

# **TANK RISER SUSPENSION SYSTEM CONCEPTUAL DESIGN (U)**

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**September 15, 2002**

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**This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U. S. Department of Energy.**

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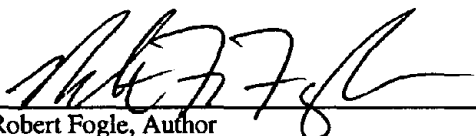
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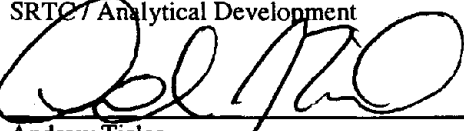
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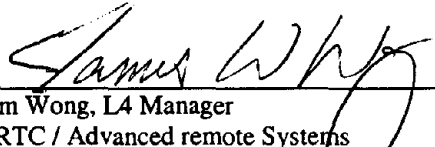
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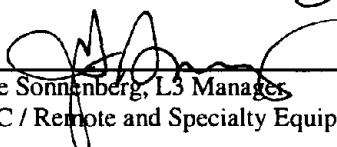
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## **EXECUTIVE SUMMARY**

A team of engineers from High Level Waste (HLW), the Savannah River Technology Center (SRTC), and Project Engineering and Construction Division (PE&CD) explored ways of more effectively utilizing the HLW tank's risers during waste removal and closure activities. Currently, some of the risers are being used to store failed and contaminated equipment. To make those risers available for tank operation, failed equipment must be moved out of the tank and relocated or disposed of appropriately. Disposing of contaminated equipment is a time consuming and expensive process. This report describes the Tank Riser Suspension System (TRSS). It will allow failed equipment to be stored inside of the tank while making riser space available for other tank process equipment. In addition, the TRSS will permit disposing of failed equipment in the tank as part of tank closure activities.

## **BACKGROUND**

High-level radioactive liquid wastes are received, stored, and processed in large underground tanks at SRS. Five different types of tanks were built at SRS. Four of the five tanks are shown in Appendix A. Each type is unique and incorporates the lessons learned from past designs. There are risers on or integral with the top of each tank. Each tank type has a unique riser configuration as shown in Appendix B. The risers permit access to the tank and the tank's annulus. They are used primarily for the installation of pumps, cooling equipment, instrumentation probes, measuring devices, monitoring tools, and samplers. Examples of pumps used in the waste tanks can be found in Appendix C.

Type I Waste tanks have 15 risers, including the center riser. Type II Waste tanks have 28 risers. Type III Waste Tanks and Type IIIA Waste tanks have 40 risers. Type IV Waste tanks have 7 risers, including the center riser. The inside diameter (ID) of typical risers normally ranges between 23" and 42", but some of them are very large. For example, the ID of the center riser of a Type IV tank is approximately 9 feet. A drawing of the cross section of a typical riser can be found in Appendix D.

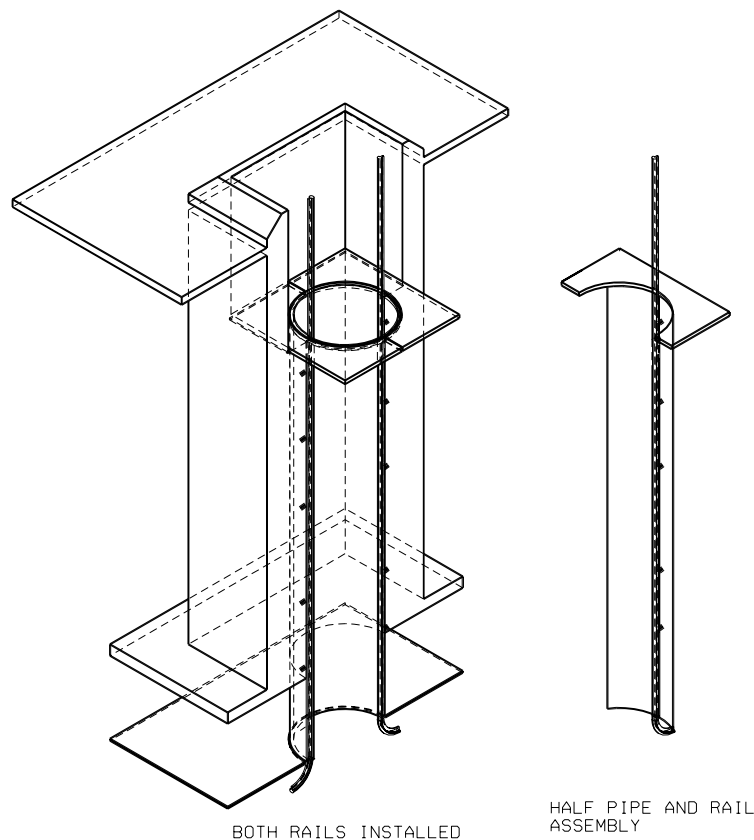
There are a limited number of risers on a tank top. Efficiently utilizing them is crucial for successful waste removal and tank disclosure operations. Some of the risers are occupied by failed and contaminated equipment. To make those risers available for tank operation, the stored failed equipment must be moved out of the tank and disposed of appropriately. Disposing of contaminated equipment is a time consuming and expensive process. An alternative is the TRSS. It permits storing equipment inside of the tank while making the riser space available for other tank process equipment. This option will allow disposing of failed equipment in the tank during tank closure and may significantly reduce personnel radiation exposure and waste disposal costs.

## CONCEPTUAL DESIGN

The TRSS is based on the concept of hanging failed equipment with cables in a riser. The major components of the TRSS include the following:

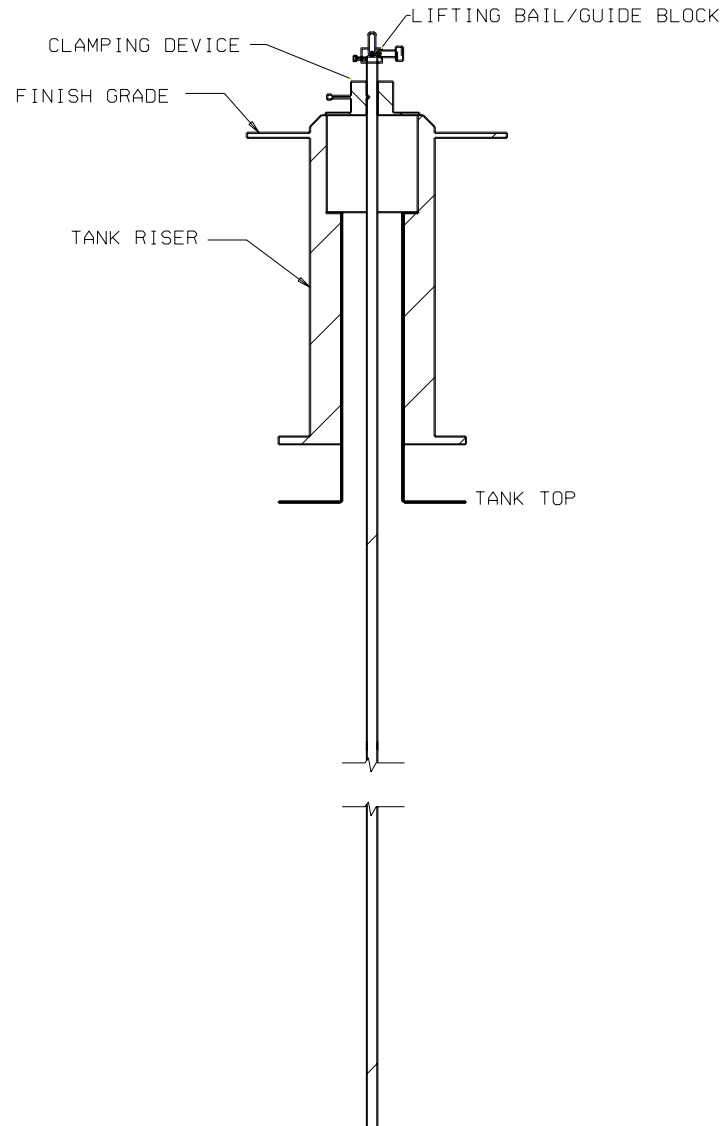
1. A riser insert with rail guides
2. A clamp and rail attachment device
3. A lifting bail/guide block
4. A remotely detachable crane hook

