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OPTIONS FOR RESPONDING TO THE ASSUMED LEAK FROM CATCH TANK 241-ER-311

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Abstract: This paper discusses options for responding to an assumed leak from catch tank 241-ER-311 and recommends a preferred path forward.

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LIST OF TERMS

AC	Administrative Control
cfm	cubic feet per minute
DOE	Department of Energy
DOT	Department of Transportation
DST	double-shell tank
ETF	Effluent Treatment Facility
HRA	high radiation area
SER	Safety Evaluation Report
SSC	structures, systems, and components
TSR	Technical Safety Requirement
VFD	variable frequency drive
WDOE	Waste State Department of Ecology

EXECUTIVE SUMMARY

The purpose of this report is to document the assessment of the various options evaluated for responding to the leak of catch tank 241-ER-311. The reviewed options may be divided into a continued monitoring and surveillance option, non-pumping options, pumping options, and options for evaluating the extent of soil contamination beneath tank 241-ER-311.

A continued monitoring and surveillance option was included due to the small volume of free liquid that remains in the tank (estimated at 300 gallons or less) as identified from video surveillance of the tank interior. This option minimizes the dose and risk of contamination to tank farm workers by not performing waste intrusive work. The tank has been previously isolated and had weather covers installed to prevent intrusion. The option provides monitoring of tank level using the installed ENRAF™.

The non-pumping options seek to minimize the free liquid available to leak from the tank or else minimize the environmental impact of the leaked material, but minimize dose and contamination risk by reducing waste intrusive activities. The options evaluated in this document include:

- Drying-out tank 241-ER-311 with a portable exhauster;
- Adding absorbent material to 241-ER-311; and
- Installation of a polyurea interim surface barrier to minimize waste migration due to precipitation.

The pumping options pump out as much residual liquid as possible from catch tank 241-ER-311, with the aim of reducing the volume of material that remains in the tank and is available to continue to leak. The primary options that have been reviewed are:

- Pump into the top load/unload Polar tanker truck utilizing in-line filtration
- Pump into top load/unload Polar tanker truck without in-line filtration
- Pump into the top load/ bottom discharge Walker tanker truck without in-line filtration
- Pump into a shielded shipping cask with conical polyethylene liner without in-line filtration
- Transfer to 244-A catch tank

With the exception of the last option involving transfer to 244-A, all the above options transfer recovered waste from 241-ER-311 to Double-Shell Tank (DST) 241-AY-101. Of the reviewed pumping options, the preferred option is to use the Walker tanker truck without inline filtration, due to the easier final cleanout of the tanker.

Additional options for evaluating the extent of soil contamination have also been reviewed in this paper and include:

- Hydraulic-hammer/Geophysical Survey Investigation using angle pushes; and
- Hydraulic-hammer/Geophysical Survey Investigation using vertical pushes.

The recommended option from this evaluation is to install an interim surface barrier over tank 241-ER-311to minimize precipitation infiltration and further migration of contaminants into the soil surrounding the tank and to continue to perform monitoring and surveillance on the catch tank contents. The barrier would be conservatively sized at approximately 100 feet by 100 feet to cover both the assumed leak from catch tank 241-ER-311 and the previous leak from the adjacent catch tank 241-ER-311A. Minimal free liquid with very low concentrations of radiological or toxicological constituents remain in this catch tank 241-ER-311 and the environmental impact of a continuing leak of the remaining liquid is low. Provisions are already in place to minimize future intrusion into this catch tank, and liquid level monitoring will ensure that additional intrusion does not accumulate in the tank, which could potentially increase the plume size. This option has advantages in that it minimizes the environmental impact of the leak by reducing infiltration and migration of contaminants into the soil. In addition, the option minimizes risk to the facility worker since it requires no waste intrusive work and does not incur risks posed from above ground transport of large volumes of radioactive liquid.

The other options presented in this evaluation also provide viable methods to mitigating the majority of remaining free liquid in catch tank 241-ER-311. However, these options either present a potentially significant risk to the facility worker or are at a significant cost while only providing minimal benefit to protect the environment.

Hydraulic-hammer/Geophysical Survey Investigation could be performed to attempt to assess the extent of contamination that may have resulted due to the leak from catch tank 241-ER-311. However, the small volume of the assumed leak and low level of associated radionuclide contamination pose a risk that push sampling could easily fail to detect the affected area of contamination, or that the most recent contamination may be masked by earlier contamination from 241-ER-311A. Considering the relatively high cost associated with push sampling (since it is an additive cost to any other option), the cost-benefit of this option is not considered to be warranted, and the option is not recommended. The released material is anticipated to have a low environmental impact; there is a risk of not obtaining meaningful information from the sampling; and the planned barrier is already conservatively sized to cover the anticipated plume from both 241-ER-311 and the earlier assumed leak from 241-ER-311A.

1.0 BACKGROUND

Tank 241-ER-311 is a direct-buried catch tank located in the 200 East Area, Southwest of B Plant and not within any tank farm. The tank is a horizontally welded cylindrical vessel made of ½-inch thick stainless steel plate (equivalent to type 347 stainless steel). It is 36 feet long with a 9 feet outside diameter and dished ends (see Appendix A for tank detail). The center of the tank is located 22 feet underground. An 18 inch flanged connection at the top of the tank reduces to a 12 inch riser that is connected to the underside of the pump pit. There are two ground level 4 inch risers on the tank; one located at the West end (location of ENRAF™) and one at the East end (location of breather filter). Three underground drain lines from the 241-ER-151 and 241-ER-152 diversion boxes enter at the top of the tank. The steam jet siphon box connection at the tank was capped, ~~but its~~ internal vertical stainless steel pipe still remains.

The tank was installed in 1954 as a replacement for a previous carbon steel tank, 241-ER-311A, that had leaked. Its primary function was to serve as a drain to diversion boxes ER-151, ER-152, and ER-153. It could have received drainage that originated from 241-B, -BX and -BY via the 244-BX Double Contained Receiver Tank and 200 West Area process and decontamination waste via the old cross site transfer system. Since 1980, the primary fluids received by ER-311 were rain water/snowmelt, line flushes, pressure test water and some leakage from 244-BX to AW-105 transfer and from ER-151 diversion box. The tank also contains some solids. Most of the solids in 241-ER-311 are located under the East riser, with little to no solids present under the West riser. Based on process history it is likely that 241-ER-311 contains a mixture of insoluble B Plant solids and wind-blown dust and sand that were carried into the tank by the water runoff. The solids are likely highly concentrated in strontium.

Tank ER-311 frequently received intrusions of liquid, until early in 2005 and was last pumped out in April 2005. The tank was pumped down to the point that the pump lost suction, which was 17.3 inches. This corresponded to a volume of approximately 1800 gallons. Tank ER-311 was taken out of service in June 2005 as part of Hanford Federal Facility Agreement and Consent Order Milestone M-48-07, and a weather cover was installed in June 2005.

In November 1999, high combustible gas monitor readings were detected in the ER-311 east riser during preparation for a grab sampling event (HNF-5985, 2000). An extensive series of actions were initiated in response to these readings, which included vapor sampling, waste sampling, installation of a temporary exhauster and installation of a permanent breather filter. It was concluded that the abnormal flammable gas concentration was confined to the small volume (2 ft^3) of the east riser and was the result of a polyvinyl chloride (PVC) sleeve that had slipped down within the riser, isolating the riser from the rest of the tank headspace. The confined space within the east riser trapped radiolytically generated hydrogen and did not permit its removal by the normal barometric breathing mechanisms occurring in the larger tank headspace. The PVC sleeve was removed on January 21, 2000 and later a breather filter was installed on the east riser.

An integrity assessment of ER-311 was performed in 2001 (*Engineering Report on Double-Shell Tank System Miscellaneous Tanks*, RPP-6829). The assessment concluded that the tank was not leaking when liquid was held at the leak check level of 50.65 inches. A video inspection showed that the tank was sound, but contained a number of somewhat randomly dispersed corrosion pits

often associated with waterline bands or marks. Little uniform (general) corrosion was observed and it was concluded that the tank thickness had not been substantially reduced. Some localized attack was observed in portions of the tank weldments.

On or about October 8, 2005, the surface level began to exhibit a slowly decreasing trend as measured by the installed ENRAF™ in the West riser (see Appendix B). Tank 241-ER-311 was investigated for a potential tank leak and that assessment is documented in *Tank 241-ER-311 Leak Assessment Report,* RPP-RPT-29163, Rev. 0. The results of that assessment were presented to the Executive Safety Review Board (ESRB) on March 17, 2006, which concurred with the recommendation of the assessment team that 241-ER-311 be declared an assumed leaking tank.

Video surveillance inside of 241-ER-311 indicates that the tank contains significantly less liquid than was originally measured by the installed ENRAF™ (see Appendix D). Riser elevations were re-surveyed on March 29, 2006 and confirmed that the elevation of the East riser matched the drawing but that the West riser elevation (on which the ENRAF™ was mounted) is 10.4 inches lower. Based on the new reference elevation for the West riser, the corrected level for the liquid remaining in the tank is 6.2 inches (or ~400 gallons). This elevation matches a calculated volume based on the drawings and the height of liquid above the pump screen based on the video.

2.0 WASTE CHARACTERIZATION

Tank 241-ER-311 is the catch tank for drainage from the 241-ER-151 and 241-ER-152 diversion boxes. The diversion boxes were used in cross-site transfers and transfer of waste from and to B-Plant and the Waste Encapsulation and Stabilization Facility. The catch tank was designed to catch leakage from operation the diversion boxes; therefore, it may have received small amounts of radioactive materials. However, it primarily collected water runoff from snow and rain. Over the years, liquid in the tank were pumped out to maintain level within operational limits. The last transfer was in April 2005 when the liquid was pumped down to the pump inlet level. The tank is known to contain both liquid and solids. A description of each phase is provided below.

Liquid in the tank was last sampled in November 1999. A summary of the sample analysis is contained in Appendix C, Table C-1. Samples were taken from both the East and West risers. The East riser samples were taken from inside a vertical polyvinyl chloride pipe that was imbedded in the tank solids at the lower end; therefore, the liquid inside the pipe was isolated from the rest of the tank and is believed to be not representative of the general tank contents. Samples taken from the West riser are believed to be more representative of the liquid waste composition that existed in the majority of the tank at that time. These sample results indicate that even in 1999, the liquid waste composition was very dilute (greater than 99% water) with very low concentrations of both radiological and toxicological constituents.

Since the November 1999 sampling event, liquid in the tank was pumped out three times in response to water intrusion. It is likely that most of the liquid in the tank at that time is no longer present, but instead has been further diluted and displaced by intrusion water. Concentrations of liquid constituents other than water are expected to decrease because the small amounts of contamination that may be entrained in the rainwater or snowmelt as they drained into 241-ER-311 are also expected to lessen with time.

The exact amount of solids in 241-ER-311 is not known but it was previously estimated that the solids level under the East riser is approximately 7 to 9 inches deep and that little to no solids exist under the West riser (HNF-5985). Recent data indicates that the liquid level in catch tank 241-ER-311 is approximately 10.4" lower than reported by the ENRAF™ due to a discrepancy associated with the reported riser flange elevation. A video camera was installed in the riser while the liquid level was approximately 6.2", and no solids were exposed under either the East or West riser, indicating that the actual solids level must be less than six inches.

The composition of the solids also is not known. Based on process history, B Plant strontium processing waste was transferred through diversion box 241-ER-152, which drains to 241-ER-311 through the East riser. Some B Plant solids probably were flushed to 241-ER-311. Soluble constituents in these solids would have been dissolved by water and transferred out. It is likely that 241-ER-311 contains a mixture of insoluble B Plant solids and wind-blown dust and sand that were carried into the tank by the water runoff. Concentrations of some key constituents in B Plant strontium recovery solids are shown in Appendix C, Table C-2 (RPP-8847, *Best-Basis Inventory Template Compositions of Common Tank Waste Layers*). These concentrations should be considered upper bounds for the 241-ER-311 solids. Due to the very low leak rate from the tank, it is not anticipated that any solids would have leaked from the tank.

3.0 ENVIRONMENTAL IMPACT OF ASSUMED WASTE RELEASE

Based on the tank history and waste characterization data discussed in the previous sections, the material that may have been released to the environment due to the assumed leak from catch tank 241-ER-311 is anticipated to be very dilute liquid (greater than 99% water) with very low levels of radiological and toxicological contamination, primarily resulting from rainwater/snowmelt intrusion into the tank. The maximum volume of waste remaining in the tank is estimated at less than 400 gallons (~1500 liters). Accounting for the volume of solids in the tank, the remaining free liquid is estimated at less than 300 gallons. 400 gallons represents a conservative estimate of the combined volume that may have already leaked plus the remaining free liquid that may still be available to leak. Based on 400 gallons of material and using the maximum radionuclide concentrations for the liquid from the West riser from the 1999 sample results, the total radiological inventory of the liquid that has leaked or is available to leak is estimated at less than 0.5 Ci. The actual radionuclide content of the liquid is anticipated to be significantly less than this value due to tank pump out and subsequent dilution with intrusion water since the date of sampling. The release is occurring in an area impacted by an earlier leak in 1953 from nearby catch tank 241-ER-311A, which 241-ER-311 replaced. This earlier leak was documented as 1700 gallons of contaminated acid lost to the ground containing approximately 10 Ci of mixed fission products. The volume and radionuclide content of the assumed leak from 241-ER-311 is small compared to the earlier leak in this vicinity.

The migration of this released material is anticipated to be minimal, based on the limited volume of liquid available to leak. Catch tank 241-ER-311 sits on a bed of sand that was used to provide an even base on which to place the tank. This bed appears to be 0.5 feet thick, based upon drawing H-2-2537. If sufficient surface recharge were available, movement of the leaked material would be downward until a spreading horizon was encountered, and at that point the "plume" would spread predominantly in the horizontal direction. Because the ground surface area above the tank is maintained free of vegetation, recharge is conservatively estimated to be about 4 inches per year.

The native soils in the vicinity of catch tank 241-ER-311 are predominantly sandy gravel in nature, and are part of the Hanford formation. The thickness of the vadose zone in this area, below the base of the tank excavation, is approximately 225 feet. The closest downgradient groundwater well, used for potable supply, is located at the Fast Flux Test Facility, approximately 12 miles to the East-Southeast. The shortest distance to an accessible surface water body, the Columbia River, is approximately 9 miles to the Southeast.

Due to the limited volume available to leak and the associated characteristics of the vadose zone near catch tank 241-ER-311, it is unlikely that contamination will reach groundwater. Also, prior to the leak, the sand bed directly under catch tank 241-ER-311 would have been dry. This would have initially delayed the downward spread of contamination until the sand bed became saturated with liquid.

4.0 CONTINUED MONITORING AND SURVEILLANCE OPTION

This option proposes that continued monitoring and surveillance of the liquid level be performed. Utilizing the transfer pump currently installed in the central pump pit, catch tank 241-ER-311 was last pumped to the minimum heel possible on April 13, 2005. As previously discussed in this report, the liquid level is actually lower than originally reported by the ENRAF™ due to a discrepancy associated with the riser flange elevation. The remaining heel in this catch tank has been determined to be ~6.2 inches, which would equate to ~400 gallons. After accounting for the volume of solids in the tank, the free liquid available to leak is approximately 300 gallons. If the remaining liquid contents in the 241-ER-311 catch tank were to leak to the soil, less that 0.5 curies would be discharged to the ground. This estimate assumes a 400 gallon leak volume and utilizes the maximum reported radionuclide concentrations from 1999 grab samples from the West riser, even without accounting for the dilution that has taken place since the last sampling event.

Estimated Effectiveness of Option:

1) Does not reduce continued leakage. However, the environmental impact of the assumed leak is low.
2) Leaves ~300 gallons of free liquid waste in tank.
3) This volume would gradually reduce until the level of the leak site is reached.

Benefits to this approach:

1) No waste intrusive work would be performed.
2) No liquid waste would be transferred out of the tank or require transport to a new tank.
3) Minimizes the potential for radiological exposure/contamination to employees.
4) Man Dose Estimates for this evolution are estimated to be 15 mrem (to restore ENRAF). This value is cumulative for an assumed field crew consisting of two operators, one HPT and one Instrument technician.
5) Residual free liquid volume available to leak is small and consists predominantly of low level contaminated rainwater and snowmelt.
6) The environmental impact of a continued leak is low, as previously discussed in Section 3.0.

Risks with this approach:

1) The liquid in catch tank 241-ER-311 would continue to leak to the environment until the liquid level reaches the leak point or the catch tank is empty.

Radiological hazards associated with this approach:

1) Man Dose Estimates for this evolution are estimated to be 15 mrem (to restore ENRAF™). This value is cumulative for an assumed field crew consisting of two operators, one HPT and one Instrument technician.

5.0 NON-PUMPING OPTIONS

Each of the three non-pumping options is summarized below.

5.1 DRY-OUT TANK 241-ER-311 WITH EXHAUSTER

This option utilizes a 500 cfm or 3,000 cfm portable exhauster to increase evaporation rates in 241-ER-311 in attempt to remove remaining liquid inventory. The portable exhauster would be connected to the West riser at catch tank 241-ER-311. Further details of the option are provided below:

1) Connect a portable exhauster to enhance evaporation of liquid. Retrieval has one 500 cfm portable exhauster available that was intended to be utilized for S-109 retrieval activities. Some upgrades and testing may be required prior to use. It should be noted that catch tank 241-ER-311 previously had a 500 cfm portable exhauster installed on the West riser in 1999 when elevated flammable gas levels were detected (see ECN #652912). There currently are no 1,000 cfm portable exhausters available for use. There are two new 3,000 cfm exhausters available. Issues were identified during testing of these exhausters that would require resolution prior to use.
2) The existing breather filter would require replacing with a tank vacuum relief and control device (see drawing H-14-106608 for example of configuration).
3) This activity would require removal of the ENRAF to reconfigure the tank with the portable exhauster. The ENRAF would have to be reinstalled once the tank is reconfigured with the portable exhauster arrangement to meet environmental requirements for level monitoring. The exhauster and ENRAF will be connected to the west riser and the east riser will serve as an inlet.

Estimated Effectiveness of Option:

1) This option would enhance the evaporation of liquid from 241-ER-311. The current evaporation time estimates are ~2 years utilizing a 500 cfm portable exhauster and ~ 8 months utilizing a 3,000 cfm portable exhauster.
2) The projected evaporation time does not account for the current leak rate.

Benefits to this approach:

1) Reduces contact radiological hazards associated with removing waste from tank and dose associated with transfer lines and waste transport. Measured dose rates through the open riser are low. All modification work is above grade and would be limited to access at top of risers.
2) Minimizes disposal costs – a subsequent transfer via a secondary transport vehicle is not required.

