HNF-3484
Revision 10

DOUBLE-SHELL TANK EMERGENCY PUMPING GUIDE

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TERMS

DOE	U.S. Department of Energy
DST	double-shell tank
Ecology	Washington State Department of Ecology
gpm	gallons per minute
HTWOS	Hanford Tank Waste Operations Simulator
in.	inches
mm	millimeters
ORP	U.S. Department of Energy, Office of River Protection
RCRA	Resource Conservation and Recovery Act of 1976
SST	single-shell tank
SACS	Surveillance Analysis Computer System
TFCOUP	Tank Farm Contractor Operation & Utilization Plan
TWINS	Tank Waste Information Network System
USQ	unreviewed safety question
WTP	Hanford Tank Waste Treatment and Immobilization Plant

1.0 GENERAL INFORMATION

1.1 PURPOSE, SCOPE, AND BACKGROUND

The purpose of this plan, HNF-3484, *Double-Shell Tank Emergency Pumping Guide*, is to provide as much preplanning as practical for pumping waste out of the primary tank system, and annulus or secondary containment of double-shell tanks (DST) in the event of a leak. If the primary tank system leaks, waste would accumulate in the secondary containment. For the purposes of this plan, the terms "secondary containment" and "annulus" are used interchangeably. The regulatory requirements applicable to a leaking DST are set forth in Washington Administrative Code (WAC).

WAC 173-303-640(7) *Responses to leaks or spills and disposition of leaking or unfit-for-use tank system* identifies the requirements for dealing with a tank leak. This pumping guide focuses on item (7)(b), *Removal of waste from tank system or secondary containment system.* Other provisions of WAC 173-303-640(7) are addressed in RPP-16922 *Environmental Specifications Requirements.* RPP-16922 is the Tank Farm environmental specifications requirements document which implements environmental-regulatory limits on the configuration and operation of the Hanford Tank Farms, 242-A Evaporator, Laboratory and related facilities that have been established by environmental regulations, orders, and agreements. The other provisions of WAC 173-303-640(7) which addressed in RPP-16922 are described below.

(7)(a) *Cessation of use; prevent flow or addition of waste* – RPP-16922, Section 8.2 requires immediate removal from service of any DST System or secondary containment system from which there has been a leak or spill.

(7)(b) *Removal of waste from tank system or secondary containment system* – RPP-16922, Section 8.2 requires compliance with the strategies and emergency pumping actions outlined in this Pumping Guide (HNF-3484). Compliance with this requirement is the primary focus of this Pumping Guide.

(7)(c) *Containment of visible releases to the environment* - Response to a release outside of the DST secondary containment is not in the scope of this document, and will be addressed in RPP-16922.

(7)(d) *Notifications, reports* - RPP-16922, Section 2.1 identifies the regulatory agency reporting requirements. Section 8.2 requires the notification of the on-call environmental representative. The on-call environmental representative determines reportability to Ecology, WDOH, and EPA in accordance with TFC-ESHQ-ENV_FS-C-01.

(7)(e) *Provision of secondary containment, repair, or closure* - assessment of tank conditions at the conclusion of pumping is not in the scope of this document, and is addressed in RPP-16922.

(7)(f) *Certification of major repairs* – The issue of major repairs will be dealt with at the conclusion of pumping and is not in the scope of this document. Section 8.2 of RPP-16922 requires certification by an independent, qualified, registered, professional engineer prior to returning the tank system to service if the tank system has had extensive repair (e.g., installation of an internal liner; repair of a ruptured primary containment or secondary containment vessel).

There are 177 underground waste storage tanks in the Hanford Site 200 East and 200 West Areas. There are 149 single-shell tanks (SSTs) and 28 DSTs. The scope of this guide includes all 28 of the Hanford Site DSTs in AN, AP, AW, AY, AZ and SY Tank Farms. The scope also includes the transfer lines, pump pits, valve pits, jumpers, transfer pumps, sump pumps, and procedures necessary to accomplish the emergency pumping. Revision 10 of HNF-3484, *Double-Shell Tank Emergency Pumping Guide*, provides additional detail on the pumping of the primary tank, available tank space for emergency use, and incorporates comments from Ecology.

1.2 DISCUSSION OF SPARE TANK SPACE

In the previous versions of this document two DSTs were identified as spares, one for typical DST waste and one for aging waste. The identified spare tanks were 241-AP-108 and 241-AY-101, respectively, which roughly provided two-million gallons of tank space. The aging waste has historically been segregated in the AY and AZ Tank Farms because of the high heat content of the solids and liquid. The DSTs in the AY and AZ Tank Farms are designed to handle the higher heat content waste. The current heat content of the liquid in the aging waste tanks has significantly decreased due to the decay of the short-lived radionuclides. The heat content is low enough that the liquid can be transferred to a standard DST for storage (Reference *Tank Waste Information Network System* [TWINS]). This reduces the need for emergency storage space in the DSTs to the equivalent of a single tank volume. In addition, contractual and safety obligations between the Hanford Tank Waste Treatment and Immobilization Plant and DST Farms have been reconciled to be consistent with the U.S. Department of Energy (DOE) Order 435.1 to maintain sufficient storage capacity for the largest volume of waste from either facility. Previously, the DOE Order had been interpreted as requiring simultaneous emergency capacity for both facilities.

Over the next few years with the accelerated retrieval of waste from the SSTs, tank space will be dynamic, and at a premium in the DST system. Waste will constantly be moved into the DST system from SSTs and run through the 242-A Evaporator for concentration. To maximize available tank space in the DSTs, re-concentration of some of the existing waste and raising the maximum tank levels is being considered. At any given time in the future, it will not be possible to keep one single tank empty as a spare for emergency pumping, because of the planned transfer sequences to evaporate and stage waste.

The plan for emergency pumping is to have 1,265,000 gallons (460 inches) of distributed tank space available at all times. Maintenance of this emergency distributed tank space will be controlled utilizing the Hanford Tank Waste Operations Simulator (HTWOS) computer model, as documented in the HNF-SD-WM-SP-012, *Tank Farm Contractor Operations and Utilization Plan*. HTWOS modeling is performed whenever it is required based on a review of all new tank waste retrieval and supplemental treatment projects and new or complex processes or processes with potential downstream impacts during the engineering planning process. Waste inventories are tracked using the Surveillance Analysis Computer System (SACs) which contains real time tank waste level data and the HNF-EP-0182, *Waste Status Summary Report* updated monthly.

Previously, Tank 241-AP-108 was identified as the most likely tank to be available for receipt of waste. However, in April of 2007, Tank 241-AP-108's available space was utilized when the tank was filled to approximately 454 inches during efforts to maximize available DST space by

increasing the tanks maximum waste operating level. The AP Tank Farm was selected as the first tank farm to have the maximum waste level operating limits increased in the DSTs. Tank 241-AW-105 is now anticipated to be the most likely tank to be available for receipt of waste based upon the revised operating strategy for AP Tank Farm. There is approximately 725,000 gallons of dedicated space in Tank 241-AW-105 that would be available for emergency use. If warranted, any additional volume would then be distributed amongst other DSTs that have space available. All DSTs with space available would be reviewed to determine the best location for any additional volume that does not fit into tank 241-AW-105. If necessary, multiple DSTs may be utilized to provide sufficient space.

Tank 241-AW-102 has been selected as the receiver tank for waste in Tank 241-AW-105 if the subject tank were to leak. Tank 241-AW-102 is typically only full of waste just prior to a 242-A Evaporator campaign. Tank 241-AW-105 waste may also be distributed amongst multiple DSTs if Tank 241-AW-102 does not have sufficient space to receive waste from Tank 241-AW-105.

The primary tank system and annulus pump-out operations would not be expected to be delayed significantly by the use of distributed space. Piping configuration changes to additional tanks are in many cases performed by valving manipulations. Alternative jumper reconfigurations to other DST storage locations can primarily be performed simultaneously with ongoing pumping operations.

The DST transfer system is composed of a series of pipe encased transfer lines connecting each tank within a tank farm, and a series of transfer lines connecting the six tank farms. Routings between tanks are accomplished by using removable piping connections (jumpers) in concrete pits. The W-314 Project has recently modified pits in AN and AW Tank Farms with multi-valved jumper manifolds that allow transfers between tanks within the tank farms to be made with simple valving manipulations. A new valve pit was installed in the AZ Tank Farm with multi-valve jumper manifolds to allow distribution of waste transfers between AN, AP, AW, AY and AZ Tank Farms. The AP Tank Farm also has this manifold configuration to simplify transfers. The scope of the W-314 Project was to replace older non-Resource Conservation and Recovery Act of 1976 (RCRA) compliant transfer piping and to upgrade process pits to meet RCRA requirements. Other ancillary equipment such as piping jumpers were replaced to provide additional transfer flexibility. The accelerated retrieval operations at the Hanford Site are requiring many transfers to be made to the different tank farms. Additional jumper configurations were installed to facilitate these transfers. These jumper configurations will in turn make emergency pumping transfers to distributed tank space more efficient. Figure 1 shows a layout of the DST transfer piping in the 200-East Area. The existing transfer pipelines between each of the 5 DST farms and between each of the 25 DSTs are shown. Many of the 25 DSTs contain active transfer pumps in the primary tank. The transfer pipeline configuration and valved pipe jumpers allow the transfer of waste from any tank to any other tank. Details of the valved pipe jumper configurations in valve pits are shown in Figure 2 to help illustrate the capability of rerouting waste from one tank to another.

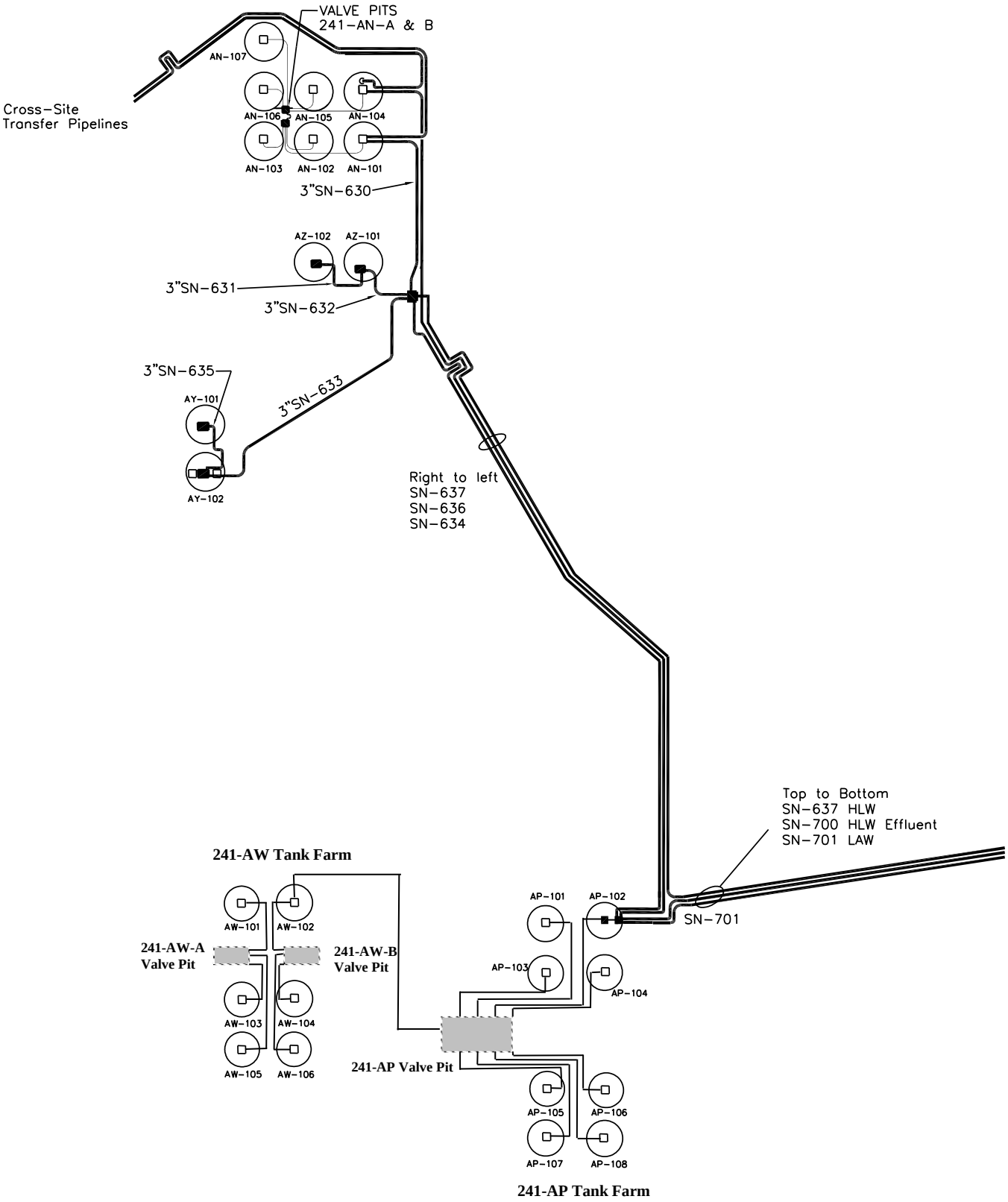
A leak in the primary tank system in SY Tank Farm is handled by initiating a cross-site transfer from 200 West Area to available emergency tank space in 200 East Area. Primary tank waste in Tank 241-SY-101 or Tank 241-SY-102 could be readily transferred to 200 East Area tanks if a

leak develops since these tanks have operable, routinely used pumps in the primary tank system. Primary tank waste in Tank 241-SY-103 would need to be transferred to either Tank 241-SY-101 or Tank 241-SY-102 which can receive waste and simultaneously transfer to available emergency tank space in 200 East Area. Any unused tank space in SY Tank Farm may be utilized as available distributed emergency tank space.

1.3 DISCUSSION OF INCREASING TANK LEVEL

The Tank Farm Contractor is in the process of reevaluating the DST tank level operating limit to potentially increase waste storage space in response to *Hanford Federal Facility Agreement and Consent Order (HFFACO)* milestones M-45-00, M-46-21, and the projected start of the Hanford Tank Waste Treatment and Immobilization Plant. The design (structurally analyzed) limit for the majority of the DSTs is currently 422 inches with an operating limit of 416 inches (1.14 million gallons). The maximum analyzed limit for 241-AP Tank Farms will be increased to 460 inches with a maximum operating limit of 454 inches (once an in-service leak test has been successfully completed). Discussion and the technical basis for the increased DST tank level is contained in *Operating Specification Document* OSD-T-151-00007. Once each tank in AP Tank Farm successfully passes an in-service leak test, each tank will be capable of storing an additional 86,500 gallons of waste. This additional space will be factored into the distributed spare tank space as required by this plan. Structural evaluations and operational controls during the increased fill have been recommended by an Expert Panel and documented in RPP-19438, *Report of Expert Panel Workshop for Hanford Site Double-Shell Tank Waste Level Increase*. Contingency planning will ensure the response to a leak is handled in a safe and efficient manner. A contingency procedure will be developed to pump down the tank being filled if a leak occurs. The procedure would include verification of an operable pump in the primary receiving tank with a contingency piping route established to a tank. In the case of a DST to DST transfer only minor changes in valving would be needed to reverse the route back to the sending tank. The only tanks planned for the increased level at this time will be in the AP Tank Farm and will receive evaporator slurry. In this case, a contingency route from the slurry receiver to Tank 241-AW-102 or an alternate tank in 241-AW Tank Farm will be established in advance. A waste compatibility report will be issued in advance as well for the contingency transfers. Any pumping operation would be stopped immediately upon detection of a leak. The intent is to commence the contingency transfer immediately upon detection of a leak, pump down to the historic operating level and remain in service. The historic operating level will be identified using the data from SACS. Removal of any waste from the annulus would be accomplished in accordance with the guidance outlined in this document.

FIGURE 1
Double-Shell Tank Piping Diagram – 200-East Area



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1.4 NON-COMPLIANT TRANSFER LINES FOR EMERGENCY USE

Replacement transfer pipe lines are not being installed in the SY Tank Farm to replace non-RCRA compliant pipe lines. The non-compliant transfer lines have encasements that do not penetrate the pit walls. Upgrades to existing pipe lines supporting transfers from the SY Tanks are being deferred due to lack of planned transfers in the next five to ten years. In the event that an unexpected transfer (e.g., primary or annulus transfer) is required from these tanks, the non-compliant pipe lines will be used. A variance letter (Ecology letter April 13, 2004) provides approval for using ten non-compliant pipe lines if several conditions are met. These transfer pipelines are identified in Appendix G.