The TRSS utilizes a riser insert with attached rails for hanging equipment as shown in Figure 1. The insert must be constructed of at least 2 sections with each part having a rail section. Figure 1 shows an insert consisting of 2 halves. The insert is installed into an empty riser using a crane. The rails extend into the tank and curve up to be parallel with the tank ceiling. In this way, the failed equipment can be stored away from the riser opening. By doing this, the riser is available for normal tank activities as well as for storage.



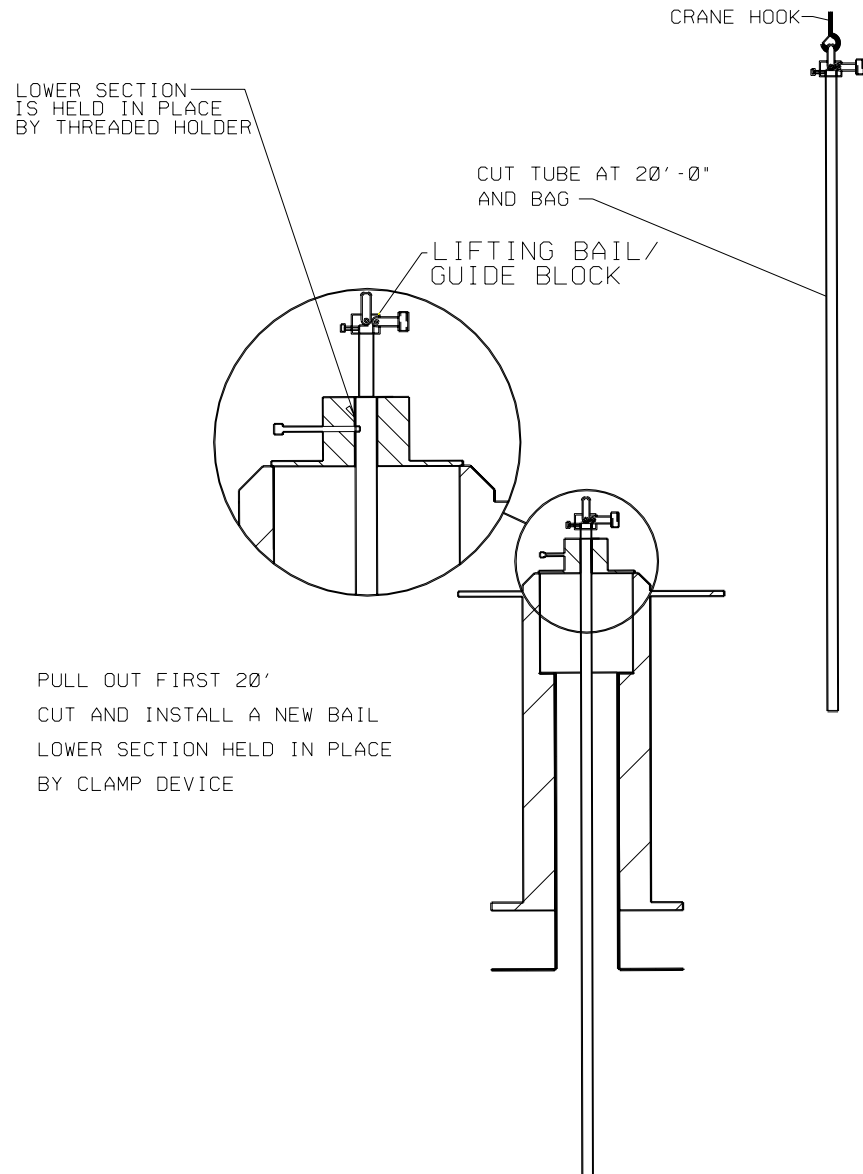
**Figure 1: Rail installation in a riser**

If a pump or other equipment should fail in a riser, the first step is to remove the equipment from the riser. A clamp and rail attachment device or devices must be designed to grip the various sizes of equipment used in riser. As an example, Figure 2 shows a simple 4-inch tube that is to be stored in the tank as failed and contaminated equipment. A clamping device is shown securing the failed equipment. The lifting bail/guide block assembly is attached to handle the failed equipment. The equipment is removed from the riser by using a crane.



**Figure 2: Riser with 4" tube installed**

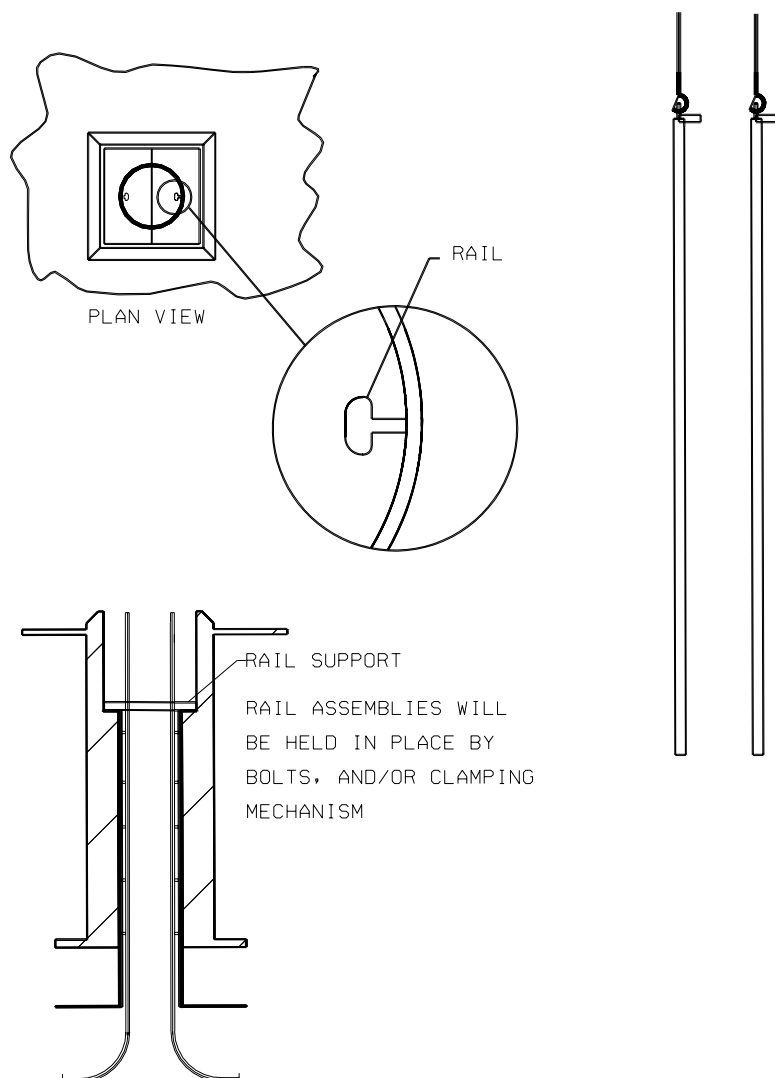
The failed equipment cannot extend into the waste as this may cause an interference with tank closure activities. Equipment that is too long will have to be size-reduced. With the failed equipment held by a crane, the clamping device is loosened. The crane can then remove an appropriate length from the tank. The clamp secures the equipment remaining in the tank. The upper section of the failed device is cut as shown in Figure 3 while the lower section is held firmly in place by the clamp.