Risks with this approach:

1) Extended period of time required to remove the catch tanks liquid contents. Utilizing a 500 cfm portable exhauster, it is estimated to take ~2 years to evaporate the remaining liquid in the tank. This estimate assumes the current liquid level is ~ 6.2", or ~ 400 gallons. The current leak rate (~0.5 gallons per day) is not accounted for in this estimate. A 3,000 cfm exhauster may be able to reduce this time to (~ 8 months) provided that vacuum control did not significantly reduce the flow through the tank.
2) The tank would have to be evaluated to ensure it did not collapse under anticipated vacuum. This will be difficult to assess due to the tank's suspect integrity. The 500 cfm portable exhauster is capable of pulling 10 to 11 inches of vacuum. The 3,000 cfm exhauster is capable of 30 inches of vacuum.
3) Several regulatory permits would be required as listed below:
    a. Radiological air emissions with Dept. of Health
    b. Non-Radiological air emissions with WDOE
    c. RCRA part A modifications with WDOE
4) A new safety analysis would be required from ORP due to the significant change in scope of this option compared to the previously presented pumping option.
5) Cost – Equipment would have to be tested, installed and maintained for duration of activities.
6) While the portable exhauster is operating, the sensitivity of the ENRAF may be reduced due to the increased air flow through the tank.
7) The time required to dry-out the catch tank would allow liquid to continue leaking from the catch tank until the liquid level reaches the leak point or the catch tank is empty. However, as discussed in Section 3.0, the environmental impacts if this were to occur are low.

Radiological hazards associated with this approach:

1) Man Dose estimates for this evolution are estimated to be 19 mrem. This value is cumulative for an assumed field crew consisting of two operators, one HPT and one Instrument technician.
2) The spread of radiological contamination may result when removing/installing equipment on tank risers (i.e., portable exhauster, zip cord, etc.);

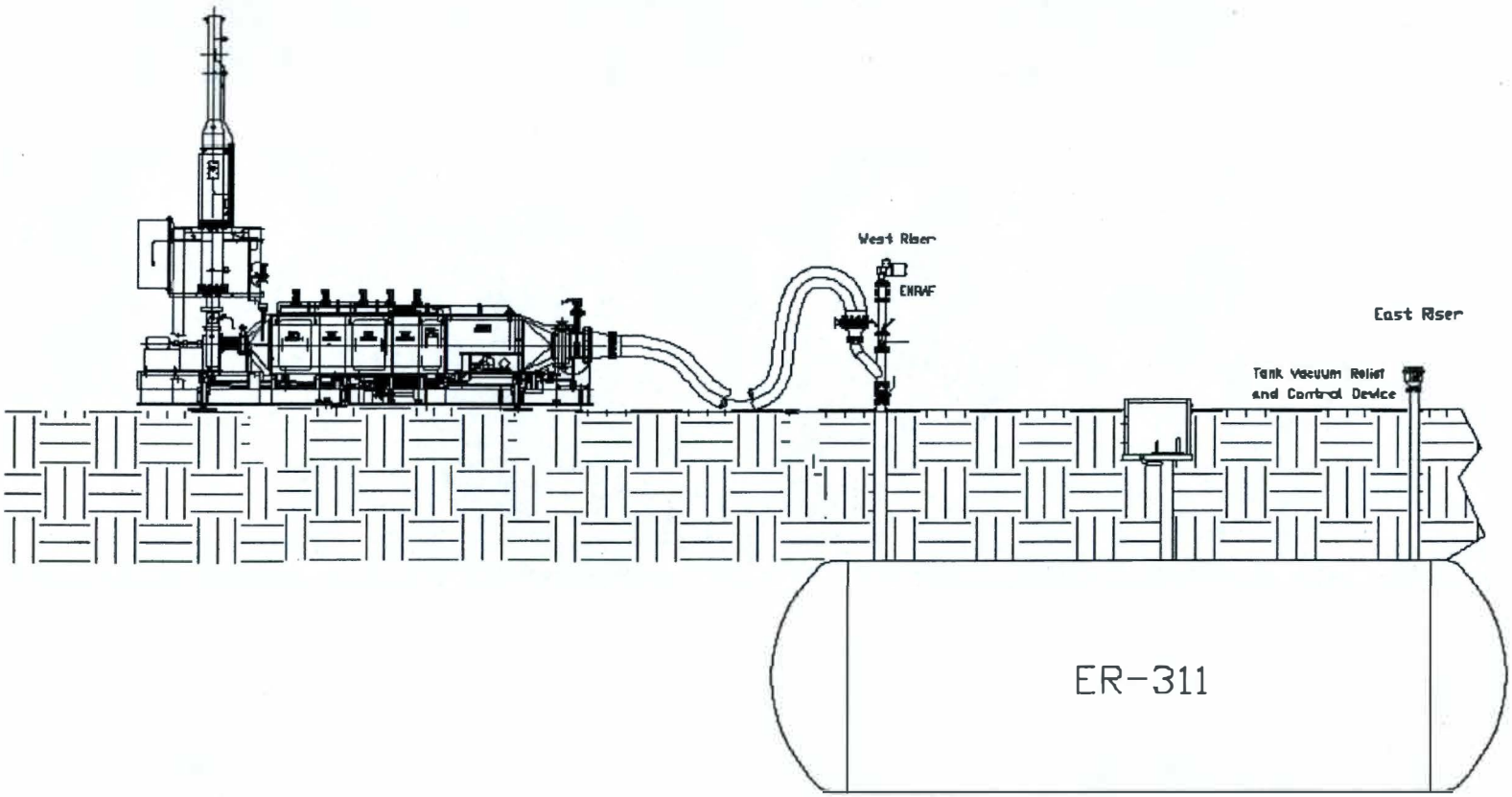
Table 5-1. Cost Estimate to Dry-Out Tank 241-ER-311 with Exhauster

Equipment Cost	
- Portable exhauster testing and maintenance	$10,000 (30 to 40 annual and 6 to 8 quarterly PMs)
- Tank vacuum relief and control device	$10,000
Labor Cost	
- Field resource cost per shift	$9,000
- Total shifts required	6½ to 9
- Field labor cost total	$58,500 to $81,000
- Engineering design support	$10,000
Total Cost	**$88,500 to $111,000**

Table 5-2. Labor Estimate to Dry-Out Tank 241-ER-311 with Exhauster

Labor Estimate (by activity):	**Shift Total**	**Description**
Equipment set-up at 241-ER-311	3 to 4	Remove ENRAF™, install exhauster, replace breather filter with tank vacuum relief and control device, install level detection device on breather filter spool piece on East riser.
Reconfigure catch tank	3 to 4	Remove portable exhauster and tank vacuum relief and control device; reinstall ENRAF™ and breather filter
Perform video inspection of tank	½ to 1	May be required once majority of free liquid is removed.
Total Shifts	**6½ to 9**	
Note: Field resource shift estimates include the following resources: five operators, four HPTs, one field work supervisor, one industrial hygiene technician, two fitters, one electrician, one teamster, two mechanical engineers, one radiological control manager, and one facility manager.		

Figure 5-1. Configuration to Dry-Out Tank 241-ER-311 with Exhauster



5.2 ADD ABSORBENT MATERIAL TO 241-ER-311

This option stabilizes 241-ER-311 residual liquid with absorbent material. Absorbent material would be added via the East and West 4-inch risers to absorb remaining free liquid. The risers are ~1.5 foot from end caps, or thirty-four feet apart. A distribution system would have to be developed to ensure adequate dispersion of the absorbent material. Absorbents such as Super Absorbent Polymers, diatomaceous earth, etc., may be utilized absorb the free liquid to minimize additional leakage of waste to the soil.

Estimated Effectiveness of Option:

1) Starting waste volume estimated at 6.2 inches (~400 gallons).
2) Approximately 0.4 to 1.5 pounds of absorbent required per gallon of liquid.
3) If complete dispersion of the solids could be achieved, all residual liquid could be absorbed.
4) However, access is only readily available through two 4" risers at each end of tank spaced 34 feet apart. Complete dispersion will be difficult unless an engineered system is designed to blow or pump solids throughout tank.
5) Actual efficiency difficult to predict accurately without testing but will likely be equal to or less than pumping option, due to difficulty of dispersion.
6) Large volumes of absorbent could be required to compensate for dispersion efficiency.

Benefits to this approach:

1) Reduces radiological hazards associated with removing waste from tank and dose associated with transfer lines and waste transport. Measured dose rate through open riser is low.
2) This approach would stabilize the majority of remaining free liquid and significantly slow further waste migration to the environment. This further reduces the environmental impacts associated with the waste leak.

Risks with this approach:

1) Use of absorbents is most typically utilized for 55 gallon drums or spills to the ground. Unique challenges are posed when designing a system to use in a horizontal underground storage tank with limited access.
2) A powder/granule dispersion system must be designed and installed in each riser - A good dispersion of the solidifier material within the waste matrix is essential for some products to ensure no islands of untreated waste remain. If the dispersion system utilizes compressed air to disperse the selected polymer into the catch tank dome space, it must be demonstrated that this does not present an increased radiological contamination hazard.
3) The selected dispersion system may also require that various regulatory permits are obtained as previously discussed in non-pumping option 1.

4) If dispersion is unsuccessful and all liquid is not solidified, pumping not longer is a viable option. If dispersion is unsuccessful, the pump in the central pump pit may have to be removed to provide access to the center of the tank.
5) Cost – Equipment would have to be designed, tested and installed to facilitate dispersion of the absorbent material. This option may also require a mock-up to demonstrate effectiveness prior to use in the field.
6) The selected absorbent must be evaluated for compatibility with the existing tank waste. This could require additional laboratory testing. An absorbent previously utilized at Hanford (Radsorb) was taken off the market because of degradation issues.
7) The addition of absorbents might complicate the final clean-out and closure of the tank.
8) A new waiver request and safety analysis would be required from ORP due to the significant change in scope of this option compared to the previously presented pumping option.
9) New permits from Washington Department of Health and WDOE may also be required.

Radiological hazards associated with this approach:

1) Man Dose estimates for this evolution are estimated to be 29 mrem. This value is cumulative for an assumed field crew consisting of two operators, one HPT and one Instrument technician. (This estimate would be higher if the pump from the 241-ER-311 central pump pit has to be removed to provide access to the center of the tank).
2) The spread of radiological contamination may result when removing/installing equipment in tank risers (i.e., absorbent distribution system).

Table 5-3. Cost Estimate to Add Absorbent Material to 241-ER-311

Equipment Cost	
- Absorbent material (1,200 lbs)	$6,500
- Absorbent distribution system	$3,000
- Equipment development and testing	$30,000
- 2 cameras	$20,000
Labor Cost	
- Field resource cost per shift	$9,000
- Total shifts required	12½ to 16
- Field labor cost total	$112,500 to $144,000
Disposal Cost	
- 6'x3'x3' mixed waste container	$15,600
- 8'x4'x4' low level waste container	$7,300
Total Cost	**$194,900 to $226,400**

Table 5-4. Labor Estimate to Add Absorbent Material to 241-ER-311

Activity Description	Shift Total	Description
Equipment set-up at 241-ER-311	5½ to 7	Remove ENRAF™ and breather filter, install camera in one riser and Absorbent Distribution System (ADS) in other riser, stage ADS support equipment and connect equipment. ADS must be deployed in both risers.
Add absorbent to West riser	1	Evaluation of application via video inspection is necessary to ensure absorbent is being dispersed adequately.
Add absorbent to East riser	1	Evaluation of application via video inspection is necessary to ensure absorbent is being dispersed adequately.
Dispose of contaminated equipment	4 to 5	This includes absorbent distribution system and camera (if contaminated)
Reinstall ENRAF™ on West riser at 241-ER-311	½ to 1	
Reinstall breather filter on East riser at 241-ER-311	½ to 1	
Total Shifts	**12½ to 16**	
Note: Field resource shift estimates include the following resources: five operators, four HPTs, one field work supervisor, one industrial hygiene technician, two fitters, one electrician, one teamster, two mechanical engineers, one radiological control manager, and one facility manager.		

Figure 5-2. Add Absorbent Material to 241-ER-311 (Pump Distribution Method)

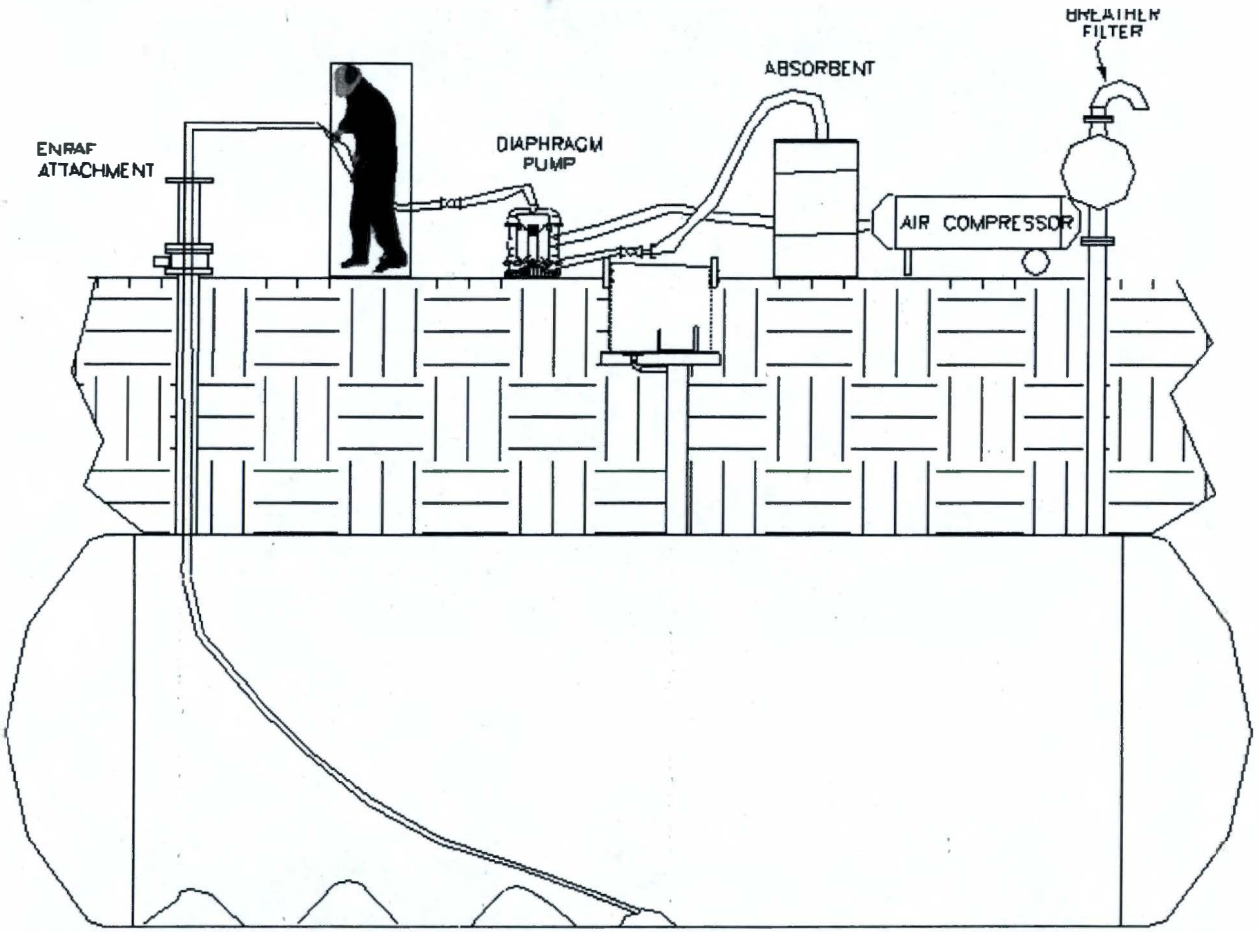
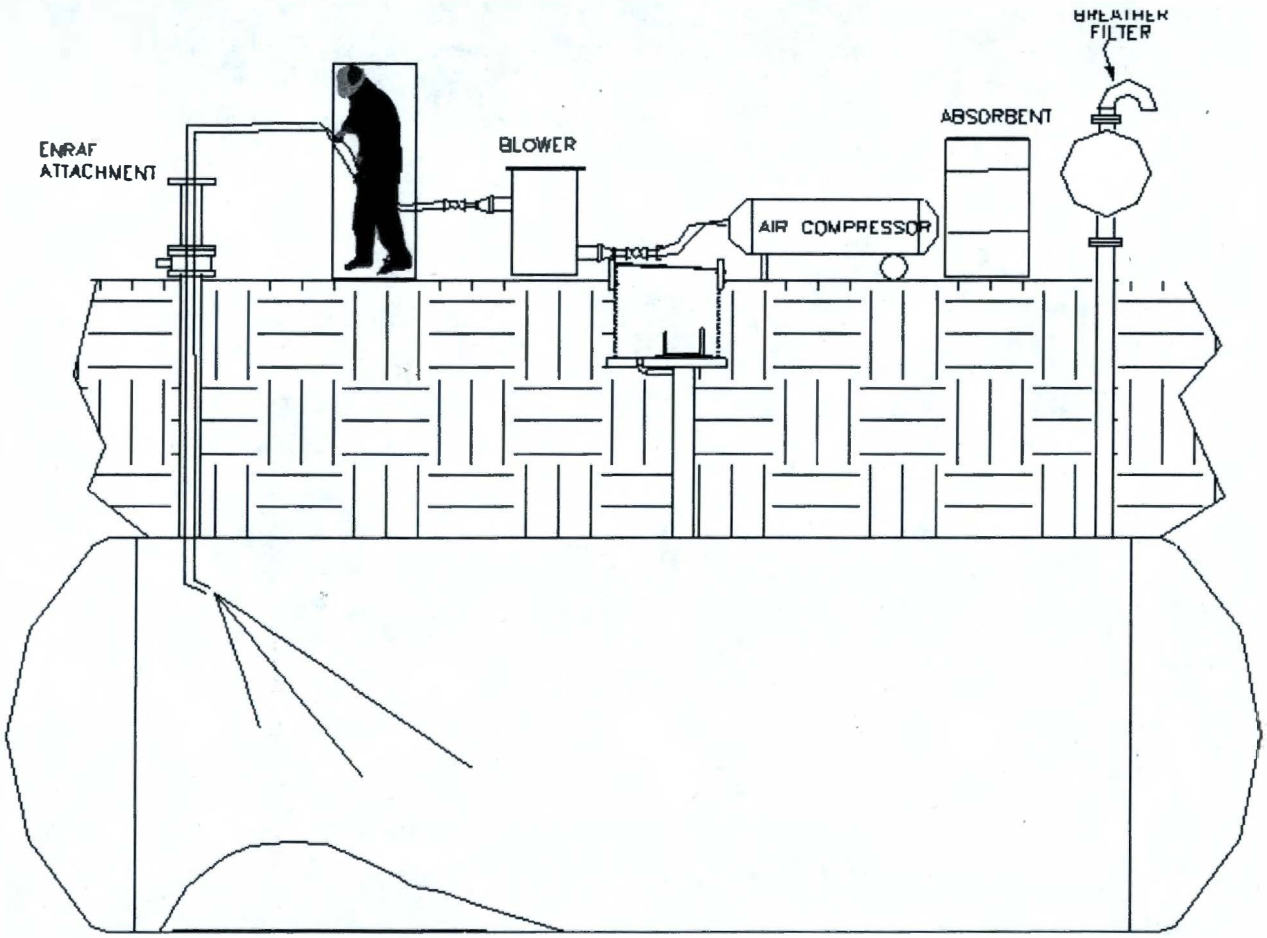


Figure 5-3. Add Absorbent Material to 241-ER-311 (Blower Distribution Method)



5.3 INSTALLATION OF AN INTERIM SURFACE BARRIER

This option proposes that an interim surface barrier be installed around the perimeter of catch tank 241-ER-311. A polyurea barrier (Envirolastic AR 425) may be applied on the surface area surrounding catch tank 241-ER-311 as an interim measure to restrict precipitation infiltration into a contaminated zone, thereby retarding the movement of contamination in the vadose zone. For the purposes of cost estimates below, it was assumed that polyurea cover would be applied to a 100 feet by 100 feet area. This area would extend a minimum of 30 feet beyond the perimeter of the area occupied by tank 241-ER-311 and the previously abandoned 241-ER-311A and would cover any assumed leak from the tank. Further details of this option are provided below:

1) Mark out area to be covered. A conservative area of 100 feet by 100 feet directly over the area occupied by the two 241-ER-311 catch tanks is assumed adequate.
2) Ensure area requiring polyurea barrier has sufficient slope to prevent pooling of liquid. This may be achieved either by grading the existing surface material or preferably by bringing in and grading clean sand over the area to be covered.
3) Apply fabric to area requiring interim barrier.
4) Spray polyurea on fabric to make a two layer barrier. The perimeter of the barrier should have a channel to divert liquid run-off to desired location.

