calibrated against a ASTM standard spindle using a standard viscosity oil to determine the spindles operating constant.

A. K. Herbst
July 1, 1997
DWM-03-97
Page 2

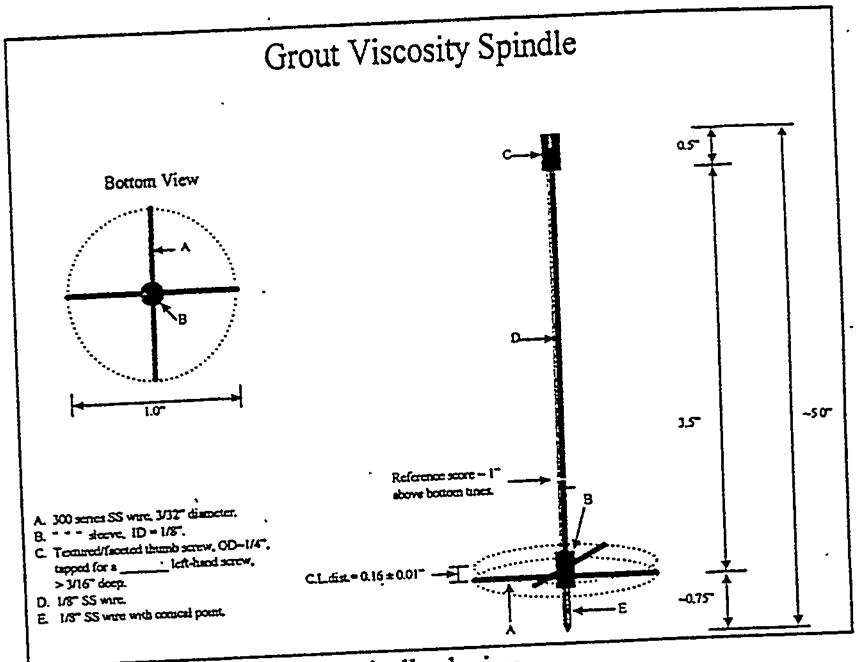


Figure 1. Grout viscosity spindle design.

One should note that the viscosity of the grout generally decreases with time at any one velocity setting and that as time progresses, the amount of viscosity hysteresis increases and the operating curves shift upward toward higher viscosities. This can be more plainly observed in Figure 2. The viscosity of grout that has been under significant shear for several minutes has a viscosity near 20 - 40 poise, whereas grout that has been stagnant for a few minutes quickly thickens. It should also be noted that the viscosity increases again as the shear rate drops off. In general, the WCF vessel fill grout has a viscosity of 40 ± 20 poise.

The conductivity of the grout was measured shortly after the grout was mixed and compared with the distilled water source in CPP-637 lab 113. The conductivity of the grout was 5750 µmho/cm and the conductivity of the distilled water was 1.03 µmho/cm.

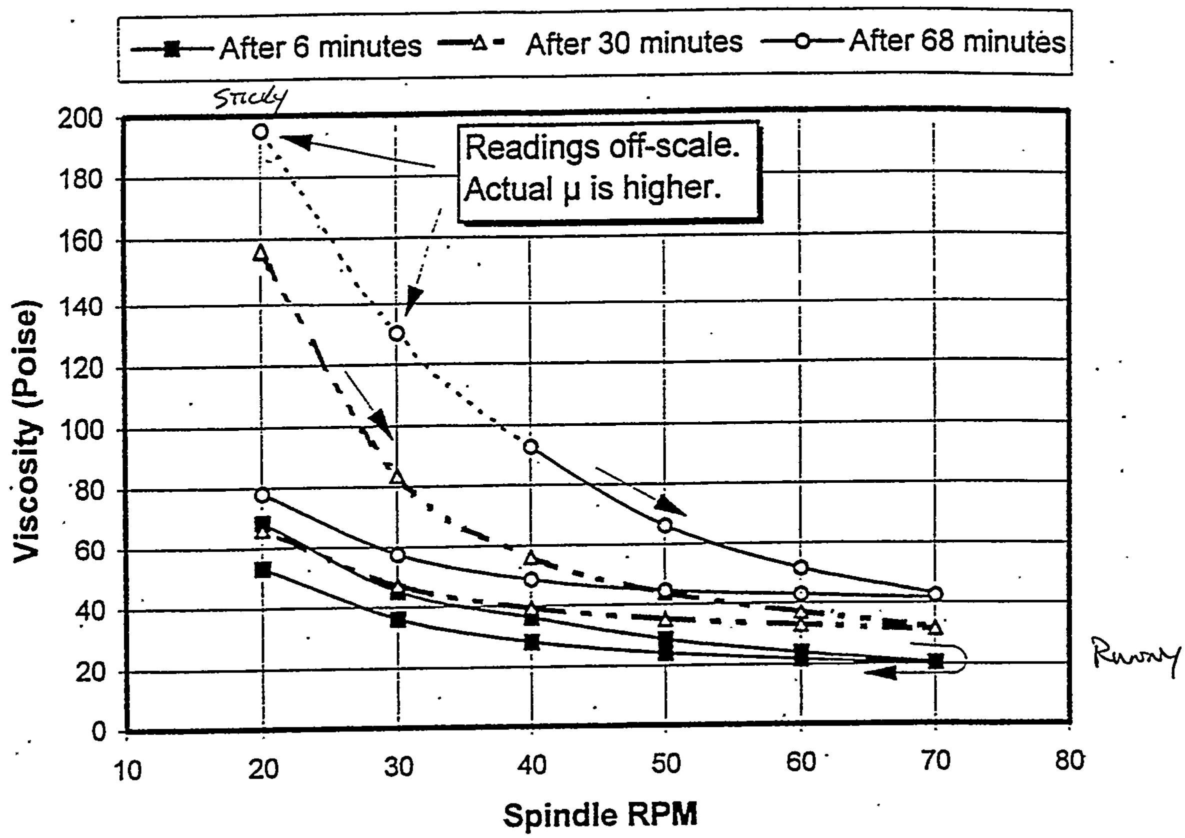


Figure 2. WCF grout viscosity as a function of shear-rate (rpm) and time. The legend indicates the time lapse from start of mixing to the time the viscosity sampling began.

rmg

cc: D. V. Croson, MS 5218
S. A. Jensen, MS 3650
T. D. Nield, MS 5304
D. W. Marshall file

1 poise = 2.09 (10^{-3}) [illegible]

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number	73501
EDF Serial Number	EDF-TFC-038
Functional File Number	RD-03

Project/Task	CPP TANK FARM CLOSURE
Sub task	TFF Loading Restrictions

TITLE: TANK FARM LOAD LIMITATIONS

SUMMARY

The TFF (Tank Farm Facility) closure will require vehicle and equipment to be placed above the Tank Farm. Due to the limited load bearing capacities of the underground vaults, maximum load limits have been established to protect the vaults from structural damage that could occur from overloading.

The TFF is divided into 4 zones, Zone A, Zone B, Zone C, Zone D, with Zones A and B containing subzones for example A-1, A-2, B-1, B-2. The limits of each Zone/Subzone and non-vehicular loads are presented. Equipment loading and various zone determinations of TFF closure equipment/vehicles were analyzed and estimated (see Table #1). A Copy of CPP-MCP-P7.5-A1—Tank Farm Surface Load Limitation and CPP-MCP-4.2B14—Load Controls for ICPP High-Level Liquid Waste Tank Vaults are given as well.

Distribution: B.R. Helm, D.J. Harrell, B.C. Spaulding, R.A. Gavalya and WTP EIS Studies Library on distribution.

Authors K.D. McAllister	Department 4130	Reviewed	Approved B.C. Spaulding
Date		Date 1/5/97	Date 1/5/97

TFF STRUCTURAL CONSIDERATIONS

Due to the underground vault systems in the Tank Farm, grade level loading created during closure activities must be analyzed. Limited load bearing capacities of the vaults requires the establishment of loading zones and loading limits above the TFF (Tank Farm Facility). Loading zones and limits are discussed below.

General Information

The introduction of vehicles, equipment, and crews into the tank farm area is necessary for tank farm closure. However the existing Tank Farm vault system structural load carrying capacity is limited (1). Guidelines were established to prevent the overburden of the vault structures. This is accomplished by the use of a very conservative and simplified "zoning" approach. The TFF site is divided into four discrete areas (A, B, C, and D) for the purpose of allowing equipment/vehicles into the site. Zones A, B, C, and D are further divided into subzones such as A-1, A-2, B-1, B-2, etc. The document "Evaluation of Existing Vaults for Vehicle Loads," (2) contains information relevant to zone loading. In general, zones A and B are located over the tanks and tank vaults, zone C includes the area between the tank vaults and the region between the tank vaults, and zone D lies on the perimeter of the TFF.

Any vehicle going into a zone must be on the approved list (3). If the vehicle is approved but the vehicle load exceeds the full nominal load, the tank farm facility management must be contacted before proceeding. If a vehicle is not on the approved list, then the tank farm facility management or liquid waste processing shift supervision must be contacted. This is to determine if the vehicle has prior access approval per the 5% and 95% criteria. The 5% and 95% criteria is to ensure that the total load of the new vehicle, including its combined weight and lift load, does not exceed the design loads of the vehicle it is to replace by more than 5%. The distance between new vehicle axles and supports must be within 5% of the vehicle it is to replace as well. Furthermore the contact areas of the new vehicle supports must not be less than 95% of the contact area of the supports of the vehicle it is to replace (4). If the vehicle has no prior access approval under the above 5% and 95% criteria, the Tank Farm Vehicle Worksheet, Load Addition Worksheet, or the ICPP-4162X form must be consulted to calculate specified variables for meeting the 5% and 95% criteria. If the vehicle meets the criteria, a complete worksheet will be given to the Tank Farm shift supervision. Once a vehicle is approved or is on the list of approved vehicles, the zones that the specified vehicle can travel on will be determined (5).

Vehicle drivers should be informed that maximum speeds on the tank farm are not to exceed 2.5 mph. This is to prevent amplifying wheel pressure on top of the soil. If a crane is operated on the tank farm, the crane boom and its load must be kept as low as reasonably possible during transition.

The Tank Farm facility engineer must be consulted if a closure activity disturbs the tank farm membrane (moisture barrier just below the Tank Farm surface) (6) or non-vehicle load such as gravel, soil, plywood, or concrete exceeds 1000 lb./zone limit (7).