**Figure 3: Sectioning equipment to fit inside the tank**

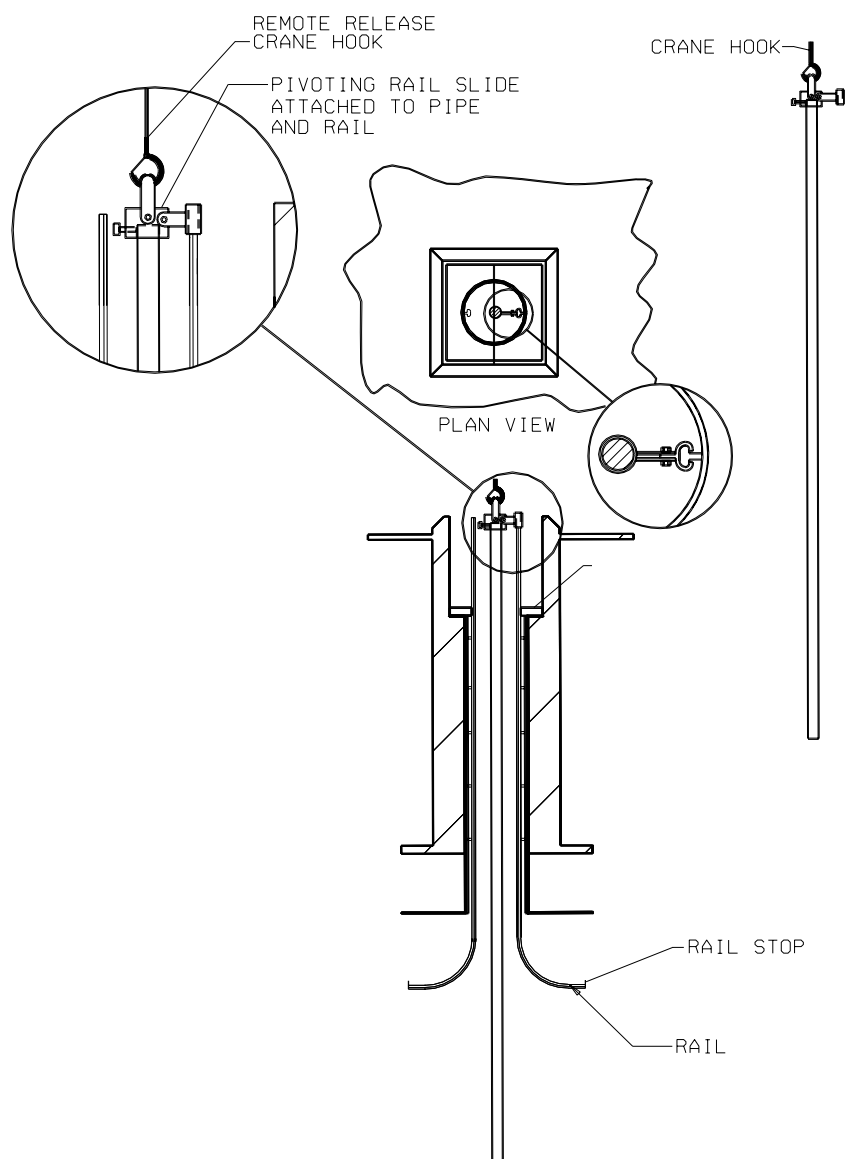


The removed section is monitored for radioactivity. It may or may not be stored in the tank based on the radiological survey. Assuming it is to be put back in the tank, it is temporarily stored on the tank top. The remaining section in the riser is then lifted out of the tank and is cut into smaller sections and surveyed. Once the equipment removal process is complete, the TRSS is installed in the riser as shown in Figure 4. The sections of failed equipment are then ready to be lifted by the crane and returned to the tank.



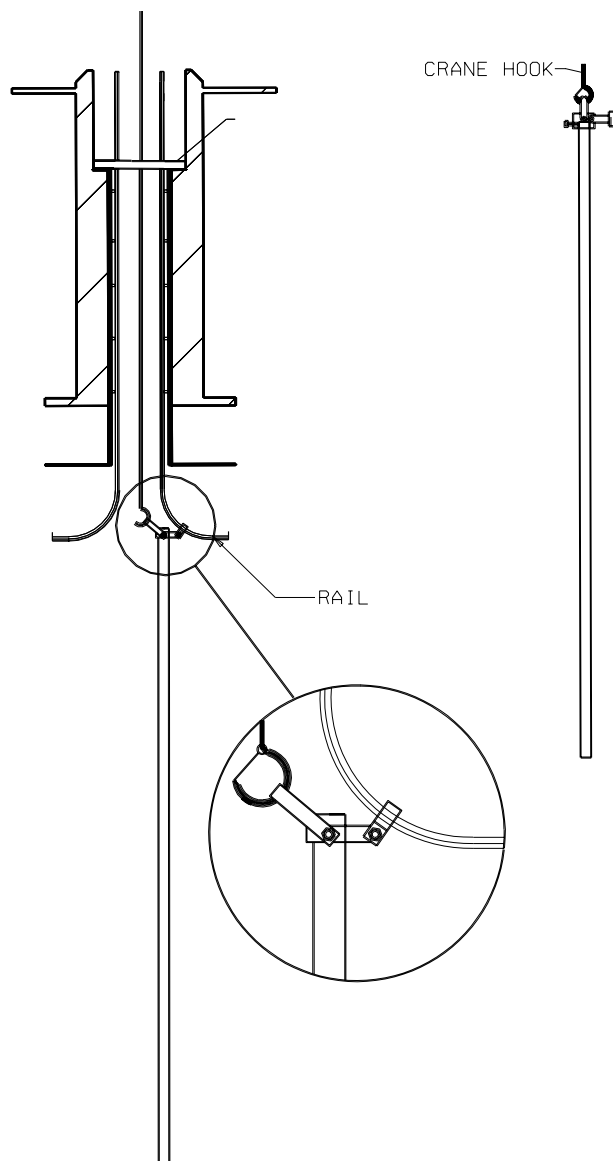
**Figure 4: Failed equipment completely removed from tank**

Relocation into the tank will require a crane hook with a remote de-coupling capability as shown in Figure 5. The equipment to be returned is positioned onto the guide rail and lowered into the tank's riser.