Estimated Effectiveness of Option:

1) The contaminant plume is assumed to be small. Up to 100 gallons of liquid may have already leaked to the soil and an additional 300 gallons of free liquid remains in the tank. Application of a surface barrier would minimize further migration of contamination, thereby reducing further the environmental impact of the assumed release.

Benefits to this approach:

1) Minimizes contaminant migration. Elimination of infiltration minimizes downward transportation of contamination. This approach would leave liquid in the catch tank that will eventually leak to the soil. However, as previously discussed in Section 3.0, due to the small volume and dilute nature of the liquid waste in the tank the environmental impact of the assumed leak is low.
2) Minimize worker exposure – This option does not require removal of contaminated soil, nor does it involve any tank intrusive work.
3) Qualifies as an Interim Measure (TPA Milestone M-45-56) as part of the RCRA Corrective Action Program with a streamlined regulatory approval process.
4) This technology will be used cover the 241-T-106 contamination area in FY07, plus three other areas at later dates, as part of TPA Milestone M-45-56.
5) Provides demonstration of technique and additional design information for later interim surface barriers.

Risks with this approach:

1) The area requiring application of an interim surface barrier must be hand graded to promote run-off prior to installing the felt. Grading may require that some existing gravel/sand be relocated within the 241-ER-311 area or may be achieved through the addition of clean sand.
2) The life span of the barrier is unknown, but is expected to be 30 years. Repair or patching of damaged or degraded sections is possible but would increase long term costs.
3) Supplied air must be used when applying polyurea because fumes are toxic.
4) Cost – The current cost may not adequately bound the proposed activity, since this will be the first application of the material. The polyurea application may be contracted out. Since application of the material will have to be performed within a fenced Tank Farm boundary, the contractor personnel must have all applicable training to allow them to ACE into the proposed work area.

Radiological hazards associated with this approach:

1) Radiological risks for this activity would be limited to the potential for radiological contamination during activities that may disturb the potentially contaminated soil surface. Radiological exposure is not anticipated to present a significant risk to workers while applying the polyurea barrier. A layer of sand/gravel may also be applied to obtain the desired slope.

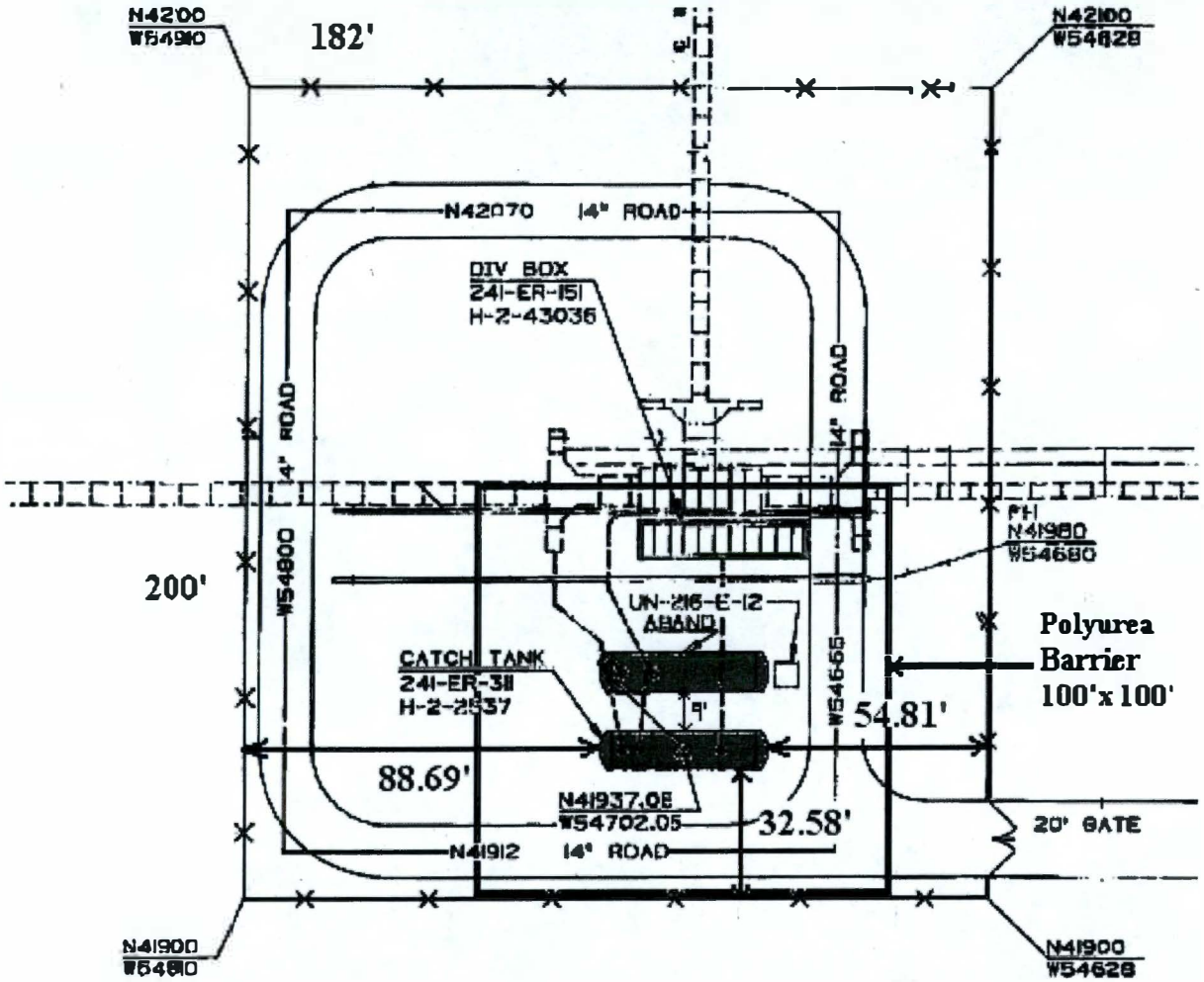
Table 5-5. Cost Estimate for Application of Interim Surface Barrier

Material Cost	
- Sand/Gravel	< $500
Labor Cost	
- Polyurea application cost (including cost for contractor application)	$40,000 to $45,000 ($4.00 to $4.50 per square foot)
- Training for contractor	$5,000
- Field Work Supervisor (FWS)	$6,340 to $9,800
- Nuclear Chemical Operators (NCOs)	$2,835 to $4,725
- HPT (survey equipment, soil, etc.)	$6,430 to $10,105
- IHT	$3,645 to $5,470
- Engineering (primarily design support)	$6,150 to $9,225
Planning	
- Work order preparation (includes time for planner, as well subject matter expert review).	$10,000
Total Cost	**$80,920 to $99,825**

Table 5-6. Labor Estimate for Application of Interim Surface Barrier

Activity Description	Shift Total	Description
Ensure polyurea application area is sloped to facilitate run-off	3 to 5	The activity will require area to be hand graded. While new gravel/sand may be placed to obtain desired slope, this estimate assumes existing gravel (potentially contaminated) will be redistributed as necessary. A run-off collection system may need to be formed at the perimeter of the barrier application area. Required Tank Farms field resources include: two NCOs, two HPTs and one FWS.
Apply fabric to polyurea application area	1 to 2	Required Tank Farms field resources include: one HPT, one FWS, and one IHT.
Spray on polyurea barrier	7 to 10	This activity must be performed on supplied air. Application area is anticipated to be 10,000 square feet. Required Tank Farms field resources include: one HPT, one FWS, and one IHT.
Total Shifts	**11 to 17**	

Figure 5-4. Interim Surface Barrier Configuration



6.0 PUMPING OPTIONS

Each of the five pumping options is summarized in this section. The preferred pumping option is discussed in detail in subsection 6.3. The pump selection process is also summarized in the following text.

In reviewing pump options for catch tank 241-ER-311, the major consideration was finding a pump that was able to be inserted through a 4" riser. Four-inch risers are available at each end of the tank, the East riser is currently used to house the breather filter assembly, and the West riser was originally used for the ENRAF™. There is a central 12" diameter riser that is occupied by the currently installed transfer pump. This riser could be used but would require significant work to remove and dispose of the existing transfer pump. A further important consideration was that the pump should be readily available and does not require unique design prior to implementation. Based upon the dilute nature of the waste, it was determined that pumps commonly utilized for groundwater sampling would be effective at removing the liquid waste.

A Grundfos Redi-Flo2 Model MPl Variable Frequency Drive (VFD) submersible pump was identified as suitable to pump catch tank 241-ER-311's liquid contents. This pump is available in tank farms and has been used for pumping leak detection pits and groundwater monitoring wells. This pump is rated at a maximum of 9 gallons per minute and 315 feet of head. The pump is 1.8 inches in diameter and 11.3 inches high. The pump motor is mounted on the bottom of the pump and the inlet is located approximately 8 to 9 inches from the bottom of the pump. Therefore, in order to utilize this pump with small volumes of waste in the tank, it is necessary to lay the pump on its side on the bottom of the tank. This has been done previously during pumping of leak detection pits. When operated on its side the pump is fitted with a shroud to facilitate flow up to the pump inlet. The pump is procured and utilized as a package unit suspended and deployed from a combined cable and hose reel. The pump is controlled via a hand held VFD, enabling precise control of the pump flow rate.

Other pumps considered were centrifugal sump pumps, piston pumps and jet pumps. Centrifugal sump pumps were excluded because they would not fit down the 4" riser. Piston pumps were excluded because of the high discharge pressure (a pressure relief valve would be necessary) and the inability to drain and back flush the pump. Jet pumps were excluded because they introduce additional liquid to the waste and their low outlet head.

6.1 PUMP CATCH TANK 241-ER-311 INTO POLAR TANKER (IN-LINE FILTRATION UTILIZED)

This option is the originally planned approach to pumping of catch tank 241-ER-311. The option utilizes a small diameter submersible pump, capable of insertion into the tank through the available 4 inch diameter at the West end of the tank. The pump is suspended from a hose reel situated a grade level. The discharge from the hose reel is directed through a cartridge filter assembly intended to remove any entrained solids from carrying over into the tanker. Downstream of the filter the hose connects into a tee assembly on the top of a 5,000 gallon capacity tanker truck. The tanker selected in this option is the "Polar" tanker, available from

Effluent Treatment Facility (ETF), which has both loading and unloading connections from the top of the tanker. There is no bottom discharge connection available on this tanker. Once the tanker is filled, hoses and equipment will be flushed with water and the tanker transported to 241-AY-101 for unloading. Further details of the option are provided below:

1) A Grundfos Redi-Flo2 Model MP1, submersible pump and hosing, will be installed in the West (ENRAF™) Riser. The pump and hosing will be sleeved into the tank to facilitate contamination control during removal.
2) The liquid will be pumped from catch tank 241-ER-311 through a hose connected directly to the pump discharge. This hose extends out of the riser and is connected to a hose reel located at grade.
3) From the hose reel, the hose connects to a 5-micron cartridge filter, which is intended to prevent any entrained solids from carrying over into the tanker. Due to the high dose rate associated with the solids, the filter will need to be placed in a shielded enclosure. Due to the assumed solids loading on the filter, a high radiation area (HRA) will be created requiring barricading and locking. Fencing and other materials would be staged at the work location in the event they are required for access control.
4) Downstream of the filter, the hose connects into one side of a flush tee, which is mounted on the load/unload connection on the top of the tanker. The other side of the flush tee may be connected to a 2-in water flush hose and water truck to provide flushing capabilities of transfer system and pump.
5) Once 241-ER-311 is pumped, the tanker will transport the liquid to the perimeter of the 241-AY Tank Farm.
6) Hoses are then connected to Riser-066 on tank 241-AY-101 and the tanker pressurized to transfer liquid into the subject DST.
7) Multiple flushes of the tanker may be performed to reduce dose rates to required levels for return to ETF.

Estimated Effectiveness of Option:

1) Starting waste volume estimated at 6.2 inches (~400 gallons).
2) Small diameter pump laid on side at West end of tank should be capable of pumping down to 3 to 4 inches (138-211 gallons total remaining waste volume).
3) Due to volume of solids at East end, the remaining free liquid volume would be less than 100 gallons (less than 1% of tank capacity).
4) Based on pump capacity available free liquid could be removed in a day or less.

Benefits to this approach:

1) In-line cartridge filtration limits prevents solids carryover to the tanker, thereby reducing dose rates from the tanker and facilitating subsequent decontamination of the tanker prior to return to ETF.
2) Polar tanker is readily available to support this evolution.
3) This option would immediately reduce the volume that would otherwise continue to leak to the environment. This would further reduce the already minimal risk to the environment.

Risks with this approach:

1) This is a top offloading tanker; if solids are accumulated in the tanker, they will be difficult to remove from the tanker, as was experienced during pumping of catch tank 241-U-301B.
2) If high solids loadings are experienced, plugging of the filter could occur, thereby restricting pumping operations.
3) Solids accumulation on the filter could result in high contact dose rates at the filter housing. This would require either shielding of the filter or posting of the area around the filter as a HRA.
4) Solids in 241-ER-311 are potentially high strontium and pose a risk of spread of radiological contamination when installing and removing equipment from tank risers and from making and breaking connections.
5) Disposal of filter – The filtration housing can be effectively shielded during transfer activities. However, excess liquid must be drained from the filter housing prior to disposal. This will pose a significant radiological risk to the workers performing the work. Risk is associated with the following types of activities: uncoupling, spill release to the environment, personnel contamination etc.
6) A one-time waiver for transport of liquids to 241-AY-101 would be necessary if dose rates exceed 200mR/hr
7) Not all of the liquid can be removed by this option. The remaining liquid (estimated to be less than 100 gallons) would likely eventually leak to the environment.
8) The 702-AZ seal pot condensate must be sampled immediately after the waste is transferred into tank 241-AY-101. Sampling would not be necessary if a different receiver tank (excluding 241-AY and 241-AZ DSTs) is selected or if ORP waives this TSR requirement.

Radiological hazards associated with this approach:

1) Man Dose estimates for this evolution range from 697 mrem to 1,438 mrem. This value is cumulative for an assumed field crew consisting of two operators, one Health Physics Technician (HPT), and one instrument technician.
2) Solids loading on the filter could expose workers to high dose rates. Shielding may be utilized during transfer activities, but will have to be partially removed to gain access to the filter housing following transfer. The excess liquid in the filter housing must be removed prior to disposal.
3) Workers could also be exposed to high dose rates on the transfer line and tanker truck. The liquid does contain moderate levels of Cs^{137}, so dose rates on the tanker truck may still exceed high radiation level limits. It should also be noted that the tanker must then be driven to the 241-AY Tank Farm to off-load the liquid. Radiological exposure would also present a similar problem when connecting up the equipment necessary to pump the tankers contents.
4) Facility workers may be exposed to high dose rates when removing equipment (i.e., pump) from the riser.

5) The spread of radiological contamination may result when performing the following activities:
   - Removing/installing equipment in tank risers;
   - Leaks from hoses/fittings during transfer;
   - Leaks from hoses, fittings while dissembling transfer system; and
   - Leaks from filter housing when removing excess free liquid.