Several transfer lines from the annulus pump pits to the central pump pits are not encased or not fully encased in the older DST Tank Farms (AY, AZ & SY). Ecology concurred with future use of emergency pump-out lines from the annulus pump pits to the central pump pits, which are considered part of secondary containment (Ecology letter January 14, 2003). This emergency pumping guide includes the planned use of annulus pump pit secondary containment transfer lines. A listing of these transfer pipelines is in Appendix G.

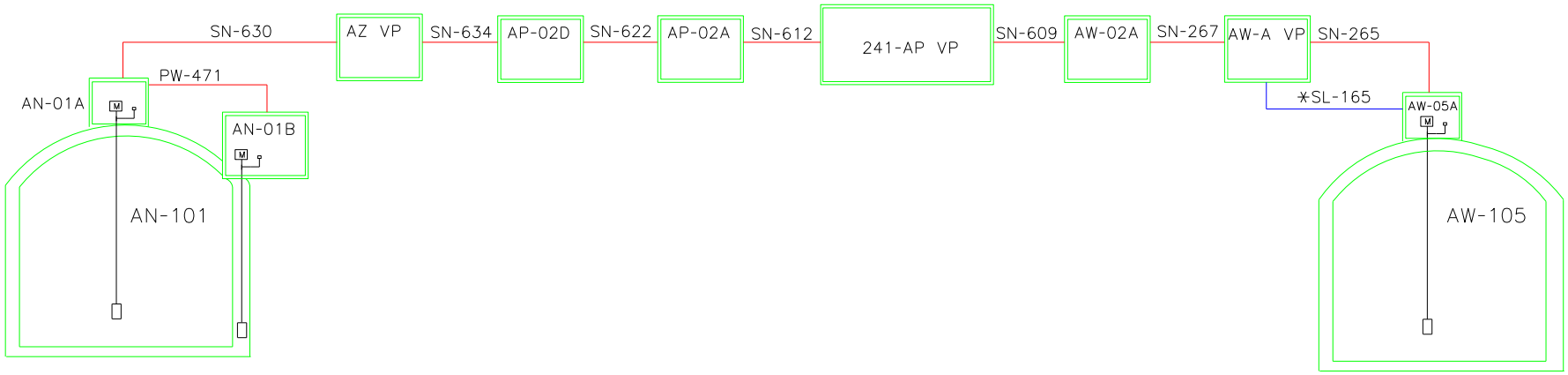
A number of compliant transfer pipelines do not have an anticipated use for the next five to ten years. Pressure testing of these pipeline encasements was not performed as part of the integrity assessment program due to the low probability of need. The encasement pressure testing of these seventeen transfer pipelines will be delayed and these pipelines will be listed in the DST Integrity Assessment Report as out-of service pending a pressure test (DOE Letter 05-TED-093). In the unlikely event of a DST leak, these pipelines will have an expedited secondary pipeline (encasement) pressure test and independent, qualified, registered, professional engineer approval prior to use. Eight of these transfer pipelines are identified in this document as necessary for emergency pumping. A listing of these transfer pipelines is in Appendix G.

One additional transfer pipeline does not have the encasement pressure testing completed. This pipeline will be listed in the DST Integrity Assessment Report as out-of service pending a pressure test. This transfer pipeline is listed in Appendix G.

Pressure testing will be performed for any variance and emergency use only transfer pipelines prior to use to verify integrity. Any pipelines that have not had the secondary pipeline (encasement) pressure tested as required in the integrity assessment report will be tested prior to use. In the event of a failed pressure test, an alternate piping route will be identified. This pumping guide primarily identifies the use of supernate transfer pipelines in the tank farms. These supernate transfer pipelines are normally three-inch diameter pipelines used for transferring the more dilute wastes. In most cases a parallel, redundant transfer pipeline to the supernate exists. This alternate is referred to as the slurry pipeline. The slurry piping is typically two-inch diameter and used for transferring the more concentrated waste. Piping jumper connection changes in the central pump pits or valve pits would be required to change configuration from the supernate to slurry piping. Spare flexible jumpers identified in Appendix F would be used for this purpose. Pressure testing of the Slurry piping encasement, as required in the integrity assessment report, will be performed prior to use. Alternative route/methods may include but not be limited to the use of Hose-in-Hose Transfer Lines or repair and/or retesting of supernate and/or slurry transfer line. Refer to Figure 3 for an example of the proposed transfer route from Tank 241-AN-101 to Tank 241-AW-105.

FIGURE 3 - ANNULUS PUMPING TRANSFER ROUTE SCHEMATIC

Example of Route from AN-101 to AW-105 (including alternate lines)



* Alternate slurry line that may be utilized if supernate line fails pressure test.

1.5 NON-COMPLIANT PROCESS PITS FOR EMERGENCY USE

The annulus pump pits are considered Emergency Use Components as discussed in Ecology Letter January 14, 2003. These annulus pits will maintain an operational leak detection system and drain to a DST as committed in the January 14, 2003 Ecology Letter. One process pit required for emergency pumping of 241-SY-01A does not yet have a specifically defined future mission. The 241-SY-01A Pit is unique in that it has a mixer pump with a significant amount of support equipment on the top of the pit cover which would require removal to allow a jumper installation. In this case the annulus pumping plan bypasses the 241-SY-01A Pit with an overground transfer line from the annulus pump pit directly to the prefabricated pump pit. This process pit will also maintain an operational leak detection system and drain to a DST.

1.6 SUMMARY OF INFORMATION PROVIDED

This guide contains a general description of the DSTs and discussions of the requirements, strategy, transfer routes, procedures, and equipment that will be used to expeditiously respond to a leaking DST. References to statutory requirements are included. The Authorization Basis requirements for DST Emergency Pumping are implemented through operating procedures and work packages. Information for each DST about the waste transfer routes, procedures, and equipment required for the transfers are contained or referenced in the appendices. These include:

Appendix A: PROPOSED PRIMARY TANK TRANSFER ROUTES

Contains a tabulated summary description of a proposed transfer route for each DST. Routes are included for transferring the waste from the primary tank to the designated receiver tank. Tank 241-AW-105 is the selected designated receiver tank for emergency transfers from all DSTs for this document. The alternate receiver tank for Tank 241-AW-105 is Tank 241-AW-102. Other or multiple tanks in the DST system may be utilized for emergency annulus pumping operations. The receiver tank for Tank 241-SY-103 is Tank 241-AW-105 via Tank 241-SY-102. Since the DST space is so dynamic, alternate routings to any of the six DST farms may be utilized for annulus emergency pumping. Transfer routes that utilize deferred use and variance transfer lines also list an alternate line (when available). Refer to Figure 3 for an example of the proposed transfer route from Tank 241-AN-101 to Tank 241-AW-105.

Appendix B: IMPLEMENTING PROCEDURES AND RELEVANT INFORMATION

Contains a list of applicable transfer operating procedures, a list of Piping and Instrumentation Drawings (P&ID) for each DST farm, and a listing of design/fabrication/installation drawings for the annulus pumping equipment.

Appendix C: INVENTORY AND STATUS OF REQUIRED EQUIPMENT

Contains a list of equipment that would be used to transfer waste out of a leaking DST primary tank system. This list includes spare primary vertical turbine pumps. If any of these pumps are utilized for operations other than annulus pumping, they must be replaced as soon as possible by the organization that utilizes the spare.

Appendix D: CROSS SECTION OF ANNULUS OF DOUBLE-SHELL TANK

Contains a sketch of a cross section of the bottom of a typical DST, a list of assumptions, and a table of the volume of liquid that would be present in the annulus at various depths.

Appendix E: ANNULUS PUMPING ROUTES

Contains a tabulated summary description of a proposed transfer route for each DST annulus. Routes are included for transferring the waste from the annulus to the designated receiver tank. Tank 241-AW-105 is the selected designated receiver tank for emergency annulus transfers from all DSTs for this document. The alternate receiver tank for Tank 241-AW-105 is Tank 241-AW-102. Other or multiple tanks in the DST system may be utilized for emergency annulus pumping operations. The receiver tank for Tank 241-SY-103 is Tank 241-AW-105 via Tank 241-SY-102. Since the DST space is so dynamic, alternate routings to any of the six DST farms may be utilized. A table of available annulus pumping risers is also included. Transfer routes that utilize deferred use and variance transfer lines also list an alternate line (when available). Refer to Figure 3 for an example of the proposed transfer route from Tank 241-AN-101 to Tank 241-AW-105.

Appendix F: APPLICABLE ANNULUS EQUIPMENT

Contains lists of applicable annulus equipment and storage locations. This equipment includes six flex jumpers, components for two complete rigid jumpers, four submersible pumps, two reciprocating pumps, components for pump assemblies, and a skid for air and electrical support equipment.

Appendix G: TRANSFER PIPELINES REQUIRING TESTING PRIOR TO USE

Contains a table of transfer pipelines primarily in SY Tank Farm that have a physical configuration which does not fully comply with the requirements or interpretations of WAC 173-303. The encasements of these pipelines do not extend through the one-foot thick pit concrete wall. These pipelines will be operated in their existing configuration utilizing the agreed upon compensatory requirements, and are referred as variance components. The appendix also contains a table of pipelines, which will be used only in the case of an accident or emergency. Some of the components in this table do not fully comply with WAC-173-303. The transfer pipelines are located between the annulus pump pits and the central pump pits and are referred to as emergency use components. The final table is a listing of transfer pipelines that are not intended to be used for over 5 years and have not been pressure tested and certified by an integrity assessment.

Appendix H: SCHEDULE OF ANNULUS PUMPING ACTIVITIES

Contains the critical path schedule of activities required to support annulus pumping developed for reference RPP-5842. Appendix H includes pressure testing of the annulus transfer lines identified in RPP-5842 Appendix B within the initial ten day response period. Additional time to prepare and pressure test an alternative transfer line will be required in the event that a noncompliant transfer line identified for use fails it is pressure test. Each identification and testing of lines is based on a ten day period which would begin at the time the previously identified transfer line failed its pressure test. The risk of failure for the noncompliant lines in the DST system has been determined

to be low based upon historical evidence and recent pressure test data from various DST system buried transfer lines. This risk is considered acceptable to protect health and the environment.

Appendix I: **SCHEDULE OF PRIMARY TANK SYSTEM PUMPING ACTIVITIES**

Contains the critical path schedule of activities required to support primary tank system pumping. In the event that a noncompliant transfer line identified for use fails its pressure test, additional time to prepare and pressure test an alternative transfer line will be required. Each identification and testing of lines is based on a ten day period which would begin at the time the previously identified transfer line failed its pressure test.

2.0 EQUIPMENT DESCRIPTION

All DSTs are similar in design and each has a capacity of approximately 3.8 to 4.8 million liters (1 to 1.26 million gal) (see Figure 4). Slight differences in the tank and ancillary equipment, however, have occurred over the years from design improvements and because of the need to accommodate variations in waste composition. Twenty-eight DSTs are located in six farms, five farms in 200 East Area and one farm in 200 West Area. DSTs consist of a carbon steel primary tank system and a carbon steel secondary containment encased by a protective reinforced concrete shell. The tanks contain a mixture of liquid, sludge, and saltcake waste with both radioactive and chemically toxic hazardous constituents. Liquids exist as supernate (liquid above solids) and interstitial liquid (liquid filling the voids between solids) in the tanks. Sludge consists primarily of solids (hydrous metal oxides) precipitated by the neutralization of acid wastes. Saltcake, generally between the supernate and sludge, consists of the various salts formed by the evaporation of water from the waste. These waste types do not necessarily exist as distinct layers and may be intermingled to differing degrees. Some sludges and saltcakes contain interstitial liquid and are relatively soft; others may be drier and harder.

Each tank is equipped with riser pipes that penetrate the concrete dome and the top of the primary tank system or secondary containment. The risers provide access to the primary tank system and to the annulus space for waste transfer operations or equipment installation for monitoring. Most risers extend above grade. However, some risers are located under covered pits (e.g., Central Pump Pits and Annulus Pump Pits).

Pits provide access from the surface to process piping and tank risers and are the points where jumpers (temporary piping systems), pumps, and other equipment are installed to establish waste transfer routes. A rigid jumper is a steel pipe that is fitted to specific wall nozzle configurations. The flexible jumpers are braided, stainless steel, flexible hose that permit connections to multiple wall nozzles.

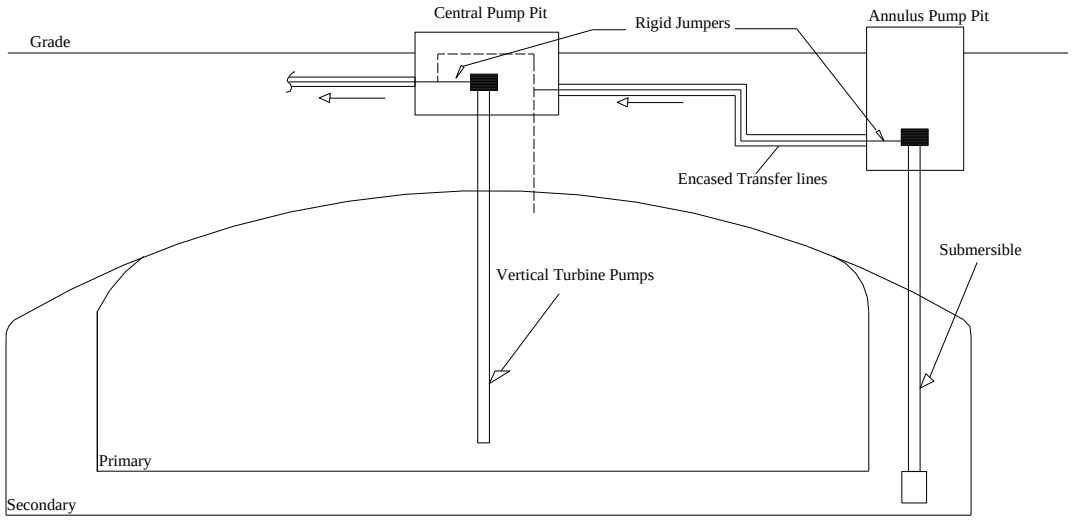
There are three types of pumps used at the tank farms to transfer waste into and out of DSTs. These types are (1) jet pumps in combination with centrifugal pumps, with nominal capacities of 0.05 to 4.0 gpm; (2) submersible pumps, with nominal capacities of 10 to 30 gpm; and (3) transfer pumps, with nominal capacities of 100 to 250 gpm.

- The components of a jet pump system located within a pump pit are a centrifugal pump, flexible or rigid jumpers, a flush line, and a flow totalizer. The centrifugal pump supplies motive fluid to the submerged jet pump system. Jet pumps are used to move liquid at very low rates.

- A submersible pump can be used to raise large volumes of supernatant. The pump motor is below the pump intake and is submersed in the liquid being pumped.

- Transfer pumps are typically installed in a pump pit, with the motor located in the pit and the intake located in the tank waste. Transfer pumps are normally deep-well, vertical turbine pumps, where the pump intake is a rigid pipe that extends to a fixed depth in the tank waste. Some transfer pumps have a floating intake, which is a flexible jumper connected to rigid pipe that does not extend into the waste.

Figure 4 – Typical DST Configuration



2.1 PRIMARY TANK PIT CONFIGURATION

All DSTs have a Central Pump Pit, which is approximately centered over the primary tank. The primary function of the pit is to provide confinement for a possible spray leak during waste transfers and to provide radiation shielding during waste transfers. The Central Pump Pits provide for access to the tank for supernatant filling or removal, slurry distribution, and mixing. Supernatant filling is accomplished though piping or jumpers connected to the riser. For supernatant removal, Central Pump Pits are designed to hold a deep-well turbine pump and piping jumpers. Central Pump Pits for receiver tanks that store slurry are equipped with slurry distributors. The jumpers installed in the Central Pump Pit are either rigid or flexible jumpers. Transfer or submersible pumps are

normally used to remove large volumes of supernatant. Jet pumps would be used to remove interstitial liquid because the liquid drains out of the sludge interstices too slowly to employ the transfer pumps. Before a jet pump system can be used to pump interstitial liquid, a stainless steel, salt screen must be installed in the waste to prevent solids from plugging the jet intakes.

2.2 SECONDARY CONTAINMENT PIT CONFIGURATION

The Annulus Pump Pit is located directly above the annulus and is connected to the annulus by a riser. The pit and riser provide access for pumping out any liquids that may accumulate in the annulus.

