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DPSPU-77-272-135

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File Code: SEP-WM 175.6

May 16, 1977

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REMOVAL OF WASTE SALT FROM ANNULUS OF TANK 16

TA 2-850 was authorized to return the waste salt in the annulus of tank 16 to double containment storage. Sand deposited beneath annulus inspection riser 151 during sand blasting operations in 1962 and 1974 was removed in June 1976. Dissolution of the salt in the annulus and transfer to tank 14 is scheduled to begin the week of 5/23. A description of the process and equipment designed to return the salt to primary containment is attached.

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Attachment

REMOVAL OF WASTE SALT FROM ANNULUS OF TANK 16

GENERAL

A program to retire the first three generations of waste tanks (Types I, II and IV) at SRP has been formulated to comply with the established criteria for waste management [1]. The operations which compose the present concept of waste tank retirement are; 1) dissolution of salt cake and transfer to evaporator feed tank, 2) suspension of sludge in a supernate slurry and removal to a sludge receiver tank, 3) chemical dissolution of residual waste on the tank interior surfaces with an organic acid and 4) cleanout of contaminated annular spaces. Tank 16 was selected as the demonstration unit for all parts of the waste tank retirement program except salt dissolution. Removal of waste salt from the annulus of tank 16 as authorized by TA 2-850 is scheduled for the second quarter of 1977. A description of the process and equipment designed to return the salt to primary containment is given in the following sections.

PROCESS DESCRIPTION

Some 6000 gallons of waste salt cake (crust and slush) residing in the 2-1/2 foot wide annular space between the primary tank and the 5 foot high secondary pan of tank 16 are to be transferred to primary containment. A significant amount of salt (dried waste deposits at leak sites) is adhering to the outer surface of the primary tank. Seepage of ground water into the annulus following waste overflow of secondary pan in 1960 [2] has left salt deposits on the interior surface of the secondary container below the pan ledge. A flow diagram of the process for removing salt from tank 16 annulus is given in Figure 1. The separate operations are I) transfer of supernate to tank 16 for ballast and removal to tank 13 upon completion, II) dissolution of salt cake in annulus bottom and salt deposits on outer surface of primary tank and inner surface of secondary pan and III) transfer of salt solution from annulus to tanks 14 and 16.

I. Ballast Liquid Transfer

The waste salt is removed from the annular space by dissolution in water. To avoid bowing the bottom of the tank upward, the hydrostatic head in the annulus must not exceed the hydrostatic head in the tank interior. Since many of the known tank wall cracks are located on the lower horizontal weld, the liquid in neither the tank nor the annulus is allowed to reach a level any higher than three inches below this weld. Salt dissolution operations require an annulus liquid level whose hydrostatic head exceeds that of the current sludge depth (19-22 inches) in the tank. A liquid level in the annulus above the top of the dehumidification duct is necessary for continuous flow and thorough flooding of duct interior surfaces. Low heat waste supernate from tank 22 is transferred into tank 16 to the maximum allowable depth of 26 inches to provide ballast for a liquid depth in the annulus of 25 inches (dependent on supernate specific gravity) [3]. Low heat waste supernate introduces lower radioactivity and radiolytic decay heat to the tank than would aged high heat waste. After the annulus cleaning operation is completed, the excess supernate is jetted to tank 13.