Table 6-1. Cost Estimate for Pumping into Polar Tanker with Filtration

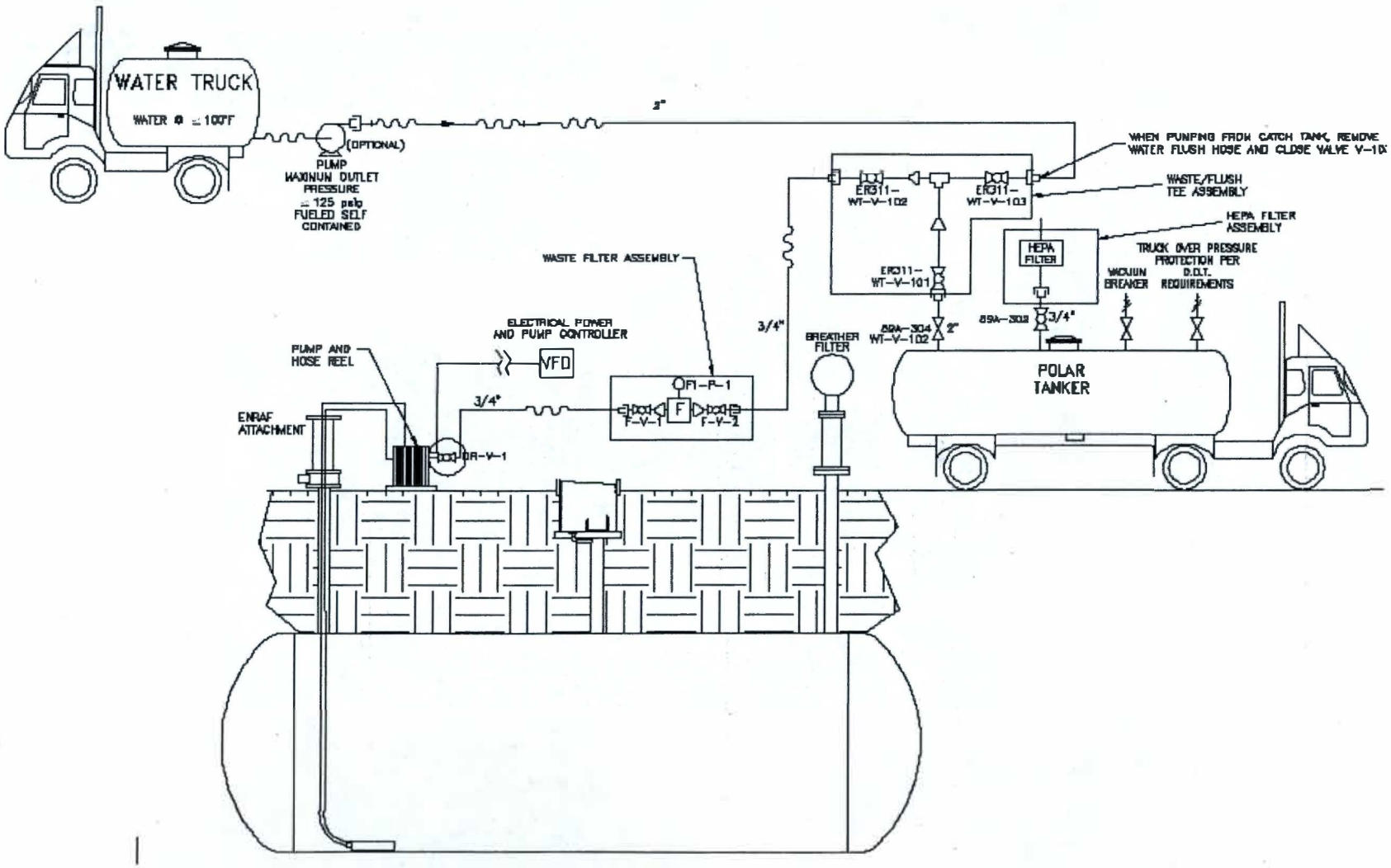
Equipment Cost	
- Pumps and hoses	$5,000
- 2 cameras	$20,000
Labor Cost	
- Field resource cost per shift	$9,000
- Total shifts required	12 to 17 ½
- Field labor cost total	$108,000 to $157,500
- Engineering design support	$30,000
Disposal Cost	
- 6'x3'x3' mixed waste container	$15,600
- 8'x4'x4' low level waste container	$7,300
Sampling Cost	
- Sample/analyze 702-AZ seal pot contents	$10,000
Total Cost	**$195,900 to $245,400**

Table 6-2. Labor Estimate for Pumping into Polar Tanker with Filtration

Activity Description	Shift Total	Description
Equipment set-up at 241-ER-311	2½ to 4	Remove ENRAF™, install pump, stage truck, connect equipment, sleeve equipment and establish HRA around tanker and filter housing.
Pump liquid from 241-ER-311 into Tanker	1	Time allotted for pumping and back flushing of lines.
Transport liquid to 241-AY Tank Farm	½	Roads may have to be closed if dose rates exceed 200 mR/hr.
Equipment set-up at 241-AY Tank Farm	2 to 3	Connect hoses to 241-AY-101 riser-066, sleeve hoses, and connect air compressor to truck.
Post 241-AY Tanker Staging Area as HRA	½ to 1	Fence paneling may be necessary to control access to HRA.
Pump liquid from Tanker into 241-AY-101	½ to 1	< 500 gallons total will be transferred
Decontaminate Tanker	½ to 1	Minimal solids anticipated to be present. However, several tanker flushes may be necessary.
Dispose of contaminated equipment	2 to 3	This includes pump at 241-ER-311 and hoses at both 241-ER-311 and 241-AY-101. Additional time allotted since camera and pump removal will be time consuming due to contamination/dose concerns.
Drain liquid from filter housing	1	The filter housing may have high radiological dose rates. A full shift may be necessary to remove liquid and dispose of this unit.
Sample 702-AZ seal pot	1	This includes sampling and transport of samples to WSCF.
Reinstall ENRAF™ at 241-ER-311	½ to 1	
Total Shifts	**12 to 17 ½**	

Note: Field resource shift estimates include the following resources: five operators, four HPTs, one field work supervisor, one industrial hygiene technician, two fitters, one electrician, one teamster, two mechanical engineers, one radiological control manager, and one facility manager.

Figure 6-1. Configuration for Pumping Catch Tank 241-ER-311 into Polar Tanker (In-line Filtration Utilized)



6.2 PUMP CATCH TANK 241-ER-311 INTO POLAR TANKER (FILTRATION NOT UTILIZED)

This option is a variation of option discussed in section 46.1 above, but eliminates the potential problems that may result from use of a filter assembly, by simply eliminating the use of the filter and pumping liquid from catch tank 241-ER-311 directly into the Polar tanker. Details of the option are provided below:

1) A Grundfos Redi-Flo2 Model MP1, submersible pump and hosing, will be installed in the West (ENRAF™) Riser. The pump and hosing will be sleeved into the tank to facilitate contamination control during removal.
2) The liquid will be pumped from catch tank 241-ER-311 through a hose connected directly to the pump discharge. This hose extends out of the riser and is connected to a hose reel located at grade.
3) From the hose reel, the hose connects into one side of a flush tee, which is mounted on the load/unload connection on the top of the tanker. The other side of the flush tee may be connected to a 2-in water flush hose and water truck to provide flushing capabilities of transfer system and pump. All hosing and connections will be sleeved in the event of a connection or line leak.
4) Once 241-ER-311 is pumped, the tanker will transport the liquid to the perimeter of the 241-AY Tank Farm.
5) Hoses are then connected to Riser-066 on tank 241-AY-101 and the tanker pressurized to transfer liquid into the subject DST.
6) Multiple flushes of the tanker may be performed to reduce dose rates to required levels for return to ETF.

Estimated Effectiveness of Option:

1) Starting waste volume estimated at 6.2 inches (~400 gallons).
2) Small diameter pump laid on side at West end of tank should be capable of pumping down to 3 to 4 inches (138-211 gallons total remaining waste volume).
3) Due to volume of solids at East end, the remaining free liquid volume would be less than 100 gallons (less than 1% of tank capacity).
4) Based on pump capacity available free liquid could be removed in a day or less.

Benefits to this approach:

1) Filter plugging problems are eliminated.
2) High dose rates associated with the filter assembly are eliminated.
3) Disposal of a highly radioactive filtration unit is not necessary.
4) Polar tanker is readily available to support this evolution.
5) This option would immediately reduce the volume that would otherwise continue to leak to the environment. This would further reduce the already minimal risk to the environment.

Risks with this approach:

1) Without the filter in the system, any solids pumped from 241-ER-311 will carry over into the tanker, increasing radiological dose rates from the tanker, since the tanker is unshielded. Posting the tanker truck staging area as an HRA at both 241-ER-311 and 241-AY Tank Farm may be necessary.
2) Since the tanker can only be unloaded from the top via a dip leg, removal of solids from the tanker will be difficult, thereby making it more difficult to decontaminate the tanker to acceptable levels prior to returning to ETF.
3) A one-time DOE waiver for transport liquids to 241-AY-101 would be necessary if dose rates exceed 200mR/hr
4) The doses on the hose are estimated to be 50 mR/hr on contact, 10 mR/hr @ 30 cm, and 5 mR/hr @ one meter.
5) Solids in 241-ER-311 are potentially high strontium and pose a risk of spread of radiological contamination when installing and removing equipment from tank risers and from making and breaking connections.
6) Not all of the liquid can be removed by this option. The remaining liquid (estimated to be less than 100 gallons) would likely eventually leak to the environment.
7) The 702-AZ seal pot condensate must be sampled immediately after the waste is transferred into tank 241-AY-101. Sampling would not be necessary if a different receiver tank (excluding 241-AY and 241-AZ DSTs) is selected or if ORP waives this TSR requirement.

Radiological hazards associated with this approach:

1) Man Dose estimates for this evolution range from 324 mrem to 667 mrem. This value is cumulative for an assumed field crew consisting of two operators, one HPT, and one Instrument technician.
2) Workers could be exposed to high dose rates on the transfer line and tanker truck. Without in-line filtration, solids carry-over could significantly increase the radiological dose rates on the tanker. Even if the solids carry-over is minimal, the liquid does contain moderate levels of Cs^{137} so dose rates on the tanker truck may still exceed high radiation level limits. It should also be noted that the tanker must then be driven to the 241-AY Tank Farm to off-load the liquid. Radiological exposure would also present a similar problem when connecting up the equipment necessary to pump the tankers contents.
3) Since the tanker can only be unloaded from the top via a dip leg, removal of solids from the tanker will be difficult. This could significantly increase the amount of time necessary to decontaminate the tanker to acceptable levels. The increased decontamination time could unnecessarily expose workers to additional dose.
4) Facility workers may be exposed to high dose rates when removing equipment (i.e., pump) from the riser.
5) The spread of radiological contamination may result when performing the following activities:
   - Removing/installing equipment in tank risers;
   - Leaks from hoses/fittings during transfer; and
   - Leaks from hoses and fittings while dissembling transfer system;

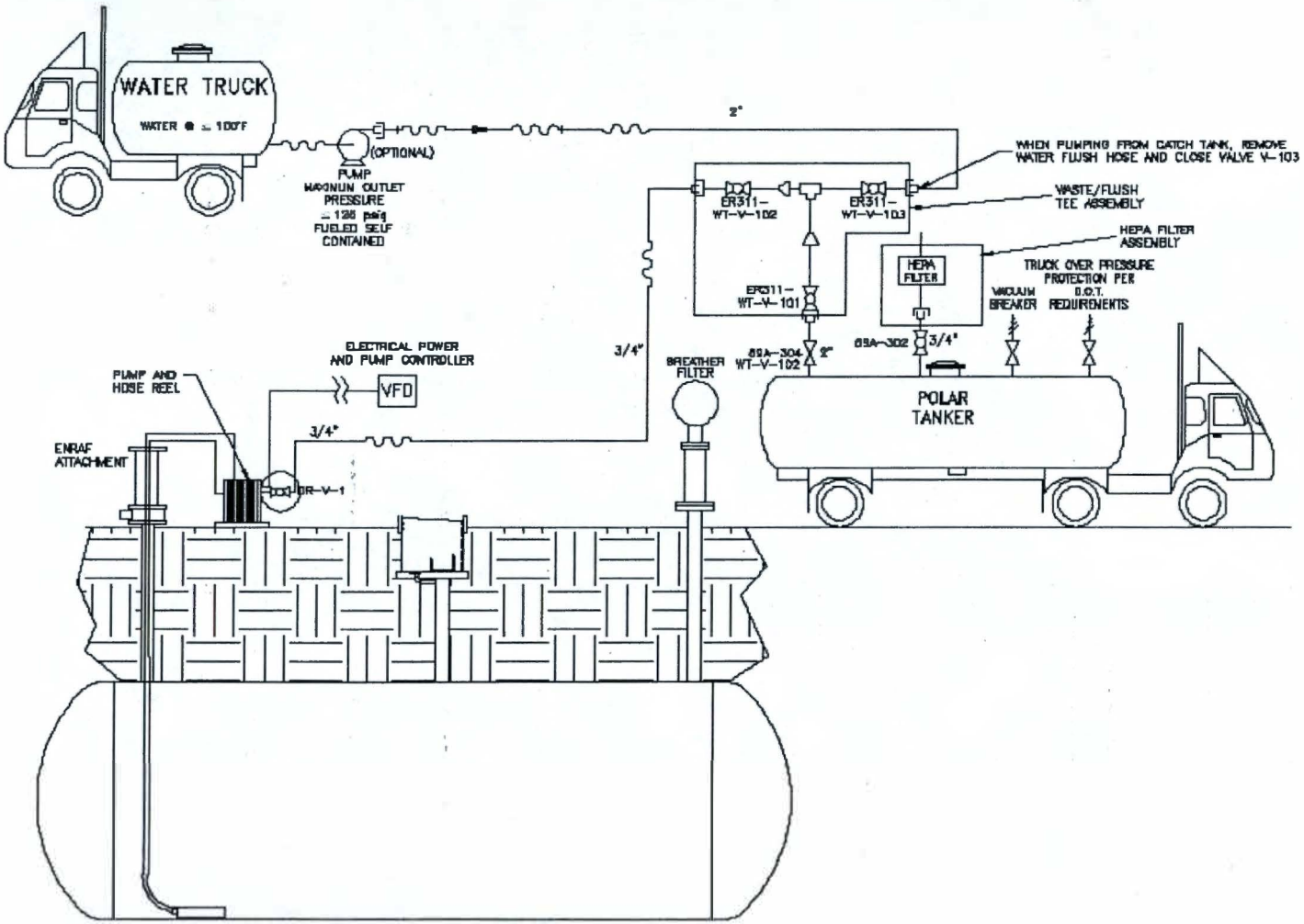
Table 6-3. Cost Estimate for Pumping into Polar Tanker without Filtration

Equipment Cost	
- Pumps and hoses	$5,000
- 2 cameras	$20,000
Labor Cost	
- Field resource cost per shift	$9,000
- Total shifts required	11½ to 17½
- Field labor cost total	$103,500 to $157,500
- Engineering design support	$30,000
Disposal Cost	
- 6'x3'x3' mixed waste container	$15,600
- 8'x4'x4' low level waste container	$7,300
Sampling Cost	
- Sample/analyze 702-AZ seal pot contents	$10,000
Total Cost	**$191,400 to $245,400**

Table 6-4. Labor Estimate for Pumping into Polar Tanker without Filtration

Activity Description	Shift Total	Description
Equipment set-up at 241-ER-311	2½ to 4	Remove ENRAF™, install pump, stage truck, connect equipment, sleeve equipment and establish HRA around tanker.
Pump liquid from 241-ER-311 into Tanker	1	Time allotted for pumping and back flushing of lines.
Transport liquid to 241-AY Tank Farm	½	Roads may have to be closed if dose rates exceed 200 mR/hr.
Equipment set-up at 241-AY Tank Farm	2 to 3	Connect hoses to 241-AY-101 riser-066, sleeve hoses, and connect air compressor to truck.
Post 241-AY Tanker Staging Area as HRA	½ to 1	Fence paneling may be necessary to control access to HRA.
Pump liquid from Tanker into 241-AY-101	½ to 1	< 500 gallons total will be transferred
Decontaminate Tanker	1 to 2	Solids are anticipated to be present due to lack of in-line filtration. Several tanker flushes may be necessary.
Dispose of contaminated equipment	2 to 3	This includes pump at 241-ER-311 and hoses at both 241-ER-311 and 241-AY-101. Additional time allotted since camera and pump removal will be time consuming due to contamination/dose concerns.
Sample 702-AZ seal pot	1	This includes sampling and transport of samples to WSCF.
Reinstall ENRAF™ at 241-ER-311	½ to 1	
Total Shifts	**11½ to 17 ½**	
Note: Field resource shift estimates include the following resources: five operators, four HPTs, one field work supervisor, one industrial hygiene technician, two fitters, one electrician, one teamster, two mechanical engineers, one radiological control manager, and one facility manager.		

Figure 6-2. Configuration for Pumping Catch Tank 241-ER-311 into Polar Tanker (Filtration Not Utilized)



6.3 PUMP CATCH TANK 241-ER-311 INTO WALKER TANKER (BOTTOM UNLOADING TANKER)

This option is similar to the option discussed in section 6.2 above, except that a different tanker is utilized. This option utilizes the "Walker" tanker, which is also available from ETF. This tanker has the advantage of being a top fill, bottom discharge configuration, which would facilitate subsequent removal of any solids that are carried over to the tanker. Details of the option are:

1) A Grundfos Redi-Flo2 Model MP1, submersible pump and hosing, will be installed in the West (ENRAF™) Riser. The pump and hosing will be sleeved into the tank to facilitate contamination control during removal.
2) The liquid will be pumped from catch tank 241-ER-311 through a hose connected directly to the pump discharge. This hose extends out of the riser and is connected to a hose reel located at grade.
3) From the hose reel, the hose connects into one side of a flush tee, which is mounted on the load connection on the top of the Walker tanker. All hosing and connections will be sleeved in the event of a connection or line leak.
4) A flush truck will be available to perform back flushing of pump and transfer system, as necessary.
5) Once 241-ER-311 is pumped, the tanker will transport the liquid to the perimeter of the 241-AY Tank Farm. Posting of tanker truck staging area as a HRA may be required.
6) The front end of the tanker must then be elevated (jacked up) to facilitate draining from a bottom drain port. However, jacks are already installed on the trailer to facilitate this operation.
7) Hoses are then connected to Riser-066 on tank 241-AY-101 and the tanker pressurized to transfer liquid into the subject DST.
8) Multiple flushes of the tanker may be performed to reduce dose rates to required levels for return to ETF.

Estimated Effectiveness of Option:

1) Starting waste volume estimated at 6.2 inches (~400 gallons).
2) Small diameter pump laid on side at West end of tank should be capable of pumping down to 3 to 4 inches (138-211 gallons total remaining waste volume).
3) Due to volume of solids at East end, the remaining free liquid volume would be less than 100 gallons (less than 1% of tank capacity).
4) Based on pump capacity available free liquid could be removed in a day or less.

Benefits to this approach:

1) Option can be readily implemented and uses familiar equipment and technologies for tank farms.

2) This option would immediately reduce the volume that would otherwise continue to leak to the environment. This would further reduce the already minimal risk to the environment.
3) Filter plugging problems are eliminated.
4) High dose rates associated with the filter assembly are eliminated.
5) Disposal of a highly radioactive filtration unit is not necessary.
6) The Walker tanker is offloaded at the bottom of the tanker, thereby facilitating flushing and removal of solids and decontamination of the tanker for return to ETF.
7) The Walker tanker is available for use here at the Hanford Site.

Risks with this approach:

1) Without the filter in the system, any solids pumped from 241-ER-311 will carry over into the tanker, increasing radiological dose rates from the tanker, since the tanker is unshielded. The staging areas for the tanker must be controlled as an HRA until proven otherwise. Temporary fencing panels must be gathered and established prior to work commencing. For the tanker, the values estimated are 450 to 1140 mR/hr on contact, 240 to 350 mR/hr @30 cm, and 95 to 130 mR/hr @ 1 meter. The doses on the hose are estimated to be 50 mR/hr on contact, 10 mR/hr @ 30 cm, and 5 mR/h @ one meter. There will be shielding available per the RWP to shield the hose lines if dose rates exceed 50 mR/hr.
2) Solids in 241-ER-311 are potentially high strontium and pose a risk of spread of radiological contamination when installing and removing equipment from tank risers and from making and breaking connections.
3) Tanker must be returned to ETF with dose levels < 5mr/hr. Current dose levels on the tanker truck are ~2 mR/hr. If tanker truck dose rates cannot be reduced to acceptable levels, Waste Feed Operations (WFO) will have to replace truck (~$50,000).
4) A one-time DOE waiver for transport liquids to 241-AY-101 would be necessary if dose rates exceed 200 mR/hr on contact with the tanker. Current dose calculations on the tanker have shown that when the waste settles, dose rates of 450 to 1140 mR/hr on contact, 240 to 350 mR/hr @30 cm, and 95 to 130 mR/hr @ 1 meter will be present. Alignments for this waiver have been made with Waste Management and no issue with obtaining a waiver is anticipated.
5) A flush system may be hooked up to the tanker to obtain the desired contact dose rates. This increases the risk of providing another potential leak point of potentially contaminated liquid.
6) Not all of the liquid can be removed by this option. The remaining liquid (estimated to be less than 100 gallons) would likely eventually leak to the environment.
7) The 702-AZ seal pot condensate must be sampled immediately after the waste is transferred into tank 241-AY-101. Sampling would not be necessary if a different receiver tank (excluding 241-AY and 241-AZ DSTs) is selected or if ORP waives this TSR requirement.