In the Annulus Pump Pit a rigid or flex jumper assembly connects the annulus pump outlet to a 51-mm (2-in.) waste transfer line enclosed in a 102-mm (4-in.) encasement. The encasement drains to the Annulus Pump Pit. The waste transfer line terminates at the Central Pump Pit of the tank. The two AY and AZ tanks have an additional route back to the primary tank via a waste transfer route from the Annulus Pump Pit to a riser, which connects directly to the primary tank.

2.3 SUPPORT SYSTEMS

Virtually all of the equipment and support systems that would be used for the emergency pumping of DSTs exist and are in nominal serviceable condition. Appendix C identifies the current pumps installed in the primary tank systems, and the available ready spares. The spare pumps for the primary tank systems (Appendix C) include a full length (49-foot) pump that can be used in a tank with little or no solids. A (33-foot) pump with a flexible end connection to a float can be used for tanks with significant inventories of solids. The above two pumps were designed for either AN, AP or AW Tank Farms, and an adapter plate (H-14-107382) can be used for installations in AY and AZ Tank Farms. A spare cross-site transfer pump is also available for the SY Tank Farm. Submersible pumps and other emergency equipment for use in annulus pumping will be stored in HO-64-07008, which is an enclosed portable trailer. Flex jumpers to be used will be stored in the 2101-M Warehouse. This equipment will be maintained per the Preventative Maintenance System (PMS) using data sheets. The following data sheets have been developed for the PMS to provide maintenance of the pumps ET-7459, ET-7460, ET-7666, and ET-7667. Procedure OTP-001-001, "*Operational Test Procedure for DST Annulus Emergency Pumping Equipment*," will be used to test the pump performance prior to installation.

For Additional information on the Emergency Pumping Equipment see references below:

- *DST Annulus Pumping Acceptance Test Report* (RPP-6638)
- *Technical Information to Support DST Emergency Annulus Pumping* (RPP-6485)
- *DST Annulus Pumping Acceptance Test Report Supplement* (RPP-7919)
- *System Design Description for Tank Farms Double-Shell Tank Emergency Annulus Pumping Systems* (RPP-15146)
- *Double Shell Tank Annulus Pumping Vendor Information File* (VI-50121)

3.0 PLAN OF ACTION

3.1 REGULATORY REQUIREMENTS APPLICABLE TO LEAKING DOUBLE-SHELL TANKS

Title 40, *Code of Federal Regulations*, Part 265.193, "Containment and Detection of Releases" (40 CFR 265.193)

"…sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills or precipitation. Spilled or leaked waste and accumulated precipitation must be removed from the secondary containment system within 24 hours, or in as timely a manner as is possible to prevent harm to human health or the environment, if removal of the released waste or accumulated precipitation cannot be accomplished within 24 hours."

***Washington Administrative Code* (WAC) 173-303-640, "Tank Systems"**

"…sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation. Spilled or leaked waste and accumulated precipitation must be removed from the secondary containment system within twenty-four hours, or in as timely a manner as is possible to prevent harm to human health and the environment, if the owner or operator can demonstrate to the department that removal of the released waste or accumulated precipitation cannot be accomplished within twenty-four hours."

***DOE* 435.1, *Radioactive Waste Management*, U.S. Department of Energy, Washington, D.C., Part II, Section H**

H. Contingency Actions. The following requirements are in addition to those in Chapter I of this Manual.

(1) Contingency Storage: For off-normal or emergency situations involving high-level waste storage or treatment, spare capacity with adequate capabilities shall be maintained to receive the largest volume of waste contained in any one storage vessel, pretreatment facility, or treatment facility. Tanks or other facilities that are designated for high-level waste contingency storage shall be maintained in an operational condition when waste is present and shall meet all the requirements of DOE O 435.1, Radioactive Waste Management, and this manual.

(2) Transfer Equipment: Pipelines and auxiliary facilities necessary for the transfer of waste to contingency storage shall be maintained in an operational condition when waste is present and shall meet the requirements of DOE O 435.1, Radioactive Waste Management, and this manual.

Ecology Letter January 14, 2003

This letter addresses non-compliant components, which are used only in the case of an accident or emergency. The components in the listing contained in the letter have a physical configuration that does not fully comply with the requirements or interpretation of WAC 173-303. The primary issue covered is the annulus pump-out pits and their transfer lines running to the central pump pit of the tank.

Ecology Letter April 13, 2004

Upgrades to existing pipe lines supporting transfers from the SY Tanks are being deferred due to lack of planned transfers in the next 5 to 10 years. In the event that an unexpected transfer (e.g., primary or annulus transfer) is required from these tanks, the non-compliant pipe lines will be used. This variance letter provides approval for using ten non-compliant pipe lines, provided that several conditions are met.

3.2 GENERAL STRATEGY

The general strategy for responding to a leaking DST is to take the appropriate actions to immediately remove leaked waste, minimize additional leakage and ensure containment to prevent harm to human health or the environment. Document RPP-5842, *Time Deployment Study for Annulus Pumping* estimates that approximately ten days will be required to initiate annulus pumping. A schedule of activities is provided in Appendix H. During the ten day period required for equipment assembly, transfer line pressure testing, transfer pump run-in and preparation of work and transfer documentation, considerations will be given to methods to minimize leakage. Primary tank pumping as discussed in Section 3.3 *Potential Leak Scenarios* could in many cases be initiated quickly within several days, since pumps and piping routes are available. A schedule of the primary tank system pumping activities is presented in Appendix I. This parallel pumping effort of the primary tank would be initiated simultaneously with the annulus pumping activities. The goal of pumping the primary tank would be to lower the liquid level below that of the leak. A video camera lowered through one of the many annulus risers will be used to identify the leak location.

The HNF-SD-WM-SP-012, *Tank Farm Contractor Operation & Utilization Plan* (TFCOUP) documents the available and projected emergency space allocation as determined by the HTWOS computer model. Tank space is planned and tracked through the HTWOS computer model to assure a minimum of 1.265 million gallons of emergency storage capacity is available prior to any transfer. This volume is the largest amount planned for storage in any one DST as discussed in Section 1.3. The use of distributed tank space is discussed in Section 1.2. There are several categories of restricted tank space maintained in reserve in the HTWOS computer model not planned to be used for storage purposes. One of the categories is “Restricted Transuranic (TRU) Space” another “Evaporator Operational Space”. The Restricted TRU Space and Evaporator Operational Space would also be considered for use in an emergency situation such as a tank leak.

Traditional vertical turbine pumps will be used for pumping the primary tank system. A submersible pump will be used for pumping in the secondary containment. Alternate pumping strategies were evaluated in document HNF-4241, *Double-Shell Tank Annulus Pumping Alternative Evaluation,* Rev. 0. The general strategy for emergency pumping a leaking DST is based on several assumptions. The more significant assumptions are:

- Tank 241-AW-105 is used as an example receiver tank in this document and supporting procedures. The procedural documentation illustrates the method that will be used to respond to an emergency transfer. Transfers to the distributed space in any of the other DSTs would be performed using the same type of documentation, equipment and controls.

- Waste compatibility will need to be addressed, but is not expected to be an issue that causes a delay in the pumping. Reserve tank space equivalent to the maximum volume of a tank is dedicated for "Emergency Use" and will not be used for operational purposes. Several categories of additional reserve tank space are restricted from use for storage. This includes "Evaporator Operational Space" and "Restricted TRU Head Space", which will be considered for use in an emergency situation such as a tank leak. The additional reserve tank space should make the resolution of waste compatibility issues easier. The waste composition for the material in the sending and receiving tanks will be obtained from the Best-Basis Inventory (BBI) TWINS, "*Tank Waste Information Network System*," https://twinsweb.pnl.gov/twinsdata/default.htm.
- To the maximum extent possible, existing double-contained, underground transfer lines will be used.
- Existing transfer pumps in the DST central pump pits will be used to pump waste out of the primary tank.
- A DST leak in the 241-SY Tank Farm could be pumped to either Tank 241-SY-101 or Tank 241-SY-102 for transfer to the 200 East Area DSTs. The transfer pumps in these two primary tanks have the capacity to transfer between the 200 West and 200 East Area.
- About six inches of liquid would need to accumulate in the bottom of the annulus before the submersible pump would automatically prime upon starting.
- Each DST annulus has a probe installed that is set to alarm if liquid is detected within the annulus.
- Each DST annulus has at least one probe installed that could be used to monitor liquid level in the annulus.
- A pumping strategy plans to use submersible pumps in all annulus locations (HNF-4241).
- Construction Projects at times may interrupt ability to transfer through proposed routings in Appendix A and Appendix E. Upon detection of a DST leak, restoration of the affected routing or use of an alternate routing will receive the highest priority and maximum appropriate resources available to the Tank Farm Contractor.

3.3 POTENTIAL LEAK SCENARIOS

The best strategy for emergency pumping of a specific DST to "prevent harm to human health and the environment" will depend upon the rate or size of leak from the primary tank. For purposes of this plan, leak scenarios are divided into three classes based upon the rate of the leak. The Minor Leak is treated separately because pumpable quantities of waste are likely to be slow to accumulate. Moderate and Major Leaks are treated together because the emergency response to them would be the same in either case. In all three scenarios, measures will be taken to identify the location of the leak point. Visual inspection of the annulus would be performed using a remote video camera mounted on a hand-held wand or using a remote video camera mounted on a robot similar to ones used for tank integrity assessments to determine location and elevation of leak. Many risers are available around the perimeter of the annulus for leak observation.

Use of the video camera to inspect the DST annulus region, as described below, will also be utilized when the other 241-AP DSTs are initially re-rated for use at the increased maximum waste

operating level. It should be noted that the scenario below is also being provided to illustrate methods that may be utilized to identify the primary tank leak location in the event a leak were to occur.

Video cameras were allocated for the four quadrant annulus surveillance activity and spare cameras were available on site. Nearly 360° coverage of the exterior of the primary tank could be inspected via access in ten different open risers during DST level rise activities in Tank 241-AP-108. Once the leak location is identified on the exterior of the primary tank, the length of the cable compared to the known riser elevation can be used to estimate the leak position. The circumferential welds joining each course may also be compared to the as-built facility drawings when determining the approximate location of the leak point. This method was utilized when monitoring of the crack-like indication region was performed during DST level rise activities in Tank 241-AP-108.

Monitoring of the waste level in the primary tank during pumping operations will also be used to determine the proximity to elevation of leak path on the sidewall or bottom of the primary tank. The accuracy of the material balance readings is impacted by the accuracy of the tank level instrumentation in the sending and receiving tanks, transfer route line hold-up volumes, and potentially tank waste characteristics (e.g., gas retention, solids, etc.). Level instrumentation accuracy varies from ± 0. 1 inches (ENRAF) to ± 0.25 inches (Manual Tape). The material balance trend will be monitored periodically while waste is transferred out of the primary tank. As long as waste continues to leak into the annulus, the material balance is anticipated to continue to trend negative. This trend should stabilize once the leak point is reached. However, it is recognized that other factors influence the material balance trend. That is why this method should be utilized in conjunction with a video inspection of the annulus to ascertain the exact location of the leak point. Pumping of the primary tank should continue until the waste level is sufficiently below the leak path to stop the leak. Once a leak has been identified, all transfers of waste into the leaking tank are terminated and the tank is considered out of service until repaired or replaced. During the emergency response period waste will be pumped to below the leak point to allow for inspection of the primary tank. Waste may remain in the tank below the leak point in compliance with WAC 173-303-640(7)(b)(i). This strategy allows for the maintenance of emergency space with in the DST system in an environmentally protective manner. The strategies in this section describe the emergency actions to stop the leak and reduce harm to human health and the environment.

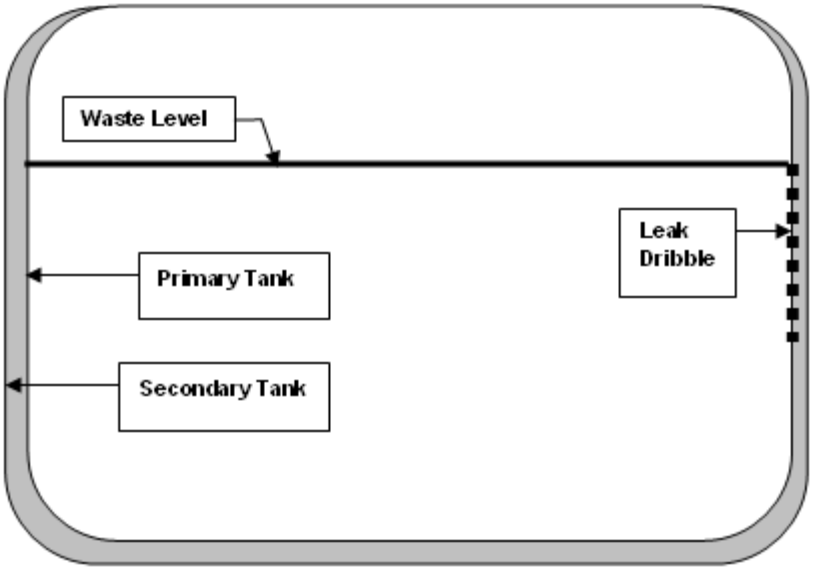
Traditional vertical turbine pumps will be used for pumping the primary tank system. A submersible pump will be used for pumping in the secondary containment. Alternate pumping strategies were evaluated in HNF-4241. A submersible pump will be installed 2.5 inches above the bottom of the secondary containment. This will allow for pumping of the waste to within approximately 6 inches of the bottom of the tank. About 2,193 gallons of residual waste would remain in the annulus (see Appendix D). An air pump will also be installed to within 2.5 inches of the bottom of the secondary containment and would be capable of pumping to within approximately three inches of the bottom of the tank. Assuming there is no absorption of waste in the insulating concrete, about 3,900 liters (1,030 gallons) of residual waste will remain in the annulus (see Appendix D). Repeated water flushing could be used as a method to remove the residual waste. Any moisture from the unpumpable residue would be evaporated by the high-efficiency particulate air filtered annulus ventilation system.

3.3.1 Strategy for Emergency Pumping after a Minor Leak

Scenario: Primary steel tank corrosion causes small breach. Waste dribbles into annulus and the annulus Continuous Air Monitor alarms. Leak rate is so slow that dried waste will form on side of tank. Liquid accumulates in the bottom of the annulus very slowly over a period of weeks or months, if at all. See Figure 5 for schematic depiction of minor leak.

The increased fill height of a tank in 241-AP Tank Farm will require actively monitoring the annulus during the time of fill to identify minor leak conditions. Recommended actions were provided in RPP-19438.

FIGURE 5 – Schematic Diagram of Minor Leak



OBJECTIVE: Pump waste out of primary tank and annulus within 24 hours or as timely as possible.

STRATEGY: Begin pumping primary tank contents via existing underground supernatant transfer pipelines with the existing transfer pump already installed in the central pump pit. In parallel, install and prepare an annulus pump. Identify location of leak point by performing video surveillance of annulus. Continue pumping the primary tank until the waste level is sufficiently below the leak path. When and if pumpable quantities of liquid accumulate in the annulus, the annulus will then be pumped through the annulus pump pit, via the submersible or reciprocating pump, to the designated receiving tanks.

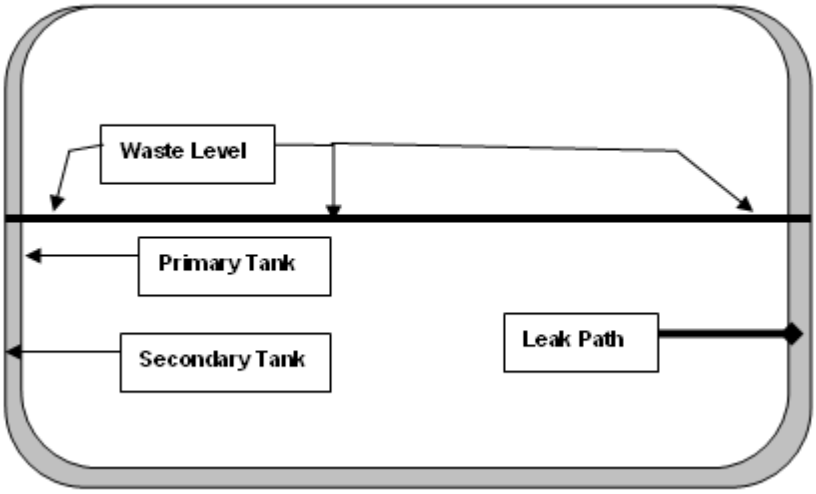
BENEFITS OF STRATEGY: For minor leaks, this strategy minimizes the amount of waste that will be leaked to the annulus by using transfer pumps and pipelines already installed and serviceable to lower the waste level in the primary tank. If pumpable quantities accumulate in the annulus, they will be removed as expeditiously as possible.