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1 "Tank Farm Load Limitations," CPP-MCP-P7.5-A1, 9-10-96.
2 "Evaluation of Existing Vaults for Vehicle Loads," HLWTFR Project, Advanced Engineering Consultants, August 1993.
3 "Evaluation of Existing Vaults for Vehicle Loads," HLWTFR Project, Advanced Engineering Consultants, August 1993, Appendix A Table 3.
4 "Evaluation of Existing Vaults for Vehicle Loads," HLWTFR Project, Advanced Engineering Consultants, August 1993, page vi-vii.
5 "Evaluation of Existing Vaults for Vehicle Loads," HLWTFR Project, Advanced Engineering Consultants, August 1993, Appendix B, Figure 15.
6 "Tank Farm Load Limitations," CPP-MCP-P7.5-A1, 9-10-96.
7 "Tank Farm Load Limitations," CPP-MCP-P7.5-A1, 9-10-96.

Vehicle Loading Requirements

The requirements and restrictions for loads in the TFF are listed below (8,9,10).

1. A maximum of two Category I vehicles/equipment (i.e. Ford F150, F250, etc.—except Bobcat 735), with at least 10 feet clear between supports are allowed in each A subzone at any given time.

2. A maximum of two Category I vehicles/equipment (i.e. Ford F150, F250, etc.), at least 10 feet clear between supports, are allowed in each B subzone at any given time.

3. Each zone C can accommodate only one of the following vehicle/equipment combinations at any given time:

   a. Four Category I vehicles/equipment (i.e. Ford F150, F250, Personnel, etc.)

   b. Two Category I vehicles/equipment (i.e. Ford F250, Personnel, etc.) and one Category II Vehicle (i.e. Backhoe, Small Cranes, etc.).

   c. Two Category II vehicles/equipment (i.e. Backhoe, Small Cranes, etc.).

   d. One Category III vehicles/equipment (i.e. Dump truck, Medium Cranes, etc.)

   Any other combinations of vehicles with a sum of weighting factors of 4.0 or less, is also allowed in each zone C. Weighting factors for each vehicle load category are given in CPP-MCP-P7.5-A1

4. Each zone D can accommodate any combination of Category I, II, III or IV vehicles/equipment (Category IV vehicles/equipment: Heavy Cranes, Heavy loaders, etc.)

5. Vehicles shall travel under 2.5 mph in TFF zones to prevent amplifying wheel pressure upon the soil.

6. Vehicle loading requirements are for dry soil conditions. Vehicles shall not be allowed in these zones during saturated soil conditions.

7. Maximum lift loads for all cranes shall be 12,000 lb.

8. Vehicles are assumed to be carrying their rated capacity or 12,000 lbs, whichever is less.

9. Lift loads on cranes shall be kept low when moved over the TFF.

10. Nonvehicle loads shall be less than 1,000 lb per zone.

CPP-MCP-P7.5-A1, "Tank Farm Surface Load Limitations," lists the vehicles, category types and weighting factors that are approved for use in the TFF. Nonapproved vehicles require an analysis to be performed by cognizant facility personnel. This analysis will determine the equivalent category type. Criteria used to determine category type are: combined weight and lift load, number of vehicle axles

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8 Evaluation of Existing Vaults for Vehicle Loads, HLWTFR Project, AEC 1002-08, Aug. 1993
9 CPP-MCP-P7.5-A1, Tank Farm Surface Load Limitations
10 CPP-MCP-4.2B14, Load Controls for ICPP High-Level Liquid Waste Tank Vaults

and supports, distance between vehicle axles and supports, and contact area of the vehicle supports. Other studies may justify allowing larger vehicle numbers in a zone, with specific limitations on location and loading of those vehicles.

Equipment Loading

The following equipment will increase loading in the zoned areas of the tank farm closure activities:

Temporary VOG system
The temporary VOG system design for Tank Farm closure is currently being developed. The VOG system will ventilate the contaminated vault and tank voids and prevent contaminants from entering the atmosphere. Loading and weight restrictions have yet to be determined.

Grouting system
The grouting system consists of cement trucks, high shear mixer, hopper, grout pump, and piping. The equipment, except for the piping, will be located in zone D, north of tanks WM-185 and WM-186, and just outside of the tank farm perimeter fencing as shown in the attached drawing. Loading created by the trucks and pump should not exceed the load limits for zone D. Grout piping will run from the grout pump to the tank or vault voids for filling. If class C grout were used, the shielding associated with the 2-inch grout piping would create a load greater than 1,000 lb./zone. A support system should be designed to distribute the load throughout the tank farm. This should be studied further to determine the areas where the limit will be exceeded.

Grout Flushing system
The flushing system will require a mechanism for collecting the water/grout flushed from the grout pump. The collection will take place at the pump location (zone D). The wash water will be transferred to a wash water dumping ground.

Line Blow-out System
The pipes will be cleaned using a rubber ball or cylinder cartridge (pig) and a portable air compressor connected to the beginning of the grout piping, next to the grout pump. The air compressor has significant weight (see Summary of Equipment Loads) and should not incur loading problems if located in zone D.

Waste Retrieval Pumps
When the waste retrieval pumps are installed, concrete riser caps will be removed. By removing these caps, a significant load is removed from the vault structure. Loading created by the shielding and pumps should be studied further to determine if the 1,000 lb./zone load limit has been reached.

General Equipment
A crane will be used for removal of existing riser equipment. It will also be used for placement of new equipment and shielding. The type of crane used depends on the boom length or reach needed to remove or place equipment/shielding. The boom length will be determined by the equipment size, such as pumps that must be lifted, and the placement of the equipment/shielding moved by the crane. The boom length will also depend on crane location. Further study is needed to determine the type of crane that can be used and the loading requirements associated with crane location within the tank farm.

Backhoes on the list of approved vehicles (11) can only be used in zones C and D. A small backhoe or drilling rig, if approved, can be use in zones A and B, otherwise excavation in these zones must be by hand. An excavator with a digging depth of approximately 20 feet for excavation of process lines needs to be selected and approved for use in zone C.

The following table summarizes weight loading zones and restrictions:

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11 "Tank Farm Load Limitations," CPP-MCP-P7.5-A1, 9-10-96.

TABLE #1
SUMMARY OF ESTIMATED EQUIPMENT LOADS

EQUIPMENT ITEM	WEIGHT (lb.)		LOCATION (zone)
VOG SYSTEM SKIDS			
Filter skid	TBD		C
Shielding for skid	TBD		C
Shielding for lines	TBD		A, B, C
Blower skid	TBD		D
INSTRUMENTATION			
Control trailers			D
TANK WASH DOWN SYSTEM			
Grout placement arm	TBD		A, B
Wash Down Skid	TBD		C
GROUT SYSTEM			
Cement Truck	66,100	(12)	D
Hopper/pump	6,500	(13)	D
2" Grout piping (full)	7/ft.	(14)	A, B, C, D
4" Grout piping (full)	19/ft.	(14)	A, B, C, D
2" pipe shielding (class C grout)	TBD		A, B, C, D
GROUT FLUSHING SYSTEM			
Wash water storage vessel	TBD		D
LINE BLOW-OUT SYSTEM			
Air compressor	1,860	(15)	D
Pipe cleaning flange	Insignificant		D
GROUT LEVEL MONITORING SYSTEM	TBD		A,B

12 "Evaluation of Existing Vaults for Vehicle Loads," HLWTFR Project, Advanced Engineering Consultants, 8-93.
13 Schwing Grouting Equipment Specification Sheets, 7-29-97.
14 "Pumping Concrete and Concrete Pumps, A concrete placing manual," Schwing America, 1983.
15 Ingersoll-Rand Equipment Specification Sheets, Idaho Bit and Steel, 8-4-97.

PUMPS

Mixer pumps	TBD		A, B
Shield Skirt	TBD		A, B
Transfer pump	150	(16)	A, B
Shield Skirt	TBD		A, B
Shielding for transfer line	TBD		A, B, C

ADDITIONAL EQUIPMENT

Drilling Rig	150	(17)	A, B
Crane	TBD		C or D
Backhoe (10' digging depth)	14,000	(18)	A, B
Excavator (20' digging depth)	50,000	(19)	C

Specific information regarding TFF load limits may be found in Management Control Procedure, CPP-MCP-P7.5-A1, "Tank Farm Surface Load Limitations", and Technical Specification TS4.2B14, "Load Controls for ICPP High-Level Liquid Waste Tank Vaults". These documents are attached to this EDF.

16 Pump Tech. Specification Sheets, 7-17-97.
14 Diamond Tech. Specification Sheets, 8-14-97.
18 John Deere Construction Equipment Specification Sheets, 8-12-97.
19 Caterpillar Construction Equipment Specification Sheets, 9-3-97.

4.2b14: Load Controls for ICPP High-Level Liquid Waste Tank Vaults

CONTROLLED DOCUMENT Copy No. DOCUMENT CATEGORY I

TECHNICAL SPECIFICATIONS/ STANDARDS STANDARD

LOAD CONTROLS FOR ICPP HIGH-LEVEL LIQUID WASTE TANK VAULTS TS 4.2b14

Rev. 0

Effective Date 2/29/96

APPLICABILITY:

This technical standard (TS) applies to the High-Level Liquid Waste (HLLW) Tank Farm tank vaults (CPP-713 and CPP-780 through CPP-786) at the Idaho Chemical Processing Plant (ICPP).

OBJECTIVE:

The objective of this standard is to prevent damage to the ICPP HLLW Tank Farm tanks and vaults that could be caused by overstressing of the tank vaults, (CPP-713 and CPP-780 through CPP-786) by operational loads.

SPECIFICATIONS:

1) OPERATIONAL LOADS IMPACTING THE HLLW TANK FARM VAULTS SHALL NOT INCREASE THE LOAD ON ANY STRUCTURAL MEMBER BY MORE THAN 10 PERCENT ABOVE THE LOAD FROM AT REST SOIL.

2) THE METHODOLOGY FOR EVALUATING OPERATIONAL LOADS AND ANY CHANGES TO THAT METHODOLOGY SHALL BE REVIEWED AND APPROVED.

BASIS:

The HLLW Tank Farm tanks are contained in eight underground concrete vaults (CPP-713 and CPP-780 through CPP-786). These vaults were designed to support the loads from the soil and other loads surrounding and covering them. The soil loads have been defined as nominal loads. The nominal loads assume waste tank WM-191 to be empty and, therefore, any volume contained in that tank must be factored into load determinations. The introduction of new operational loads, both static and dynamic, can result in additional pressures on the HLLW tank vaults.