Radiological hazards associated with this approach:

1) Man Dose estimates for this evolution range from 324 mrem to 667 mrem. This value is cumulative for an assumed field crew consisting of two operators, one HPT, and one Instrument technician.
2) Workers could be exposed to high dose rates on the transfer line and tanker truck. Without in-line filtration, solids carry-over could significantly increase the radiological dose rates on the tanker. Even if the solids carry-over is minimal, the liquid does contain moderate levels of Cs^{137} so dose rates on the tanker truck may still exceed high radiation level limits. It should be noted that the tanker must then be driven to the 241-AY Tank Farm to off-load the liquid. Radiological exposure would also present a similar problem when connecting up the equipment necessary to pump the tankers contents.
3) Facility workers may be exposed to high dose rates when removing equipment (i.e., pump) from the riser.
4) The spread of radiological contamination may result when performing the following activities:
   - Removing/installing equipment in tank risers;
   - Leaks from hoses/fittings during transfer; and
   - Leaks from hoses, fittings while dissembling transfer system;

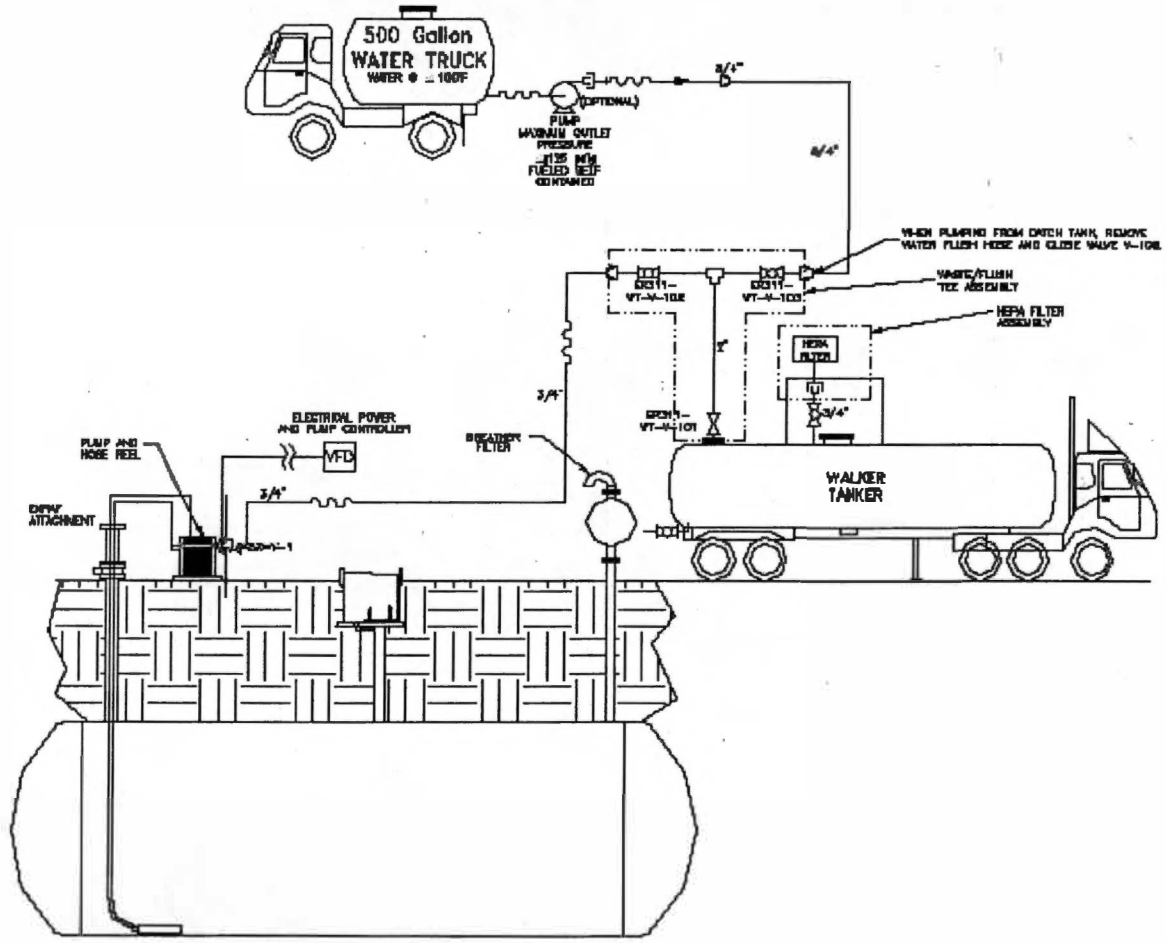
Table 6-5. Cost Estimate for Pumping into Walker Tanker

Equipment Cost	
- Pumps and hoses	$5,000
- 2 cameras	$20,000
Labor Cost	
- Field resource cost per shift	$9,000
- Total shifts required	11 to 16 ½
- Field labor cost total	$99,000 to $145,500
- Engineering design support	$30,000
Disposal Cost	
- 6'x3'x3' mixed waste container	$15,600
- 8'x4'x4' low level waste container	$7,300
Sampling Cost	
- Sample/analyze 702-AZ seal pot contents	$10,000
Total Cost	**$186,900 to $236,400**

Table 6-6. Labor Estimate for Pumping into Walker Tanker

Activity Description	Shift Total	Description
Equipment set-up at 241-ER-311	2½ to 4	Remove ENRAF™, install pump, stage truck, connect equipment, sleeve equipment and establish HRA around tanker and filter housing.
Pump liquid from 241-ER-311 into Tanker	1	Time allotted for pumping and back flushing of lines.
Transport liquid to 241-AY Tank Farm	½	Roads may have to be closed if dose rates exceed 200 mR/hr.
Equipment set-up at 241-AY Tank Farm	2 to 3	Connect hoses to 241-AY-101 riser-066, sleeve hoses, and connect air compressor to truck.
Post 241-AY Tanker Staging Area as HRA	½ to 1	Fence paneling may be necessary to control access to HRA.
Pump liquid from Tanker into 241-AY-101	½ to 1	< 500 gallons total will be transferred
Decontaminate Tanker	½ to 1	Minimal solids anticipated to be present. However, several tanker flushes may be necessary.
Dispose of contaminated equipment	2 to 3	This includes pump at 241-ER-311 and hoses at both 241-ER-311 and 241-AY-101. Additional time allotted since camera and pump removal will be time consuming due to contamination/dose concerns.
Sample 702-AZ seal pot	1	This includes sampling and transport of samples to WSCF.
Reinstall ENRAF™ at 241-ER-311	½ to 1	
Total Shifts	**11 to 16 ½**	
Note: Field resource shift estimates include the following resources: five operators, four HPTs, one field work supervisor, one industrial hygiene technician, two fitters, one electrician, one teamster, two mechanical engineers, one radiological control manager and one facility manager.		

Figure 6-3. Configuration for Pumping Catch Tank 241-ER-311 into Walker Tanker (Bottom Unloading Tanker)



6.4 PUMP CATCH TANK 241-ER-311 INTO A DURATEK SHIPPING CASK (21-300) WITH CONICAL POLYETHYLENE LINER.

This option uses the same submersible pump and hose reel as the previous options. This option also eliminates the use of a cartridge filter as originally proposed. In this option the previously utilized tankers are replaced with the use of a leased, shielded shipping cask fitted with a 2,200 gallon capacity polyethylene liner. The liner has a slightly conical bottom head to facilitate emptying. All connections to the cask are via a top lid assembly. A specifically designed lid to facilitate loading and unloading connections would need to be procured. The cask will be transported via a flatbed trailer. Because of the weight of the cask and shielding, a mobile crane will be required to remove the cask lid and to remove the liner from the cask. Once the cask is full, the hose and connections would be flushed into the cask as in previous options and the cask transported to 241-AY-101 for emptying. The cask would be emptied utilizing a diaphragm pump supplied by the cask supplier. On completion of transfer, the liner would be removed from the cask and disposed of. The shielded cask would be returned to the cask supplier.

1) A Grundfos Redi-Flo2Model MP1, submersible pump, will be installed in the West riser.
2) The liquid will be pumped from catch tank 241-ER-311 through a hose connected directly to the pump discharge. This hose extends out of the riser and is connected to a hose reel located at grade.
3) From the hose reel, the hose would connect into one side of a flush tee, which will connect into the load/unload connection on the top of the 21-300 IP-II Type A cask (a lid would need to be designed to accommodate desired configuration, which would include a load/unload connection and a connection point for a breather filter).
4) A flush truck will be available to perform back flushing of pump and transfer system, as necessary.
5) Once 241-ER-311 is pumped, the shipping cask will be transported to the perimeter of 241-AY Tank Farm.
6) The sleeved hose will be connected from the shipping cask to Riser-066 on Tank 241-AY-101.
7) Waste will then be transferred out of the cask utilizing a sand piper pump (air diaphragm pump – Duratek supplied).
8) Upon completion of the transfer, the polyethylene liner would have to be removed from the shipping cask and disposed of.
9) The shipping cask and cask trailer would be returned to Duratek upon completion of this activity.

Estimated Effectiveness of Option:

1) Starting waste volume estimated at 6.2 inches (~400 gallons).
2) Small diameter pump laid on side at West end of tank should be capable of pumping down to 3 to 4 inches (138-211 gallons total remaining waste volume).
3) Due to volume of solids at East end, the remaining free liquid volume would be less than 100 gallons (less than 1% of tank capacity).

4) Based on pump capacity available free liquid could be removed in a day or less.

Benefits to this approach:

1) Filter plugging problems are eliminated.
2) High dose rates associated with the filter assembly are eliminated.
3) Disposal of a highly radioactive filtration unit is not necessary.
4) The use of a shielded cask will substantially reduce dose rates from either liquid or solid waste accumulated in the cask.
5) The cask liner in conical and will somewhat facilitate emptying of the liner. The polyethylene liner has an internal volume of 300 cubic feet, or ~2,240 gallons.
6) Cask could be delivered in ~ 2 days - Duratek will supply cask, trailer, liner, pump and technician.
7) This option would immediately reduce the volume that would otherwise continue to leak to the environment. This would further reduce the already minimal risk to the environment.

Risks with this approach:

1) Cost – See table below for cost estimate. It is assumed that the liner will be disposed of by WFO. It should be noted that if the cask and hauling trailer are contaminated and can not be returned, the expense would be significantly higher.
2) Unanalyzed configuration under current safety basis – Another safety basis waiver from TSR controls may need to be prepared for this alternate configuration.
3) Although the liner has a slightly conical bottom, it will still prove difficult to remove solids from the liner due to the lack of a bottom discharge.
4) Solids in 241-ER-311 are potentially high strontium and pose a risk of spread of radiological contamination when installing and removing equipment from tank risers and from making and breaking connections.
5) The weight of the shielding on the cask lid will require the use of a mobile crane.
6) The polyethylene liner must be disposed of by WFO.
7) Open top cask filling and draining possibly creates an unmonitored emission point. Air sampling will be required at fill and drain openings on cask.
8) Shielding of transfer lines is still required if dose rates exceed 50 mR/hr.
9) Based on dose calculations, 1.5 inches of lead on cask may still require HRA controls.
10) A Notice of Construction (NOC) would have to be developed and approved for this configuration.
11) Not all of the liquid can be removed by the option. The remaining liquid (estimated to be less than 100 gallons) would likely eventually leak to the environment.
12) The 702-AZ seal pot condensate must be sampled immediately after the waste is transferred into tank 241-AY-101. Sampling would not be necessary if a different receiver tank (excluding 241-AY and 241-AZ DSTs) is selected or if ORP waives this TSR requirement.

Radiological hazards associated with this approach:

1) Workers could be exposed to high dose rates on the transfer line. Back flushing the line may be utilized to reduce dose rates following transfer and prior to disassembly of equipment.
2) Facility workers may be exposed to high dose rates when removing equipment (i.e., pump) from the riser.
3) The spread of radiological contamination may result when performing the following activities:
   - Removing/installing equipment in tank risers;
   - Leaks from hoses/fittings during transfer;
   - Leaks from hoses and fittings while dissembling transfer system; and
   - Transferring into an open top cask.

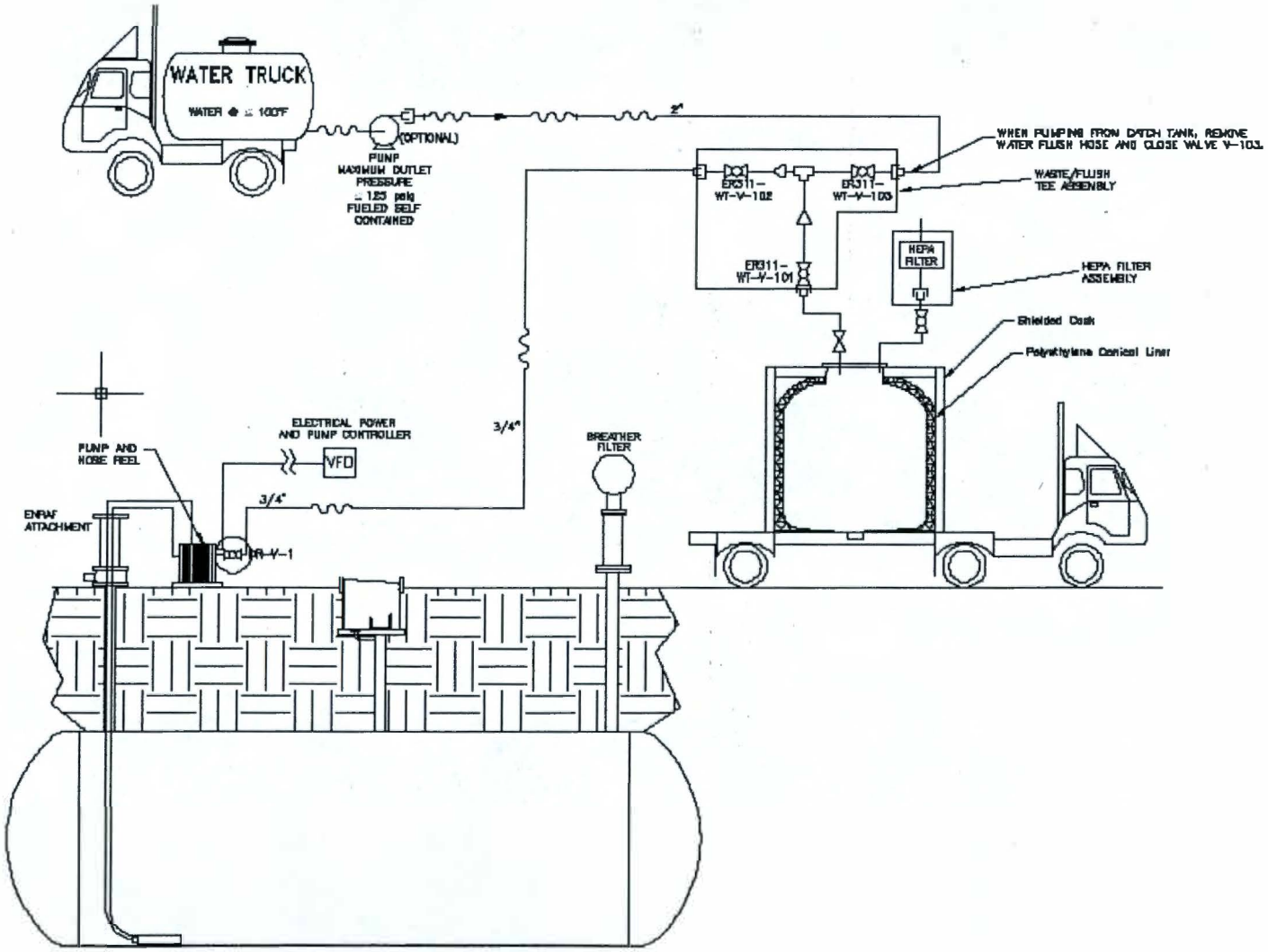
Table 6-7. Cost Estimate for Pumping into Shipping Cask

Equipment Cost	
- Pumps and hoses (to empty 241-ER-311)	$5,000
- 1 camera	$10,000
- Cask rental	$10,000/month
- Cask transportation	$18,000 (6,000 total miles @ ~ $3 per mile)
- Polyethylene liner	$6,000
- Sand piper pump (to unload cask)	$6,000
Labor Cost	
- Field resource cost per shift	$9,000
- Total shifts required	11 ½ to 16 ½
- Field labor cost total	$108,000 to $148,500
- Engineering design support (includes update of DSA)	$50,000
Disposal Cost	
- 6'x3'x3' mixed waste container	$15,600
- 8'x4'x4' low level waste container	$7,300
- Disposal of polyethylene liner	$15,000
Sampling Cost	
- Sample/analyze 702-AZ seal pot contents	$10,000
Total Cost	**$270,900 to $311,400**

Table 6-8. Labor Estimate for Pumping into Shipping Cask

Activity Description	Shift Total	Description
Equipment set-up at 241-ER-311	2½ to 4	Remove ENRAF™, install pump, stage truck and cask, connect equipment and sleeve equipment.
Pump liquid from 241-ER-311 into cask	1	Time allotted for pumping and back flushing of lines.
Transport liquid to 241-AY Tank Farm	½	Cask is shielded so roads will not likely need to be closed.
Equipment set-up at 241-AY Tank Farm	2 to 3	Connect hoses to 241-AY-101 riser-066 and sleeve hoses.
Pump liquid from cask into 241-AY-101	1 to 2	< 500 gallons total will be transferred. Several flushing evolutions may be necessary to remove solids so polyethylene liner can be disposed of as low level waste.
Dispose of contaminated equipment	3 to 4	This includes pump at 241-ER-311 and hoses at both 241-ER-311 and 241-AY-101. Additional time allotted since camera and pump removal will be time consuming due to contamination/dose concerns. The polyethylene liner must also be disposed of.
Sample 702-AZ seal pot	1	This includes sampling and transport of samples to WSCF.
Reinstall ENRAF™ at 241-ER-311	½ to 1	
Total Shifts	**11½ to 16 ½**	
Note: Field resource shift estimates below include the following resources: five operators, four HPTs, one field work supervisor, one industrial hygiene technician, two fitters, one electrician, one teamster, two mechanical engineers, one radiological control manager and one facility manager.		

Figure 6-4. Configuration for Pumping Catch Tank 241-ER-311 into a Duratek Shipping Cask (21-300) with Conical Polyethylene Liner



6.5 TRANSFER 241-ER-311 CATCH TANK TO 244-A CATCH TANK

This option would utilize existing non-compliant underground transfer lines to transfer residual liquid to 244-A catch tank. This option would utilize the same submersible pump configuration as previous options. Cover blocks would need to be removed at 241-ER-311 central pump pit and modifications performed to connect the discharge hose from the submersible pump into the jumper/nozzle assembly to allow connection to line V-224. Liquid would be transferred via a series of transfer lines into the 244-A pump pit. A flex jumper has been dropped in this pit and liquid would be drained to the pit floor and allowed to enter 244-A via the pit drain. The pit would then be flushed into 244-A to remove solids /gross contamination from the pit.