Once the primary tank waste level has been lowered below the leak path and any pumpable quantities of waste in the annulus are removed, the emergency nature of the transfers can be downgraded and a permanent resolution determined. Removing as much of the waste as possible in a non-emergency mode is more likely to prevent harm to human health or the environment than pumping all of the tank's contents in an emergency mode.

3.3.2 Strategy for Emergency Pumping after a Moderate or Major Leak

Scenario: A moderate or major leak occurs in the primary steel tank somewhere below the waste level. The waste levels in the primary tank system and secondary containment equilibrate within hours or days. See Figure 6 for schematic depiction of a moderate to major leak.

FIGURE 6 – Schematic Diagram of Major Leak in Double-Shell Tank



OBJECTIVE: Pump waste out of primary tank and annulus within 24 hours or as timely as possible.

STRATEGY: Begin pumping primary tank via existing underground supernatant transfer pipelines with the transfer pump installed in the leaking tank's central pump pit. Identify location of leak point by performing video surveillance of annulus. Continue pumping the primary tank until the waste level is sufficiently below the leak path. In parallel with pumping of the primary tank, install and prepare annulus pump. Monitoring and controlling the waste level in the annulus with respect to the waste level in the primary tank is important to prevent buoyant forces from floating the primary tank.

Once the primary tank waste level has been lowered below the leak path, begin pumping waste from the annulus via existing underground transfer lines from the annulus pump pit to the central pump pit. From the central pump pit, the route would be jumpered to the same route used for transferring waste from the primary tank to the designated receiver tanks.

BENEFITS TO STRATEGY: Most DSTs have primary transfer pumps installed. This strategy uses transfer pumps and pipelines already installed and serviceable so that pumping could be initiated more quickly. The leak will be stabilized faster and the portion of the annulus above the leak path will be pumped faster by using the higher capacity primary tank transfer pump than by using the annulus pump.

The waste in the annulus would be pumped to the designated receiver tank via the established transfer route as necessary. Once the location of the leak is determined and the annulus is pumped, the emergency nature of the transfer could be downgraded. The waste remaining in the non-leaking portion of the tank could be left in the tank or pumped to some other tank, depending upon the best solution under the circumstances. Removing as much of the waste as possible in a non-emergency mode is more likely to prevent harm to human health or the environment than pumping all of the tanks contents in an emergency mode.

If the leak path is near the bottom of the tank, then this approach will result in removing waste from the annulus in the most timely manner because the highest capacity pump and transfer routes are employed. The annulus level will equalize with the primary tank level and have a volume reduction as the primary is pumped.

Because the primary tank pumping and annulus pumping use a common route to the designated receiver tank, an alternate strategy could also be considered. This alternate strategy would be to initiate pumping of the primary tank to the designated receiver and then pump the annulus back into the leaking tank. This strategy would allow both primary tank and annulus transfers simultaneously through separate routes.

3.4 RESPONSIBILITIES

The responsibilities for various actions and activities associated with emergency pumping are detailed in the specific emergency pumping procedures. See Appendix B. Because a leaking tank may constitute both a safety issue and an environmental issue, the emergency response must be planned in cooperation with the U.S. Department of Energy, Office of River Protection (ORP), Ecology, and the Washington State Department of Health. Notifications and responses will be made in accordance with the following Tank Farm Contractor procedures:

- Event Notification (TFC-OPS-OPER-D-01)
- Event Investigation Process (TFC-OPS-OPER-C-14)
- Occurrence Reporting and Processing of Operations Information (TFC-OPS-OPER-C-24)
- Emergency Management (TFC-OPS-EP-C-01).

3.5 MAJOR ACTIVITIES

3.5.1 Pre-Emergency Pumping Planning Activities

- Hold a kickoff meeting to bring together all required participants (e.g., Operations management, Engineering management and Environmental, Safety, Health, and Quality

[ESH&Q] management) to assign responsibilities and action items necessary to initiate pumping.

- Walk-down the facility to identify needed repairs or scheduled maintenance that may need to be accelerated.
- Review applicable operating and emergency transfer procedures and validate for specific conditions or circumstances if necessary.

- Other activities as defined by the *Time Deployment Study for Annulus Pumping* (RPP-5842).

3.5.2 Check Waste Characterization and Compatibility

Before waste is transferred, compatibility tests or assessments are performed on the waste in both the supply and receiver tanks to ensure that undesirable chemical reactions do not occur. The document, *Data Quality Objectives for the Waste Compatibility Program* (HNF-SD-WM-DQO-001) discusses the criteria used to assess the compatibility of wastes before they are mixed. The Waste Compatibility Program does restrict waste transfers based on various criteria and specifications, however, the majority of Hanford tank waste forms are compatible with each other. There are several categories of restricted tank space that are not planned to be used for operational or emergency purposes. One of the categories is “Restricted Transuranic (TRU) Space” another “Safety Basis Head Space” which is space in tanks that cannot be used because of a safety issue associated with the waste (e.g., Buoyant Displacement Gas Release Event). Heat load and phosphate has not been an issue to date during recent retrieval operations. All of the recently retrieved waste is being routed into the standard low heat load tanks and phosphate segregation has not been necessary. As higher heat load, phosphate concentrated waste is transferred in the future, similar restricted space will be designated. Additionally, Evaporator Operational Space is also maintained in reserve in the HTWOS computer model. The Restricted TRU Space and Evaporator Operational Space would be considered for use in an emergency situation such as a tank leak.

In preparation for final waste retrieval, there is an ongoing Characterization Program within the RPP to fully document the chemical and physical characteristics of the waste stored in each tank. This data will be used if available.

3.5.3 Review/Prepare Safety Documentation

All provisions of *Tank Farms Documented Safety Analysis* (RPP-13033) and *Tank Farms Technical Safety Requirements* (HNF-SD-WM-TSR-006) must be met during emergency pumping activities. Provisions of Occupational Safety and Health procedures, Radiation Protection Procedures, and *Tank Farms Health and Safety Plan* (HNF-SD-WM-HSP-002) apply to all work performed. Health physics shall assist in issuing special Radiation Work Permits as needed to safely pump waste from the DST primary tank system or secondary containment.

The emergency pumping procedures (see Appendix B) will be pre-approved and will have unreviewed safety question (USQ) screening/determinations completed to ensure that emergency pumping can be executed within the existing safety basis. The USQ procedure is defined in the TFC-ENG-SB-C-03, *Unreviewed Safety Question Process*.

3.5.4 Ensure Equipment Readiness

Confirm proposed transfer route, destination of the waste, and heat trace operability. A proposed transfer route for each primary tank is identified in Appendix A. A proposed transfer route for each annulus is identified in Appendix E.

Obtain and install necessary jumpers in valve pits, if required. Ensure availability and readiness of transfer pumps.

3.6 ESTIMATED TIME TO START PUMPING TANKS

To the extent practical, all equipment and documentation necessary to perform emergency transfers from the primary tank and secondary containment systems of the DSTs have been prepared ahead of time.

The regulations require removing "Spilled or leaked waste and accumulated precipitation… from the primary tank system and secondary containment system within twenty-four hours, or in as timely a manner as possible to prevent harm to human health and the environment, if the owner or operator can demonstrate to the department that removal of the released waste or accumulated precipitation cannot be accomplished within twenty-four hours." In most cases, the nature of the leak will make a 24-hour response impossible.

The major tasks involved in starting the pumping of a primary tank system include: updating or preparing the transfer procedure, preparing the waste compatibility report, and pressure testing transfer pipelines. In a few cases, installation of additional piping jumpers may be necessary; in which case spare flexible jumpers identified in Appendix F will be used. In the event the existing transfer pump is inoperable, a spare replacement pump (identified in Appendix C) will need to be installed. The estimated time required to complete the major tasks necessary to initiate the primary tank system pumping is three days if the existing pump is operable and up to eight days if jumper installations and or a pump replacement is necessary. A schedule of the activities required to support the emergency pumping of a double-shell primary tank system is provided in Appendix I.

The major tasks involved in installing a submersible pump into a DST secondary containment and initiate pumping include: preparing and approving work packages, validating the transfer procedure, preparing waste compatibility report, performing dome loading calculations, preparing a critical lift procedure for the crane, setting up the crane, removing pit cover blocks, pressure testing transfer pipelines, inserting the pump, installing necessary pipe jumpers, making electrical connections, and closing the pit. The estimated time required to complete the major tasks necessary to install an annulus pumping system is ten days (Reference *Time Deployment Study for Annulus Pumping* RPP-5842). A schedule of the activities required to support the emergency pumping of a DST annulus is provided in Appendix H (Reference *Time Deployment Study for Annulus Pumping* RPP-5842).

Work packages are common to all the activities involving field operations. The preparation and approval of the packages will be staggered in such a way that distribution is balanced for the planners and prioritized according to the critical needs of the schedule. Because this is an emergency action plan, personnel scheduling assumed work on a day and swing shift schedule including weekends. In reality work will be scheduled for some of the critical activities around the

clock by staggering personnel on shifts. The tasks will receive unlimited resources to the extent practical and the actual schedules will reflect the intense nature of the work.

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APPENDIX A

PROPOSED EMERGENCY PUMPING TRANSFER ROUTES FROM PRIMARY TANK TO DESIGNATED RECEIVER TANK

APPENDIX A

The proposed transfer routes described below are for the emergency pumping of the primary tanks. The transfer pipelines for pumping all DST primary tanks are pipe-in-pipe, or encased pipelines. Where possible, alternate transfer lines have been listed for transfer routes that have deferred use and variance transfer lines. Alternate lines are denoted with brackets (i.e., [line]).

TRANSFER ROUTES FROM 241-AN PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-AN-101 Transfer Route to Designated Receiver Tank	
241-AN-01A Pump Pit	Transfer Pump through Rigid/Flex Jumper to Nozzle D Line SN-630
241-AZ Valve Pit	Nozzle A through Rigid Jumper to Nozzle E to Line SN-634
241-AP-02D Valve Pit	Nozzle S through Rigid Jumper to Nozzle A to Line SN-622
241-AP-02A Pump Pit	Nozzle Q through Rigid Jumper to Nozzle A Line SN-612
241-AP Valve Pit	Nozzle 19 through Rigid Jumpers to Nozzle 14 Line SN-609
241-AW-02A	Nozzle V through Rigid Jumper to Nozzle J Line SN-267
241-AW-A	Nozzle L1 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)
Tank 241-AN-102 Transfer Route to Designated Receiver Tank	
241-AN-02A Pump Pit	Transfer Pump through Rigid/Flex Jumper to Nozzle A to Line SN-262* [Alternate line SL-162* - requires jumper installation]
241-AN-B Valve Pit	Nozzle R16 through Rigid Jumper to Nozzle R15 Line SN-261
241-AN-01A Pump Pit	Nozzle A through Rigid/Flex Jumper to Nozzle D Line SN-630
Same as remaining Tank 241-AN-101 to Tank 241-AW-105 route	
Tank 241-AN-103 Transfer Route to Designated Receiver Tank	
241-AN-03A Pump Pit	Transfer Pump through Rigid/Flex Jumper to Nozzle A to Line SN-263* [Alternate line SL-163* - requires jumper installation]
241-AN-B Valve Pit	Nozzle R14 through Rigid Jumper to Nozzle R15 Line SN-261
241-AN-01A Pump Pit	Nozzle A through Rigid/Flex Jumper to Nozzle D Line SN-630
Same as remaining Tank 241-AN-101 to Tank 241-AW-105 route	

TRANSFER ROUTES FROM 241-AN PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-AN-104 Transfer Route to Designated Receiver Tank	
241-AN-04A Pump Pit	Transfer Pump through Rigid/Flex Jumper to Nozzle A to Line SN-264* [Alternate line SL-164* - requires jumper installation]
241-AN-A Valve Pit	Nozzle L15 through Rigid Jumper to Nozzle L19 via E to Line SN-268
241-AN-B Valve Pit	Nozzle R19 through Rigid Jumper to Nozzle R15 Line SN-261
241-AN-01A Pump Pit	Nozzle A through Rigid/Flex Jumper to Nozzle D Line SN-630
Same as remaining Tank 241-AN-101 to Tank 241-AW-105 route	
Tank 241-AN-105 Transfer Route to Designated Receiver Tank	
241-AN-05A Pump Pit	Transfer Pump through Rigid/Flex Jumper to Nozzle A to Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AN-A Valve Pit	Nozzle L16 through Rigid Jumper to Nozzle L19 Line SN-268
241-AN-B Valve Pit	Nozzle R19 through Rigid Jumper to Nozzle R15 Line SN-261
241-AN-01A Pump Pit	Nozzle A through Rigid/Flex Jumper to Nozzle D Line SN-630
Same as remaining Tank 241-AN-101 to Tank 241-AW-105 route	
Tank 241-AN-106 Transfer Route to Designated Receiver Tank	
241-AN-06A Pump Pit	Transfer Pump through Flex Jumper to Nozzle A to Line SN-266
241-AN-A Valve Pit	Nozzle L14 through Rigid Jumper to Nozzle L19 Line SN-268
241-AN-B Valve Pit	Nozzle R19 through Rigid Jumper to Nozzle R15 Line SN-261
241-AN-01A Pump Pit	Nozzle A through Rigid/Flex Jumper to Nozzle D Line SN-630
Same as remaining Tank 241-AN-101 to Tank 241-AW-105 route	
Tank 241-AN-107 Transfer Route to Designated Receiver Tank	
241-AN -07A Pump Pit	Transfer Pump through Rigid/Flex Jumper to Nozzle A to Line SN-267* [Alternate line SL-167* - requires jumper installation]

TRANSFER ROUTES FROM 241-AN PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-AN-107 Transfer Route to Designated Receiver Tank	
241-AN-A Valve Pit	Nozzle L1 through Rigid Jumper to Nozzle L19 Line SN-268. A jumper installation is required.
241-AN-B Valve Pit	Nozzle R19 through Rigid Jumper to Nozzle R15 Line SN-261
241-AN-01A Pump Pit	Nozzle A through Rigid/Flex Jumper to Nozzle D Line SN-630
Same as remaining Tank 241-AN-101 to Tank 241-AW-105 route	

TRANSFER ROUTES FROM 241-AP PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-AP-101 Transfer Route to Designated Receiver Tank	
241-AP-01A Pump Pit	Transfer Pump through Rigid Jumper to Nozzle A to Line SN-611
241-AP Valve Pit	Nozzle 18 through Rigid Jumper to Nozzle 14 to Line SN-609
241-AW-02A	Nozzle V through Rigid Jumper to Nozzle J Line SN-267
241-AW-A	Nozzle L1 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)
Tank 241-AP-102 Transfer Route to Designated Receiver Tank	
241-AP-02D	Transfer pump through flex/rigid jumper to Nozzle A to Line SN-622. Jumper installation required.
241-AP-02A Pump Pit	Nozzle Q through Rigid Jumper to Nozzle A to Line SN-612
Same as remaining Tank 241-AP-101 to Tank 241-AW-105 route	
Tank 241-AP-103 Transfer Route to Designated Receiver Tank	
241-AP-03A Pump Pit	Transfer Pump through Rigid Jumper to Nozzle A to Line SN-613
Same as remaining Tank 241-AP-101 to Tank 241-AW-105 route	
Tank 241-AP-104 Transfer Route to Designated Receiver Tank	
241-AP-04A Pump Pit	Transfer Pump through Rigid Jumper to Nozzle A to Line SN-614
Same as remaining Tank 241-AP-101 to Tank 241-AW-105 route	

TRANSFER ROUTES FROM 241-AP PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-AP-105 Transfer Route to Designated Receiver Tank	
241-AP-05A Pump Pit	Transfer Pump through Rigid Jumper to Nozzle A to Line SN-615
Same as remaining Tank 241-AP-101 to Tank 241-AW-105 route	
Tank 241-AP-106 Transfer Route to Designated Receiver Tank	
241-AP-06A Pump Pit	Transfer Pump through Rigid Jumper to Nozzle A to Line SN-616
Same as remaining Tank 241-AP-101 to Tank 241-AW-105 route	
Tank 241-AP-107 Transfer Route to Designated Receiver Tank	
241-AP-07A Pump Pit	Transfer Pump through Rigid Jumper to Nozzle A to Line SN-617
Same as remaining Tank 241-AP-101 to Tank 241-AW-105 route	
Tank 241-AP-108 Transfer Route to Designated Receiver Tank	
241-AP-08A Pump Pit	Transfer Pump through Rigid Jumper to Nozzle A to Line SN-618
Same as remaining Tank 241-AP-101 to Tank 241-AW-105 route	