EN-2216

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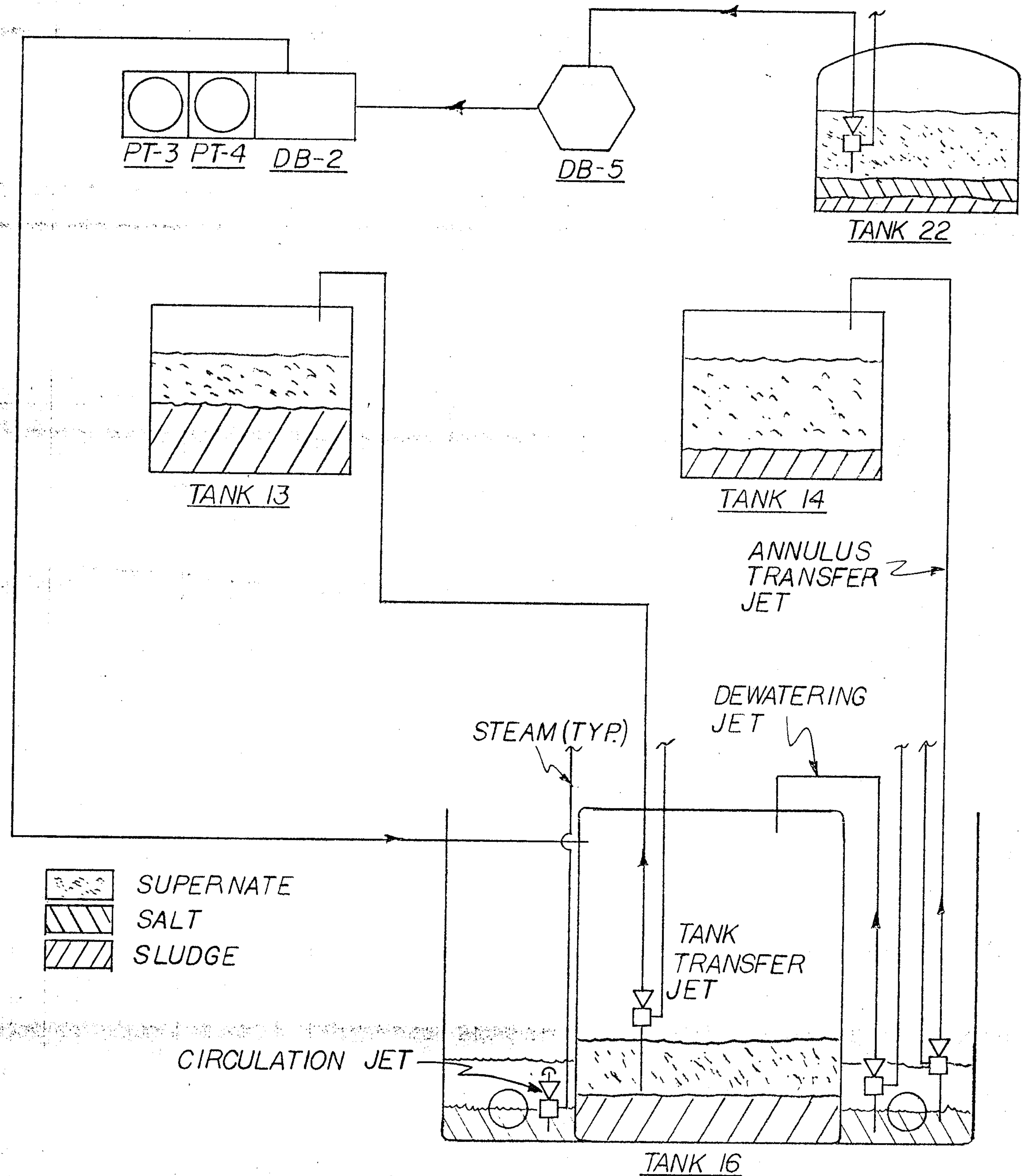
PROJ. NO. ______ PLANT SRP TITLE TANK 16 ANNULUS CLEANING