A load study, which has been reviewed and approved, was performed for the tank farm area to examine the effects of vehicles and mobile equipment on the tank farm to prevent overloading of the tank vaults. Overloading the tank vaults could result in damage to the HLLW tanks and vaults. The study established specific operational load limits and restrictions. The study used the in-situ at rest soil pressure as the baseline load conditions. Operational loads are introduced by various activities, such as normal operation, construction, maintenance, and environmental restoration. Operational loads can include 1) vehicular traffic, 2) equipment, 3) materials, 4) personnel, or 5) changes to the elevation and contour of the soil surface. Operational loads introduced to the tank farm area may be distributed over a large area or applied at one or more concentrated points. Further studies will be performed to augment this initial study.

The basis for analysis of nominal loads applied to the vaults was in-situ nominally moist soil (125 lb/ft2). Loads from ICPP rain and snow melt is included in the nominal in-situ soil weight. The amount of permissible snow ground accumulation, coincident with other loads has yet to be established. The design snow load for the ICPP (35 lb/ft2) acting alone does not exceed the study acceptance criteria.

The load study1 established the 10% acceptance criteria for load affect on the tank farm. The use of a 10% acceptance criteria is an acceptable approach that recognizes that these vaults have withstood at-rest soil pressures. The vaults have been subjected to temporary load effects from surface construction vehicles, for example, large cranes brought on site periodically to support operations of the tank farm. This performance history of the tank vaults justifies the conclusion that they can accommodate a 10% increase in stress than those from at-rest soil conditions.

Load studies for the tank farm area must include, as a minimum, 1) acceptance criteria for evaluating loads, 2) limits on loads to prevent exceeding the 10% acceptance criteria that are used to preclude overloading of the HLLW tank vaults, and 3) an overall load control boundary area. Normally, these studies are updated as new information becomes available or if major conditions or operations within the tank farm area have changed.

New operational loads and changes in operational load configurations that could exceed limits specified by established load studies require further evaluation prior to being allowed in the tank farm area. These additional evaluations for the tank farm area include analysis and verification that determine whether 1) loads are within the allowable load limits and 2) if additional load restrictions are required. Also, these additional operational loads and configuration changes must be evaluated against the existing nominal and operational loads and conditions within the tank farm area. These studies must be performed and verified by qualified personnel in accordance with procedures. These changes to tank farm operational loads are approved and implemented by a methodology defined in controlled procedures.

This standard is implemented by approved operating procedures.

REFERENCE:

Approved by DOE-ID: R. M. Stallman, Letter to R. N. Gurley, "DOE Approval of Tank Farm Load Control Safety Document Revisions (OPE-CPP-96-006)," dated January 31, 1996.

p7.5-a1: Tank Farm Surface Load Limitations

DOCUMENT CATEGORY II Lockheed Martin Idaho Technologies CompanyINEL FORM L-0412.9# (08-96 - Rev. #00)

Management Control Procedure

ICPP--D&RI TANK FARM LOAD LIMITATIONS Identifier: CPP-MCP-P7.5-A1 Revision: 3 Page: of 5

Document Control Center (208) 526-3501 Document Owner/Approver: R. L. Hastings Effective Date:

P75-A1.WPD/LS/WPMCPDAR Number: 13860

1. PURPOSE

This procedure outlines the limitations for surface loads to enter the tank farm load zones in various surface conditions as per TS 4.2B14.

2. SCOPE AND APPLICABILITY

This procedure identifies loads that can be used on applicable tank farm load zones; included are actions to take when load type is needed, but not listed, or surface conditions such as snow or mud are present.

3. PREREQUISITES

None

4. INSTRUCTIONS

Survey Requirements for Tank Farm Surface Load Zones

4.1 Liquid Waste Processing Operators: GO TO form ICPP-4163X, Tank Farm Surface Load Zone Inspections, and perform a weekly (see instructions on 4163X) survey of existing surface conditions, vehicles and loads.

NOTE: Drawing number 097726, Limitations On Vehicle Loads On The ICPP Tank Farm, can be used as a reference.

4.2 Tank Farm Facility Management or Designee, or Liquid Waste Processing Shift Supervision: Review conditional steps 4.2.1 through 4.2.4 and go to the appropriate response step (4.3 through 4.6) for limitations and controls.

4.2.1 IF controlling and monitoring vehicles, THEN GO TO step 4.3.

4.2.2 IF controlling and monitoring non-vehicle loads such as gravel, soil, plywood and cement barriers, for example, THEN GO TO step 4.4.

4.2.3 IF controlling and monitoring large personnel groups, THEN GO TO step 4.5.

4.2.4 IF controlling and monitoring weather caused surface conditions, THEN GO TO step 4.6.

4.3 Prior to any vehicle entering tank farm load control zones, do the following:

NOTE 1: Drawing number 097726, Limitations On Vehicle Loads On The ICPP Tank Farm, can be used as a reference.

NOTE 2: Appendix A vehicle weights include the vehicle's nominal full loading.

4.3.1 IF the actual vehicle load exceeds the vehicle's full nominal load, contact tank farm facility management before proceeding.

4.3.2 GO TO Appendix A, Specified Vehicle Listing, to ensure vehicle is listed; THEN RETURN TO step 4.3.3.

4.3.3 IF a vehicle is not listed in Appendix A, THEN contact Tank Farm Facility management or Liquid Waste Processing shift supervision to see if the vehicle has prior access approval and filed per the 5% and 95% criteria (filed 4162X).

4.3.4 IF the vehicle has no prior access approval under the 5% and 95% criteria, THEN GO TO form ICPP-4162X, Tank Farm Vehicle or Load Addition Worksheet, to calculate the specified variables to verify if the 5% and 95% criteria can be met, AND RETURN TO step 4.3.5.

NOTE 1: Vehicles may be replaced by other vehicles on a one for one basis, provided they have similar loads and configurations.

NOTE 2: The 5% and 95% criteria are defined on form ICPP-4162X, Tank Farm Vehicle or Load Addition Worksheet.

NOTE 3: New vehicles are evaluated against those vehicles listed in Appendix A only.

4.3.5 IF the vehicle meets the criteria THEN GO TO ICPP-4162X, Tank Farm Vehicle or Load Addition Worksheet, complete, give to shift supervision, AND RETURN TO step 4.3.6.

4.3.6 WHEN a vehicle is approved (as shown on 4162X) or is listed in Appendix A's table, THEN GO TO the beginning of Appendix A for a listing of zones the specified vehicle can travel on, AND RETURN TO step 4.3.7.

4.3.7 Inform drivers that to prevent amplifying wheel pressure upon the soil, vehicle speed must be a maximum 2.5 mph.

4.3.8 IF moving a crane on location, THEN inform the crane operator that the crane boom and its load must be kept low (as reasonably possible) for safe transportation.

4.3.9 IF maintenance, access, or general activities to the tank farm disturbs the tank farm membrane, THEN contact the Tank Farm Facility Engineer or designee.

4.4 IF a non-vehicle load such as gravel, soil, plywood and concrete, for example, are needed on the tank farm, do the following:

4.4.1 IF the non-vehicle load is 1000 pounds or less, THEN no monitoring is needed.

4.4.2 IF a non-vehicle load exceeds 1000 pounds, THEN contact tank farm Facility Engineer or designee for further instructions.

4.5 IF a large closely assembled group needs access to the tank farm, do the following:

NOTE: Groups less than 17 need no monitoring.

4.5.1 IF a group between 18 and 54 accumulate in one area, THEN the group must be controlled and monitored to the equivalency and restrictions of a Category 1 vehicle.

4.5.2 IF a closely assembled group between 55 and 108 accumulate in one area, THEN the group must be controlled and monitored to the equivalency and restrictions of a Category 2 vehicle.

NOTE: Closely assembled groups beyond 108 are not allowed on the tank farm.

4.6 IF rain or snow has caused surface conditions to become questionable (visible puddles, obviously wet soil, or more than 16 inches of snow), THEN do the following:

NOTE 1: Rain amounts need not be monitored for tank farm surface load control.

NOTE 2: A tour group, regardless of individual spacing, is considered closely assembled.

4.6.1 IF more than 16 inches of surface snow depth is measured, THEN stop vehicle entrances, exits or movement on the tank farm, AND contact the Tank Farm Facility Engineer or designee.

4.6.2 IF surface conditions exist under heavy rain or snow accumulations, or is excessively muddy, THEN contact Industrial Safety or Tank Farm Facility management to determine if circumstances will make driving hazardous or will disturb the tank farm membrane.

5. RECORDS

ICPP-4162X, Tank Farm Vehicle or Load Addition Worksheet ICPP-4163X, Tank Farm Surface Load Zone Inspections

6. SOURCE REQUIREMENTS

TS 4.2b14, Load Controls for ICPP High-Level Liquid Waste Tank Vaults

7. APPENDICES

Appendix A, Vehicle Load Zone Guide and Specified Vehicle Listing

1. Vehicles given in the below table are grouped in four categories: I, II, II & IV.

2. Vehicles allowed in each zone as shown on drawing number 097726, Limitations On Vehicle Loads On The ICPP Tank Farm, are as follows.

1) Zone A: A maximum of two (2) category I vehicles (except Bobcat 753), at least 10 feet apart.

2) Zone B: A maximum of two (2) category I at least 10 feet apart.

3) Zone C: Zone can accommodate one of the following vehicles combinations at any given time

a. Four (4) category I vehicles

b. Two (2) category I vehicles and one (1) category II vehicle

c. Two (2) category II vehicles

d. One (1) category III vehicle

e. Any other combination of vehicles with a sum weighing factor of 4.0 or less (see table category headings) is also allowed in Zone C.

4) Zone D: Any combination of categories I, II, III, or IV (ò 50 ft. from VES-WM-180 through VES-WM-190 vault walls).