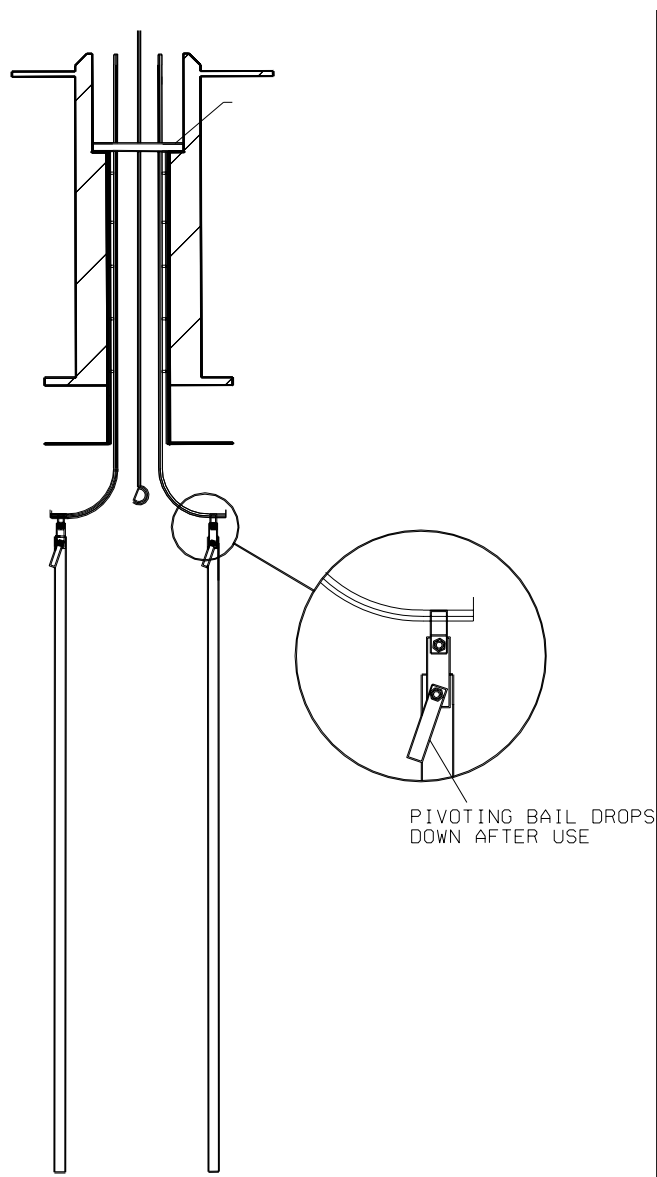
**Figure 5: Inserting failed equipment into a tank using the guide rail system**

The guide block must be hinged to allow the equipment to transition the curved part of the TRSS rail as shown in Figure 6.



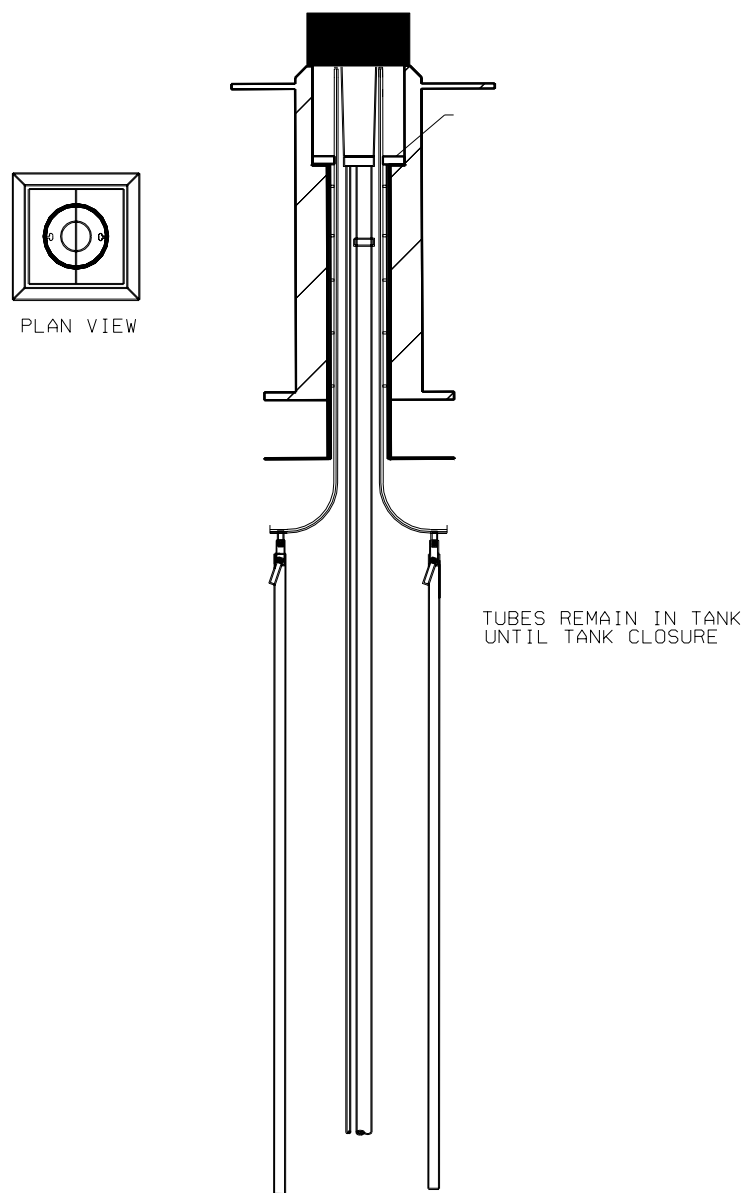
**Figure 6: Lowering failed equipment into the tank**

When the returned equipment reaches the end of the curved section of rail, the crane hook de-couples from it as shown in Figure 7. This process is repeated for all sections being stored in the tank.



**Figure 7: Failed equipment sections hanging inside the tank**

Once the storage process is completed, new process equipment can be lowered into the riser as shown in Figure 8.



**Figure 8: New equipment installed**

## **CONCLUSION**

The Tank Riser Suspension System would be a great asset to the tank farm operation and is highly recommended. It would allow HLW to store several pieces of equipment and simultaneously use the tank's riser in closure activities. However, working on tank tops and utilizing riser space for hanging multiple components presents significant engineering challenges:

- Designing the insert and rail system
- Designing a universal clamping device or a suite of clamping devices
- Developing a remotely detachable crane hook

Many factors and safety issues must be addressed during the development of design requirements. They include:

- Performing load limit calculations for riser and tank top support of suspended equipment
- Ensuring that suspended equipment won't interfere with tank closure efforts
- Ensuring that suspended equipment won't interfere with existing equipment inside the tanks

## **ACKNOWLEDGEMENTS**

A special thanks to the following team members for their creativity in providing a solution to a problem in HLW tank closure activities:

Don Pak, SRTC

Jonathan Thomas, HLW/Waste Removal Project

Randall Forty, PE&CD/Design Execution

Toby Hess, HLW/FTF Waste Removal Project Liaison

Wade Faires, PE&CD/Structural Mechanics

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1. Pak, D. J., Eberl, K. R., *Baseline Technology Report For the Tank Riser Suspension System (U)* WSRC-TR-2001-00441, Savannah River Site, Aiken, SC 29808.
2. Pak, D. J., Eberl, K. R., *Functions and Requirements for the Tank Riser Suspension System (U)* WSRC-TR-2001-00442, Savannah River Site, Aiken, SC 29808.