BLDG. OR AREA 241-H FUNCTION ______ SUBJECT ______

NAME DE GORDON DATE MAY 16, 1977

FIGURE 1



II. Salt Dissolution

The level of waste salt in the annulus is 12-15 inches. Photographic inspections show the dehumidification duct to be filled with salt cake in almost its entire circumferential length. In 1972 only 150 cfm of air could be forced down the annulus inlet duct; the flow rate measured in 1970 was 500 cfm. Initially, water is added to the annular space through the dehumidification supply duct to enhance dissolution of salt in the duct. The chemical composition of the waste salt is such that inhibitors (OH^- and NO_2^-) are initially present in sufficient concentrations to prevent stress corrosion cracking due to NO_3^- and $SO_4^=$ [4]. The water temperature is 75°C to promote dissolution (solubility of waste salt increases with temperature) while remaining below the maximum permissible liquid temperature in the annulus, 80°C [4]. When the liquid level in the annulus reaches 18 inches, the hot water addition stops and steam jets with submerged discharge nozzles directed clockwise are used to promote circumferential flow. The stirring action of the jets allows better contact between the unsaturated liquid and the salt. To prevent the liquid temperature from increasing above 75°C due to heat input from the steam jets, the tank's horizontal and vertical cooling coils are put in service and, if necessary, the operation of the steam jets is staggered.

When a stable condition is reached, steam is sprayed into the top of the annulus. To prevent the possibility of sustaining a positive pressure in the annulus, the 30 inch diameter exhaust duct which vents through a HEPA filter is left open. A new duct connecting the annulus to the primary tank provides a path for air flow from the annulus, and the tank purge system supplies the motive force. The steam is added slowly to prevent the flow of water vapor through the annulus exhaust duct (high moisture air could blind and collapse the paper HEPA filter).

As the annulus air becomes saturated, water vapor condenses on all surfaces and dissolves the salt deposits. The undermined salt deposits slide down the sides of the tank and secondary pan to the liquid in the pan bottom. If steam dissolution is unsuccessful, directed water sprays will be used. Whenever the condensate from the steam sprays and jets increases the annulus liquid level to 21 inches, the salt solution is jetted to tank 14 until the liquid level is reduced to 18 inches. The liquid buildup and subsequent removal to tank 14 continues until the solution in the annulus becomes dilute (specific gravity less than 1.1). The annulus is then emptied to a one inch heel. Progress of the cleaning is determined by periscopic inspection. If further salt dissolution is required, chemicals are added to the water to ensure recommended concentrations of NO_2^- and OH^- (500 ppm and pH 12). The salt dissolving operation ends when no salt is visible in the annular space. A final rinse with uninhibited water is then made, sampled to determine concentration of radionuclides, and removed.

III. Annulus Solution Transfer

Solution is transferred from tank 16 annulus to tank 14 with an existing 75 gpm transfer jet with a suction leg extending down to three inches from the pan bottom. The transfer jet is used to lower the annulus liquid level to 18 inches during recirculating steam jet operation or to empty the annulus to the three inch level. A 10 gpm dewatering jet which discharges back to tank 16 lowers the liquid level in the annulus to within one inch of the bottom. After the uninhibited water flush has been removed by the transfer and dewatering jets, the dehumidification system is returned to normal and used to remove the one inch liquid heel by evaporation.

An estimated 30,000-50,000 gallons of water are required to dissolve the 6000 gallons of salt in the annulus of tank 16. The space available in tank 14 for receipt of salt solution is 84,000 gallons (current waste depth is 276 inches and the operating limit is 300 inches); additional space can be provided in tank 14 by jetting liquid waste directly to tank 13.

PROCESS EQUIPMENT

A description of the process equipment to remove waste salt from tank 16 annulus is given below.

I. Ballast Liquid Transfer

1. Supernate Supply

Low heat waste supernate from tank 22 is transferred by steam jet (type D, 75 gpm) through existing lines between tank 22, DB-5 and DB-2 to pump tank No. 3. The solution is then pumped into tank 16.

2. Supernate Removal

Upon completion of annulus cleaning, the supernate in tank 16 is removed to tank 13 using the steam jet (type D) in riser 7 on tank 16 and the existing transfer line.