3. Zones A, B, and C are figured for the vehicle and its load weight only.

Category I vehicles (Weighing Factor equals 1.0)

Trucks

Ford Ranger 4X2

Ford Ranger 4X4

Ford F150

Ford F250

Ford F250 HD

Bobcat 753 Loader

Vibratory Rammers

Wacker BS45Y

Wacker BS60Y & GVR151Y

Wacker BS62Y, 65Y

Stone Duomat DR60 Roller

Personnel

Accumulate group of 18 to 54

Category II Vehicles (Weighing Factor equals 2.0)

Trucks

Ford F350 SWR

Ford F350 DRW

Ford F350 SD

Forklifts

Caterpillar V70F

Caterpillar V80F

Caterpillar V90F

Caterpillar V100F

Caterpillar VC110F

Caterpillar V110B

Backhoes

Case 580 Backhoe

Case 580E Extendahoe

Case 580 Super K Loader

Case 580D Backhoe

John Deere 310D Loader

Grove AP 308 Crane

Drill Rigs

Long Year 2200

Killman BK-B1

Wacker BS105Y

(continued)

(category II vehicles continued)

Category II Vehicles (Weighing Factor equals 2.0)

Vibratory Rollers

Wacker Mikasa MT-85

Wacker RS800A,H

Wacker RD880V

Wacker WDH86/110

Wacker W55, 55T, 74, 74A

Wacker RT560

Wacker RT820

Wacker R1000,S,B

Stone Duomat R50P

Stone Duomat DR70, 70P

Stone Duomat R778, DR77

Stone Duomat R90B

Stone Duomat CP323, CS323

Ingersol Rand DA-30 Roller

D4H Crawler Tractor

Simon MPL-60 Manlift

Personnel

Accumulate group of 55 to 108

Category III Vehicles (Weighing Factor equals 4.0)

Trucks

10 Yd. Dump Truck

Truck Tractor with 40 foot trailer

10 Yd. Concrete Truck

GM Two-Ton

Forklifts

Caterpillar V130B

Caterpillar V155B

Becho Drill Rig

CME 55 Drill Rig

Caterpillar 966C Loader

Caterpillar CB434 Roller

Cranes

P&H 18

P&H 35

P&H 120

P&H 122

P&H 128

Grove RT58C
RT 58 E

Grove RT418

Grove RT500

Grove RT550

Grove RT528C

Grove RT630B

Hitachi Trackhoe UH082

International 520 Loader

Liftall Forklift HT150

Single Loaded Hot Waste Box

Category IV Vehicles (Weighing Factor equals 5.0)

Cranes

P&H 150

P&H 165

P&H 750

Grove RT740B

Grove RT760

Grove RT865B

Grove RT990

Caterpillar 235 Loader

DOCUMENT CATEGORY II Lockheed Martin Idaho Technologies CompanyINEL FORM L-0412.9# (08-96 - Rev. #00)

Procedure Basis Document

ICPP--D&RI TANK FARM LOAD LIMITATIONS Identifier: CPP-PBD-B7.5-A1 Revision: 3 Page: of 1

Document Control Center (208) 526-3501 Document Owner/Approver: R. L. Hastings Effective Date:

P75-A1.WPD/LS/WPMCPDAR Number: 13860

The following writing team members should approve all substantive changes to P7.5-A1. The following subject matter experts (SMEs) helped create revision 0 of P7.5-A1.

Writing Team SMEs

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Engineering: Rhoel Tierra

Engineering: Nate Smith

Engineering: Sal Mascarenas

Step Number Step Basis Information Source

1. Procedure satisfies Technical Standard 4.2b14, Specification number 2 as the Methodology. TS 4.2b14, Spec. 2

4.5.1 Groups of 18 to 54 as Category 1 vehicle. Letter from Denis McGee to Robert Davis, WDM-32-95

4.5.2 Groups of 55 to 108 as Category 2 vehicle. Letter from Denis McGee to Robert Davis, WDM-32-95

4.6.1 and NOTE 1 Rain amounts need not be monitored for tank farm surface load control. Letter from Denis McGee to Robert Davis, WDM-31-95

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number: 73501
EDF Serial Number: EDF-TFC-039
Functional File Number: BC-22

Project/Task: CPP Tank Farm Closure
Sub task: LLW Grout Description

Title: NRC LOW LEVEL WASTE GROUT

SUMMARY

This EDF discusses the NRC LLW (Low Level Waste) grout classification requirements. Classification requirements are determined by radionuclide concentrations in Curies per cubic meter. There are three grout classification types, Class A, B, and C. The maximum requirements for these classifications are given in Table 1. A typical NRC Class C grout formula using 25% waste weight loading and the estimated radiological composition of NRC Class C grout are presented.

Distribution: B.R. Helm, D.J. Harrell, B.C. Spaulding, R.A. Gavalya and WTP EIS Studies Library on distribution.

Authors	Department	Reviewed	Approved
K.D. Mcallister	4130	R.A. Gavalya	B.C. Spaulding
Date 1-29-98		Date 1.29.98	Date 1/29/98

NRC Low Level Waste (LLW) Grout

The LLW fraction resulting from the separations process and Low Level Waste (LLW) generated during decontamination efforts will be grouted to stabilize the waste form. Since these wastes are highly acidic and contain high concentrations of nitrates, they become detrimental to Portland cement grout. Research is a must for preconditioning processes such as solidification, denitration, mixing processes and curing properties for LLW grout. Waste form qualification must also begin which includes compressive strength, leach resistance, thermal cycling, and immersion testing[1]. This research and testing is on going at present time by Allen Herbst, LLW grout technical lead at ICPP. Future tests will validate federal waste stability requirements.

Once a consensus is obtained on the preconditioning process of the grout, the grout classification must be determined. There are three types of NRC grout classifications: Class A, Class B, and Class C, with Class A and C grout being the least and most radioactive respectively. The following table shows requirements for three NRC LLW grout classifications[2]:

Table 1. NRC LLW Grout Classification Requirements.

	CONCENTRATION (maximums)		
Radionuclide	**Class A**	**Class B**	**Class C**
^{3}H	40 Ci/ m^3	N/A	N/A
^{63}Ni	3.5 Ci/ m^3	70 Ci/ m^3	700 Ci/ m^3
^{90}Sr	0.04 Ci/ m^3	150 Ci/ m^3	7000 Ci/ m^3
^{137}Cs	1 Ci/ m^3	44 Ci/ m^3	4600 Ci/ m^3
^{14}C	0.8 Ci/ m^3	***	8 Ci/ m^3
^{99}Tc	0.3 Ci/ m^3	***	3 Ci/ m^3
^{129}I	0.008 Ci/ m^3	***	0.08 Ci/ m^3
^{241}Pu	350 nCi/g	***	3500 nCi/g
Alpha-emitting radionuclides with half-lives > 5 years	10 nCi/g	***	100 nCi/g

*** These values cannot be determined from federal regulation 10 CFR 61.55.

NRC LLW grout is a mixture of LLW and clean grout and behaves much the same way as high strength clean grout (strength, flowability, etc.). Typically, the waste loading (by weight) is about 25% LLW and 75% clean grout. Table 2 is an example of a formulation for typical NRC LLW grout for Class C (or Class A grout) based on 25% waste weight loading and makes 1.0 ft^3:

Table 2. Typical Class C Grout Formula[3].

Specific Weight	115	lb/ft^3	
Strength	+3000	psi	
Recipe	28.9	lb/ft^3	Dry Denitrated Waste
	18	lb/ft^3	Portland Cement
	18	lb/ft^3	Blast Furnace Slag
	18	lb/ft^3	Fly Ash
	32.7	lb/ft^3	Water

[1] Tom Wichmann, Nicole Brooks, Mike Heiser, Regulatory Analysis and Proposed Path Forward for the Idaho National Engineering Laboratory High-level Waste Program, Oct. 1996: p A-3.

[2] 10 CFR 61.55

[3] AKH-02-97, October 20, 1997 Letter (Table 12)

NRC requires LLW grout strength to be at least 500 psi. This value of compressive strength is recommended as a practical strength value that is representative of the quality of cementitious material that should be used in the waste form to provide assurance that it will maintain integrity and thus possess long term structural capability[4].

Along with the strength requirement, NRC LLW grout requires shielding due to the radiation field potential. Table 3 shows the estimated radiological composition of Class C grout based on Doug Wenzel's Calcine Activities[5].

Table 3. Estimated Radiological Composition of Class C Grout.

Radionuclide	Alumina Calcine [Ci/m^3]	Zirconia Calcine [Ci/m^3]	SBW [Ci/m^3]
^{3}H	N/A	N/A	N/A
^{63}Ni	N/A	N/A	6.9E-02
^{90}Sr	6.2E+02	5.1E+02	5.2E+01
^{137}Cs	6.8E +02	3.9E+02	5.5E+01
^{14}C	N/A	N/A	N/A
^{99}Tc	3.3E-01	1.2E-01	2.1E-02
^{129}I	2.7E-04	9.3E-05	2.3E-03
^{241}Pu	1.4E-17 [Ci/g]	2.4E-16 [Ci/g]	5.9E-19 [Ci/g]
Alpha-emitting radionuclides with half-lives > 5 years	7.71E-10 [Ci/g]	4.60E-09 [Ci/g]	4.10E-13 [Ci/g]

Comparing Tables 1 and 3 it can be seen that the radiological composition of the Class C grout falls below the Class C grout requirement criteria. Therefore Class C grout radiation fields will not be as strong as they could be. This will reduce the amount of grout shielding and equipment needed to protect workers while emplacing the grout. After the pouring process has been completed, Class C grout emplacement equipment must be washed down, decontaminated and, if necessary, stored in an appropriate storage facility.

[4] Low-Level Waste Management Branch Division and Low-Level Waste Management and Decommissioning, Technical Position on Waste Form Rev. 1, Jan 1991, p A-3

[5] Charles Barnes, Estimates of Feed and Waste Volumes, Compositions and Properties, Aug. 21 1997, EDF-FDO-001, Function File Number ED-01.

EDF-TFC-040
CANCLED

INEL ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501

EDF Serial Number EDF-TFC-041

Functional File Number BC-21

Project/Task CPP Tank Farm Closure Study

Sub task Dose Rates for the Tank Farm

TITLE: DOSE RATES FOR TANK FARM CLOSURE TASKS

SUMMARY

This Engineering Design File presents the expected dose rates for the required tasks during the Tank Farm Facility closure.

A radiological engineer (Mac McCoy) who has had experience with the Tank Farm over a number of years provided the dose rates during a telephone conversation on 11/24/97. Some of the dose rates are based on work or studies that have been performed on the TFF, while others were estimated using engineering judgment.

See Table 1 on the following page for a description of the closure tasks and the corresponding dose rates.

Distribution: G. C. McCoy, MS 5209; D. J. Harrell, MS 3211; B. C. Spaulding, MS 3765; B. R. Helm, MS 3765; M. M. Dahlmeir, MS 3765; S. P. Swanson, MS 3765; Project File (Original +1)

Authors	Department	Reviewed	Approved
S. P. Swanson	MC&IE/4130	Date 11/25/97	Date 12/9/97

This Engineering Design File presents the expected dose rates for Tank Farm closure activities as provided by Mac McCoy (Radiological Engineer) during a telephone conversation on 11/24/97. The dose rates are based on a combination of studies, performed work, and engineering judgment.

See Table 1 for a list of the Tank Farm closure activities along with the corresponding radiation dose rates.