1) A Grundfos Redi-Flo2Model MP1, submersible pump, will be installed in the West Riser.
2) The liquid will be pumped from catch tank 241-ER-311 through a hose connected directly to the pump discharge. This hose extends out of the riser and is connected to a hose reel located at grade.
3) From the hose reel, the hose would connect into the jumper/nozzle that connects into line V-224.
4) Liquid would then be transferred through a series of waste transfer lines (V-224, PSN-V229, PAS-244, and SN-234) into the 244-A pump pit. Liquid will drain to pit floor, then into the associated catch tank. Note that the estimated transfer volume (< 300 gallons) is significantly less than the line hold-up volume (> 3,000 gallons) for the route to the 244-A pump pit.

Estimated Effectiveness of Option:

1) Starting waste volume estimated at 6.2 inches (~400 gallons).
2) Small diameter pump laid on side at West end of tank should be capable of pumping down to 3 to 4 inches (138-211 gallons total remaining waste volume).
3) Due to volume of solids at East end, the remaining free liquid volume would be less than 100 gallons (less than 1% of tank capacity).
4) Based on pump capacity available free liquid could be removed in a day or less.

Benefits to this approach:

1) A significant portion of the transfer route is underground, eliminating issues with shielding that result from transfer of solids.
2) A tanker truck/shielded cask does not have to be emptied.
3) No risk of cost due to inheriting a contaminated tanker or vendor equipment.
4) This option would immediately reduce the volume that would otherwise continue to leak to the environment. This would further reduce the already minimal risk to the environment.

Risks with this approach:

1) The option utilizes non-compliant transfer systems that have been previously taken out of service and were not planned to be used again. Approval from WDOE would be required to transfer through four non-RCRA compliant transfer pipelines and five non-RCRA compliant process pits is necessary. This option would likely not be viewed favorably by WDOE.
2) Pit work and jumper modification would be required. Cover blocks must be removed at 241-ER-311 pump pit to reconfigure the transfer route. Increased radiological hazards in opening pits and performing work in pits.
3) Liquid would be pumped/drained directly to the 244-A pump pit floor.
4) Liquid would eventually have to be pumped out of 244-A into a DST.
5) Solids in 241-ER-311 are potentially high strontium and pose a risk of spread of radiological contamination when installing and removing equipment from tank risers and from making and breaking connections.
6) Not all of the liquid can be removed by the option. The remaining liquid (estimated to be less than 100 gallons) would likely eventually leak to the environment.
7) The 702-AZ seal pot condensate must be sampled immediately after the waste is transferred into tank 241-AY-101. Sampling would not be necessary if a different receiver tank (excluding 241-AY and 241-AZ DSTs) is selected or if ORP waives this TSR requirement.

Radiological hazards associated with this approach:

1) Workers could be exposed to high dose rates on the transfer line. However, back flushing the line may be utilized to reduce dose rates following transfer and prior to disassembly of equipment.
2) Facility workers may be exposed to high dose rates when removing equipment (i.e., pump) from the riser.
3) The spread of radiological contamination may result when performing the following activities:
   - Removing/installing equipment in tank risers;
   - Leaks from hoses/fittings during transfer;
   - Leaks from hoses and fittings while dissembling transfer system; and
   - Performing pit entry into 241-ER-311 pump pit to connect equipment to transfer line.

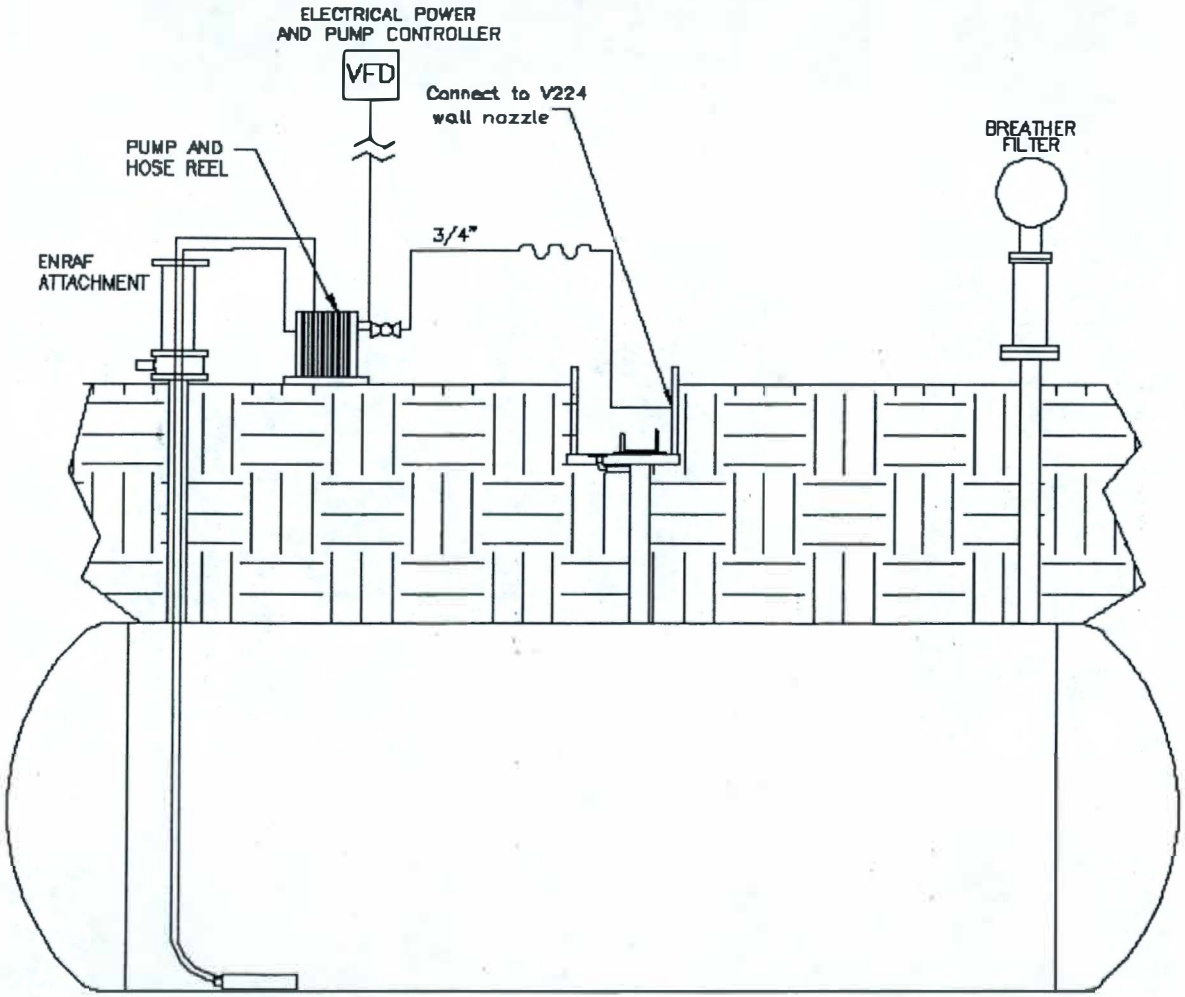
Table 6-9. Cost Estimate for Transferring to 244-A Catch Tank

Equipment Cost	
- Pumps and hoses	$5,000
- 1 camera	$10,000
Labor Cost	
- Field resource cost per shift	$9,000
- Total shifts required	7½ to 12 ½
- Field labor cost total	$67,500 to $112,500
- Engineering design support	$10,000
Disposal Cost	
- 6'x3'x3' mixed waste container	$15,600
- 8'x4'x4' low level waste container	$7,300
Total Cost	**$115,400 to $160,400**

Table 6-10. Labor Estimate for Transferring to 244-A Catch Tank

Activity Description	Shift Total	Description
Equipment set-up at 241-ER-311	2½ to 4	Remove ENRAF™, install pump, stage truck, connect equipment, sleeve equipment and establish HRA around tanker and filter housing.
Connect pump and hoses to existing transfer system	2 to 3	This requires a pit entry into the 241-ER-311 pump pit. The existing flex jumper must be disconnected, and the new pumping system must be connected to the wall nozzle.
Pump liquid from 241-ER-311 into 244-A via line V224.	½	
Dispose of contaminated equipment	1 to 2	This includes pump and hoses at 241-ER-311.
Reconfigure 241-ER-311 pump pit and reinstall cover blocks	1 to 2	
Reinstall ENRAF™ at 241-ER-311	½ to 1	
Total Shifts	**7½ to 12 ½**	
Note: Field resource shift estimates include the following resources: five operators, four HPTs, one field work supervisor, one industrial hygiene technician, two fitters, one electrician, one teamster, two mechanical engineers, one radiological control manager and one facility manager.		

Figure 6-5. Configuration for Transferring 241-ER-311 Catch Tank Waste to 244-A Catch Tank



7.0 OPTIONS TO EVALUATE EXTENT OF CONTAMINATION BELOW CATCH TANK 241-ER-311

Hydraulic-hammer/Geophysical Survey Investigation may be performed to assess the extent of contamination that may have resulted due to the leak from catch tank 241-ER-311. This approach may also be performed to ascertain the extent of contamination near the previously failed adjacent tank, 241-ER-311A. Two options are discussed in more detail in the sections below.

7.1 HYDRAULIC-HAMMER/GEOPHYSICAL SURVEY INVESTIGATION USING ANGLE PUSHES

This option is designed to use angle pushes to interrogate the subsurface beneath Catch Tank 241-ER-311, in an attempt to ascertain the presence of, and if present, the extent of contamination resulting from a waste leak of approximately 100 gallons. Five angle pushes will be advanced, within 3 feet of the tank, to interrogate the region beneath the tank. Pushes will be advanced at an angle of 30° from the horizontal (60° from vertical). This angle allows the Hydraulic-Hammer Unit (HHU) to be located outside the respiratory protection zone along the south side of the enclosure. Two of the pushes will be directed to test the end sections of the tank, which are thought to be the most likely point for a leak to occur. The remaining three pushes will be evenly distributed, with one in the center and the remaining two at 9 feet from the ends of the tank. Gamma probes will then be inserted into the probe holes to determine the extent of contamination.

This option requires a ground-penetrating radar survey of the area to be conducted to provide input to the excavation permit process. A composite map will be made using ground penetrating radar survey data and subsurface identified on engineering drawings. This survey will be overlain on a composite drawing to provide a permanent record of the environment. This option also assumes that the waste has sufficient gamma emitting radionuclide activity that its presence can be identified by gamma logging.

Estimated Effectiveness of Option:

1) This method has been successfully utilized in the past to assess contaminant migration from SST leaks. The leak estimate at 241-ER-311 was originally projected to be approximately 100 gallons. A 100 gallon release would nominally impact a spherical ellipsoid with a horizontal radius of 6.5 feet and a depth of 6.8 feet by increasing the moisture content 2 percent and transporting contained contaminants to that extent. This would increase to a horizontal radius of 15.5 feet and a depth of 15.5 feet if the remaining 400 gallons were to leak to the soil.
2) The small volume of the assumed leak and low level of radionuclide contamination pose a risk that push sampling and use of gamma or neutron monitors could easily fail to detect the affected area of contamination.

3) If contamination from preceding releases (at adjacent 241-ER-311A) is high enough, they may mask the event being characterized at 241-ER-311, although records from installation of 241-ER-311 indicate minimal contamination in the excavation.

Benefits to this approach:

1) The extent of the contaminant migration resulting from the leak can be adequately assessed.
2) Disposal costs are minimal - All drill rods are recovered, decontaminated, and reused. Equipment is staged outside the Tank Farm
3) Risks to facility workers are minimal since all equipment is located outside the fenced area.
4) Soil sampling and analysis is not required to determine the extent of contaminant migration, but may be performed at an additional cost.

Risks with this approach:

1) The small volume of the assumed leak and low level of radionuclide contamination pose a risk that push sampling could easily fail to detect the affected area of contamination.
2) If contamination from preceding releases (at adjacent 241-ER-311A) is high enough, they may mask the event being characterized at 241-ER-311, although records from installation of ER-311 indicate minimal contamination in the excavation.
3) This option would cost in excess of $150,000 and would be an incremental cost to any other option. An increase of approximately 20 percent in total cost may be incurred if soil sampling and analysis is required.

Radiological hazards associated with this approach:

1) Minimal potential for radiological exposure to employees exist – This option does not involve transport of solids with high radiological dose rates, nor does it involve any tank intrusive work. All pushes are performed outside the fenced barrier. Some exposure could occur if contaminated soil samples are obtained, or during the process of decontaminating the drill rods.

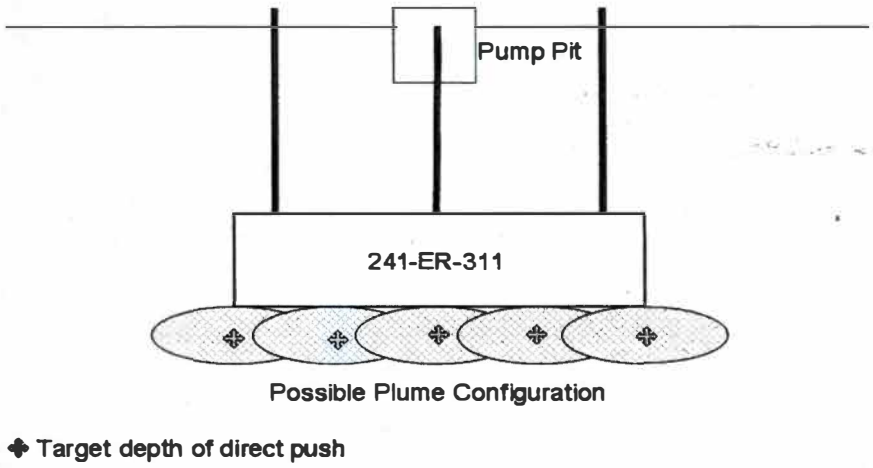
Table 7-1. Cost Estimate for Geophysical Survey Investigation using Angle Pushes

Subcontract Costs	
- HHU Subcontractor	19 days @ $4000/day
- Geophysical Logging Subcontractor	5 days @ $1000/day
- Ground Penetrating Radar (GPR) Subcontractor	2 @ 40 hrs @ $80/hr
Labor Cost	
- Geologist	$23,455
- HPT	$7,928
- Nuclear Chemical Operators	$16,022
- Designer	$2,136
- Field Work Supervisor	$9,754
Total Cost	**$157,000**
Cost Basis: Planner = 120 hours, Designer = 40 hours, HPT (1) = 140 hours, NCOs (2) = 280 hours, Geologist/Project Supervisor = 300 hours, Field Work Supervisor = 140 hours	

Table 7-2. Labor Estimate for Geophysical Survey Investigation using Angle Pushes

Activity Description	Total Time	Description
Work package development and approval	15 days	
Ground Penetrating Radar (GPR) Survey	9 days	This includes training and overlay of GPR survey results on drawings
Mobilize HHU to site	1 day	
Drill, log, and decommission boreholes	15 days	This allows for 3 days per push.
Demobilize	1 day	
Prepare report on findings	15 days	
Total Days	**52**	

Figure 7-1. Angle Push Locations



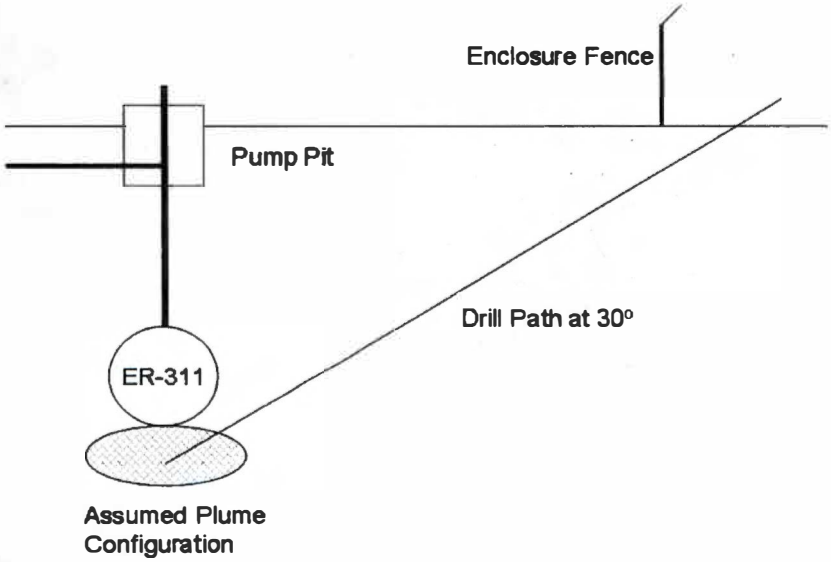
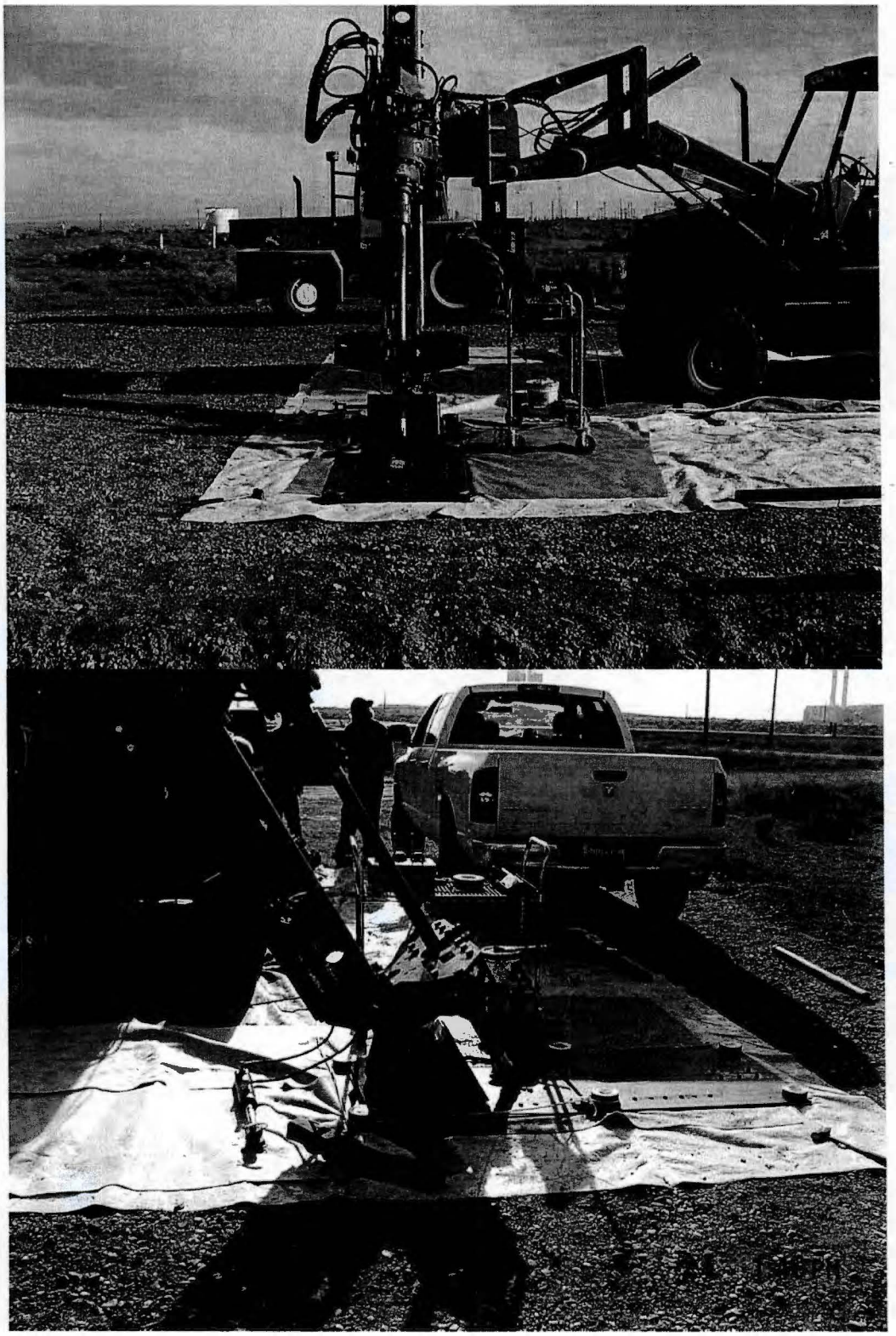


Figure 7-2. Direct Push Equipment



7.2 HYDRAULIC-HAMMER/GEOPHYSICAL SURVEY INVESTIGATION USING VERTICAL PUSHES

This option is designed to interrogate the subsurface in the vicinity of Catch Tanks 241-ER-311 and 241-ER-311A, in an attempt to ascertain the extent of contamination. This limited investigation would be performed to determine if a 100-foot x 100-foot temporary barrier is sufficient to keep the contaminants from being leached by infiltrating precipitation and eventually migrating to groundwater.