# **Appendix A**

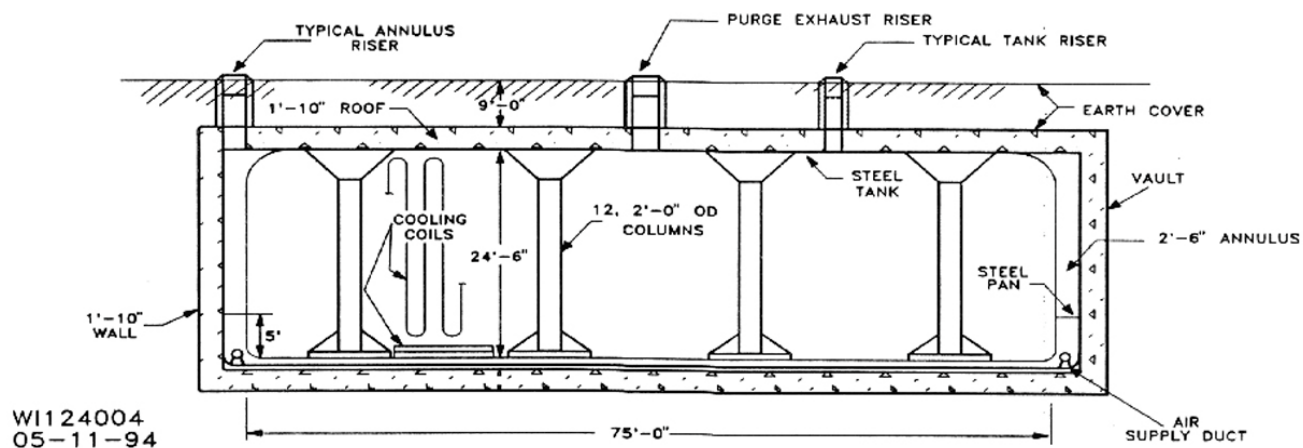


Figure 1A: Type I Waste Tank



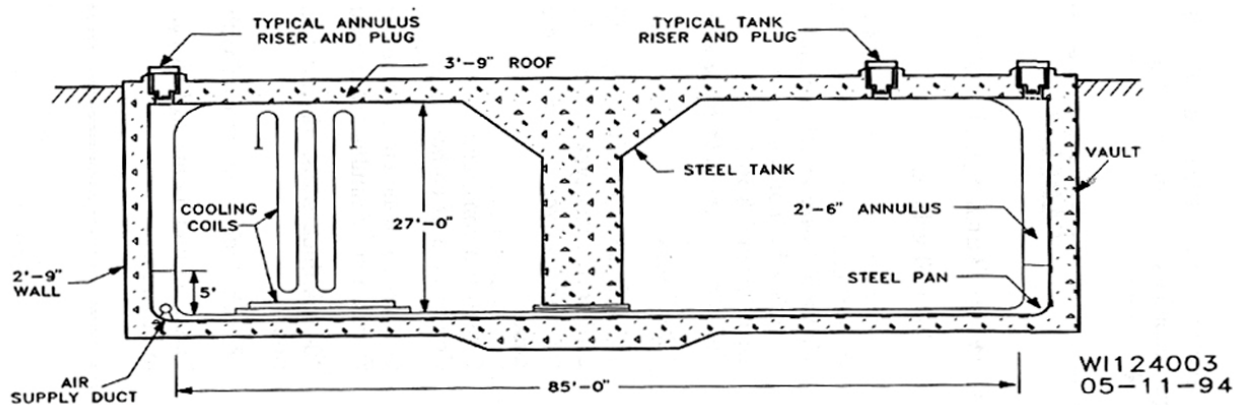


Figure 2A: Type II Waste Tank

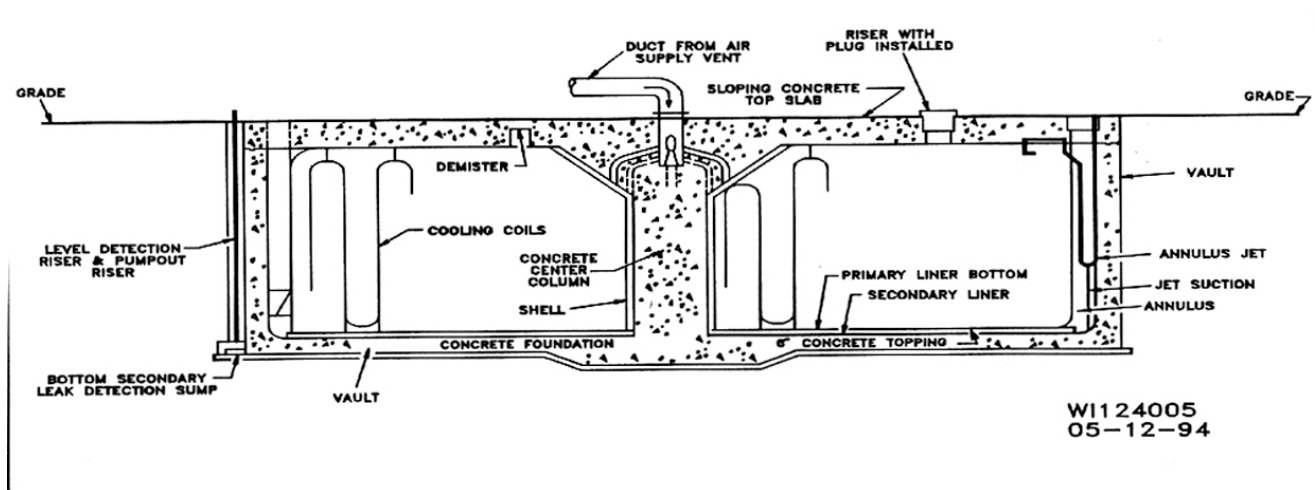


Figure 3A: Type IIIA Waste Tank

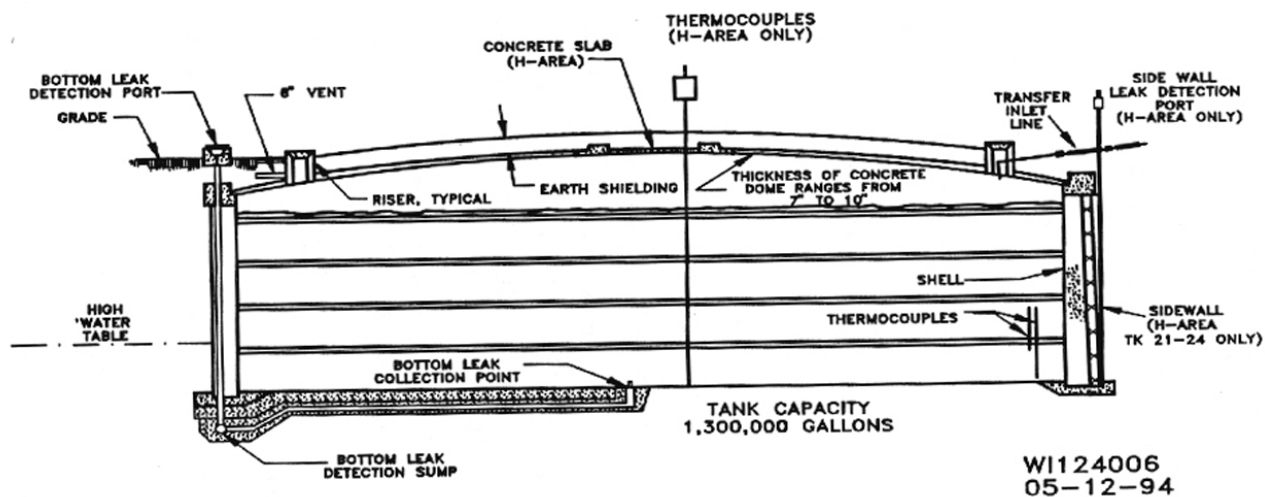
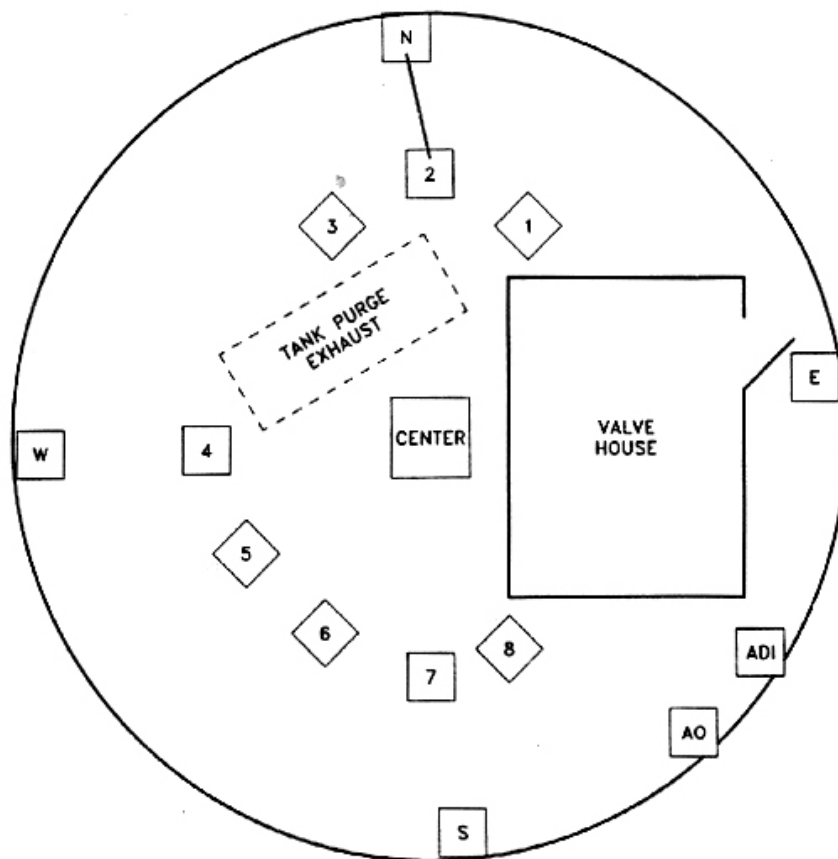


Figure 4A: Type IV Waste Tank

# **Appendix B**



RISER DESCRIPTION

N ANNULUS JET, CONDUCTIVITY PROBE, STAND PIPE, INSPECTION PORT  
E INSPECTION PORT, THERMOCOUPLE WELL, STAND PIPE  
S CONDUCTIVITY PROBE, INSPECTION PORT, STAND PIPE  