TRANSFER ROUTES FROM 241-AW PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-AW-101 Transfer Route to Designated Receiver Tank	
241-AW-01A Pump Pit	Pump Nozzle through Flex/Rigid Jumper to Nozzle A to Line SN-261
241-AW-A Valve Pit	Nozzle L16 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)
Tank 241-AW-102 Transfer Route to Designated Receiver Tank	
241-AW-02E Pump Pit	Pump Nozzle through Rigid Jumper to Nozzle D to Line SN-272
241-AW-02A Pump pit	Nozzle K through Flex Jumper to Nozzle Q to Line SN-268 (requires jumper installation)
241-AW-A	Nozzle L1 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)

TRANSFER ROUTES FROM 241-AW PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-AW-103 Transfer Route to Designated Receiver Tank	
241-AW-03A Pump Pit	Pump Nozzle through Flex Jumper to Nozzle A to Line SN-263* [Alternate line SL-163* - requires jumper installation]
241-AW-A Valve Pit	Nozzle L14 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)
Tank 241-AW-104 Transfer Route to Designated Receiver Tank	
241-AW-04A Pump Pit	Pump Nozzle through Flex Jumper to Nozzle A to Line SN-264*. Requires jumper installation. [Alternate line SL-164* - requires jumper installation]
241-AW-B Valve Pit	Nozzle R14 through Rigid Jumper to Nozzle R1 via C to Line SN-268
241-AW-02A Pump Pit	Nozzle H through Rigid Jumper to Nozzle J to Line SN-267
241-AW-A	Nozzle L1 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)
Tank 241-AW-105 Transfer Route to Alternate Receiver Tank	
241-AW-05A Pump Pit	Pump Nozzle through Rigid Jumper to Nozzle A and Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-A Valve Pit	Nozzle L15 through Rigid Jumper to Nozzle L1 via F & D to Line SN-267
241-AW-02A Central Pump Pit	Nozzle J through Rigid Jumper to Nozzle L(Tank Return)
Tank 241-AW-106 Transfer Route to Designated Receiver Tank	
241-AW-06A Pump Pit	Pump Nozzle through Rigid Jumper to Nozzle A to Line SN-266* [Alternate line SL-166 - requires jumper installation]
241-AW-B Valve Pit	Nozzle R15 through Rigid Jumper to Nozzle R1 via C to Line SN-268
Tank 241-AW-106 Transfer Route to Designated Receiver Tank	
241-AW-02A Pump Pit	Nozzle H through Rigid Jumper to Nozzle J to Line SN-267
241-AW-A	Nozzle L1 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)

TRANSFER ROUTES FROM 241-AY PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank-241-AY-101 Transfer Route to Designated Receiver Tank	
241-AY-01A Pump Pit	Pump Nozzle through Flex Jumper to Nozzle U13 to Line SN-635
241-AY-02A Pump Pit	Nozzle U12 through Flex/Rigid Jumper to Nozzle U5 to Line SN-633
241-AZ Valve Pit	Nozzle F through Rigid Jumper to Nozzle E Line SN-634
241-AP-02D Valve Pit	Nozzle S through Rigid Jumper to Nozzle A to Line SN-622
241-AP-02A Pump Pit	Nozzle Q through Rigid Jumper to Nozzle A Line SN-612
241-AP Valve Pit	Nozzle 19 through Rigid Jumpers to Nozzle 14 Line SN-609
241-AW-02A	Nozzle V through Rigid Jumper to Nozzle J Line SN-267
241-AW-A	Nozzle L1 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)
Tank 241-AY-102 Transfer Route to Designated Receiver Tank	
241-AY-02A Pump Pit	Pump Nozzle through Flex Jumper to Nozzle U5 to Line SN-633
Same as remaining Tank 241-AY-101 to Tank 241-AW-105 route	

TRANSFER ROUTES FROM 241-AZ PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-AZ-101 Transfer Route to Designated Receiver Tank	
241-AZ-01A Pump Pit	Pump Nozzle through Flex Jumper to Nozzle U12 to Line SN-632
241-AZ Valve Pit	Nozzle H through Rigid Jumper to Nozzle E Line SN-634
241-AP-02D Valve Pit	Nozzle S through Rigid Jumper to Nozzle A to Line SN-622
241-AP-02A Pump Pit	Nozzle Q through Rigid Jumper to Nozzle A Line SN-612
241-AP Valve Pit	Nozzle 19 through Rigid Jumpers to Nozzle 14 Line SN-609
241-AW-02A	Nozzle V through Rigid Jumper to Nozzle J Line SN-267
241-AW-A	Nozzle L1 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]

241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)
Tank 241-AZ-102 Transfer Route to Designated Receiver Tank	
241-AZ-02A Pump Pit	Pump Nozzle through Flex Jumper to Nozzle U13 to Line SN-631
241-AZ-01A Pump Pit	Nozzle 11 through Flex Jumper to Nozzle U12 to Line SN-632
241-AZ Valve Pit	Nozzle H through Rigid Jumper to Nozzle E Line SN-634
Same as remaining Tank 241-AZ-101 to Tank 241-AW-105 route	

TRANSFER ROUTES FROM 241-SY PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-SY-101 Transfer Route to Designated Receiver Tank	
241-SY-101 Prefabricated Pump Pit	Pump Nozzle through Rigid Jumper to Over Ground Transfer Line
241-SY-A Valve Pit	Rigid/Flex Jumper Nozzle I to Nozzle L12 via L & H to line SNL-3150
241-AN-01A	Nozzle H through Flex Jumper to Nozzle D Line SN-630
241-AZ Valve Pit	Nozzle A through Rigid Jumper to Nozzle E to Line SN-634
241-AP-02D Valve Pit	Nozzle S through Rigid Jumper to Nozzle A to Line SN-622
241-AP-02A Pump Pit	Nozzle Q through Rigid Jumper to Nozzle A Line SN-612
241-AP Valve Pit	Nozzle 19 through Rigid Jumpers to Nozzle 14 Line SN-609
241-AW-02A	Nozzle V through Rigid Jumper to Nozzle J Line SN-267
241-AW-A	Nozzle L1 through Rigid Jumper to Nozzle L15 Line SN-265* [Alternate line SL-165* - requires jumper installation]
241-AW-05A	Nozzle A through Rigid Jumper to Nozzle G (Tank Return)
Tank 241-SY-102 Transfer Route to Designated Receiver Tank	
241-SY-102 Pump Pit	Pump Nozzle through Rigid Jumper to Nozzle J Line SN-285 (Variance) [Alternate variance Lines SL-177 and SN-277 - requires jumper installation]
241-SY-A Valve Pit	Nozzle L11 through Flex/Rigid Jumper to Nozzle L12 Line SNL-3150
Same as remaining Tank 241-SY-101 to Tank 241-AW-105 route	

TRANSFER ROUTES FROM 241-SY PRIMARY TANKS TO DESIGNATED RECEIVER TANK 241-AW-105	
Tank 241-SY-103 Transfer Route to Designated Receiver Tank	
241-SY-03A Pump Pit	Pump Nozzle through Flex Jumper to Nozzle A to Line SN-279 (Variance) [Alternate variance Line SL-179 - requires jumper installation]
241-SY-B Valve Pit	Nozzle R14 through Flex Jumper to Nozzle R19 to Line SN-280 (Variance) [Alternate variance Line SN-286 from SY-B to SY-02A - requires jumper installation]
241-SY-A Valve Pit	Nozzle L19 through Flex Jumper to Nozzle L16 via H to Line SN-277 (Variance) [Alternate variance Line SL-177 - requires jumper installation]
241-SY-02A Pump Pit	Nozzle A through Rigid Jumper to Nozzle G (Tank Return) into Tank SY-102
Waste would then be pumped from 241-SY-102 to 241-AW-105 using its specified route.	

* Denotes Deferred Use Component

[] - Denotes alternate line for deferred use/variance lines not yet tested.

APPENDIX B

LIST OF IMPLEMENTING PROCEDURES AND RELEVANT DRAWINGS

APPENDIX B

DST ANNULUS EMERGENCY PUMPING PROCEDURES		
TANK FARM	**PROCEDURE NUMBER**	**PROCEDURE TITLE**
AN	TO-001-281	Emergency Annulus Pumping Procedure for AN Farm
AP	TO-001-282	Emergency Annulus Pumping Procedure for AP Farm
AW	TO-001-283	Emergency Annulus Pumping Procedure for AW Farm
AY	TO-001-288	Emergency Annulus Pumping Procedure for AY Farm
AZ	TO-001-289	Emergency Annulus Pumping Procedure for AZ Farm
SY	TO-001-284	Emergency Annulus Pumping Procedure for SY Farm

APPENDIX B

PIPING AND INSTRUMENT DIAGRAMS		
TANK FARM	**DWG. NO.**	**TITLE**
AN	H-14-020501	WASTE STORAGE TANK ANNULUS INSTM SYS WSTA O&M SYS P&ID
	H-14-020601	WASTE STORAGE TANK INSTM SYSTEM WST O&M SYSTEM P&ID
	H-14-020801	WASTE TRANSFER SYSTEM-WST-O&M SYSTEM P&ID
AP	H-14-020503	WASTE STORAGE TANK ANNULUS INSTM SYS WSTA O&M SYS P&ID
	H-14-020603	WASTE STORAGE TANK INSTR SYSTEM WST O&M SYSTEM P&ID
	H-14-020803	WASTE TRANSFER SYSTEM (WT) O&M SYSTEM P&ID
AW	H-14-020502	WASTE STORAGE TANK ANNULUS INSTM SYS WSTA O&M SYS P&ID
	H-14-020602	WASTE STORAGE TANK INSTM SYSTEM WST O&M SYSTEM P&ID
	H-14-020803	WASTE TRANSFER SYSTEM-WT-O&M SYSTEM P&ID
AY	H-14-020506	WASTE STORAGE TANK ANNULUS INSTM SYS WSTA O&M SYS P&ID
	H-14-020606	WASTE STORAGE TANK INSTM SYSTEM WST O&M SYSTEM P&ID
	H-14-020806	WASTE TRANSFER SYSTEM (WT) O&M SYSTEM P&ID
	H-14-020507	WASTE STORAGE TANK ANNULUS INSTM SYS WSTA O&M SYS P&ID
AZ	H-14-020607	WASTE STORAGE TANK INSTM SYSTEM WST O&M SYSTEM P&ID
	H-14-020807	WASTE TRANSFER SYSTEM (WT) O&M SYSTEM P&ID
	H-14-020531	WASTE STORAGE TANK ANNULUS SYSTEM (WSTA) O&M SYSTEM P&ID
SY	H-14-020631	WASTE STORAGE TANK SYSTEM (WST) O&M SYSTEM P&ID
	H-14-020831	WASTE TRANSFER SYSTEM (WT) O&M SYSTEM P&ID

APPENDIX B ANNULUS PUMPING EQUIPMENT DRAWINGS	
DRAWING NO.	**TITLE**
DRAWING LIST	
H-14-104118	DRAWING LIST AND AREA MAP
PIPING & VESSEL	
H-14-103869 SH 1	TEST SKID SUBMERSIBLE PUMP ARRANGEMENT
H-14-103869 SH 2	TEST SKID SUBMERSIBLE PUMP VIEWS AND DETAILS
H-14-103870	AIR PUMP IN TANK TEST ARRANGEMENT
H-14-103871 SH 1	MOCK ANNULUS RISER AND LOWER PUMP ARRANGEMENT
H-14-103871 SH 2	MOCK ANNULUS RISER AND LOWER PUMP DETAILS
H-14-103873	JUMPER ASSEMBLY ANNULUS PUMP PITS PRELIMINARY FABRICATION
H-14-104122	JUMPER ARRANGEMENT ANNULUS PUMP PIT 241-AN-01B THRU –07B
H-14-104123 SH 1	JUMPER ARRANGEMENT ANNULUS PUMP PIT 241-AP-01B, 03B, 06B, 08B
H-14-104123 SH 2	JUMPER ARRANGEMENT ANNULUS PUMP PIT 241-AP-02B, 04B, 05B, 07B
H-14-104124	JUMPER ARRANGEMENT ANNULUS PUMP PIT 241-AW-01B THRU –06B
H-14-104125	JUMPER ARRANGEMENT ANNULUS PUMP PIT 241-AY-01F & -02F
H-14-104126	JUMPER ARRANGEMENT ANNULUS PUMP PIT 241-AZ-01F & -02F
H-14-104127	JUMPER ARRANGEMENT ANNULUS PUMP PIT 241-SY-01B, -02B & -03B
H-14-104128 SH 1&2	JUMPER ASSEMBLY ANNULUS PUMP PIT 241-AN-01B THRU –07B
H-14-104129 SH 1&2	JUMPER ASSEMBLY ANNULUS PUMP PIT 241-AP-01B THRU –08B
H-14-104130 SH 1&2	JUMPER ASSEMBLY ANNULUS PUMP PIT 241-AW-01B THRU –06B
H-14-104131 SH 1&2	JUMPER ASSEMBLY ANNULUS PUMP PIT 241-AY-01F & -02F
H-14-104132 SH 1&2	JUMPER ASSEMBLY ANNULUS PUMP PIT 241-AZ-01F & -02F
H-14-104133 SH 1&2	JUMPER ASSEMBLY ANNULUS PUMP PIT 241-SY-01B, -02B & -03B
H-14-104134 SH 1&2	PUMP ASSEMBLY ANNULUS PUMP PIT 241-AN-01B THRU –07B
ANNULUS PUMPING EQUIPMENT DRAWINGS	
DRAWING NO.	**TITLE**
H-14-104135 SH 1&2	PUMP ASSEMBLY ANNULUS PUMP PIT 241-AP-01B THRU –08B
H-14-104136 SH 1&2	PUMP ASSEMBLY ANNULUS PUMP PIT 241-AW-01B THRU –06B
H-14-104137 SH 1&2	PUMP ASSEMBLY ANNULUS PUMP PIT 241-AY-01F & -02F
H-14-104138 SH 1&2	PUMP ASSEMBLY ANNULUS PUMP PIT 241-AZ-01F & -02F
H-14-104139 SH 1&2	PUMP ASSEMBLY ANNULUS PUMP PIT 241-SY-01B, -02B & -03B

APPENDIX B ANNULUS PUMPING EQUIPMENT DRAWINGS	
DRAWING NO.	**TITLE**
H-14-104140	SUBMERSIBLE PUMP ASSEMBLY MODIFICATIONS
DRAWING NO.	**TITLE**
ELECTRICAL	
H-14-104119	DST ANNULUS PUMPING UTILITY WIRING DIAGRAM
H-14-104120	DST ANNULUS PUMP SYSTEM – FUSED DISCONNECT SKID ASSY
H-14-104141 SH 1	DST ANNULUS PUMP SYSTEM – FIELD RACK ARRANGEMENT
H-14-104141 SH 2	DST ANNULUS PUMP SYSTEM – FIELD RACK ARRANGEMENT
H-14-104141 SH 3	DST ANNULUS PUMP SYSTEM – FIELD RACK SCHEMATIC
H-14-104141 SH 4	DST ANNULUS PUMP SYSTEM – FIELD RACK ASSEMBLY
H-14-104142	DST ANNULUS PUMP UTILITY ARRANGEMENT 241-AN TANK FARM
H-14-104143	DST ANNULUS PUMP UTILITY ARRANGEMENT 241-AP TANK FARM
H-14-104144	DST ANNULUS PUMP UTILITY ARRANGEMENT 241-AW TANK FARM
H-14-104145	DST ANNULUS PUMP UTILITY ARRANGEMENT 241-AY TANK FARM
H-14-104146	DST ANNULUS PUMP UTILITY ARRANGEMENT 241-AZ TANK FARM
H-14-104147	DST ANNULUS PUMP UTILITY ARRANGEMENT 241-SY TANK FARM