II. Salt Dissolution

1. Hot Water Preparation and Delivery

Water for salt dissolution in the dehumidification duct and annulus is heated in a 3000 gallon tank truck with two 75 psig steam spargers. The water is transferred to a portable 500 gallon hold tank with the tank truck transfer pump (300 gpm). The water in the hold tank is maintained at 75°C with one of the two steam spargers. Mixing of corrosion inhibiting chemicals (caustic and sodium nitrite) with water in the hold tank is accomplished with a recycle pump which discharges back into the tank. The solution in the hold tank is added to the annulus through the dehumidification supply duct using the hold tank discharge pump (70 gpm).

2. Annulus Circumferential Flow

Circumferential flow of the solvent solution in the annulus is promoted by three steam jets with discharge nozzles directed clockwise and spaced 90°, 180° and 270° around the annulus from plant north. Two of the steam jets are supplied with 75 psig steam and the third one uses 150 psig steam. The jets are equipped with a water supply pipe to hydraulically mine through the salt during installation.

3. Salt Deposit Removal

Steam (25 psig) is sprayed into the top part of the annulus through two 1/2" nozzles located approximately 180° apart. The steam saturates the air space and water vapor condenses on all surfaces and dissolves the salt deposits. Water sprayed through a directed hose nozzle is planned if the steam condensate does not satisfactorily remove the salt.

4. Heat Removal

The tank cooling coils are used to help remove the heat introduced by the steam jets and sprays. None of the 44 main and auxiliary cooling coil loops have failed to date. The four bottom coils and forty vertical coils are placed in service.

5. Ventilation System

The tank and annulus are connected with an 8" diameter duct. The air handling capacity of the tank purge system is 400 cfm. All openings into the tank and annulus are sealed except the annulus exhaust duct which is left open to the atmosphere through a HEPA filter.

6. Instrumentation

The liquid level in tank 16 is recorded on the reel tape in riser 4. The temperature of the waste in the tank is measured by thermocouples in riser 1 thermowell. Dip tubes are used to measure the specific gravity and liquid level of solution in the annulus. Thermocouples in two annulus thermowells sense temperatures in the vapor and liquid regions. Annulus pressure is measured on a vacuum gauge. A dip tube in the annulus dehumidification supply duct alarms if liquid level rises above 8'3" from secondary pan bottom during water addition.

III. Annulus Solution Transfer

1. Transfer Jets

Salt solution is removed from tank 16 annulus to tank 14 with a transfer jet (type D). The suction leg of the jet is 3 inches from the pan bottom. A 10 gpm dewatering jet transfers solution from the annulus back to the primary tank. Its suction is 1 inch above the pan bottom.

2. Annulus Heel Removal

The annulus dehumidification system is returned to normal after cleaning operation is completed and its 1500 cfm air flow is used to evaporate the 1 inch liquid heel from the annulus.

REFERENCES

Literature

1. R. Maher and E. O. Kiger to W. J. Mottel, Criteria For Waste Management, DPSPU-74-255, June 24, 1974.
2. Leakage From Waste Tank 16, DP-1358.
3. TA 2-850, "Salt Removal From Walls and Annulus of Tank 16", D. W. Tharin, July 28, 1975.
4. S. P. Rideout to K. W. French-J. A. Porter, Metallurgical Aspects of Cleaning Annuli of Waste Storage Tanks, DPST-75-292, June 27, 1975.

Drawing Nos.

SSK5-2-3129	Annulus Cleaning Piping Plan
SSK5-2-3130	Annulus Cleaning Sections
SSK5-2-3131	Annulus Cleaning South Mixing Jet
SSK5-2-3132	Annulus Cleaning East Mixing Jet
SSK5-2-3133	Annulus Cleaning Details
SSK5-2-3134	Annulus Cleaning Instrument Diagram
SSK5-2-3141	Air Outlet Demister Assembly and Details
SSK5-2-3242	Annulus Cleaning West Mixing Jet
SSK5-2-3256	Annulus Cleaning HEPA Filter Arrangement and Details
S5-2-5793	Alarm System Electrical Diagrams

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