Five vertical pushes will be advanced to interrogate the region around the tank. Four of these pushes will be distributed to form a square 100 feet on a side with one of the pushes located adjacent to the Southeast corner of the enclosure fence. One push will be made between tanks 241-ER-311 and 241-ER-311A. All pushes will be to 40 feet below ground surface. Neutron-moisture and gamma logs will be run in these holes to ascertain the presence or absence of contaminants. The drill string used between the two tanks will be left in place for subsequent monitoring. One of the drill strings placed outside the enclosure will also be left in place for monitoring purposes.

This option requires a ground-penetrating radar survey of the area to be conducted to provide input to the excavation permit process. A composite map will be made using ground penetrating radar survey data and subsurface identified on engineering drawings. This survey will be overlain on a composite drawing to provide a permanent record of the environment. This option also assumes that the waste has sufficient gamma emitting radionuclide activity that its presence can be identified by gamma logging.

Estimated Effectiveness of Option:

1) This method has been successfully utilized in the past to assess contaminant migration from SST leaks. The leak estimate at 241-ER-311 was originally projected to be approximately 100 gallons. A 100 gallon release would nominally impact a spherical ellipsoid with a horizontal radius of 6.5 feet and a depth of 6.8 feet by increasing the moisture content 2 percent and transporting contained contaminants to that extent. This would increase to a horizontal radius of 15.5 feet and a depth of 15.5 feet if the remaining 400 gallons were to leak to the soil.
2) The small volume of the assumed leak and low level of radionuclide contamination pose a risk that push sampling and use of gamma or neutron monitors could easily fail to detect the affected area of contamination.
3) If contamination from preceding releases (at adjacent 241-ER-311A) is high enough, they may mask the event being characterized at 241-ER-311, although records from installation of 241-ER-311 indicate minimal contamination in the excavation.

Benefits to this approach:

1) The extent of the contaminant migration resulting from the leak can be adequately assessed.
2) Disposal costs are minimal - Three sets of drill rods are to be recovered, decontaminated and available for reuse. Two sets of drill rods will remain in place and available for future monitoring of moisture change and barrier effectiveness.
3) Soil sampling and analysis is not required to determine the extent of contaminant migration, but may be performed at an additional cost.

Risks with this approach:

1) If contamination from preceding releases (at adjacent 241-ER-311A) is high enough, they may mask the event being characterized at 241-ER-311, although records from installation of ER-311 indicate minimal contamination in the excavation.
2) Cost –This option would cost approximately $74,000 and would be an incremental cost to any other option. An increase of approximately 20 percent in total cost may be incurred if soil sampling and analysis is required.

Radiological hazards associated with this approach:

1) Minimal potential for radiological exposure to employees exist – This option does not involve transport of solids with high radiological dose rates, nor does it involve any tank intrusive work. All pushes are performed outside the fenced barrier. Some exposure could occur if contaminated soil samples are obtained, or during the process of decontaminating the drill rods.

Table 7-3. Cost Estimate for Geophysical Survey Investigation Using Vertical Pushes

Subcontract Costs (includes 20 joints of drill rod at $250/joint)	
- HHU Subcontractor	9 days @ $4000/day
- Geophysical Logging Subcontractor	2 days @ $1000/day
- Ground Penetrating Radar (GPR) Subcontractor	2 @ 32 hrs @ $80/hr
Labor Cost	
- Geologist	$11,721
- HPT	$3,058
- Nuclear Chemical Operators	$6,180
- Nuclear Chemical Operators	$961
- Field Work Supervisor	$3,762
Total Cost	**$73,883**
Cost Basis: Planner = 120 hours, Designer = 18 hours, HPT (1) = 54 hours, Nuclear Chemical Operators (2) = 180 hours, Geologist/Project Supervisor = 160 hours, Field Work Supervisor = 54 hours	

Table 7-4. Labor Estimate for Geophysical Survey Investigation Using Vertical Pushes

Activity Description	Total Time	Description
Work package development and approval	15 days	
Ground Penetrating Radar (GPR) Survey	6 days	This includes training and overlay of GPR survey results on drawings
Mobilize HHU to site	1 day	
Drill, log, and decommission boreholes	5 days	This allows for 1 days per push.
Demobilize	1 day	
Prepare report on findings	15 days	
Total Days	39	

8.0 CONCLUSION

The environmental risks and hazards that would result if the remaining free liquid in catch tank 241-ER-311 were to leak to the environment have been determined to be minimal. Sampling data obtained in 1999 indicates that the liquid in catch tank 241-ER-311 contains greater than 99% water with minimal radiological and toxicological constituents. The majority of the radiological hazards are associated with the solids, which are anticipated to remain in the subject catch tank.

The recommended option from this evaluation is to install an interim surface barrier over tank 241-ER-311 to minimize precipitation infiltration and further migration of contaminants into the soil surrounding the tank and to continue to perform monitoring and surveillance on the catch tank contents. The barrier would be conservatively sized at approximately 100 feet by 100 feet to cover both the assumed leak from catch tank 241-ER-311 and the previous leak from the adjacent catch tank 241-ER-311A. Minimal free liquid with very low concentrations of radiological or toxicological constituents remain in this catch tank 241-ER-311 and the environmental impact of a continuing leak of the remaining liquid is low. Provisions are already in place to minimize future intrusion into this catch tank, and liquid level monitoring will ensure that additional intrusion does not accumulate in the tank, which could potentially increase the plume size. This option has advantages in that it minimizes the environmental impact of the leak by reducing infiltration and migration of contaminants into the soil. In addition, the option minimizes risk to the facility worker since it requires no waste intrusive work and does not incur risks posed from above ground transport of large volumes of radioactive liquid.

The other options presented in this evaluation also provide viable methods to mitigating the majority of remaining free liquid in catch tank 241-ER-311. However, these options either present a potentially significant risk to the facility worker or are at a significant cost while only providing minimal benefit to protect the environment.

Hydraulic-hammer/Geophysical Survey Investigation could be performed to attempt to assess the extent of contamination that may have resulted due to the leak from catch tank 241-ER-311. However, the small volume of the assumed leak and low level of associated radionuclide contamination pose a risk that push sampling could easily fail to detect the affected area of contamination, or that the most recent contamination may be masked by earlier contamination from 241-ER-311A. Considering the relatively high cost associated with push sampling (since it is an additive cost to any other option), the cost-benefit of this option is not considered to be warranted, and the option is not recommended. The released material is anticipated to have a low environmental impact; there is a risk of not obtaining meaningful information from the sampling; and the planned barrier is already conservatively sized to cover the anticipated plume from both 241-ER-311 and the earlier assumed leak from 241-ER-311A.

9.0 REFERENCES

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APPENDIX A

CATCH TANK 241-ER-311 CONFIGURATION

Figure A-1. Layout of 241-ER-311 (Taken from H-2-71760)

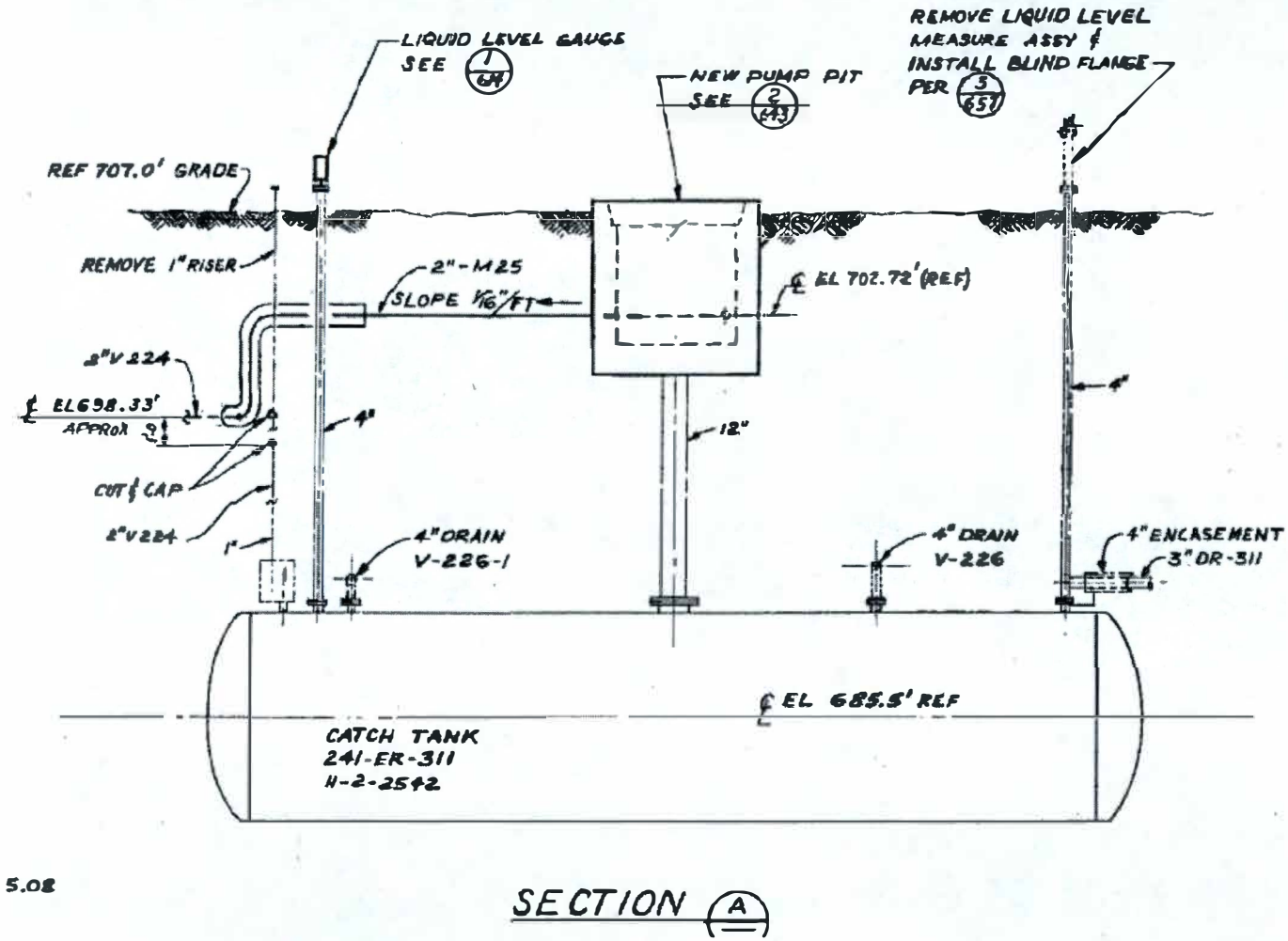
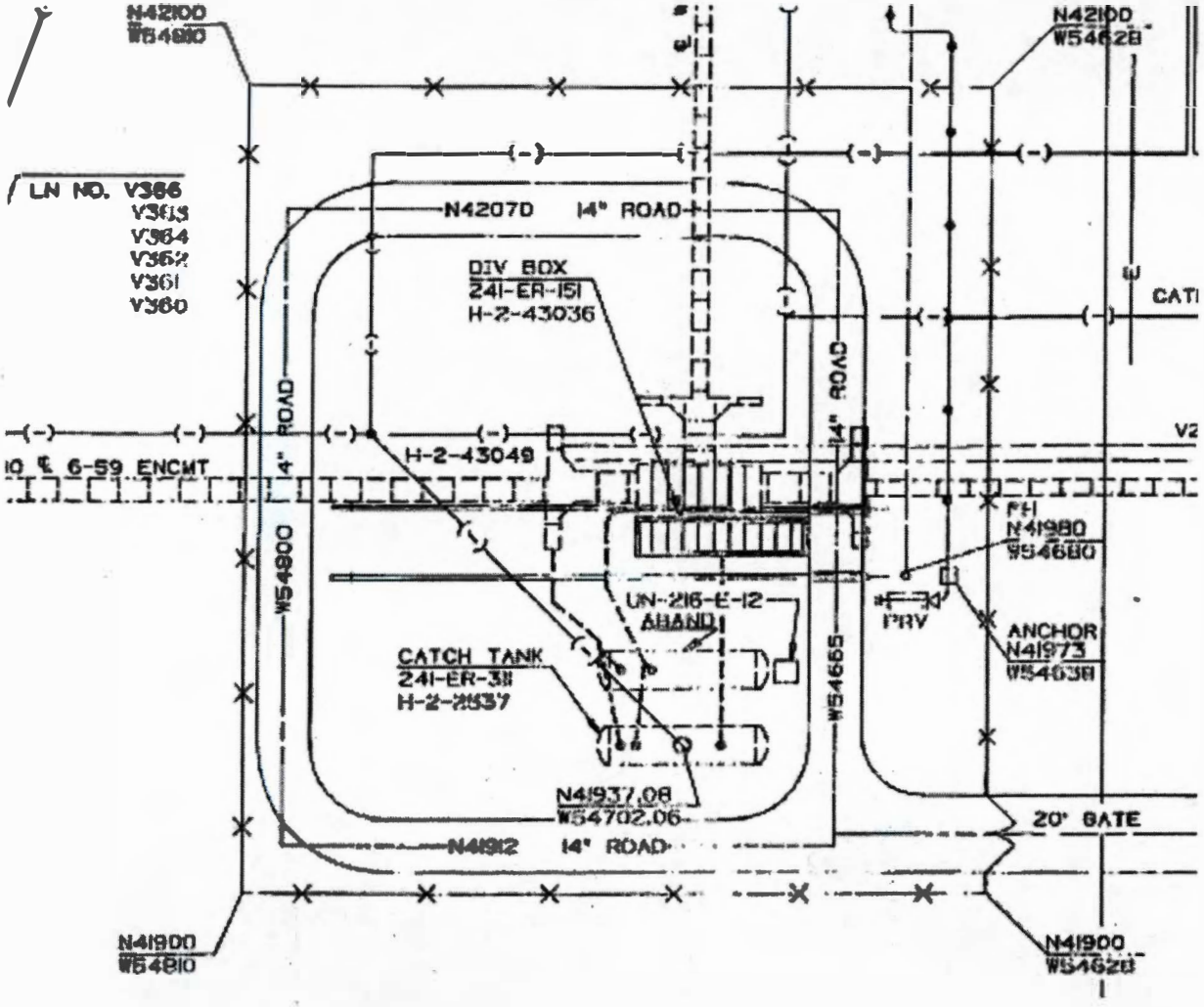


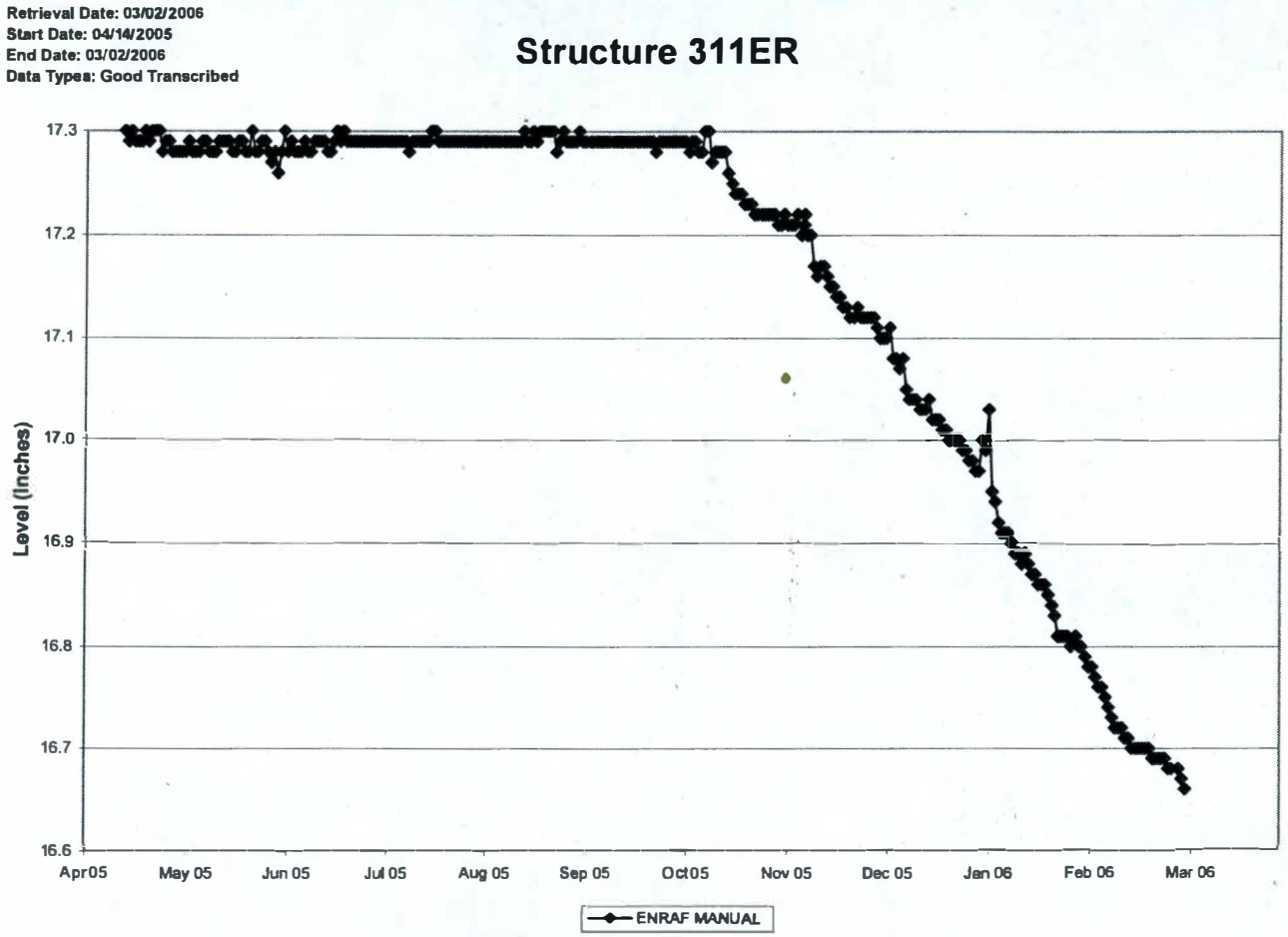
Figure A-2. Layout of 241-ER-311 (Taken from H-2-44501, Sheet 86)