Table 1. Tank Farm Activities and Dose Rates

TASK	AVERAGE DOSE RATE mR/hr	REFERENCE
TANK AND PIPING ISOLATION (WITHIN VALVE BOXES)	30	Based on experience from the Valve Box Upgrade Project at the Tank Farm
CHARACTERIZE HEEL CONTAMINANTS	10	Engineering judgement – use remote equipment, personnel may temporarily be exposed to shine from an open riser during mobilization and demobilization of equipment, design the equipment and procedures to accommodate this dose rate
ITERATIVE VAULT DECONTAMINATION	5	Engineering judgement – use remote equipment, personnel may temporarily be exposed to shine from an open riser during mobilization and demobilization of equipment
ITERATIVE TANK DECONTAMINATION	5	Engineering judgment – use remote equipment, personnel may temporarily by exposed to shine from an open riser during mobilization and demobilization of equipment
CHARACTERIZE HEEL CONTAMINATNS FOR RA	10	Engineering judgement – use remote equipment, personnel may temporarily be exposed to shine from an open riser during mobilization and demobilization of equipment, design the equipment and procedures to accommodate this dose rate
GROUT HEEL (CLEAN GROUT)	1	Engineering judgement – radiation field should not be much higher than regular TFF field of .1 mR/hr

GROUT VAULT (CLEAN GROUT)	1	Engineering judgement – radiation field should not be much higher than regular TFF field of .1 mR/hr
TANK VOID (CLASS C GROUT FILL) – REMOTE OPERATIONS	100	100 mR/hr reading on above grade transport piping at 1 foot distance is the transition point between a Radiation Area and a High Radiation Area – shield the piping to this dose rate to prevent having a High Radiation Area
TANK VOID (CLEAN GROUT FILL)	1	Engineering judgement – radiation field should not be much higher than regular TFF field of .1 mR/hr

See EDT-TFC-040 for the expected dose estimates to personnel. EDF-TFC-040 utilizes these dose rates, along with expected manhours required for the tasks, to estimate the total exposure to personnel for each Tank Farm Closure option.

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501

EDF Serial Number EDF-TFC-042

Functional File Number C-10

Project/Task CPP Tank Farm Closure Study

Sub task Radiological Controls And Concerns

TITLE: Exposure and Shielding Calculations for Grout Lines

SUMMARY

This Engineering Design File contains the calculations from MicroShield Version 5.01 for the estimated radiation dose rates expected from the grout transfer lines. Assumptions used for the calculation of these dose rates are listed on the following pages.

Based on these calculations, if the grout transfer lines are shielded, the weight of the line plus shielding would be approximately 150 lbs. per linear foot of the 2" sched. 40 pipe. The larger pipes would be significantly more weight per linear foot.
If the lines are allowed to be left unshielded, the Tank Farm Facility would be required to be evacuated of personnel during the transfer to reduce exposures to ALARA.
Exposure rates from the residual grout are low enough to control exposures to a reasonable level if leaks or other problems arise the would require "hands-on" repairs.

Distribution: D. J. Harrell, MS 3211; B. C. Spaulding, MS 3765; B. R. Helm, MS 3765; M. M. Dahlmeir, MS 3765; G. C. McCoy, MS 5209; Project File (Original +1)

Authors	Department	Reviewed	Approved
G. C. McCoy (signature)	ES&H RadCon/1341	Robert Sant per TeleCom (signature) Date 12/17/97	(signature) Date 12/17/97

Calculation Assumptions

1. Activity of the grout listed in EDF-FDO-041, Table 32 is the base source term activity used for these calculations.

2. The only significant nuclides contributing to personnel exposure are Cs - 137 / Ba - 137M.

3. The activity will be homogeneously mixed in the grout.

4. Geometry used is a 100 ft. Length of pipe, of varying diameters, with the exposure rates taken at the midpoint of the pipe.

5. Pipe and wall thickness are based on standard schedule 40 values.

   A. 2" sched. 40, ID=2.067", wall=0.154"

   B. 3" sched. 40, ID=3.068", wall=0.216"

   C. 4" sched. 40, ID=4.026", wall=0.237"

6. Grout density, flowing grout = 1.5, dry grout (residual left in pipe) = 2.35

7. Grout activity:

   A. Cs- 137 = 590 Ci/M^3, (16.71 Ci/ft^3)

   B. Ba- 137M = 560 Ci/M^3, (15.86 Ci/ft^3)

8. Residual grout left inside of pipe after "pig" clean-out = 1/32" caked on the wall.

Three separate calculations were made on each pipe size.

1. Exposure rate at 1 ft., 30 centimeters (cm), at the midpoint of the pipe full of flowing grout.

2. Exposure rate at 1 ft., 30 centimeters (cm), at the midpoint of the pipe full of flowing grout shielded with enough steel to reduce exposure rate to less than 100 mr/hr (limit for a High Radiation Area).
3. Exposure rate at 1 ft., 30 centimeters (cm), at the midpoint of the pipe with a 1/32" coating of residual, dried grout, unshielded.

Based on these calculations, if the grout transfer lines are shielded, the weight of the line plus shielding would be approximately 150 lbs. per linear foot of the 2" sched. 40 pipe. The larger pipes would be significantly more weight per linear foot.

If the lines are allowed to be left unshielded, the Tank Farm Facility would be required to be evacuated of personnel during the transfer to reduce exposures to ALARA.

Exposure rates from the residual grout are low enough to control exposures to a reasonable level if leaks or other problems arise the would require "hands-on" repairs.

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: 2-RLGROT.MS5
Run Date: December 2, 1997
Run Time: 11:29:33 AM
Duration: 00:00:13

File Ref: EDF-TFC-042
Date: 12/2/97
By: [signature]
Checked: [signature]
12.2.97
Pg 4 of 12

Case Title: 2" Real Grout
Description: 2" Xfer line w/ calculated grout activity @ 30 cm
Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height	3.0e+3 cm	100 ft
Radius	2.625 cm	1.0 in

Dose Points

	X	Y	Z
# 1	33.49625 cm	1524 cm	0 cm
	1 ft 1.2 in	50 ft	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	6.60e+04 cm³	Concrete	1.5
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.391 cm	Iron	7.86

Source Input
Grouping Method : Standard Indices
Number of Groups : 4
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	3.6952e+001	1.3672e+012	5.6000e+002	2.0720e+007
Cs-137	3.8932e+001	1.4405e+012	5.9000e+002	2.1830e+007

Buildup
The material reference is : Wall Clad

Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	50

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	2.831e+10	1.870e-08	2.044e-08	1.558e-10	1.703e-10
0.0322	5.222e+10	7.339e-08	8.040e-08	5.906e-10	6.470e-10
0.0364	1.900e+10	2.025e-05	2.274e-05	1.151e-07	1.292e-07
0.6616	1.230e+12	8.113e+05	1.342e+06	1.573e+03	2.602e+03
TOTALS:	1.330e+12	8.113e+05	1.342e+06	1.573e+03	2.602e+03

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: 2-RLGRTS.MS5
Run Date: December 2, 1997
Run Time: 11:33:57 AM
Duration: 00:00:13

File Ref: EDF-TFC-04[illegible]
Date: 12/2/97
By: [signature]
Checked: [signature]
12.2.97
Pg 5 of 12

Case Title: 2" Real Grout Shld.
Description: 2" Xfer line-Calc. grout act.-Shielded to <100 mr/hr @ 30 cm
Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height	3.0e+3 cm	100 ft
Radius	2.625 cm	1.0 in

Dose Points

	X	Y	Z
# 1	40.48125 cm	1524 cm	0 cm
	1 ft 3.9 in	50 ft	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	6.60e+04 cm³	Concrete	1.5
Shield 1	6.985 cm	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.391 cm	Iron	7.86

Source Input
Grouping Method : Standard Indices
Number of Groups : 4
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	3.6952e+001	1.3672e+012	5.6000e+002	2.0720e+007
Cs-137	3.8932e+001	1.4405e+012	5.9000e+002	2.1830e+007

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	50

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	2.831e+10	2.852e-169	1.735e-23	2.376e-171	1.446e-25
0.0322	5.222e+10	2.357e-163	3.253e-23	1.897e-165	2.618e-25
0.0364	1.900e+10	5.444e-115	1.426e-23	3.093e-117	8.102e-26
0.6616	1.230e+12	5.369e+03	4.060e+04	1.041e+01	7.871e+01
TOTALS:	1.330e+12	5.369e+03	4.060e+04	1.041e+01	7.871e+01

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: 2-RLGRTR.MS5
Run Date: December 3, 1997
Run Time: 7:33:29 AM
Duration: 00:00:47

File Ref: EDF-TFC-042
Date: 12/3/97
By: [signature]
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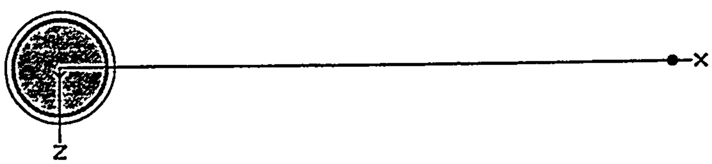
Pg 6 of 12

Case Title: 2" w/residual rl grt
Description: 2" Xfer line w/ 1/32" residual calc. grout @ 30 cm
Geometry: 12 - Annular Cylinder - External Dose Point



Source Dimensions

Height	3.0e+3 cm	100 ft
Radius	2.546 cm	1.0 in

Dose Points

	X	Y	Z
# 1	33.49625 cm	1524 cm	0 cm
	1 ft 1.2 in	50 ft	0.0 in

Shields

Shield Name	Dimension	Material	Density
Cyl. Core	.155 in³	Air	0.00122
Source	.031 in	Concrete	2.35
Shield 3	.154 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 4
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.2009e+000	8.1432e+010	5.6000e+002	2.0720e+007
Cs-137	2.3188e+000	8.5795e+010	5.9000e+002	2.1830e+007

Buildup
The material reference is : Shield 3

Integration Parameters

Radial	20
Circumferential	20
Y Direction (axial)	50

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	1.686e+09	3.798e-09	4.150e-09	3.163e-11	3.457e-11
0.0322	3.110e+09	1.456e-08	1.595e-08	1.172e-10	1.283e-10
0.0364	1.132e+09	3.179e-06	3.566e-06	1.806e-08	2.026e-08
0.6616	7.327e+10	5.970e+04	8.860e+04	1.157e+02	1.718e+02
TOTALS:	7.920e+10	5.970e+04	8.860e+04	1.157e+02	1.718e+02

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: 3-RLGROT.MS5
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Run Time: 2:25:28 PM
Duration: 00:00:13

File Ref: EDF-TFC-0
Date: 12/2/97
By: [signature]
Checked: [signature]

Pg 7 of 12

Case Title: 3" Real Grout
Description: 3" Xfer line w/ calculated grout activity @ 30 cm
Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height	3.0e+3 cm	100 ft
Radius	3.896 cm	1.5 in