W DIP TUBES, INSPECTION PORT, STAND PIPE, LIQUID LEVEL TRANSMITTER  
ADI ANNULUS AIR DEHUMIDIFIER INLET  
AO ANNULUS AIR OUTLET

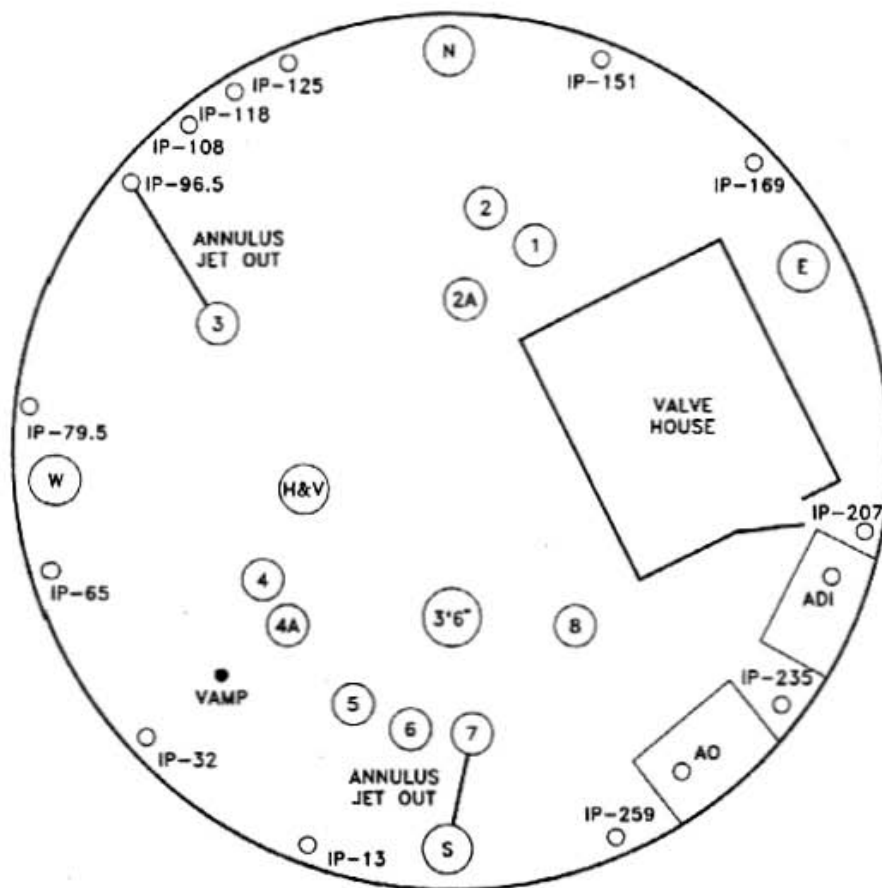
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RISER DESCRIPTION

CENTER INSPECTION PORT  
1 SPRAY CHAMBER (SLURRY PUMP)  
2 INSPECTION PORT, STEEL TAPE RISER, ANNULUS JET INLET  
3 JET RISER CONDUCTIVITY PROBE, INSPECTION PORT  
4 SPRAY CHAMBER, (SLURRY PUMP)  
5 REEL TAPE, H2 SAMPLE POINT, INSPECTION PORT, (H&V)  
6 SPRAY CHAMBER, (SLURRY PUMP)  
7 INSPECTION PORT  
8 THERMOCOUPLE WELL, PURGE AIR INLET, SIMULATED VERTICAL COIL, STAND PIPE