APPENDIX B

PCSACS ENRAF™ (APRIL 14, 2005 TO MARCH 2, 2006)

Figure B-1. PCSACS ENRAF™ (April 14, 2005 to March 2, 2006)



APPENDIX C

CATCH TANK 241-ER-311 GRAB SAMPLES RESULTS FROM 1999 GRAB SAMPLING EVENT

Table C-1. Catch Tank 241-ER-311 Grab Samples Results from 1999 Grab Sampling Event

Constituent (Unit in μg/mL)	November 1999 Sample Results, East Riser	November 1999 Sample Results, West Riser
Na	418 to 421	272 to 282
NO_3	0.15	0.14 to 0.50
NO_2	0.15	0.14 to 0.50
F	16.3 to 19.8	0.34 to 0.38
Cl	29.8-37.2	10.0 to 10.3
SO_4	3.1 to 4.1	1.41 to 1.94
PO_4	0.71	14.2 to 17.0
Weight % Water	99.3 to 99.5	99.4 to 99.6
SpG (unitless)	0.97 to 1.00	0.98 to 0.99
pH (unitless)	6.6 to 6.7	7.9 to 8.0
Total U	65 to 268	1.6 to 3.9
Sr^{90} (μCi/mL)	0.4 to 1.0	**0.28 to 0.30**
Cs^{137} (μCi/mL)	1.9 to 3.3	**0.02 to 0.04**
Total inorganic carbon	172	150 to 157
Total organic carbon	256 to 264	72.6 to 84.7

NOTES:

- **Samples taken in the East riser were taken inside a PVC sleeve that had fallen into the sludge layer and prevented communication between liquid inside and outside of the sleeve. Samples from the West riser are considered more representative of the majority of the liquid in the tank.**
- **Since the November 1999 sampling event, liquid in the tank was pumped out three times in response to water intrusion.**
- **Concentrations of liquid constituents other than water are expected to be reduced compared to 1999 sample analysis due to dilution with water from intrusion.**

Table C-2. Estimated Catch Tank 241-ER-311 Solids Composition (Based Upon Concentrations of B Plant Strontium Recovery Solids)

Constituent	Concentration	Unit
^{90}Sr	9,400	µCi/g
^{137}Cs	97.5	µCi/g
$^{239/240}Pu$	6.16	µCi/g
Total U	31,800	µg/g
Total organic carbon	2.28	µg/g
Total inorganic carbon	20,700	µg/g
Density	1.51	g/mL
Weight percent water	62.2	%
Fe	55,800	µg/g
Cl	1,150	µg/g
Si	50,000	µg/g
Ca	8,870	µg/g

APPENDIX D

CATCH TANK 241-ER-311 IN-TANK IMAGES

Figure D-1. In-Tank Photo – West End of Catch Tank 241-ER-311

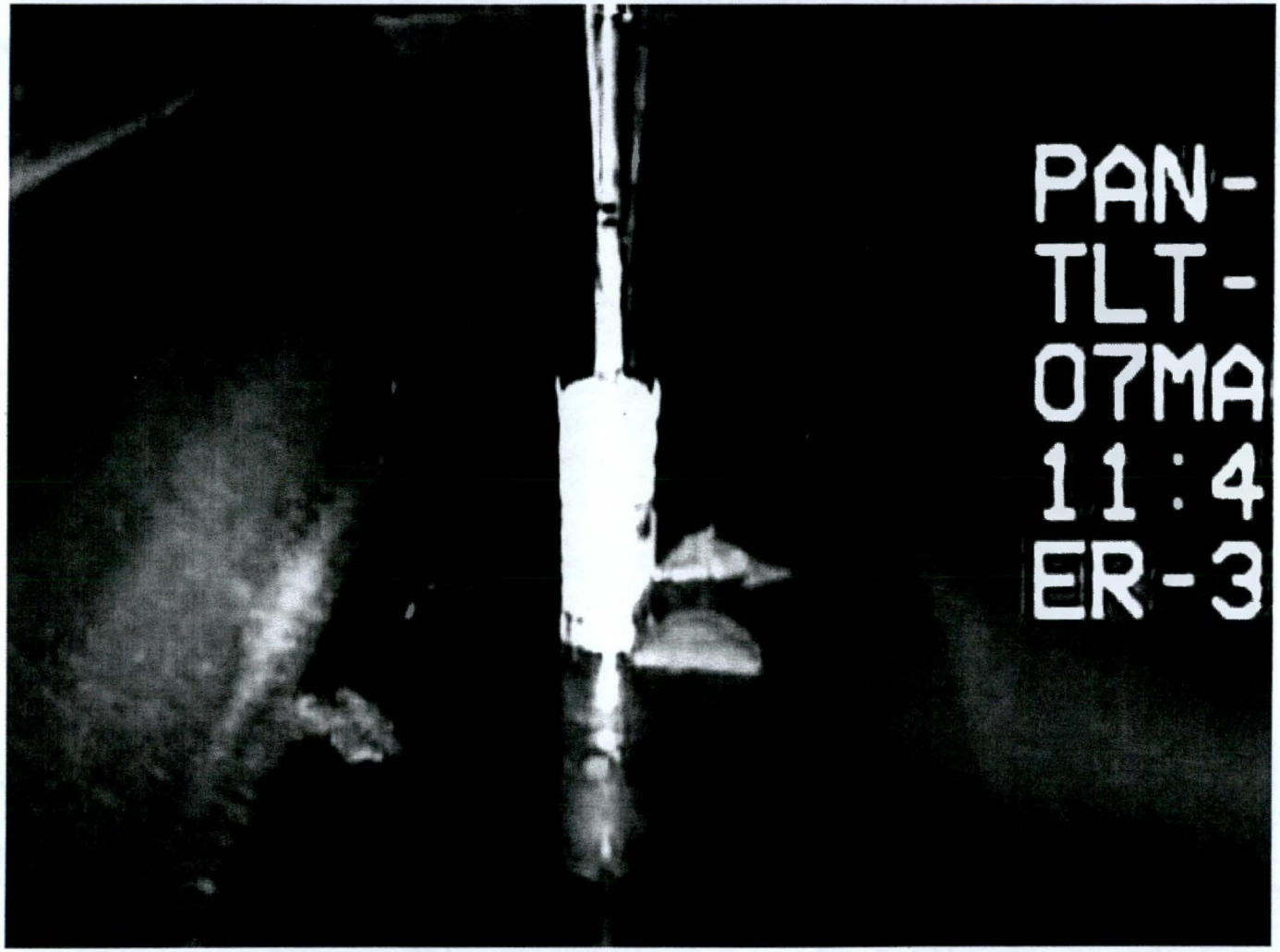


Figure D-2. In-Tank Photo – West End of Catch Tank 241-ER-311

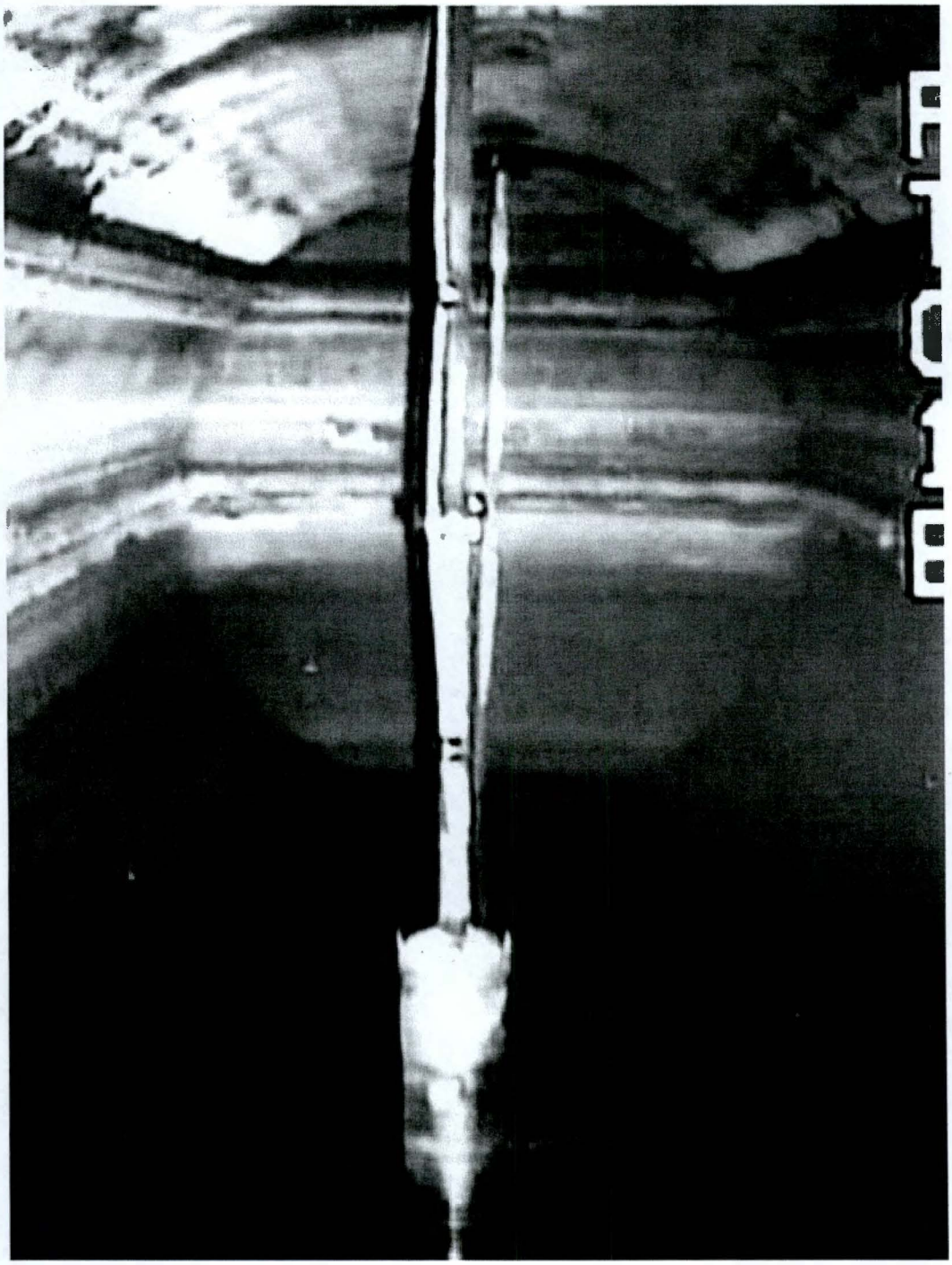


Figure D-3. In-Tank Photo – Sludge Visible Near Center of Catch Tank 241-ER-311

Figure D-4. In-Tank Photo – View Directly Below East Riser

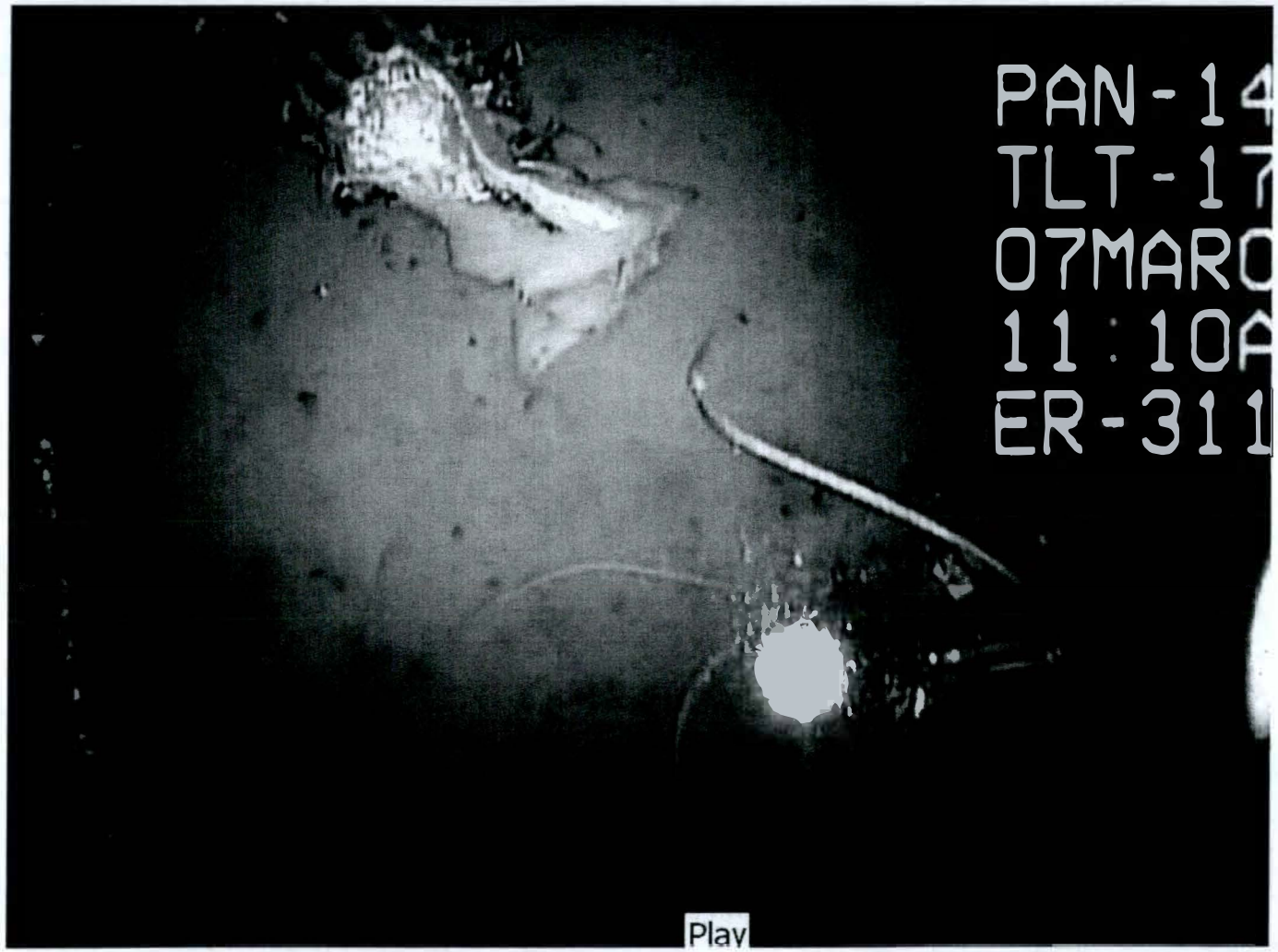
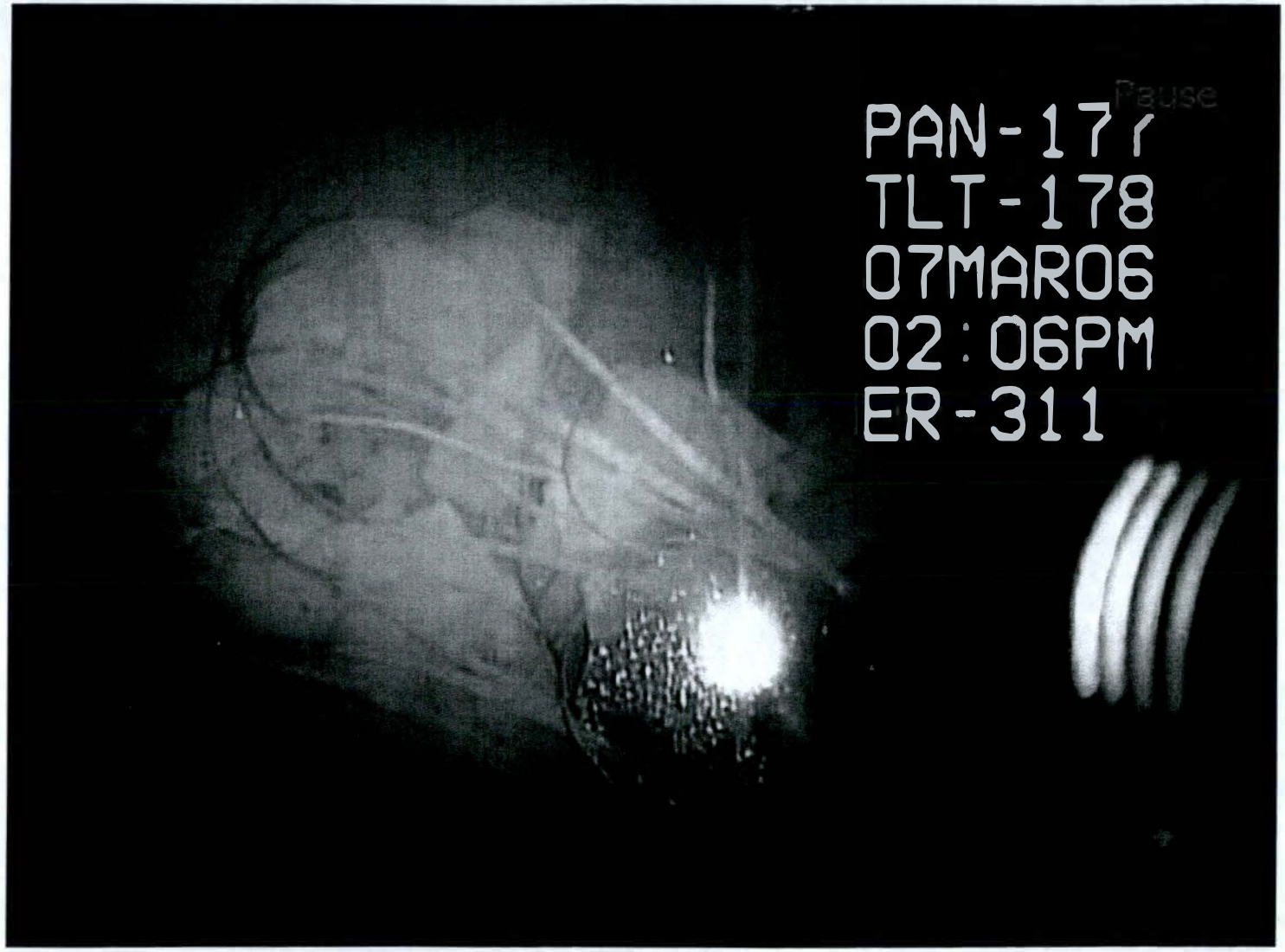



Figure D-5. In-Tank Photo – View Directly Below West Riser