Dose Points

	X	Y	Z
# 1	34.925 cm	1524 cm	0 cm
	1 ft 1.7 in	50 ft	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.45e+05 cm³	Concrete	1.5
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.549 cm	Iron	7.86

Source Input
Grouping Method : Standard Indices
Number of Groups : 4
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	8.1420e+001	3.0125e+012	5.6008e+002	2.0723e+007
Cs-137	8.5790e+001	3.1742e+012	5.9014e+002	2.1835e+007

Buildup
The material reference is : Wall Clad

Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	50

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	6.237e+10	5.056e-12	5.581e-12	4.212e-14	4.649e-14
0.0322	1.151e+11	2.606e-11	2.881e-11	2.097e-13	2.318e-13
0.0364	4.187e+10	7.640e-08	8.645e-08	4.341e-10	4.912e-10
0.6616	2.711e+12	1.277e+06	2.410e+06	2.475e+03	4.672e+03
TOTALS:	2.930e+12	1.277e+06	2.410e+06	2.475e+03	4.672e+03

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: 3-RLGRTS.MS5
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File Ref: EDF-TFC-042
Date: 12/2/97
By: [signature]
Checked: [signature]

Pg 8 of 12

Case Title: 3" Real Grout Shld.
Description: 3" Xfer line-Calc. grout act.-Shld to < 100 mr/hr @ 30 cm
Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height	3.0e+3 cm	100 ft
Radius	3.896 cm	1.5 in

Dose Points

	X	Y	Z
# 1	42.545 cm	1524 cm	0 cm
	1 ft 4.8 in	50 ft	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.45e+05 cm³	Concrete	1.5
Shield 1	7.62 cm	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.549 cm	Iron	7.86

Source Input
Grouping Method : Standard Indices
Number of Groups : 4
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	8.1420e+001	3.0125e+012	5.6008e+002	2.0723e+007
Cs-137	8.5790e+001	3.1742e+012	5.9014e+002	2.1835e+007

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	50

Results

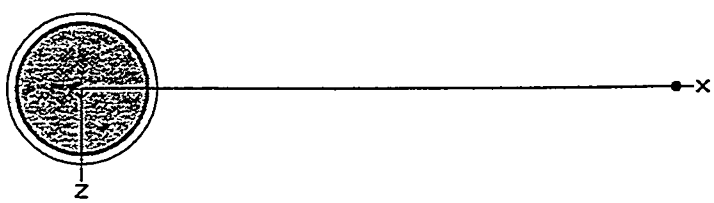
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	6.237e+10	2.515e-187	3.637e-23	2.095e-189	3.030e-25
0.0322	1.151e+11	8.373e-181	6.818e-23	6.739e-183	5.487e-25
0.0364	4.187e+10	3.171e-127	2.988e-23	1.802e-129	1.698e-25
0.6616	2.711e+12	5.750e+03	4.987e+04	1.115e+01	9.668e+01
TOTALS:	2.930e+12	5.750e+03	4.987e+04	1.115e+01	9.668e+01

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: 3-RLGRTR.MS5
Run Date: December 3, 1997
Run Time: 7:41:01 AM
Duration: 00:00:47

File Ref: EDF-TFC-04
Date: 12/3/97
By: [signature]
Checked: [signature]
Pg 9 of 12

Case Title: 3" w/residual rl grt
Description: 3" Xfer line w/ 1/32" residual calc. grout @ 30 cm
Geometry: 12 - Annular Cylinder - External Dose Point



Source Dimensions

Height	3.0e+3 cm	100 ft
Radius	3.817 cm	1.5 in

Dose Points

	X	Y	Z
# 1	34.925 cm	1524 cm	0 cm
	1 ft 1.7 in	50 ft	0.0 in

Shields

Shield Name	Dimension	Material	Density
Cyl. Core	.233 in³	Air	0.00122
Source	.031 in	Concrete	2.35
Shield 3	.216 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 4
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	3.2831e+000	1.2147e+011	5.6000e+002	2.0720e+007
Cs-137	3.4589e+000	1.2798e+011	5.9000e+002	2.1830e+007

Buildup
The material reference is : Shield 3

Integration Parameters

Radial	20
Circumferential	20
Y Direction (axial)	50

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	2.515e+09	1.005e-12	1.109e-12	8.373e-15	9.237e-15
0.0322	4.640e+09	5.073e-12	5.603e-12	4.083e-14	4.509e-14
0.0364	1.688e+09	1.182e-08	1.336e-08	6.716e-11	7.593e-11
0.6616	1.093e+11	6.977e+04	1.141e+05	1.353e+02	2.212e+02
TOTALS:	1.181e+11	6.977e+04	1.141e+05	1.353e+02	2.212e+02

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: 4-RLGROT.MS5
Run Date: December 2, 1997
Run Time: 2:30:53 PM
Duration: 00:00:13

File Ref: EDF-TFC-042
Date: 12/2/97
By: [signature]
Checked: [signature]
Pg 10 of 12

Case Title: 4" Real Grout
Description: 4" Xfer line w/ calculated grout activity @ 30 cm
Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height	3.0e+3 cm	100 ft
Radius	5.113 cm	2.0 in

Dose Points

	X	Y	Z
# 1	36.195 cm	1524 cm	0 cm
	1 ft 2.3 in	50 ft	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	2.50e+05 cm³	Concrete	1.5
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.602 cm	Iron	7.86

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	1.4021e+002	5.1878e+012	5.6009e+002	2.0723e+007
Cs-137	1.4773e+002	5.4660e+012	5.9013e+002	2.1835e+007

Buildup
The material reference is : Wall Clad

Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	50

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	1.074e+11	3.577e-13	3.954e-13	2.979e-15	3.294e-15
0.0322	1.982e+11	2.019e-12	2.238e-12	1.625e-14	1.801e-14
0.0364	7.211e+10	1.304e-08	1.478e-08	7.407e-11	8.399e-11
0.6616	4.668e+12	1.778e+06	3.596e+06	3.447e+03	6.971e+03
TOTALS:	5.046e+12	1.778e+06	3.596e+06	3.447e+03	6.971e+03

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: 4-RLGRTS.MS5
Run Date: December 2, 1997
Run Time: 3:09:24 PM
Duration: 00:00:13

File Ref: EDF-TFC-04
Date: 12/2/97
By: [signature]
Checked: [signature]
Pg 11 of 12

Case Title: 4" Real Grout Shld.
Description: 4" Xfer line-Calc. grout act.-Shielded to <100 mr/hr @ 30 cm
Geometry: 7 - Cylinder Volume - Side Shields

Source Dimensions

Height	3.0e+3 cm	100 ft
Radius	5.113 cm	2.0 in

Dose Points

	X	Y	Z
# 1	44.45 cm	1524 cm	0 cm
	1 ft 5.5 in	50 ft	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.53e+04 in³	Concrete	1.5
Shield 1	3.25 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122
Wall Clad	.237 in	Iron	7.86

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	1.4021e+002	5.1878e+012	5.6009e+002	2.0723e+007
Cs-137	1.4773e+002	5.4660e+012	5.9013e+002	2.1835e+007

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	10
Circumferential	10
Y Direction (axial)	50

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	1.074e+11	4.811e-203	5.994e-23	4.008e-205	4.992e-25
0.0322	1.982e+11	5.386e-196	1.124e-22	4.335e-198	9.042e-25
0.0364	7.211e+10	7.076e-138	4.925e-23	4.020e-140	2.798e-25
0.6616	4.668e+12	5.292e+03	5.124e+04	1.026e+01	9.934e+01
TOTALS:	5.046e+12	5.292e+03	5.124e+04	1.026e+01	9.934e+01

MicroShield v5.01 (5.01-00121)
Lockheed Martin Idaho Technologies Company

Page : 1
DOS File: 4-RLGRTR.MS5
Run Date: December 3, 1997
Run Time: 7:45:57 AM
Duration: 00:00:47

File Ref: EDF-TFC-042
Date: 12/3/97
By: [signature]
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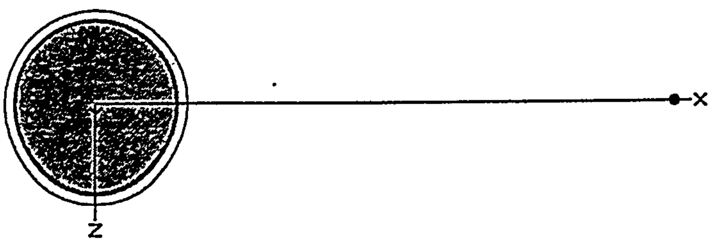
Pg 12 of 12

Case Title: 4" w/residual rl grt
Description: 4" Xfer line w/ 1/32" residual calc. grout @ 30 cm
Geometry: 12 - Annular Cylinder - External Dose Point



Source Dimensions

Height	3.0e+3 cm	100 ft
Radius	5.034 cm	2.0 in

Dose Points

	X	Y	Z
# 1	36.195 cm	1524 cm	0 cm
	1 ft 2.3 in	50 ft	0.0 in

Shields

Shield Name	Dimension	Material	Density
Cyl. Core	.307 in³	Air	0.00122
Source	.031 in	Concrete	2.35
Shield 3	.237 in	Iron	7.86
Transition		Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 4
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	4.3188e+000	1.5979e+011	5.6000e+002	2.0720e+007
Cs-137	4.5501e+000	1.6835e+011	5.9000e+002	2.1830e+007

Buildup
The material reference is : Shield 3

Integration Parameters

Radial	20
Circumferential	20
Y Direction (axial)	50

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	3.308e+09	6.986e-14	7.723e-14	5.819e-16	6.433e-16
0.0322	6.104e+09	3.873e-13	4.292e-13	3.117e-15	3.454e-15
0.0364	2.221e+09	2.022e-09	2.291e-09	1.149e-11	1.301e-11
0.6616	1.438e+11	8.184e+04	1.384e+05	1.587e+02	2.682e+02
TOTALS:	1.554e+11	8.184e+04	1.384e+05	1.587e+02	2.682e+02

ENGINEERING DESIGN FILE

Project File Number 73501

Project/Task CPP Tank Farm Closure Study

Subtask Estimated Radionuclide Release Rates

Title: TFF Radionuclide Release Rates

Summary: The following identifies the amount or radioactive contamination expected to be released during the closure of the Tank Farm. The release rate, in Ci/yr, were determined for each of the closure options. The contaminant sources used for this analysis are based on inventories reported in the Waste Inventories/Characterization Study (Garcia 1997). Conservative assumptions were made based on the six closure options that have been proposed for the facility. The results show that the release rate for the five options where the tanks are left in place is 3.1E-02 Ci/yr. The release rate for the sixth option was not quantitatively determined since time for the total removal of the tanks has not been determined. However, the total release of radionuclides over the lifetime of this option will be the same as that for the other five options. Attached are the assumptions and calculations that were performed to reach these conclusions.