APPENDIX C

IDENTIFICATION AND LOCATION OF DST PUMPS AND JUMPERS THAT WOULD BE USED FOR EMERGENCY PUMPING

IDENTIFICATION AND LOCATION OF DST PUMPS AND JUMPERS THAT WOULD BE USED FOR EMERGENCY PUMPING										
241-AN Tank Farm										
Facility Location	**Pump Pit**	**Pump Use**	**Pump # Currently**	**Pump Length**	**Fabrication Drawing**	**Pump Pit Clearance ****	**Pump Flange to Bottom of Tank**	**Jumpers install for transfer**	**Jumper Drawing**	**Comments**
TK - 101	01A	Transfer	AN01A-WT-P-022	36'-0 11/16" with adjustable intake	CVI 50301 Sup 2	4'-5 3/64"	49'-9"	Yes	H-14-104547	
	01B	Annulus	Open	46' 2 1/2"	H-14-104134	8'-2 7/32"	46'-5 1/4"	No, w/isolation blanks	H-14-104128	
TK-102	02A	Transfer	65P-TX4	49'-0 1/2"	H-2-46205	4'-5 3/32"	49'-9"	No	H-2-72026	
	02B	Annulus	Open	46' 2 1/2"	H-14-104134	8'-2 7/32"	46'-5 1/4"	No, w/isolation blanks	H-14-104128	
TK-103	03A	Transfer	202P-TX1	49'-0 3/8"	H-2-91943	4'-4 23/32"	49'-9 3/8"	No	H-2-94863	
	03B	Annulus	Open	46' 2 1/2"	H-14-104134	8'-2 7/32"	46'-5 1/4"	No, w/isolation blanks	H-14-104128	
TK-104	04A	Transfer	64P-TX4	49'-0 1/2"	H-2-91943	4'-4 23/32"	49'-9 31/64"	No	H-2-94863	
	04B	Annulus	Open	46' 2 1/2"	H-14-104134	8'-2 7/32"	46'-5 1/4"	No, w/isolation blanks	H-2-104128	
TK-105	05A	Transfer	84P-TX4/SW	49'-0 3/8"	H-2-91943	4'-4 23/32"	49'-9 31/64"	No	H-2-94863	
	05B	Annulus	Open	46' 2 1/2"	H-14-104134	8'-2 7/32"	46'-5 1/4"	No, w/isolation blanks	H-14-104128	
TK-106	06A	Transfer	AN06A-WT-P-022	36' 9-7/8"	CVI 50306 Sup 1	4'-4 23/32"	49'-9 1/8"	Yes	H-14-107489	2P-TX1-XCF is installed but is not operable
	06B	Annulus	Open	46' 2 1/2"	H-14-104134	8'-2 7/32"	46'-5 1/4"	No, w/isolation blanks	H-14-104128	
TK-107	07A	Transfer	Open	49'-0 3/8"	H-2-91943	4'-4 23/32"	49'-9 1/8"	No	H-2-72026	
	07B	Annulus	Open	46' 2 1/2"	H-14-104134	8'-2 7/32"	46'-8 3/8"	No, w/isolation blanks	H-14-104128	

** Pump Pit Clearance is taken from face of flange to bottom of cover block

IDENTIFICATION AND LOCATION OF DST PUMPS AND JUMPERS THAT WOULD BE USED FOR EMERGENCY PUMPING										
241-AP Tank Farm										
Facility Location	**Pump Pit**	**Pump Use**	**Pump # Currently Installed**	**Pump Length**	**Fabrication Drawing**	**Pump Pit Clearance ****	**Pump Flange to Bottom of Tank**	**Jumpers install for transfer**	**Jumper Drawing**	**Comments**
TK-101	01A	Transfer	T60V41	49'2"	CVI 50295	4'-9 13/16"	49'-5 11/16"	Yes	H-14-010802	
	01B	Annulus	Open	46' 2 1/2"	H-14-104135	8'-9 3/4"	46'-4 11/16"	NO, w/isolation blanks	H-14-104129	
TK-102	02B	Annulus	Open	46' 2 1/2"	H-14-104135	8'-9 3/4"	46'-4 11/16"	NO, w/isolation blanks	H-14-104129	
	02D	Transfer	1-TX-XCF	44'-7" w/screen	H-2-91943	9'-3 19/64"	44'-8 13/64"	No	Flex required	
TK-103	03A	Transfer	2P-AP-3	49'-0 3/8"	H-2-91943	4'-9 25/64"	49'-5 23/32"	Yes	H-2-90725	Spare run -in completed 11/29/89. Has Graphite bearings. 30 HP. 160 GPM at 250' TDH
	03B	Annulus	Open	46' 2 1/2"	H-14-104135	8'-9 3/4"	46'-4 11/16"	NO, w/isolation blanks	H-14-104129	
TK-104	04A	Transfer	4P-AP-3	49'-0 3/8"	H-2-91943	4'-9 27/32"	49'-5 21/32"	Yes	H-2-90725	
	04B	Annulus	Open	46' 2 1/2"	H-14-104135	8'-9 3/4"	46'-4 11/16"	NO, w/isolation blanks	H-14-104129	
TK-105	05A	Transfer	1P-AP-3	49'-0 3/8"	H-2-91943	4'-9 13/16"	49'-5 11/16"	Yes	H-2-90725	
	05B	Annulus	Open	46' 2 1/2"	H-14-104135	8'-9 3/4"	46'-4 11/16"	NO, w/isolation blanks	H-14-104129	
TK-106	06A	Transfer	2P-AP-4	33'-0" Flex Float	H-2-91943	4'-9 53/64"	49'-5 43/64"	Yes	H-2-90725	
	06B	Annulus	Open	46' 2 1/2"	H-14-104135	8'-9 3/4"	46'-4 11/16"	NO, w/isolation blanks	H-14-104129	
TK-107	07A	Transfer	Open	49'-0 3/8"	H-2-91943	4'-9 49/64"	49'-5 47/64"	Yes	H-2-90725	
	07B	Annulus	Open	46' 2 3/8"	H-14-104135	8'-9 3/4"	46'-4 11/16"	NO, w/isolation blanks	H-14-104129	
TK-108	08A	Transfer	1P-TX4-XCR-1	49'-0 3/8"	H-2-91943	4'-9 45/64"	49'-5 45/64"	Yes	H-2-90725	
	08B	Annulus	Open	46' 2 1/2"	H-14-104135	8'-9 3/4"	46'-4 11/16"	NO, w/isolation blanks	H-14-104129	
** Pump Pit Clearance is taken from face of flange to bottom of cover block										

IDENTIFICATION AND LOCATION OF DST PUMPS AND JUMPERS THAT WOULD BE USED FOR EMERGENCY PUMPING

241-AW Tank Farm

Facility Location	Pump Pit	Pump Use	Pump # Currently Installed	Pump Length	Fabrication Drawing	Pump Pit Clearance **	Pump Flange to Bottom of Tank	Jumpers install for transfer	Jumper Drawing	Comments
TK - 101	01A	Transfer	85P-TX4 (Oil Lubed)	49'-0 3/8"	Max 36'-2" Adjustable Length	4' 10 5/8"	49' 6 1/2"	Yes	H-14-107642	To be installed FY 2009
	A	Transfer			H-2-91943	4'-5 21/32"	49'-5 15/32"	No	H-2-70445	No info availiable on this pump
	B	Annulus	Open	46'-2 1/2"	H-14-104136	8'-3 25/64"	45'-4 15/32"	No, w/isolation blanks	H-14-104130	
TK-1	01B	Transfer	78P-TX4GT	45'-3 3/8"	H-2-91943	8'-3 5/32"	45'-4 31/32"	No	None	
	B	Annulus	Open	46' 2 1/2"	H-14-104136	8'-3 27/64"	46'-4 13/64"	No, w/isolation blanks	H-14-104130	
	01D	Transfer	122P-10	47'-3 3/8"	H-2-65054	5'-10 5/8"	48'-0 1/8"	Yes	H-2-64421	
TK-1	01F	Transfer	1P-TX1-XCR-1	33' 0" Flex Float	46'-1 9/16"	4'-5 21/32"	46'-4 1/2"	No	H-2-70445	
		Annulus	Open		H-14-104137	8'-3 1/2"		No	H-14-104131	
TK-102	03B	Annulus	Open	46' 2 1/2"	H-14-104136	5'-3 3/16"	46'-4 7/16"	No, w/isolation blanks	H-14-104130	
	02A	Transfer	AY02A-WT-P-022	48'-4 7/12"	GVI 22541	4'-10 5/8"	49'-6 1/2"	Yes	H-14-106842	
TK-1	A	Transfer	3P-TX1-XCR-1	41'-0"	H-2-91943	4'-5 55/64"	49'-5 45/64"	No	H-2-70445	
	02D	Transfer	57P-TX-4/5TX6	47'-3 7/8"	H-2-93179	5'-10 5/8"	48'-0 1/8"	Yes	H-2-64421	
	B	Annulus	Open	46' 2 1/2"	H-14-104136	8'-3 3/16"	46'-4 7/16"	No, w/isolation blanks	H-14-104130	
TK-1	02E	Transfer	PO621/PO622	33' 0" Flex Float	Adjustable Length	H-2-818494	48'-0 1/8"	Yes	H-2-818503	W-320 Project
	A	Transfer	1P-TX1		H-2-91943	4'-5 11/16"	49'-5 7/16"	Yes	H-2-70445	
	02F	Annulus	Open	46' 2 1/2"	H-14-104136	8'-3 27/64"	46'-4 27/64"	No, w/isolation blanks	H-14-104130	
					H-14-104137	8'-3 1/2"		No	H-14-104131	
TK-106	06A	Transfer	1P-TX1-XCR-1	49'-0 3/8"	H-2-91943	4'-5 53/64"	49'-5 19/64"	Yes	H-2-70445	
	06B	Annulus	Open	46' 2 1/2"	H-14-104136	8'-3 3/16"	46'-4 7/16"	No, w/isolation blanks	H-14-104130	

** Pump Pit Clearance is taken from face of flange to bottom of cover block

IDENTIFICATION AND LOCATION OF DST PUMPS AND JUMPERS THAT WOULD BE USED FOR EMERGENCY PUMPING										
241-AZ Tank Farm										
Facility Location	**Pump Pit**	**Pump Use**	**Pump # Currently Installed**	**Pump Length**	**Fabrication Drawing**	**Pump Pit Clearance ****	**Pump Flange to Bottom of Tank**	**Jumpers Install for Transfer**	**Jumper Drawing**	**Comments**
TK - 101	01C	Transfer	74-TX4/1P-TX5	47'-3 3/8"	H-2-93179	7'-2 49/64"	47'-11 63/64	Yes	H-2-68427	
	01F	Annulus	Open	46'-1 9/16"	H-14-104138	8'-3 31/64"	46'-4 21/64"	No, w/isolation blanks	H-14-104132	
TK-102	02A	Transfer	1P-TX1-XCR-2	45'-3 5/8"	H-2-91943-9, CVI 22044	6'-6 5/8"	49'-7 13/64"	Yes	H-2-92058-050	
	02B	Transfer	Open	46'-1 9/16"	H-2-93179	7'-2 49/64"	47'-11 63/64	No	H-2-68427	
	02F	Annulus	Open	46'-1 9/16"	H-14-104138	8'-3 31/64"	46'-4 21/64"	No, w/isolation blanks	H-14-104132	

** Pump Pit Clearance is taken from face of flange to bottom of cover block

IDENTIFICATION AND LOCATION OF DST PUMPS AND JUMPERS THAT WOULD BE USED FOR EMERGENCY PUMPING											
241-SY Tank Farm											
Facility Location	**Pump Pit**	**Pump Use**	**Pump # Currently Installed**	**Pump Length**	**Fabrication Drawing**	**Spare Pump #**	**Pump Pit Clearance ****	**Pump Flange to Bottom of Tank**	**Jumpers Install for Transfer**	**Jumper Drawing**	**Comments**
TK - 101	01A Riser 3A	Transfer	Open	TBD	H-2-75352 & H-2-46206		4'-5 11/16"	47'-6 9/16"	No	H-2-46215	One of the spares is located in 400 area (FFTF), and the other is in 2101M
	01A Riser 2A	Mixer	N/A	48'-1 1/8"	H-2-821329	2 each	3'-8 1/4"	50'-2 11/16"	N/A	N/A	
	Riser 007	Transfer	2A-513-A1	47'-3"	CVI 50071			55'-9"	Yes	H-14-103616	
	01B	Annulus	Open	46' 2 1/2"	H-14-104139	No	8'-3 3/16"	46'-4 13/16"	No	H-14-104133	
TK-102	02A	X-Site	SY-02A-3	33' Flex Flo	H-2-75352 & H-2-46205	1P-Sy1-102	4'-5 11/16"	47'-6 9/16"	Yes	H-2-37782	
	02B	Annulus	Open	46' 2 1/2"	H-14-104139	No	8'-3 3/16"	46'-4 13/16"	No	H-14-104133	35 feet of the old pump broke off in tank
	02E	Transfer	49-PTX-4	36'-8"	?	No	8'-4 15/16	45"-8 3/16"	Yes	H-2-37812	
TK-103	03A	Transfer	116P-10	47'-0"	H-2-75352 & H-2-46206	No	4'-5 11/16"	47'-6 9/16"	No	H-2-46215	
	03B	Annulus	Open	46' 2 1/2"	H-14-104139	No	8'-3 3/16"	46'-4 13/16"	No	H-14-104133	
** Pump Pit Clearance is taken from face of flange to bottom of cover block											

Spare Primary Tank Pumps

Pumps Stored at 2101-M on Hanford Site

1) Vertical Turbine Standard Inlet (49') – 6411-2225-5672, Cat. ID# 561300, 6411-2225-2P-TX1-XCR-1, Floway Pumps Inc., AN/AP/AW Compatible, H-2-91943 Assembly 5, *Specification for Refurbishment, Modification and Testing for Vertical Turbine Transfer Pumps*, RPP-10745.
2) Vertical Turbine Flexible Inlet (33') – 6411-2225-5677, Cat. ID# 561304, 6411-2225-1P-TX4-XCR-2, Floway Pumps Inc., AN/AP/AW Compatible, H-2-91943 Assembly 7, 17-foot flex & float, *Specification for Refurbishment, Modification and Testing for Vertical Turbine Transfer Pumps*, RPP-10745.
3) Vertical Turbine Flexible Inlet (33') – 6411-2187-5655, Cat. ID# 561285, S/N TC-6703 VIN 22534, Johnston Pump Co., Cross-site 241-SY-102, H-14-106255, *Specification for Refurbishment, Design, Modification and Testing of Vertical Turbine Transfer Pump for Tank 241-SY-102*, RPP-18672.
4) Vertical Turbine (45.3') – 6411-2225-5676, Cat. ID# 561304, 6411-2225-2P-TX1-XCR-2, Floway Pump Inc., Evaporator Feed 241-AW-02E, H-2-91943-9 *Specification for Refurbishment, Modification and Testing of Vertical Turbine Transfer Pump for Tank 241-AW-102*, RPP-20202.

Support Equipment for Pumps (Stored at 2101-M on Hanford Site)

1) Flex and Float Assembly F/A Pump for Vertical Turbine Flexible Inlet (Pump #3 on above list) – Cat. ID 630851, H-2-38654 and H-2-91943.

APPENDIX D

CROSS SECTION OF ANNULUS OF DOUBLE-SHELL TANK

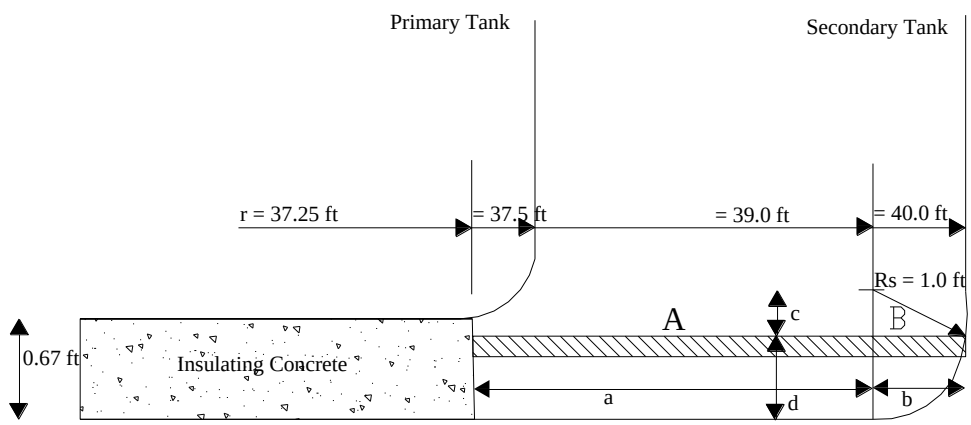
Cross-Section of Annulus of Double-Shell Tank

PROBLEM: Calculate volume of liquid in annulus at various depths.