Figure 1B: Typical Type I Waste Tank Riser Layout





RISER DESCRIPTION

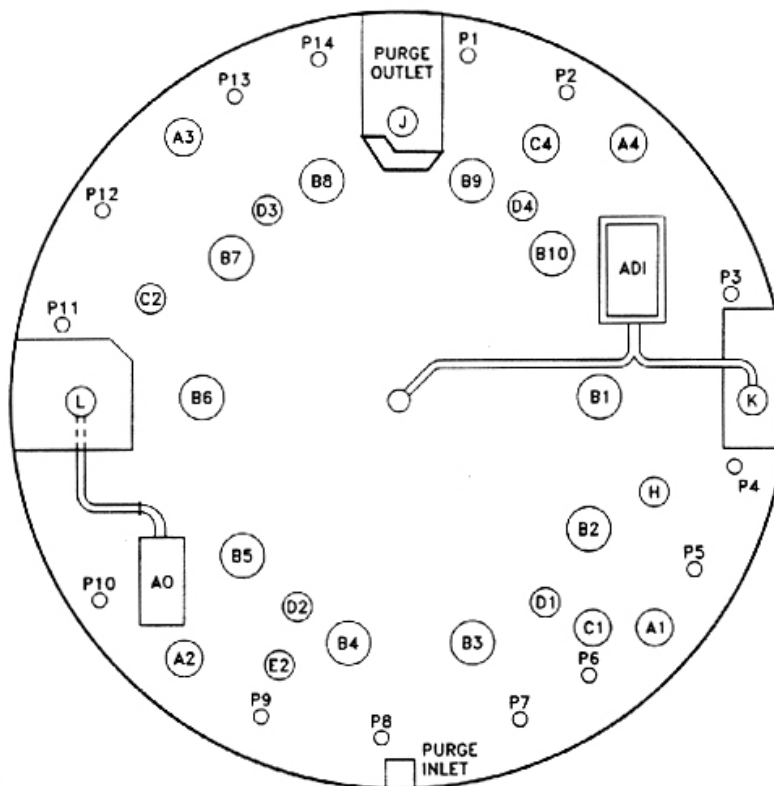
- 1 THERMOCOUPLE WELL, INSPECTION PORT, H2 SAMPLE POINT
- 2 THERMOCOUPLE WELL, INSPECTION PORT
- 2A STEEL TAPE, THERMOCOUPLE WELL, CAPPED PIPE
- 3 THERMOCOUPLE WELL, SPARE
- 4 DIP TUBES, REEL TAPE, CAPPED PIPE
- 4A INSPECTION PORT, CAPPED PIPE
- 5 THERMOCOUPLE WELL, INSPECTION PORT, CAPPED PIPE
- 6 INSPECTION PORT, CAPPED PIPE

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RISER DESCRIPTION

- 7 ANNULUS JET OUTLET, SPARE
- 8 THERMOCOUPLE WELL, PURGE INLET
- N NECKLACE ALARM (ABANDONED), INSPECTION PORT, THERMOCOUPLE WELL, CAPPED PIPE
- S INSPECTION PORT, ANNULUS JET, 150# STEAM LINE
- E DIP TUBES, CONDUCTIVITY PROBE, LIQUID LEVEL TRANSMITTER
- W SOIL THERMOCOUPLE, INSPECTION PORT
- 3'6" THERMOCOUPLE WELL, CAPPED PIPE, DIP TUBES, SPARE
- IP INSPECTION PORT
- AO ANNULUS AIR OUTLET
- ADI ANNULUS DEHUMIDIFIER AIR INLET

Figure 2B: Typical Type II Waste Tank Riser Layout



RISER DESCRIPTION

A1 ANNULUS JET, CONDUCTIVITY PROBE, ANNULUS ACCESS PORT  
A2 LIQUID LEVEL TRANSMITTER, CONDUCTIVITY PROBE, ANNULUS ACCESS PORT  
A3 CONDUCTIVITY PROBE, ANNULUS ACCESS PORT  
A4 CONDUCTIVITY PROBE, ANNULUS ACCESS PORT  
B1 SPARE  
B2, B4, B6, B9-10 COOLING WATER BUNDLE  
B3 SPARE  
B5 SPARE  
B7 SPARE  
B8 SPARE  
C1 TRANSFER JET (WASTE OUTLET), DOWNCOMER (WASTE INLET)  
C2 CTS DRAWOFF VALVE  
ADI ANNULUS DEHUMIDIFIER AIR INLET

RISER DESCRIPTION

D1 THERMOCOUPLE WELL, H2 MONITOR  
D2 THERMOCOUPLE WELL, SPARE PIPE  
D3 THERMOCOUPLE WELL, H2 SAMPLE POINT  
D4 THERMOCOUPLE WELL, SPARE PIPE  
E1 DIP TUBES, ANNULUS JET OUTLET  
E2 REEL TAPE, ACCESS PORT  
H STEEL TAPE, HIGH LIQUID LEVEL CONDUCTIVITY PROBE  
J DEMISTER (PURGE AIR OUT)  
K ANNULUS AIR INLET  
L ANNULUS AIR OUTLET  
P1-P14 INSPECTION PORT  
AO ANNULUS AIR OUTLET

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Figure 3B: Typical Type III Waste Tank Riser Layout