Distribution (complete package): R. A. Gavalya, D. J. Harrell, B. R. Helm, B. C. Spaulding, LMITCO; WTP EIS Studies Library, Tank Farm Closure Library

Distribution (summary package only):

Author	Dept.	Reviewed	Date	Approved	Date
I. E. Stepan [signature]	3170 1/14/98	R. G. Peatross [signature]	1/14/98 1/14/98	[signature]	1/29/98
		LMITCO Review [signature: Rick A. Gavalya]	Date 1.29.98	LMITCO Approval	Date

The following assumptions were made in developing the tank farm source term:

- The inventories from the Waste Inventories/Characterization Study (Garcia 1997) were used as a basis for the source term.
- A heel of 1 inch is assumed to be left in each of the tanks prior to washing and grouting. The 1 inch heel converts to a volume of 1230 gal of waste remaining in each of the tanks..
- It was assumed the liquid in the tanks is homogeneous.
- An offgas system containing at least 1 HEPA filter will be in place to remove 99% of any material which may be released via the airborne pathway.
- No material is assumed to be released during the filling operations because, (1) the fill will be prepared offsite and (2) it will be introduced into the tanks through a closed system.
- The washing and grouting operations will take place over a 12 year period for all options.
- It is assumed that 0.2% of the material will become airborne during the washing and grouting operations.

Shown in Table 1 are the concentrations, in mCi/l, for the tank farm radiological contaminant inventory as taken from Tables 15 and 18 from the Waste Inventories/Characterization Study (Garcia 1997). These concentrations were multiplied by the assumed tank heel volumes of 1230 gal and the appropriate conversion factors which results in the total radiological source term (in curies) for each of the tanks. These values are listed in Table 2. Also listed in the last column of Table 2 and the second column of Table 3 is the total amount of curies assumed to be in the Tank Farm prior to the washing and grouting operations.

During the washing and grouting operations, it is assumed that 0.2 % of the material becomes airborne and is released. This value comes from DOE-HDBK-3010-94, which is the release fraction of material from a boiling liquid. The value is conservative since material should not be released as readily from the washing and grouting operations as would be released from the boiling liquid. Only 1% of any airborne material released will be released to the atmosphere because it first goes through a HEPA filter where 99% of the airborne material will be removed. Multiplying the total amount of each radionuclide in the Tank Farm by the release fraction (0.002) and the HEPA fraction (0.01) yields the amount released to the atmosphere during the washing and grouting operations. These values are listed in the third column in Table 3. Finally, it is assumed that the washing and grouting operations for the entire tank farm will occur over a span of 12 years. Therefore, the yearly release rate of material is found by dividing this number into the amount of material released. The release rates are given in the final column of Table 3 with the total release rate being 3.1E-02 Ci/yr. This is the release rate for all 5 Tank Farm options since it was assumed that nothing would be released during the filling operations.

One last option to be considered is the total removal of the material from the tank farm. The release rate for this option will be approximately the same as that for grouting the material in place. The release fraction used for the other options (0.002) can also be used for this option because it is a conservative value. And assuming an offgas system is in operation when removing the material from the Tank Farm, the resulting total release is the same as the previous options. The release rate, therefore, depends on the time it takes to remove the material. If it is shorter than 12 years, the release for this option is higher than that of the other six, and vise versa if the time is greater than 12 years.

Table 1. Concentration (mCi/l) of radionuclides in the Tank Farm.

Contaminant	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190
Am-241	6.30E-02	3.40E-02	0.00E+00	6.40E-02	6.20E-02	0.00E+00	0.00E+00	0.00E+00	5.80E-02	0.00E+00	0.00E+00
Ce-144	0.00E+00	8.60E+00	4.17E+01	2.40E+00	0.00E+00	3.80E+00	2.20E+00	2.54E+00	2.40E+01	5.41E+00	2.40E-01
Co-60	0.00E+00	3.80E-01	0.00E+00	2.50E-01	0.00E+00	2.04E-01	1.50E-01	3.60E-01	3.69E-01	2.10E-01	0.00E+00
Cs-134	1.20E-01	2.20E+00	4.14E+01	1.40E+00	3.00E-02	3.40E+00	2.00E+00	3.82E+00	1.60E+00	2.16E+00	3.40E-01
Cs-137	3.00E+01	6.04E+01	6.51E+02	2.30E+02	2.40E+01	6.48E+01	3.80E+01	4.06E+02	3.64E+02	1.18E+02	1.58E+01
Eu-154	7.80E-04	7.70E-01	8.87E+00	1.40E+00	4.00E-02	4.50E-01	2.60E-01	3.66E+00	1.84E+00	7.60E-01	1.20E-01
Eu-155	0.00E+00	3.80E-01	3.80E+00	1.70E+00	0.00E+00	0.00E+00	0.00E+00	1.56E+00	7.19E-01	3.10E-01	5.30E-02
H-3	2.80E-02	5.00E-02	2.21E+00	2.30E-04	3.00E-02	0.00E+00	0.00E+00	2.10E-01	1.40E-01	0.00E+00	0.00E+00
I-129	1.40E-05	3.30E-04	0.00E+00	1.20E-02	5.40E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-63	2.60E-02	9.30E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-237	2.80E-03	4.80E-03	0.00E+00	8.00E-03	4.60E-04	0.00E+00	0.00E+00	0.00E+00	7.00E-03	0.00E+00	0.00E+00
Pu-238	6.60E-01	1.05E+00	6.70E-01	2.10E-01	6.59E-01	0.00E+00	0.00E+00	8.60E-01	8.04E-01	0.00E+00	0.00E+00
Pu-239	9.50E-02	4.20E-02	1.34E+00	7.40E-02	8.30E-02	0.00E+00	0.00E+00	1.74E+00	1.21E-01	0.00E+00	0.00E+00
Pu-241	6.05E-01	9.56E-01	2.10E-01	0.00E+00	6.95E-01	0.00E+00	0.00E+00	2.80E-01	0.00E+00	0.00E+00	0.00E+00
Pu-242	1.00E-05	2.00E-05	9.00E-04	0.00E+00	1.00E-05	0.00E+00	0.00E+00	1.15E-03	0.00E+00	0.00E+00	0.00E+00
Ru-106	0.00E+00	3.90E+00	1.08E+01	0.00E+00	0.00E+00	1.19E+00	6.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sb-125	0.00E+00	5.40E-01	7.80E-01	0.00E+00	0.00E+00	4.30E-01	2.50E-01	1.84E+00	0.00E+00	0.00E+00	0.00E+00
Sr-90	2.50E+01	5.84E+01	6.19E+02	2.40E+02	2.70E+01	6.09E+01	3.50E+01	4.00E+02	2.76E+02	6.59E+01	0.00E+00
Tc-99	0.00E+00	0.00E+00	0.00E+00	1.70E-02	8.70E-03	1.35E-02	7.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
U-234	2.92E-06	2.85E-06	1.20E-06	4.87E-06	2.17E-06	3.22E-06	0.00E+00	2.98E-07	4.53E-06	2.08E-07	0.00E+00
U-235	1.03E-06	1.00E-06	4.22E-07	1.71E-06	7.64E-07	1.13E-06	0.00E+00	1.05E-07	1.59E-06	7.33E-08	0.00E+00
U-236	7.43E-07	7.24E-07	3.05E-07	1.24E-06	5.53E-07	8.20E-07	0.00E+00	7.58E-08	1.15E-06	5.30E-08	0.00E+00
U-238	2.61E-05	2.54E-05	1.07E-05	4.35E-05	1.94E-05	2.88E-05	0.00E+00	2.66E-06	4.05E-05	1.86E-06	0.00E+00
Zr-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-01	0.00E+00	0.00E+00

Table 2. Total curies of radionuclides in the Tank Farm.[a]

Contaminant	WM-180	WM-181	WM-182	WM-183	WM-184	WM-185	WM-186	WM-187	WM-188	WM-189	WM-190	Total Curies
Am-241	2.92E-01	1.57E-01	0.00E+00	2.96E-01	2.87E-01	0.00E+00	0.00E+00	0.00E+00	2.69E-01	0.00E+00	0.00E+00	1.30E+00
Ce-144	0.00E+00	3.98E+01	1.93E+02	1.11E+01	0.00E+00	1.76E+01	1.02E+01	1.18E+01	1.11E+02	2.51E+01	1.11E+00	4.21E+02
Co-60	0.00E+00	1.76E+00	0.00E+00	1.16E+00	0.00E+00	9.45E-01	6.95E-01	1.67E+00	1.71E+00	9.72E-01	0.00E+00	8.91E+00
Cs-134	5.56E-01	1.02E+01	1.91E+02	6.48E+00	1.39E-01	1.57E+01	9.26E+00	1.77E+01	7.41E+00	1.00E+01	1.57E+00	2.71E+02
Cs-137	1.39E+02	2.80E+02	3.02E+03	1.07E+03	1.11E+02	3.00E+02	1.76E+02	1.88E+03	1.69E+03	5.46E+02	7.32E+01	9.27E+03
Eu-154	3.61E-03	3.57E+00	4.11E+01	6.48E+00	1.85E-01	2.08E+00	1.20E+00	1.69E+01	8.52E+00	3.52E+00	5.56E-01	8.41E+01
Eu-155	0.00E+00	1.76E+00	1.76E+01	7.87E+00	0.00E+00	0.00E+00	0.00E+00	7.22E+00	3.33E+00	1.44E+00	2.45E-01	3.95E+01
H-3	1.30E-01	2.32E-01	1.02E+01	1.07E-03	1.39E-01	0.00E+00	0.00E+00	9.72E-01	6.48E-01	0.00E+00	0.00E+00	1.24E+01
I-129	6.48E-05	1.53E-03	0.00E+00	5.56E-02	2.50E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.22E-02
Ni-63	1.20E-01	4.31E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.51E-01
Np-237	1.30E-02	2.22E-02	0.00E+00	3.70E-02	2.13E-03	0.00E+00	0.00E+00	0.00E+00	3.24E-02	0.00E+00	0.00E+00	1.07E-01
Pu-238	3.06E+00	4.86E+00	3.10E+00	9.72E-01	3.05E+00	0.00E+00	0.00E+00	3.98E+00	3.72E+00	0.00E+00	0.00E+00	2.28E+01
Pu-239	4.40E-01	1.94E-01	6.21E+00	3.43E-01	3.84E-01	0.00E+00	0.00E+00	8.06E+00	5.60E-01	0.00E+00	0.00E+00	1.62E+01
Pu-241	2.80E+00	4.43E+00	9.72E-01	0.00E+00	3.22E+00	0.00E+00	0.00E+00	1.30E+00	0.00E+00	0.00E+00	0.00E+00	1.27E+01
Pu-242	4.63E-05	9.26E-05	4.17E-03	0.00E+00	4.63E-05	0.00E+00	0.00E+00	5.33E-03	0.00E+00	0.00E+00	0.00E+00	9.68E-03
Ru-106	0.00E+00	1.81E+01	5.02E+01	0.00E+00	0.00E+00	5.51E+00	3.20E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.70E+01
Sb-125	0.00E+00	2.50E+00	3.61E+00	0.00E+00	0.00E+00	1.99E+00	1.16E+00	8.52E+00	0.00E+00	0.00E+00	0.00E+00	1.78E+01
Sr-90	1.16E+02	2.70E+02	2.87E+03	1.11E+03	1.25E+02	2.82E+02	1.62E+02	1.85E+03	1.28E+03	3.05E+02	0.00E+00	8.37E+03
Tc-99	0.00E+00	0.00E+00	0.00E+00	7.87E-02	4.03E-02	6.25E-02	3.61E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.18E-01
U-234	1.35E-05	1.32E-05	5.55E-06	2.26E-05	1.01E-05	1.49E-05	0.00E+00	1.38E-06	2.10E-05	9.65E-07	0.00E+00	1.03E-04
U-235	4.76E-06	4.64E-06	1.95E-06	7.93E-06	3.54E-06	5.25E-06	0.00E+00	4.85E-07	7.38E-06	3.39E-07	0.00E+00	3.63E-05
U-236	3.44E-06	3.35E-06	1.41E-06	5.74E-06	2.56E-06	3.80E-06	0.00E+00	3.51E-07	5.34E-06	2.45E-07	0.00E+00	2.62E-05
U-238	1.21E-04	1.18E-04	4.96E-05	2.01E-04	8.98E-05	1.33E-04	0.00E+00	1.23E-05	1.87E-04	8.61E-06	0.00E+00	9.21E-04
Zr-95	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.63E-01	0.00E+00	0.00E+00	4.63E-01