ASSUMPTIONS: Reference drawings H-2-37772, and H-2-37705 are accurate.
Insulating concrete absorbs no liquid. SY-101 is representative of all DSTs.
Volume can be approximated by dividing annulus space into relatively simple geometric forms and calculating the volume of those forms.

Forms A & B are squat hollow cylinders where Volume = Pi height ($radius_o^2 - radiusj^2$).
a = 1.75 ft from 0 to 8 inches above bottom; a = 1.50 ft above 8 inches above bottom.
$Rs^2 = b^2 + c^2$ or b = square foot ($Rs^2 - c^2$)
Volume $_{insulating\ concrete}$ = Pi height (radius ^{2}) = Pi(0.67)$(37.25)^2$ = 2,908 ft ^{3} = 21,780 gal.
Volume per inch in annulus above 12 inches above bottom is constant at 380 gal/inch.

d (inches)	a (ft)	c (ft)	b ft)	Vol A (ft3)	Vol B (ft3)	Vol A & B (ft3)	Vol (gal)	Vol Cum (gal)
1	1.75	0.92	0.40	34.9	8.2	43	323	323
2	1.75	0.83	0.55	34.9	11.4	46	347	670
3	1.75	0.75	0.66	34.9	13.6	49	364	1,034
4	1.75	0.67	0.75	34.9	15.4	50	377	1,410
5	1.75	0.58	0.81	34.9	16.8	52	387	1,797
6	1.75	0.50	0.87	34.9	17.9	53	396	2,193
7	1.75	0.42	0.91	34.9	18.8	54	402	2,595
8	1.75	0.33	0.94	34.9	19.5	54	408	3,003
9	1.50	0.25	0.97	30.0	20.0	50	375	3,378
10	1.50	0.17	0.99	30.0	20.4	50	378	3,756
11	1.50	0.08	1.00	30.0	20.6	51	379	4,135
12	1.50	0.00	1.00	30.0	20.7	51	380	4,515
13	1.50	0.00	1.00	30.0	20.7	51	380	4,895



APPENDIX E

PROPOSED ANNULUS EMERGENCY PUMPING TRANSFER ROUTES TO DESIGNATED RECEIVER TANK

APPENDIX E

The proposed route for emergency pumping of the annulus will be from the Annulus Pump Pit through rigid/flex jumpers to an encased, below-grade pipeline to the Central Pump Pit. The route would be jumpered through the central pump pit to the same route used for transferring waste from the primary tank to the designated receiver tank as outlined in Appendix A. The transfer pipelines from the Annulus Pump Pit to the Central Pump Pit for all DST tanks are pipe-in-pipe or encased pipelines except for Tanks 241-AY-101, 241-AY-102 and 241-AZ-102. The two tanks in AY farm have direct-buried, unencased pipelines from the annulus pump pits to the central pump. Tank 241-AZ-102 also has a direct-buried unencased pipeline from the annulus pump pit to the central pump pit. Where possible, alternate transfer lines have been listed for transfer routes that have deferred use and variance transfer lines. Alternate lines are denoted with brackets (i.e., [line]).

TRANSFER ROUTES FROM 241-AN ANNULUS TO DESIGNATED RECEIVER Tank 241-AW-105

Tank 241-AN-101 Annulus Transfer Route to Designated Receiver Tank	
241-AN-01B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-471
241-AN-01A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AN-101 primary route listed in Appendix A.	
Tank 241-AN-102 Annulus Transfer Route to Designated Receiver Tank	
241-AN-02B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-472
241-AN-02A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AN-102 primary route listed in Appendix A.	
Tank 241-AN-103 Annulus Transfer Route to Designated Receiver Tank	
241-AN-03B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-473
241-AN-03A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AN-103 primary route listed in Appendix A.	
Tank 241-AN-104 Annulus Transfer Route to Designated Receiver Tank	
241-AN-04B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-474
241-AN-04A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AN-104 primary route listed in Appendix A.	

TRANSFER ROUTES FROM 241-AN ANNULUS TO DESIGNATED RECEIVER Tank 241-AW-105

Tank 241-AN-105 Annulus Transfer Route to Designated Receiver Tank	
241-AN-05B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-475
241-AN-05A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AN-105 primary route listed in Appendix A.	
Tank 241-AN-106 Annulus Transfer Route to Designated Receiver Tank	
241-AN-06B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-476
241-AN-06A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AN-106 primary route listed in Appendix A.	
Tank 241-AN-107 Annulus Transfer Route to Designated Receiver Tank	
241-AN-07B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-477
241-AN-07A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AN-107 primary route listed in Appendix A.	

TRANSFER ROUTES FROM 241-AP ANNULUS TO DESIGNATED RECEIVER TANK 241-AW-105

Tank 241-AP-101 Annulus Transfer Route to Designated Receiver Tank	
241-AP-01B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-811
241-AP-01A Central Pump Pit	Nozzle C through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AP-101 primary route listed in Appendix A.	
Tank 241-AP-102 Annulus Transfer Route to Designated Receiver Tank	
241-AP-02B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-812
241-AP-02A Central Pump Pit	Nozzle C through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AP-102 primary route listed in Appendix A.	

TRANSFER ROUTES FROM 241-AP ANNULUS TO DESIGNATED RECEIVER TANK 241-AP-108

Tank 241-AP-103 Annulus Transfer Route to Designated Receiver Tank	
241-AP-03B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-813
241-AP-03A Central Pump Pit	Nozzle C through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AP-103 primary route listed in Appendix A.	
Tank 241-AP-104 Annulus Transfer Route to Designated Receiver Tank	
241-AP-04B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-814
241-AP-04A Central Pump Pit	Nozzle C through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AP-104 primary route listed in Appendix A.	
Tank 241-AP-105 Annulus Transfer Route to Designated Receiver Tank	
241-AP-05B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-815
241-AP-05A Central Pump Pit	Nozzle C through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AP-105 primary route listed in Appendix A.	
Tank 241-AP-106 Annulus Transfer Route to Designated Receiver Tank	
241-AP-06B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-816
241-AP-06A Central Pump Pit	Nozzle C through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AP-106 primary route listed in Appendix A.	
Tank 241-AP-107 Annulus Transfer Route to Designated Receiver Tank	
241-AP-07B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-817
241-AP-07A Central Pump Pit	Nozzle C through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AP-107 primary route listed in Appendix A.	
Tank 241-AP-108 Annulus Transfer Route to Alternate Receiver Tank	
241-AP-08B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-818
241-AP-08A Central Pump Pit	Nozzle C through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AP-108 primary route listed in Appendix A.	

TRANSFER ROUTES FROM 241-AW ANNULUS TO DESIGNATED RECEIVER TANK 241-AW-105

Tank 241-AW-101 Annulus Transfer Route to Designated Receiver Tank	
241-AW-01B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-471
241-AW-01A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AW-101 primary route listed in Appendix A.	
Tank 241-AW-102 Annulus Transfer Route to Designated Receiver Tank	
241-AW 02B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-472
241-AW-02A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle Q to Line SN 609
Remaining route is the same as 241-AW-102 primary route listed in Appendix A.	
Tank 241-AW-103 Annulus Transfer Route to Designated Receiver Tank	
241-AW-03B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-473
241-AW-03A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AW-103 primary route listed in Appendix A.	
Tank 241-AW-104 Annulus Transfer Route to Designated Receiver Tank	
241-AW-04B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-474
241-AW-04A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AW-104 primary route listed in Appendix A.	
Tank 241-AW-105 Annulus Transfer Route to Designated Receiver Tank	
241-AW 05B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW 475
241-AW-05A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AW-105 primary route listed in Appendix A.	
Tank 241-AW-106 Annulus Transfer Route to Designated Receiver Tank	
241-AW-06B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-476
241-AW-06A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A
Remaining route is the same as 241-AW-106 primary route listed in Appendix A.	

TRANSFER ROUTES from 241-AY ANNULUS TO DESIGNATED RECEIVER Tank 241-AW-105

Tank 241-AY101 Annulus Transfer Route to Designated Receiver Tank	
241-AY-01F Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle to Line PW-4531
241-AY-01A Central Pump Pit	Nozzle U10 through Rigid/Flex Jumper to nozzle U13 to Line SN-635
Remaining route is the same as 241-AY-101 primary route listed in Appendix A.	
Tank 241-AY-102 Annulus Transfer Route to Designated Receiver Tank	
241-AY-02F Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle to Line PW-4532
241-AY-02A Central Pump Pit	Nozzle U10 through Rigid/Flex Jumper to Nozzle U5 to Line SN-633
Remaining route is the same as 241-AY-102 primary route listed in Appendix A.	

TRANSFER ROUTES from 241-AZ ANNULUS TO DESIGNATED RECEIVER Tank 241-AW-105

Tank 241-AZ-101 Annulus Transfer Route to Designated Receiver Tank	
241-AZ-01F Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle to Line PW-4623
241-AZ-01A Central Pump Pit	Nozzle U3 through Rigid/Flex Jumper to Nozzle U12 to Line SN-632
Remaining route is the same as 241-AZ-101 primary route listed in Appendix A.	
Tank 241-AZ-102 Annulus Transfer Route to Designated Receiver Tank	
241-AZ-02F Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle U1 to Line PW-4609
241-AZ-02A Central Pump Pit	Nozzle U11 through Rigid/Flex Jumper to Nozzle U13 to Line SN-631
Remaining route is the same as 241-AZ-102 primary route listed in Appendix A.	

TRANSFER ROUTES FROM 241-SY ANNULUS TO DESIGNATED RECEIVER TANK 241-AW-105

Tank 241-SY-101 Annulus Transfer Route to Designated Receiver Tank	
241-SY-01B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle to a new over-ground line to PPP
Prefabricated Pump Pit	Over-ground transfer line from 241-SY-01B to existing over-ground to 241-SY-A
241-SY-A Valve Pit	Nozzle I through Rigid/Flex jumper to Nozzle L16 via H to Line 277 (Variance)
241-SY-02A Pump Pit	Nozzle A through Rigid Jumper to Nozzle G into Tank 241-SY-102
Waste would then be pumped from 241-SY-102 to 241-AW-105 per Appendix A route.	
Tank 241-SY-102 Annulus Transfer Route to Designated Receiver Tank	
241-SY-02B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-475
241-SY-02A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A to Line SN-277 (Variance) [Alternate variance line SL-177 - requires jumper installation]
241-SY-A Valve Pit	Nozzle L16 through Rigid/Flex jumper to nozzle I via Over-ground Line to Pre-fabricated Pump Pit
Pre-Fabricated Pump Pit	Over-ground Line nozzle through rigid jumper to nozzle in riser-007 into Tank 241-SY-101
Waste would then be pumped from 241-SY-101 to 241-AW-105 per Appendix A route.	
Tank 241-SY-103 Annulus Transfer Route to Designated Receiver Tank	
241-SY 03B Annulus Pump Pit	Transfer Pumps through Rigid/Flex Jumper to Nozzle A to Line PW-479
241-SY-03A Central Pump Pit	Nozzle E through Rigid/Flex Jumper to nozzle A to line SN-279 (Variance) [Alternate variance line SL-179 - requires jumper installation]
241-SY-B Valve Pit	Nozzle R14 through Rigid/Flex jumper to Nozzle R19 to line SN-280 (Variance) [Alternate variance Line SN-286 from SY-B to SY-02A - requires jumper installation]
241-SY-A Valve Pit	Nozzle L19 through Rigid/Flex jumper to Nozzle L16 via H to line SN-277(Variance) [Alternate variance line SL-177 - requires jumper installation]
241-SY-02A Central Pump Pit	Nozzle A through Rigid jumper to Nozzle G into Tank 241-SY-102
Waste would then be pumped from 241-SY-102 to 241-AW-105 per Appendix A route.	

Annulus Pumping Riser Availability

Annulus Pump Pit	Riser
241-AN-01B	12 inch
241-AN-02B	12 inch
241-AN-03B	12 inch
241-AN-04B	12 inch
241-AN-05B	12 inch
241-AN-06B	12 inch
241-AN-07B	12 inch
241-AP-01B	12 inch
241-AP-02B	12 inch
241-AP-03B	12 inch
241-AP-04B	12 inch
241-AP-05B	12 inch
241-AP-06B	12 inch
241-AP-07B	12 inch
241-AP-08B	12 inch
241-AW-01B	12 inch
241-AW-02B	12 inch
241-AW-03B	12 inch
241-AW-04B	12 inch
241-AW-05B	12 inch
241-AW-06B	12 inch
241-AY-01F	12 inch
241-AY-02F	12 inch
241-AZ-01F	12 inch
241-AZ-02F	12 inch
241-SY-01B	12 inch
241-SY-02B	12 inch
241-SY-03B	12 inch

APPENDIX F

APPLICABLE ANNULUS EQUIPMENT

APPENDIX F

FLEX JUMPERS FOR ANNULUS PUMPING

Jumper Identification	Drawing	Quantity	Location
9900-4254-2001 (599325)	H-2-92058 SH. 1	3	2101-M: E-B-P-G03C/G05C/G05D
9900-4254-2002 (599326)	H-2-92058 SH. 5	2	2101-M: E-B-P-F06A
9900-4254-2003 (599327)	H-2-92058 SH. 9	1	2101-M: E-B-P-F06C

ANNULUS PUMPING EQUIPMENT

Equipment	Storage Location
Components for 2 Complete Jumpers	Trailer HO-64-07008
4 Submersible Pumps	Trailer HO-64-07008
2 Reciprocating Pumps	Trailer HO-64-07008
Components for Pump Assemblies	Trailer HO-64-07008
Skid for Air and Electrical	Trailer HO-64-07008

APPENDIX G

TRANSFER PIPELINES REQUIRING TESTING PRIOR TO USE

Variance Transfer Pipelines		
Transfer Line	**Description**	**Location**
SL-177	Slurry transfer line	241-SY-02A to 241-SY-A
SN-277*	Supernatant transfer line	241-SY-02A to 241-SY-A
SL-178	Slurry transfer line	241-SY-01A to 241-SY-B
SN-278	Supernatant transfer line	241-SY-01A to 241-SY-B
SL-179	Slurry transfer line	241-SY-03A to 241-SY-B
SN-279*	Supernatant transfer line	241-SY-03A to 241-SY-B
SN-280*	Supernatant transfer line	241-SY-A to 241-SY-B
SN-285*	Supernatant transfer line	241-SY-02A to 241-SY-A
SN-286	Supernatant transfer line	241-SY-02A to 241-SY-B
LIQW-702	204-AR Facility transfer line	204-AR to 241-A-A

* Transfer Pipelines identified in this document for Emergency Pumping

Reference – Ecology Letter April 13, 2004
Document RPP-16922 *Environmental Specifications Requirements* contains the official up-to-date listing

Emergency Use Transfer Pipelines		
Transfer Line*	**Description**	**Location**
PW-471	Annulus Transfer Lines	241-AN-01B to 241-AN-01A
PW-472		241-AN-02B to 241-AN-02A
PW-473		241-AN-03B to 241-AN-03A
PW-474		241-AN-04B to 241-AN-04A
PW-475		241-AN-05B to 241-AN-05A
PW-476		241-AN-06B to 241-AN-06A
PW-477		241-AN-07B to 241-AN-07A
PW-811		241-AP-01B to 241-AP-01A
PW-812		241-AP-02B to 241-AP-02A
PW-813		241-AP-03B to 241-AP-03A
PW-814		241-AP-04B to 241-AP-04A
PW-815		241-AP-05B to 241-AP-05A
PW-816		241-AP-06B to 241-AP-06A
PW-817		241-AP-07B to 241-AP-07A
PW-818		241-AP-08B to 241-AP-08A
PW-471		241-AW-01B to 241-AW-01A
PW-472		241-AW-02B to 241-AW-02A
PW-473		241-AW-03B to 241-AW-03A
PW-474		241-AW-04B to 241-AW-04A
PW-475		241-AW-05B to 241-AW-05A
PW-476		241-AW-06B to 241-AW-06A
PW-4531		241-AY-01F to 241-AY-01A
PW-4532		241-AY-02F to 241-AY-02A
PW-4623		241-AZ-01F to 241-AZ-01A
PW-4609		241-AZ-02F to 241-AZ-02A
PW-477		241-SY-01B to 241-SY-01A
PW-475		241-SY-02B to 241-SY-02A
PW-479		241-SY-03B to 241-SY-03A

* All of these Transfer Pipelines are identified in this document for Emergency Pumping