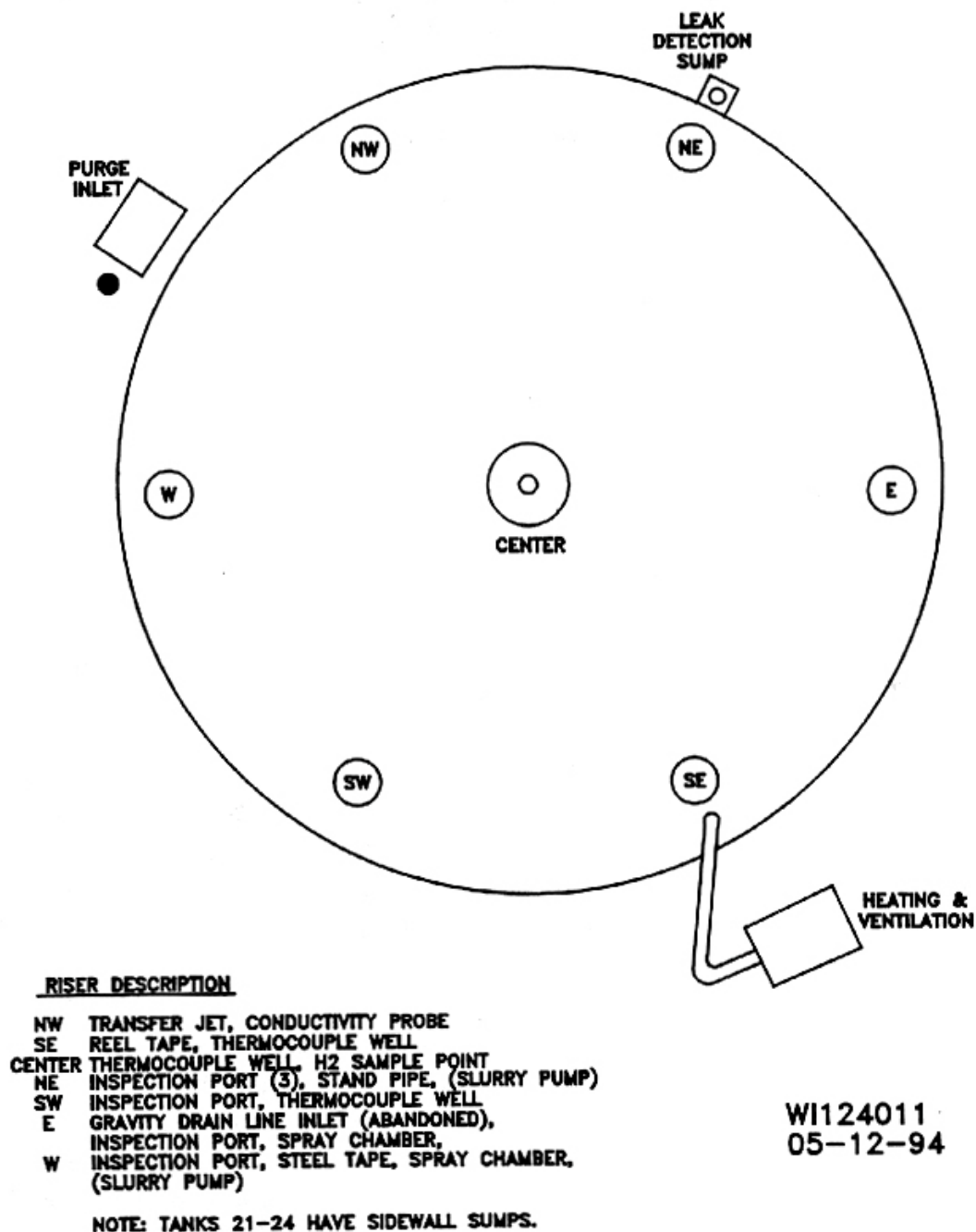


Figure 4B: Typical Type IV Waste Tank Riser Layout

# **Appendix C**



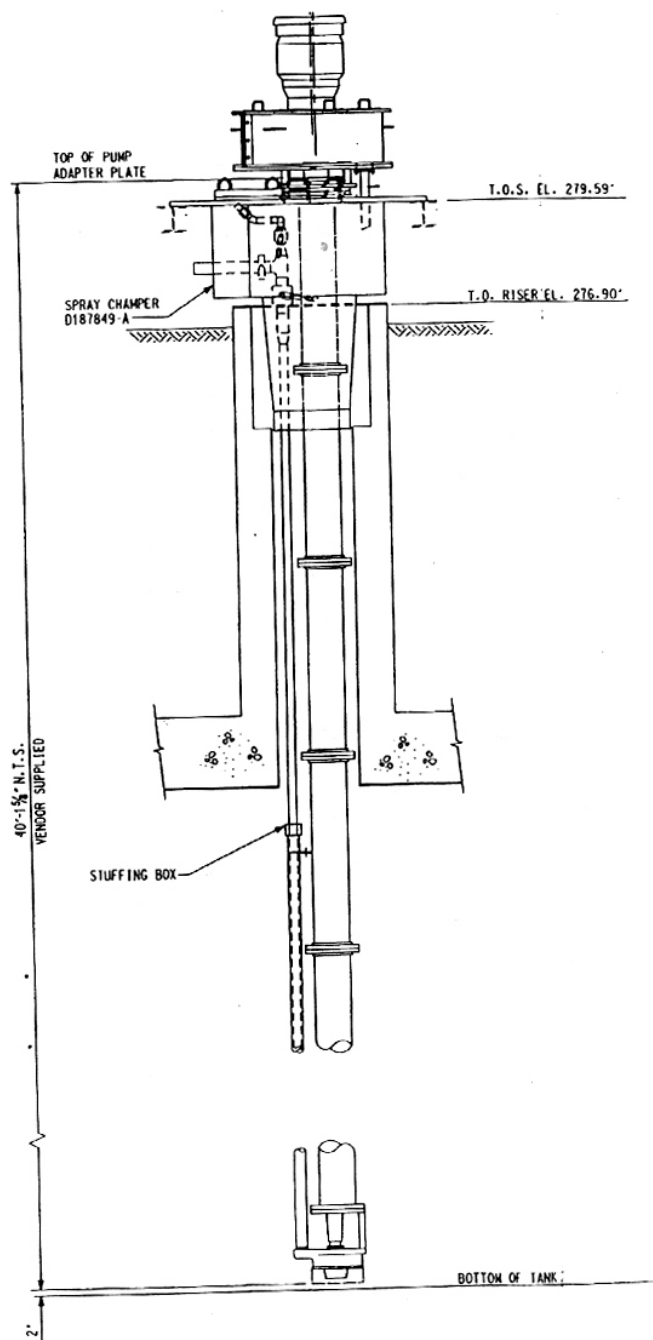


Figure 2C: Telescoping Transfer Pump

# **Appendix D**

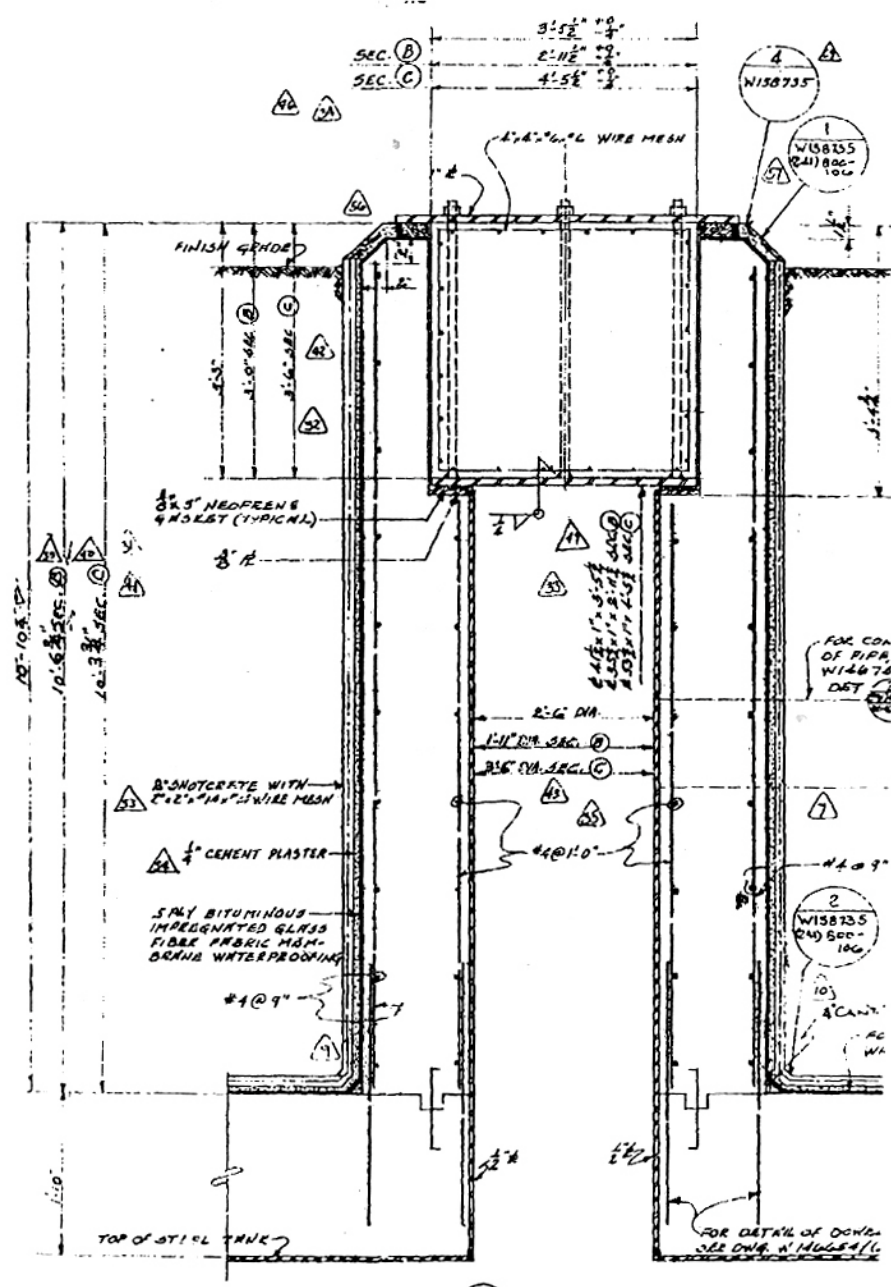


Figure 1D: Typical Type 1 Riser Cross Section