a. This is the total inventory assuming a 1" heel remains in each of the tanks.

Table 3. Release rate of radionuclides from the Tank Farm.[a]

Contaminant	Total Curies	Curies Released	Release Rate (Ci/y)
Am-241	1.30E+00	2.60E-05	2.17E-06
Ce-144	4.21E+02	8.42E-03	7.02E-04
Co-60	8.90E+00	1.78E-04	1.48E-05
Cs-134	2.71E+02	5.41E-03	4.51E-04
Cs-137	9.27E+03	1.85E-01	1.55E-02
Eu-154	8.41E+01	1.68E-03	1.40E-04
Eu-155	3.95E+01	7.89E-04	6.58E-05
H-3	1.24E+01	2.47E-04	2.06E-05
I-129	8.22E-02	1.64E-06	1.37E-07
Ni-63	5.51E-01	1.10E-05	9.18E-07
Np-237	1.07E-01	2.14E-06	1.78E-07
Pu-238	2.28E+01	4.55E-04	3.79E-05
Pu-239	1.62E+01	3.24E-04	2.70E-05
Pu-241	1.27E+01	2.54E-04	2.12E-05
Pu-242	9.68E-03	1.94E-07	1.61E-08
Ru-106	7.70E+01	1.54E-03	1.28E-04
Sb-125	1.78E+01	3.56E-04	2.96E-05
Sr-90	8.37E+03	1.67E-01	1.40E-02
Tc-99	2.18E-01	4.35E-06	3.63E-07
U-234	1.03E-04	2.06E-09	1.72E-10
U-235	3.63E-05	7.26E-10	6.05E-11
U-236	2.62E-05	5.25E-10	4.37E-11
U-238	9.21E-04	1.84E-08	1.53E-09
Zr-95	4.63E-01	9.26E-06	7.72E-07
Total	1.86E+04	3.73E-01	3.10E-02

a. These results based on a 1" heel remaining in each of the tanks.

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501
EDF Serial Number EDF-TFC-044
Functional File Number BC-22

Project/Task CPP Tank Farm Closure Study
Sub task Documentation of Clean Closure of Percolation Ponds at ICPP

TITLE: Documentation of the Clean Closure of a System with Listed Waste Discharge

SUMMARY

This EDF provides documentation of the clean-closure of the ICPP Percolation Ponds #1 and #2. This is documented by the attached letter, dated November 29, 1995 from O. D. Green, Assistant Administrator, Idaho Division of Environmental Quality, to D. N. Rasch, DOE-ID.

These ponds had both listed and characteristic hazardous wastes discharged to the ponds. The closure, through a sampling effort and subsequent preparation of a risk assessment, identified that there was no unacceptable risk associated with the closure. The State of Idaho accepted this documentation per this attachment.

Distribution: B. C. Spaulding, MS 3765; B. R. Helm, MS 3765; M. M. Dahlmier, MS 3765; L. C. Tuott, MS 3428; Project File (orginal +1)

Authors	Department	Reviewed	Approved
L. C. Tuott (signature) 1-23-98	Environmental Affairs	(signature) Date 1/28/98	(signature) Date 1/28/98

IDAHO DEPARTMENT
OF HEALTH AND WELFARE
DIVISION OF
ENVIRONMENTAL QUALITY

1410 North Hilton, Boise, ID 83706-1255, (208) 334-0502

Philip E. Batt, Governor

RECEIVED IN
DEC 05 1995
Environmental Support

RECEIVED
Jay R. Mitchell
DEC 09 1995

Action to: ______ Info Only: ____
Due Date: ______ Copy to: ____

November 29, 1995

Donald N. Rasch
Senior Environmental Engineer
Sitewide Programs
Department of Energy
Idaho Operations Office
850 Energy Drive
Idaho Falls, Idaho 83401-1563

Dear Mr. Rasch:

The Idaho Division of Environmental Quality (IDEQ) has received and reviewed the RCRA Clean-Closure Certifications for the ICPP-Percolation Pond #1 (OPE\ES-94-165), dated June 1, 1994, and for Percolation Pond #2 (OPE-SP-95-239), dated April 21, 1995. The closure requirements for both Percolation Ponds #1 and #2 are pursuant to the October 7, 1992 and October 6, 1995 Consent Orders.

After review of the RCRA Clean-Closure Certifications for the ICPP-Percolation Ponds #1 and #2, it appears that DOE has complied with all terms and conditions of the approved Closure Plan for the Percolation Ponds. IDEQ confirms the ICPP-Percolation Ponds #1 and #2 are now "clean closed" under the Federal Resource Conservation and Recovery Act (RCRA)/Idaho Hazardous Waste Management Act (HWMA).

IDEQ thanks you for your cooperation in this matter. If you have any questions, please contact D. Michael Gregory of my staff at (208) 373-0502.

Sincerely,

Orville D. Green

Orville D. Green
Assistant Administrator
Permits and Enforcement
Idaho Division of Environmental Quality

ODG:tg c:\...\mike\inel\ppond.clo

cc: J. Johnston, EIRO
B. Monson, IDEQ-OPB
D. Pisarski, IDEQ-EB
INipc

INEL

ENGINEERING DESIGN FILE

Form L-0431.2#
(05-96-Rev.#02)

Project File Number 73501
EDF Serial Number EDF-TFC-045
Functional File Number BC-22

Project/Task: CPP Tank Farm Closure Study
Sub task: ORNL Method of Calculation of Concentrations of Radionuclide in Tanks

TITLE: Documentation of the ORNL Method of Radionuclide Concentrations in Tanks

SUMMARY

This EDF provides documentation of the method and assumptions used by ORNL to calculate the radionuclide concentrations in mixed waste storage tanks that had residue in the bottom. This is documented by the attached "Responses to Regulator's Concerns Associated with In-place Stablizization of Tank WC-14" dated April 30, 1997 from J. R. DeVore to M. R. Peet. The ORNL calculated that the radionuclides would be mixed throughout the volume of the tank for the calculation purposes.

Distribution: B. C. Spaulding, MS 3765; B. R. Helm, MS 3765; M. M. Dahlmier, MS 3765; L. C. Tuott, MS 3428; Project File (orginal +1)

Authors	Department	Reviewed	Approved
L. C. Tuott 1-23-98	Environmental Affairs	Date 1/28/98	Date 1/28/98

Attachment 1 (Page 2 of 2)
Responses to Regulator's Concerns Associated with In-Place Stabilization of Tank WC-14

Date: 30 April, 1997

To: M. R. Peet

From: J. R. DeVore

Subject: Radionuclide and RCRA Material Concentration of Materials in Tank WC-14 after Solidification

Reference: Sampling and Analysis of Inactive Radioactive Waste Tanks W-17, W-18, WC-5, WC-6, WC-8, and WC-11 through WC-14 at ORNL, ORNL/TM-13017,
E-mail, W. R. Clark to M. R. Peet, Result on WC-14 Sludge, 3/3/97,
ORNL C&AS Results of Analysis, IPA7980, 3/8/97.

The concentration of TRU radionuclides, PCBs, and RCRA metals for the solidified sludge in tank WC-14 have been calculated and are shown in the tables below. The assumptions used in doing these calculations are: 1) that the volume of original sludge is 100 gal., 2) that the tank volume is 1000 gal, and 3) that the sludge is 100% mixed with the added grout. The concentrations could be somewhat different if these are incorrect.

RCRA Metals

Component	Concentration (mg/kg)	Concentration (mg/kg) (20x dilution)	RCRA TCLP Limit (mg/L)
Ag	4.8	0.2	5
As	<0.006	<0.006	5
Ba	3.5	0.18	100
Cd	11.1	0.6	1
Cr	16	0.8	5
Hg	0.4	0.02	0.2
Ni	62	3.1	-
Pb	27	1.4	5
Se	<0.006	<0.006	1
PCBs			TSCA Limit (mg/L)
Arochlor 1242	9.2	-	50
Arochlor 1254	2	-	50
Transuranic Radionuclides	Concentration (Bq/g)	-	DOE Limit (Bq/g)
Pu238	1.07E2	-	3.7E3
Pu239/240	1.024E3	-	3.7E3
Cm244	1.30E2	-	3.7E3
Am241	7.45E2	-	3.7E3
TRU Alpha	1.862E3	-	3.7E3

The above concentrations are expressed in mg per kilogram (or Bq per gram) of grouted sludge. The above concentrations of radionuclides are below the DOE guideline for TRU waste of 100 nCi/g (3700 Bq/g). The RCRA metals above are also below their regulatory limits.