Reference – Ecology Letter January 14, 2003
Document RPP-16922 *Environmental Specifications Requirements* contains the official up-to-date listing

Non-Integrity Assessed Transfer Pipelines (Deferred)		
Transfer Line	**Description**	**Location**
SL-162	Slurry transfer line	241-AN-02A to 241-AN-B
SN-262*	Supernatant transfer tine	241-AN-02A to 241-AN-B
SL-163	Slurry transfer line	241-AN-03A to 241-AN-B
SN-263*	Supernatant transfer line	241-AN-03A to 241-AN-B
SL-164	Slurry transfer tine	241-AN-04A to 241-AN-A
SN-264*	Supernatant transfer line	241-AN-04A to 241-AN-A
SL-165	Slurry transfer line	241-AN-05A to 241-AN-A
SN-265*	Supernatant transfer line	241-AN-05A to 241-AN-A
SL-167	Slurry transfer line	241-AN-07A to 241-AN-A
SN-267*	Supernatant transfer line	241-AN-07A to 241-AN-A
SL-163	Slurry transfer line	241-AW-03A to 241-AW-A
SN-263*	Supernatant transfer line	241-AW-03A to 241-AW-A
SL-165	Slurry transfer line	241-AW-05A to 241-AW-A
SN-265*	Supernatant transfer line	241-AW-05A to 241-AW-A
SL-164	Slurry transfer line	241-AW-04A to 241-AW-B
SN-264*	Supernatant transfer line	241-AW-04A to 241-AW-B
SN-274	Supernatant transfer line	241-AW-04A to 241-AW-B

* Transfer pipelines identified in this document for Emergency Pumping

Reference – DOE Letter 05-TED-093
Document RPP-16922 *Environmental Specifications Requirements* contains the official up-to-date listing

Additional Non-Integrity Assessed Transfer Pipelines (Deferred)		
Transfer Line	**Description**	**Location**
SLL-3160	Slurry transfer line	241-SY-B to 241-AN-104

* Transfer pipelines identified in this document for Emergency Pumping

Document RPP-16922 *Environmental Specifications Requirements* contains the official up-to-date listing

APPENDIX H

SCHEDULE OF CRITICAL PATH ANNULUS PUMPING ACTIVITIES

Schedule of Critical Annulus Pumping Activities

Activity ID	Activity Name	Duration
Annulus Inspections		3
Video Leak Check of Annulus		3
AP1-1560	Work Package Prep & Approval	3
AP1-1720	Remove Shield Plugs	1
AP1-1730	Video Leak Check of Annulus	1
Pressure Test Annulus line		3
AP1-1000	Notify Department of Ecology	0
AP1-1010	Work Package Prep & Approval	2
AP1-1020	Field Work Prep & Erect Tent	4
AP1-1030	Pressure Test	1
Annulus Pumping Schedule - Supernate Line		7
Pressure Test Supernate Transfer Line		3
AP1-1570	Notify Department of Ecology	0
AP1-1580	Work Package Prep & Approval	2
AP1-1590	Field Work Prep & Erect Tent	4
AP1-1600	Pressure Test	1
Uprade Annulus Pit Leak Detector		3
AP1-1610	Prepare ECN	1
AP1-1620	Work Package Prep & Approval	2
AP1-1630	Upgrade Intrinsically Safe Leak Detector	1
Fabricate Rigid/Flex Jumper		4
AP1-1640	Upgrade Drawings by ECN	1
AP1-1650	Fabrication Request (J10)	1
AP1-1660	Shop Traveler	2
AP1-1670	Transport Components	1
AP1-1680	Fab Jumpers	3
AP1-1690	Leak Test	1
AP1-1700	Deliver to Work Site	1
AP1-1710	Green Tag	1
Leak Test Route		4
AP1-2030	Work Package Prep & Approval	2
AP1-2040	Perform Leak Checks	1
Operations Activities		4
AP1-2050	Update Transfer Procedure	3
AP1-2080	Safety & DOE Approval to Pump to Watchli...	7
AP1-2060	Equipment Check	3
AP1-2070	Valve Lineup	3

Forecast Bar
Forecast MS
Critical Activity
Progress Bar

Integrated Misson Execution Schedule

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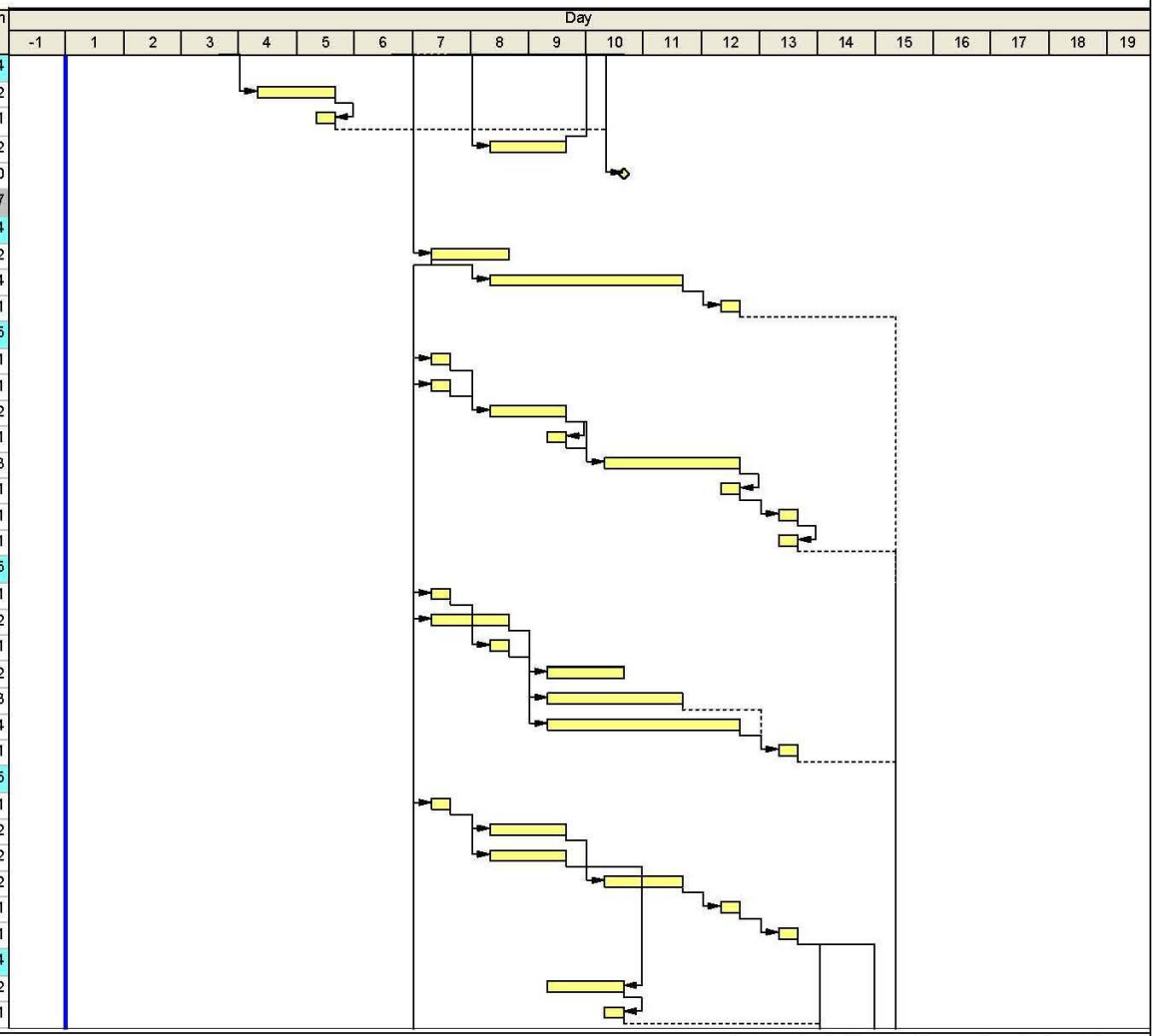
Schedule of Critical Annulus Pumping Activities

Activity ID	Activity Name	Duration
Field Locate Electrical / Pneumatic Skid		4
AP1-2090	Work Package Prep & Approval	2
AP1-2100	Move Skids to Field	1
AP1-2110	Hook Up Air & Power to Panels	2
AP1-2120	Start Annulus Pumping	0
Annulus Pumping Schedule - Slurry Line		7
Pressure Test Slurry Transfer Line (If Necessary)		4
AP1-1750	Work Package Prep & Approval (If Necess...	2
AP1-1760	Field Work Prep & Erect Tent (If Necessary)	4
AP1-1770	Pressure Test (If Necessary)	1
Fabricate Rigid/Flex Jumper		5
AP1-1070	Upgrade Drawings by ECN	1
AP1-1080	Fabrication Request (J10)	1
AP1-1090	Shop Traveler	2
AP1-1100	Transport Components	1
AP1-1110	Fab Jumpers	3
AP1-1120	Leak Test	1
AP1-1130	Deliver to Work Site	1
AP1-1140	Green Tag	1
Waste Compatibility		5
AP1-1150	Work Package Prep & Approval for Tank S...	1
AP1-1160	Obtain Past Tank Sample Analysis	2
AP1-1170	Obtain Tank Sample	1
AP1-1180	Analyze Tank Sample	2
AP1-1190	Engineering Evaluation of Waste Pumping ...	3
AP1-1200	Waste Compatibility Report	4
AP1-1210	Approve Waste Compatibility Report	1
Test Pump		5
AP1-1220	Transport Pump to Shop	1
AP1-1230	Perform PM Pump Testing	2
AP1-1240	Work Package Prep & Aprroval for Pump A...	2
AP1-1250	Assemble Pump	2
AP1-1260	Test Pump Assembly	1
AP1-1270	Deliver Pump to Work Site	1
Install Pump		4
AP1-1280	Work Package Prep & Approval	2
AP1-1290	Field Work Prep	1



Forecast Bar
Forecast MS
Critical Activity
Progress Bar

Integrated Misson Execution Schedule

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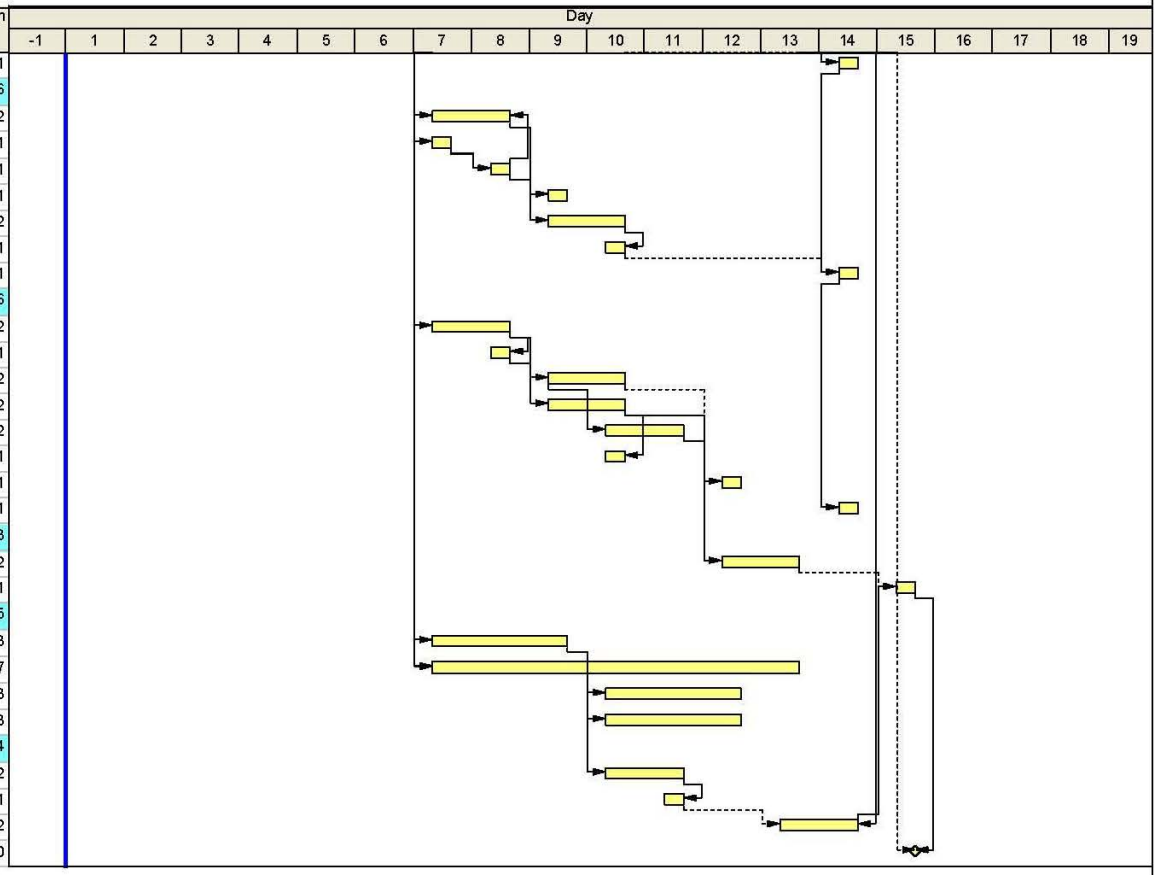
Schedule of Critical Annulus Pumping Activities

Activity ID	Activity Name	Duration
AP1-1300	Install Pump	1
Install Jumpers		6
AP1-1310	Work Pakcage Prep & Approval for Flex Ju...	2
AP1-1320	Procure Cover Block Plugs	1
AP1-1330	Field Work Prep for Flex Jumper	1
AP1-1340	Install Jumper in Support Pit	1
AP1-1350	Work Package Prep & Approval for Rigid in...	2
AP1-1360	Field Work Prep for Rigid in Annulus PP	1
AP1-1370	Install Annulus Rigid Jumper	1
Install Jumper Central PP		6
AP1-1380	Work Package Prep & Approval for Equip ...	2
AP1-1390	Field Work Prep for Equip Removal	1
AP1-1400	Remove External Pit Equipment	2
AP1-1430	Work Package Prep & Approval for Rigid in...	2
AP1-1410	Remove Internal Pit Equipment	2
AP1-1440	Field Work Prep for Rigid in Central PP	1
AP1-1420	Install Cover Block Plugs	1
AP1-1450	Install CPP Jumper	1
Leak Test Route		3
AP1-1460	Work Package Prep & Approval	2
AP1-1470	Perform Leak Checks	1
Operations Activities		5
AP1-1480	Update Transfer Procedure	3
AP1-1510	Safety & DOE Approval to Pump to Watchli...	7
AP1-1490	Equipment Check	3
AP1-1500	Valve Lineup	3
Field Locate Electrical / Pneumatic Skid		4
AP1-1520	Work Package Prep & Approval	2
AP1-1530	Move Skids to Field	1
AP1-1540	Hook Up Air & Power to Panels	2
AP1-1550	Start Annulus Pumping	0



Forecast Bar
Critical Activity
Progress Bar
Forecast MS

Integrated Misson Execution Schedule

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APPENDIX I

SCHEDULE OF CRITICAL PATH PRIMARY TANK SYSTEM PUMPING ACTIVITIES

Schedule of Critical Path Primary Tank System Pumping Activities

Activity Name	Duration
Prepare Transfer Procedure	3
Notify Department of Ecology	0
Prepare Transfer Procedure	2
Pre-Job and Valve Lineup	1
Waste Compatability	3
Obtain Past Tank Sample Analysis	1
Analyze Waste Data	1
Prepare Waste Compatibility Report	1
Start Transfer	0
Run-in Spare Pump	3
Prepare Run-In Test Plan	2
Identify Pump Failure	0
Transport Spare Pump to the Shop	1
Perform Spare Pump Run-In	1
Transport Spare Pump to the Field	1
Prepare for Removal of Existing Pump	5
Removal Work Package Preparation	3
Disposal Work Package Preparation	3
Field Work Prep for Removal	3
Remove Pump	1
Dispose of Pump	3
Spare Pump Installation	6
Install Work Package Preparation	3
Field Work for Pump Install	1
Install Pump	1
Pre-Job and Valve Lineup	1
Start Transfer	0
Pressure Test Supernate Transfer Line	4
Work Package Prep & Approval	2
Field Work Prep & Erect Tent	4
Pressure Test	1
Pressure Test Slurry Transfer Line (If Necessary)	4
Work Package Prep & Approval	2
Field Work Prep & Erect Tent	4
Pressure Test	1

Integrated Misson Execution Schedule